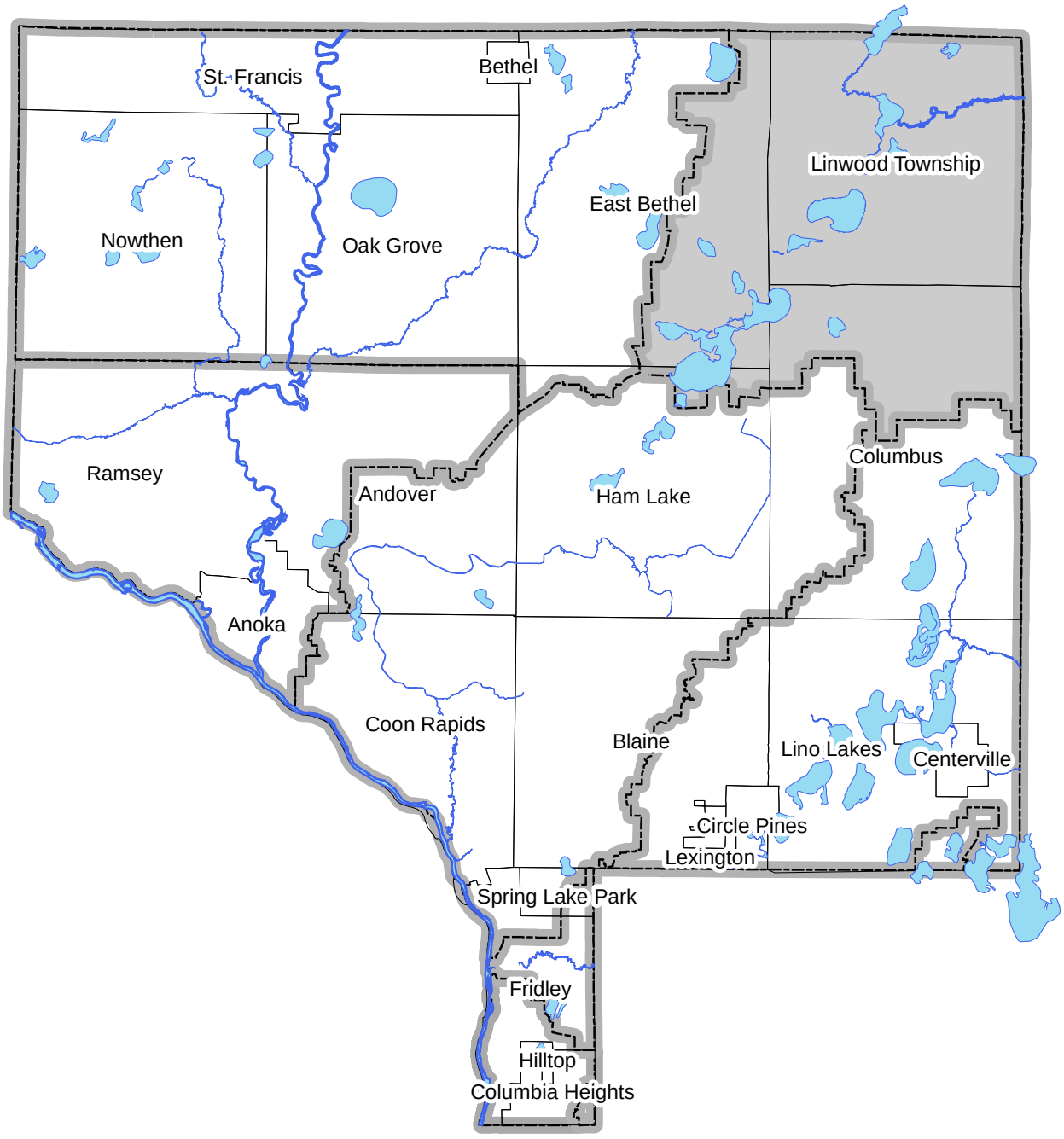
Excerpt from the
2015 Anoka Water Almanac

Chapter 2: Sunrise River Watershed



Prepared by the Anoka Conservation District

CHAPTER 2:
SUNRISE RIVER WATERSHED

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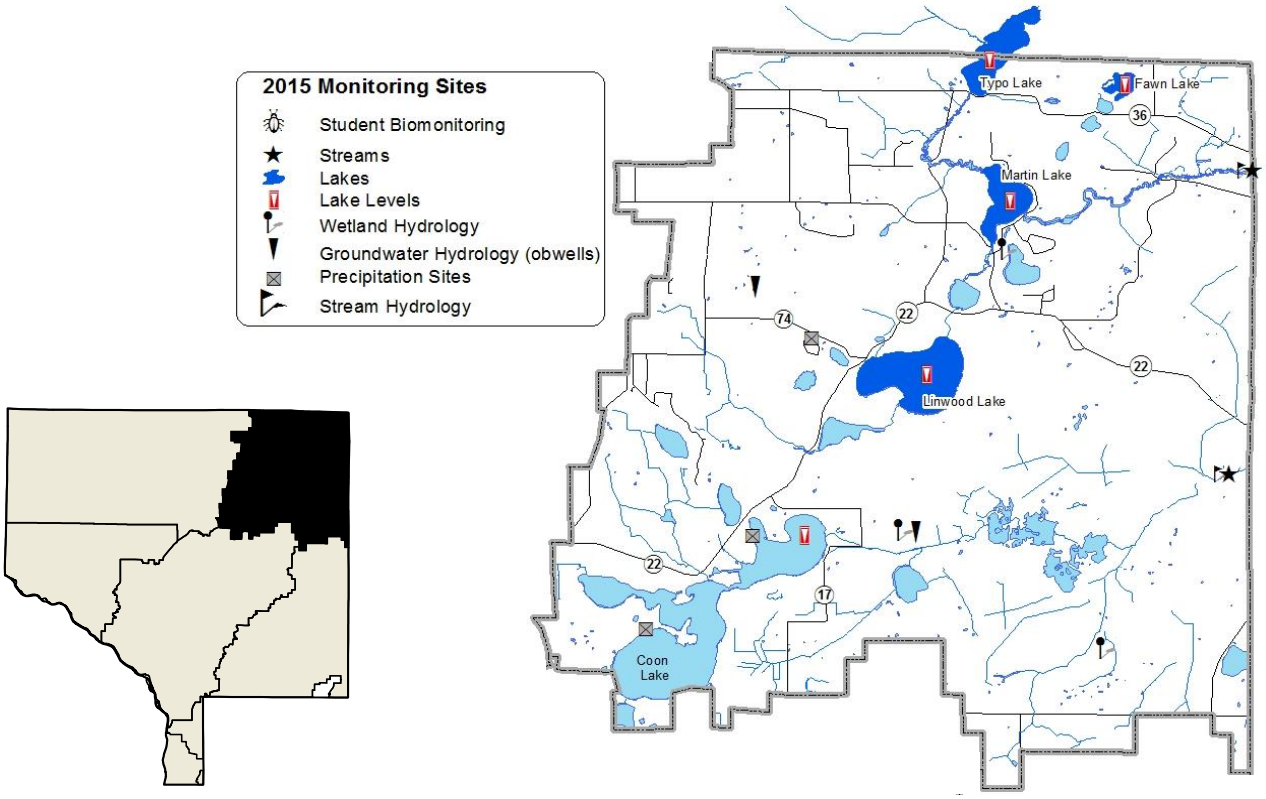
ACD = Anoka Conservation District, SRWMO = Sunrise River Watershed Management Organization,
MNDNR = Minnesota Dept. of Natural Resources, ACAP = Anoka County Ag Preserves



Lake Levels

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

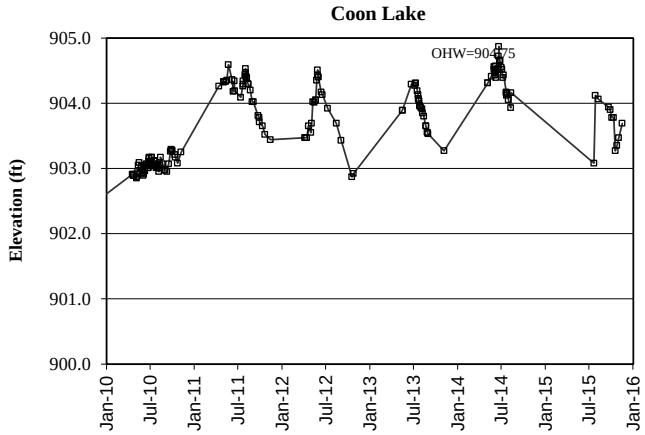
Purpose: To understand lake hydrology, including the impact of climate or other water budget changes. These data are useful for regulatory, building/development, and lake management decisions.

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

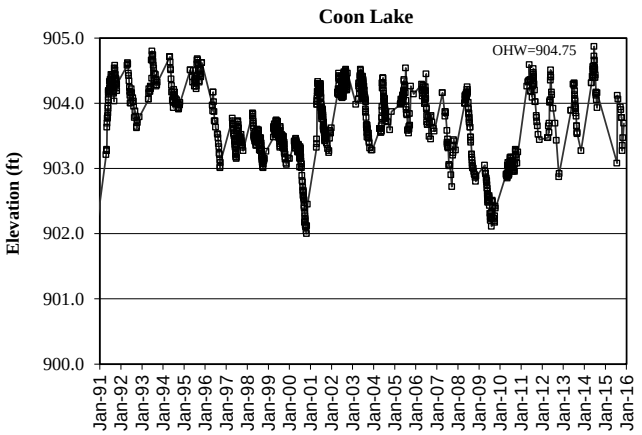
Results: Lake levels were measured by volunteers throughout the 2015 open water season. Lake gauges were installed and surveyed by the Anoka Conservation District and MN DNR. Lakes had increasing water levels in spring and early summer and then fell later in the year due to less rainfall. Increased rainfall late into fall cause a spike in lake levels at the end of the year. Overall lake levels were lower than in 2014 when very heavy rainfall totals occurred.

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

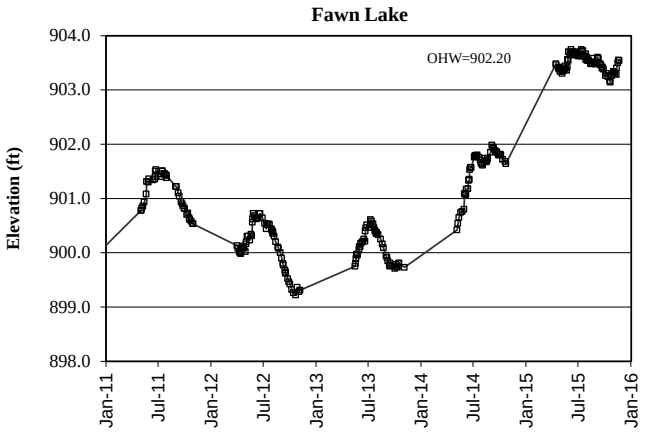
Coon Lake Levels – last 5 years



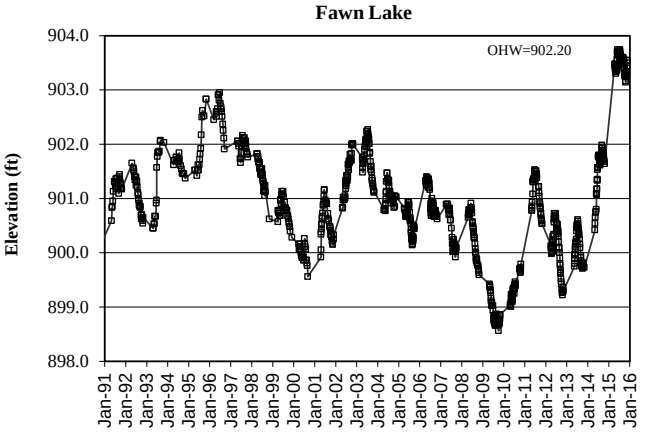
Coon Lake Levels – last 25 years



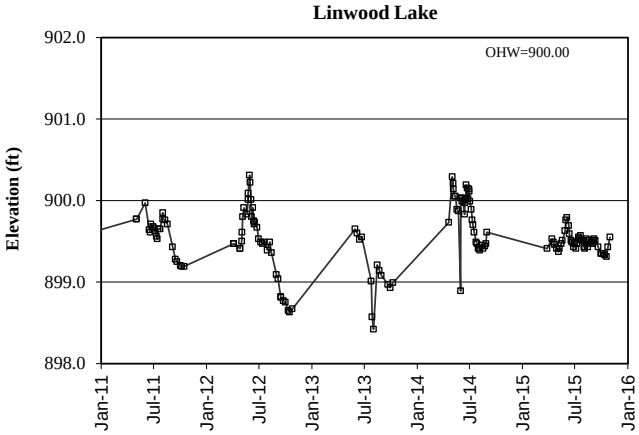
Fawn Lake Levels – last 5 years



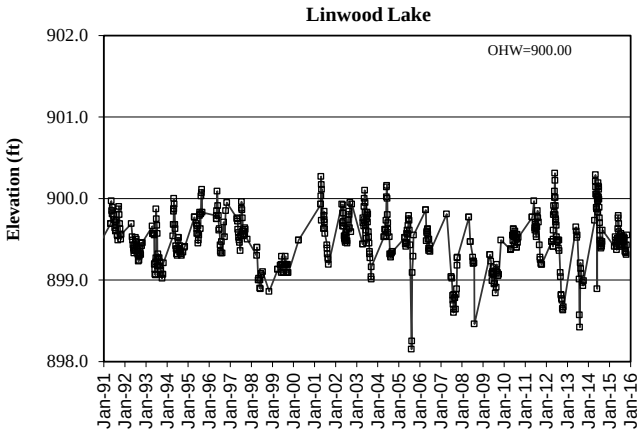
Fawn Lake Levels – last 25 years



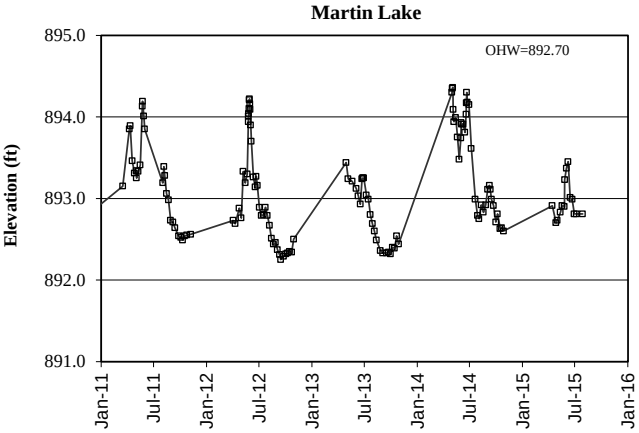
Linwood Lake Levels – last 5 years



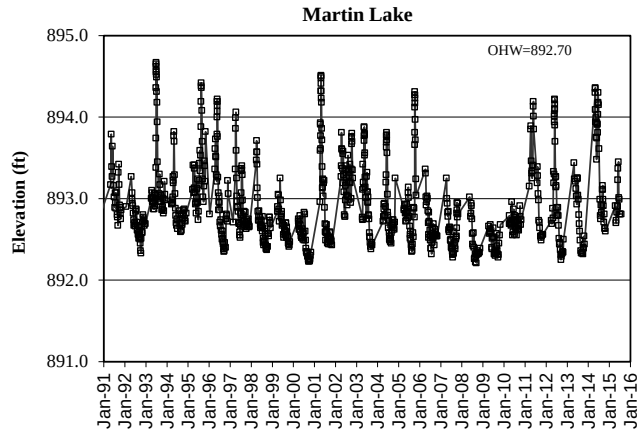
Linwood Lake Levels – last 25 years



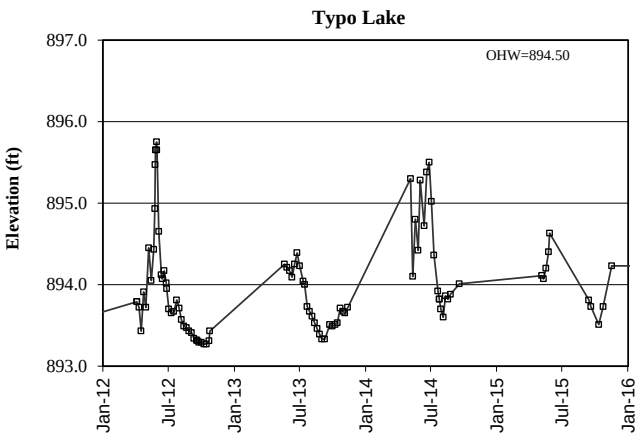
Martin Lake Levels – last 5 years



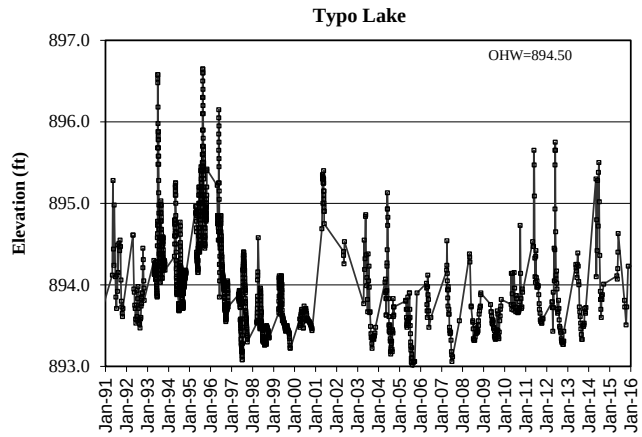
Martin Lake Levels – last 25 years



Typo Lake Levels – last 5 years



Typo Lake Levels – last 25 years



Lake Water Quality

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

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

Locations: Linwood Lake

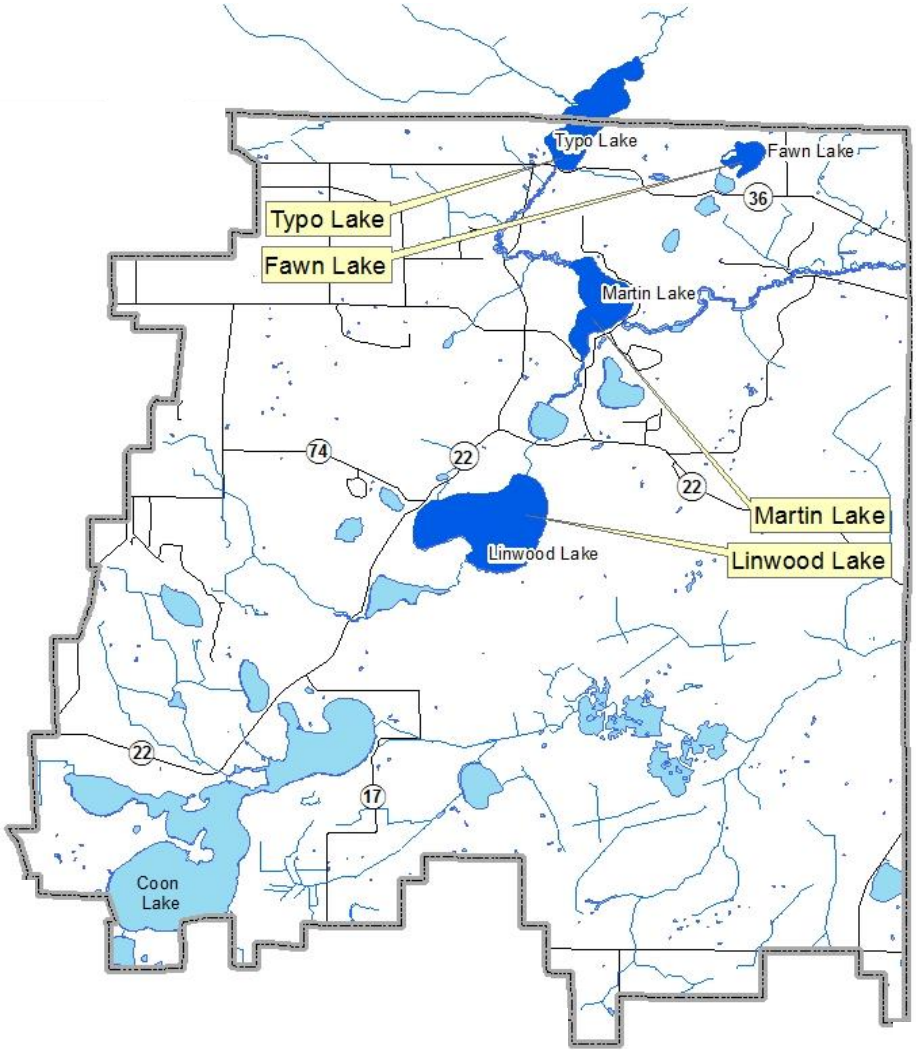
Fawn Lake

Martin Lake

Typo Lake

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

Sunrise Watershed Lake Water Quality Monitoring Sites



Linwood Lake

Linwood Township, Lake ID # 02-0026

Background

Linwood Lake is located in the northeast portion of Anoka County. It has a surface area of 559 acres and maximum depth of 42 feet (12.8 m). Public access is available on the north side of the lake at Martin-Island-Linwood Regional Park, and includes a boat landing and fishing areas. The lake's shoreline is about 1/3 developed and 2/3 undeveloped. Most of the undeveloped shoreline is on the eastern shore and is part of a regional park. The lake's watershed is primarily vacant with scattered residential.

Linwood Lake is on the Minnesota Pollution Control Agency's 303(d) list of impaired waters for excess nutrients.

2015 Results

In 2015 Linwood Lake had average or slightly below average water quality for this region of the state (NCHF Ecoregion), receiving an overall C grade. The lake is slightly eutrophic. In 2015 total phosphorus averaged 41.0 µg/L, chlorophyll-a averaged 10.5 µg/L, and Secchi transparency averaged 1.2 m. These measurements were within similar range relative to the range observed in other years. ACD staff's subjective observations of the lake's physical characteristics were that there were large suspended algae in mid-May with a more significant algae bloom beginning in July and continuing through September. ACD staff subjectively ranked the lake as having some impairment of swimming in early May and again from mid-June through September.

Trend Analysis

Seventeen years of water quality data have been collected by the Metropolitan Council (1980, '81, '83, '89, '94, '97, 2008) and the ACD (1998-2001, 2003, '05, '07, '09, '12, '15). Water quality has not significantly changed from 1980 to 2015 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,14}$=3.38, p=0.08). However, when analyzed individually Cl-a indicates a significant (one-way ANOVA $F_{1,15}$=5.34, p=0.04).

Discussion

Linwood Lake is on the Minnesota Pollution Control Agency's (MPCA) list of impaired waters, but it is a borderline case. Linwood Lake was placed on the state impaired waters because summertime average total phosphorus is routinely over the water quality standard of 40 µg/L for deep lakes. The state has since added separate standards for shallow lakes. Linwood does not technically meet the definition of a shallow lake (maximum depth of <15 ft or >80% of the lake shallow enough to support aquatic plants) due to a deep spot. However it is very similar to other shallow lake systems and expectations for water quality should be more in line with shallow lake standards (total phosphorus <60 µg/L, chlorophyll-a <20 µg/L, and Secchi transparency >1m). In the last 10 years Linwood has been substantially lower than the shallow lake phosphorus standard, but it has occasionally exceeded the other two standards. Regardless, water quality improvement is needed.

It is likely that major factors degrading water quality originate from the lake itself and/or its developed shoreline. The primary inlet to Linwood Lake comes from Boot Lake, a scientific and natural area, and it likely has good water quality (though has not been monitored). Threats to Linwood Lake likely include rough fish, failing shoreland septic systems, poor lakeshore lawn care practices, and natural sources such as nutrient-rich lake sediments. High powered boats may be impacting water quality by disturbing sediments because the lake is large enough for these boats to get up to full speed, but is mostly shallow.

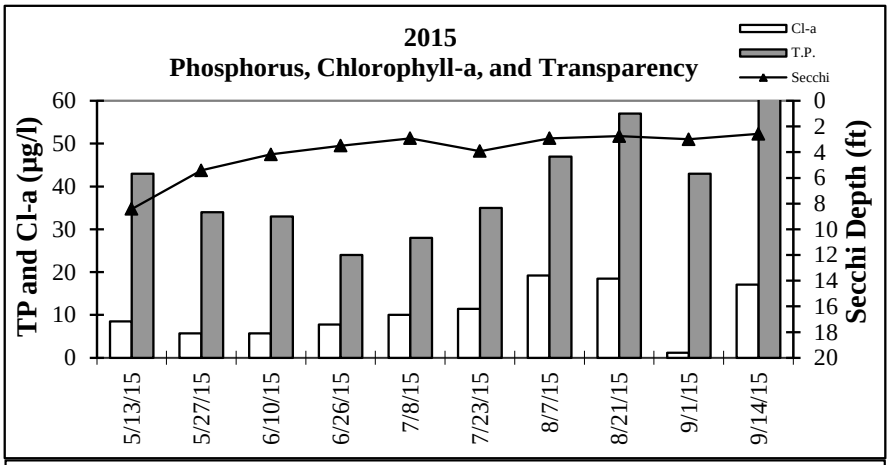
2015 Linwood Lake Water Quality Data

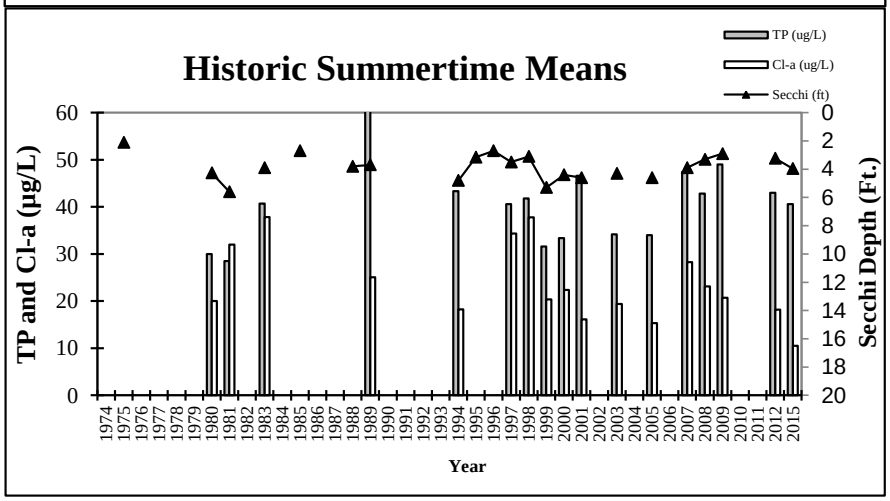
Linwood Lake

2015 Water Quality Data			Date	5/13/2015	5/27/2015	6/10/2015	6/26/2015	7/8/2015	7/23/2015	8/7/2015	8/21/2015	9/1/2015	9/14/2015			
			Time	15:20	13:15	14:25	13:40	13;40	13:04	11:50	13:20	12:45	13:45			
	Units	R.L.*		Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1		8.08	8.17	8.34	8.65	8.48	8.61	8.38	7.65	8.45	8.14	8.30	7.65	8.65
Conductivity	mS/cm	0.01		0.300	0.301	0.302	0.330	0.332	0.281	0.308	0.349	0.287	0.329	0.312	0.281	0.349
Turbidity	FNRU	1		3.6	5.00	8.90	6.70	15.00	11.40	21.60	22.60	19.40	19.20	13	4	23
D.O.	mg/L	0.01		9.25	9.48	8.98	9.50	6.92	9.26	7.51	6.68	10.12	6.72	8.44	6.68	10.12
D.O.	%	1		92%	102%	109%	120%	85%	119%	89%	77%	123%	78%	99%	77%	123%
Temp.	°C	0.1		14.6	17.6	23.2	25.6	24.0	26.3	23.8	21.9	23.3	20.6	22.1	14.6	26.3
Temp.	°F	0.1		58.2	63.7	73.8	78.1	75.2	79.4	74.8	71.4	73.9	69.0	71.8	58.2	79.4
Salinity	%	0.01		0.14	0.14	0.14	0.16	0.16	0.14	0.15	0.17	0.14	0.16	0.15	0.14	0.17
Cl-a	µg/L	1		8.5	5.7	5.7	7.8	10.0	11.4	19.2	18.5	1.2	17.1	10.5	1.2	19.2
T.P.	mg/L	0.005		0.043	0.034	0.033	0.024	0.028	0.035	0.047	0.057	0.043	0.062	0.041	0.024	0.062
T.P.	µg/L	5		43	34	33	24	28	35	47	57	43	62	41	24	62
Secchi	ft	0.1		8.4	5.4	4.2	3.5	2.9	3.9	2.9	2.8	3.0	2.6	4.0	2.6	8.4
Secchi	m	0.10		2.6	1.7	1.3	1.1	0.9	1.2	0.9	0.8	0.9	0.8	1.2	0.8	2.6
Field Observations																
Physical				1	2.0	2.0	2.0	2.0	4.0	2.0	2.0	2.0	2.0	2.1	1.0	4.0
Recreational				1	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	1.0	1.3	1.0	2.0

*reporting limit

Linwood Lake Water Quality Results

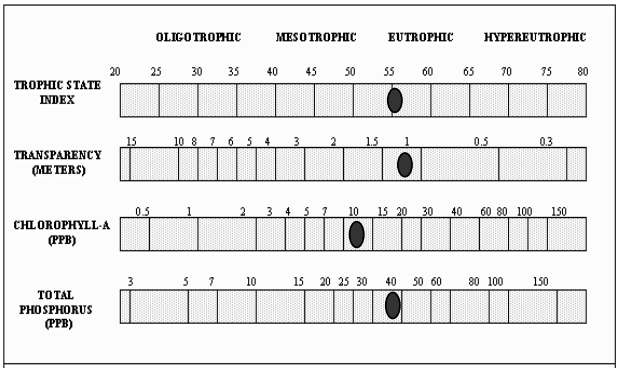




Linwood Lake Summertime Historic Mean

	CAMP	MC	MC	MC	CAMP	CAMP	MC	MC	CAMP	CAMP	MC	ACD	ACD	ACD	ACD	ACD	ACD	ACD	CAMP	ACD	ACD	ACD
	1975	1980	1981	1983	1985	1988	1989	1994	1995	1996	1997	1998	1999	2000	2001	2003	2005	2007	2008	2009	2012	2015
TP (ug/L)		30.0	28.5	40.7			64.8	43.3			40.6	45.7	48.6	44.4	46.6	34.2	34.0	47.4	42.8	49.0	43.0	41.0
Cl-a (ug/L)		20.0	32.0	37.9			25.1	18.3			34.4	40.0	31.7	31.2	16.1	19.4	15.3	28.3	23.1	20.7	18.2	10.5
Secchi (m)	0.64	1.30	1.70	1.20	0.82	1.17	1.12	1.45	0.96	0.82	1.06	0.94	1.10	1.34	1.4	1.31	1.4	1.19	1.01	0.88	1	1.2
Secchi (ft)	2.1	4.3	5.6	3.9	2.7	3.8	3.7	4.8	3.2	2.7	3.5	3.1	3.6	4.4	4.6	4.3	4.6	3.9	3.3	2.9	3.2	4
Carlson's Tropic State Indices																						
TSIP		53	52	58			64	58			58	59	54	54	59	55	55	60	58	60	58	58
TSIC		60	65	66			62	59			65	67	60	61	57	60	57	63	62	60	59	54
TSIS	66	56	52	57	63	58	58	55	61	63	59	61	53	55	56	56	55	57	60	62	60	57
TSI		57	57	60			62	57			61	62	56	57	57	57	56	60	60	61	59	56
Linwood Lake Water Quality Report Card																						
Year	1975	1980	1981	1983	1985	1988	1989	1994	1995	1996	1997	1998	1999	2000	2001	2003	2005	2007	2008	2009	2012	2015
TP		B	B	C			C	C			C	C	C	C	C	C	C	C	C	C	C	C
Cl-a		B	B	C			C	B			C	C	C	C	B	B	B	C	C	C+	B	B
Secchi	F	C	C	C	D	D	D	C	D	D	D	D	D	C	C	C	C	D	D	D	D	C
Overall		**B**	**B**	**C**			**C**	**C**			**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**

Carlson's Trophic State Index



Fawn Lake
Linwood Township Lake ID # 02-0035

Background

Fawn Lake is located in extreme northeast Anoka County. Fawn Lake has a surface area of 57 acres and a maximum depth of 30 feet (9.1 m). There is no public access to this lake and no boat landing. A neighborhood association has established a small park and swimming beach for the homeowners. Most of the lake is surrounded by private residences, with the densest housing on the southern and western shores. The watershed for this lake is quite small, consisting mostly of the area within less than ¼ mile of the basin.

Fawn is one of the clearest lakes in the county. Groundwater likely feeds this lake to a large extent. Vegetation in the lake is healthy, but not so prolific to be a nuisance, and contributes to high water quality. In 2008 and 2010 an invasive plant species, curly-leaf pondweed, was noticed in a few locations, although it may have been present for some time. It does not appear occur in high densities. Another aquatic invasive species survey was conducted in 2015 by the Anoka Conservation District. Curly-leaf pondweed was still not a nuisance and no new species were identified. Once again a great variety of healthy-native vegetation was identified.

2015 Results

Fawn Lake is classified as mesotrophic and has some of the clearest water in Anoka County. In 2015, Fawn Lake continued its trend of excellent water quality for this region of the state (NCHF Ecoregion) by receiving an overall A grade. Water clarity was high while total phosphorus and chlorophyll *a* were low throughout the 2015 sampling season. Water clarity was 19.4 feet in spring, and averaged 14.5 feet from May through September. The subjective observations of the lake's physical characteristics and recreational suitability by the ACD staff indicated that lake conditions were excellent for swimming and boating throughout the summer.

Trend Analysis

Thirteen years of water quality data have been collected by the Minnesota Pollution Control Agency (1988) and the Anoka Conservation District (between 1997 and 2015). If we examine all years, there is a nearly statistically significant trend of improving water quality (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{2,10} = 4.49$, $p = 0.04$). It has been concluded that this was driven nearly entirely by poor water quality in the earliest year monitored (1988). If 1988 is excluded, water quality has been consistent among years monitored.

Discussion

This lake's water quality future lies with the actions of the lakeshore homeowners. Because the lake has such a small watershed each lakeshore lot comprises a significant portion of the watershed. Poor practices on a few lots could result in noticeable changes to the lake. Some ways to protect the lake include lakeshore buffers of native vegetation, keeping yard waste out of the lake, and eliminating or minimizing the use of fertilizer. Soil testing on nearby lakes and throughout the metro has found that soil phosphorus fertility is high, and lawns do not benefit from additional phosphorus. Additionally, lakeshore homeowners should refrain from disturbing or removing lake vegetation. One reason is that this lake's exceptionally high water quality is in part due to its healthy plant community. Moreover, curly-leaf pondweed, an invasive only recently noticed in the lake, readily colonizes disturbed areas and can affect both water quality and recreation.

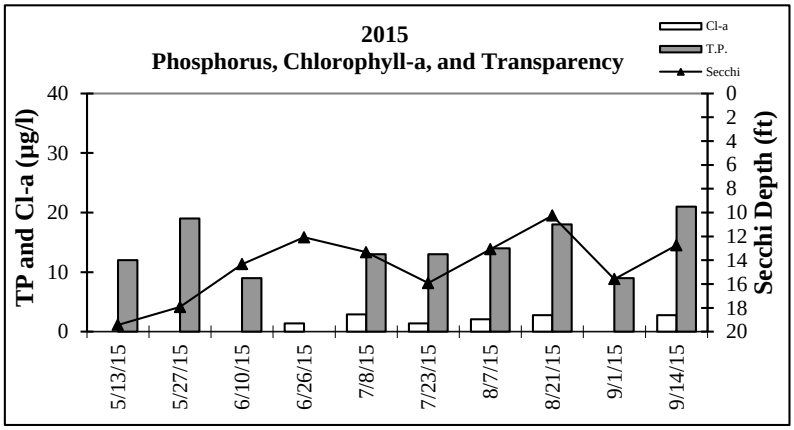
2015 Fawn Lake Water Quality Data

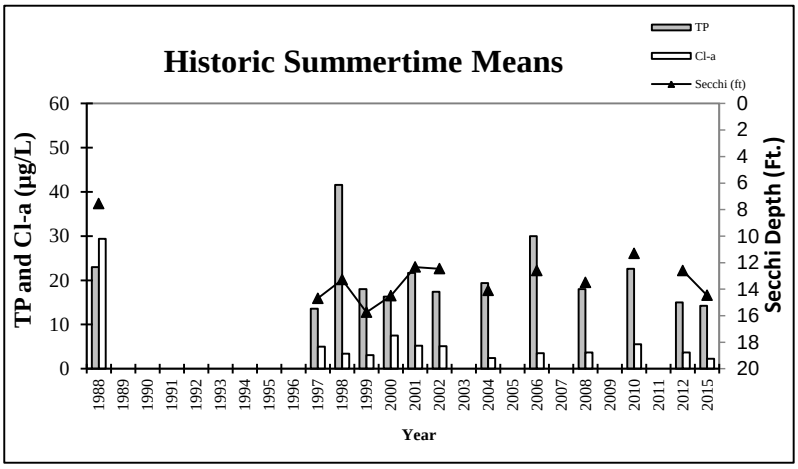
Fawn Lake
2015 Water Quality Data

			Date	5/13/2015	5/27/2015	6/10/2015	6/26/2015	7/8/2015	7/23/2015	8/7/2015	8/21/2015	9/1/2015	9/14/2015			
			Time	14:00	12:00	12:30	12:20	12:10	12:20	10:25	12:05	11:35	12:30			
	Units	R.L.*		Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1		8.13	8.47	8.71	8.59	8.52	8.60	8.33	7.70	7.93	8.14	8.31	7.70	8.71
Conductivity	mS/cm	0.01		0.230	0.223	0.214	0.236	0.237	0.195	0.218	0.250	0.217	0.239	0.226	0.195	0.250
Turbidity	FNRU	1.0		0.60	0.00	0.00	0.80	3.20	0.20	5	2	2	0	1	0	5
D.O.	mg/L	0.01		9.98	9.67	9.07	8.70	7.55	8.17	7.56	7.60	8.93	8.42	8.57	7.55	9.98
D.O.	%	1.0		99%	106%	113%	109%	93%	105%	90%	88%	109%	99%	101%	88%	113%
Temp.	°C	0.10		14.5	17.8	24.4	25.4	24.4	26.6	24.4	22.6	23.6	21.1	22.5	14.5	26.6
Temp.	°F	0.10		58.0	64.0	76.0	77.8	76.0	79.9	75.9	72.6	74.5	69.9	72.5	58.0	79.9
Salinity	%	0.01		0.11	0.11	0.10	0.11	0.12	0.10	0.11	0.12	0.10	0.11	0.11	0.10	0.12
Cl-a	µg/L	1.0		<1	<1	<1	1.4	2.9	1.4	2.1	2.8	<1	2.8	2.2	1.4	2.9
T.P.	mg/L	0.005		0.012	0.019	0.009	<0.02	0.013	0.013	0.014	0.018	0.009	0.021	0.014	0.009	0.021
T.P.	µg/L	5		12	19	9	#VALUE!	13	13	14	18	9	21	14	9	21
Secchi	ft	0.1		19.4	17.9	14.3	12.1	13.3	15.9	13.1	10.3	15.6	12.8	14.5	10.3	19.4
Secchi	m	0.1		5.9	5.5	4.4	3.7	4.1	4.9	4.0	3.1	4.7	3.9	4.4	3.1	5.9
Field Observations																
Physical				1.0	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.5	1.0	2.0
Recreational				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

*Reporting Limit

Fawn Lake Water Quality Results

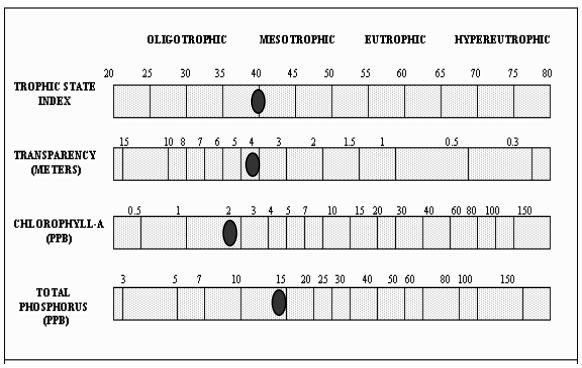




Fawn Lake Historic Summertime Mean Values

Agency	MPCA	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1988	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010	2012	2015
TP (µg/L)	23.0	13.6	41.6	18.0	16.3	21.7	17.4	19.4	30.0	18.0	22.6	15.0	14.2
Cl-a (µg/L)	29.4	5.0	3.4	3.1	7.5	5.2	5.1	2.4	3.5	3.7	5.6	3.7	2.2
Secchi (m)	2.3	4.5	4.1	4.8	4.4	3.8	3.8	4.3	3.8	4.1	3.5	3.8	4.4
Secchi (ft)	7.5	14.7	13.3	15.7	14.5	12.3	12.5	14.1	12.6	13.5	11.3	12.6	14.5
Carlson's Trophic State Indices													
Year	1988	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010	2012	2015
TSIP	49	42	58	46	44	49	45	47	53	46	49	43	42
TSIC	64	46	43	42	50	47	47	39	43	44	47	43	38
TSIS	48	38	40	37	39	41	41	39	41	40	42	41	39
TSI	54	42	47	42	44	45	44	42	46	43	46	42	40
Fawn Lake Water Quality Report Card													
Year	1988	1997	1998	1999	2000	2001	2002	2004	2006	2008	2010	2012	2015
TP (µg/L)	B	A	C	A	A	A	A	A	B	A	A	A	A
Cl-a (µg/L)	C	A	A	A	A	A	A	A	A	A	A	A	A
Secchi (m)	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall	**B**	**A**	**B**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**	**A**

Carlson's Trophic State Index



Typo Lake

Linwood Township, Lake ID # 03-0009

Background

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

2015 Results

In 2015 Typo Lake had extremely poor water quality compared to other lakes in this region (NCHF Ecoregion), receiving an overall F letter grade. This overall grade is worse than the 2014 but is consistent to all previous years monitored. In addition, some of the most important parameters were much better than many of the years observed. In the worst two years of results, total phosphorus averaged 340 (2007) and 353 µg/L(2009), respectively. Total phosphorus in 2015 averaged 201.4 µg/L, which while still very high, but was the second lowest reading since 1997. Chlorophyll-a levels in 2015 (57.5 µg/L) were the second lowest throughout all years monitored. In both 2007 and 2009 a bright white Secchi disk could be seen only 5-6 inches below the surface, on average. There was a slight improvement in 2012 to 9-10 inches and a larger improvement in 2014 to 21-22 inches. The reason for the especially poor conditions in 2007 and 2009 seems to be drought-induced low water levels. To that same sentiment, it is reasonable to believe that the improvements observed in 2014 may be a result of above average rainfall.

Trend Analysis

Fifteen years of water quality monitoring have been conducted by the Minnesota Pollution Control Agency (1993, '94, and '95) and the Anoka Conservation District (1997-2001, '03, '05, '07, '09, '12, '14, '15). Water quality has significantly deteriorated from 1993 to 2015 (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,12}$=5.97, p=0.02). Though, tested individually (one-way ANOVAs on the individual response variables) TP, Cl-a, and Secchi depth show no significant change. The trend toward poorer phosphorus and transparency continue to appear to be strong despite the fact that in 2012, 2014 and 2015 these parameters were slightly better than the previous years monitored.

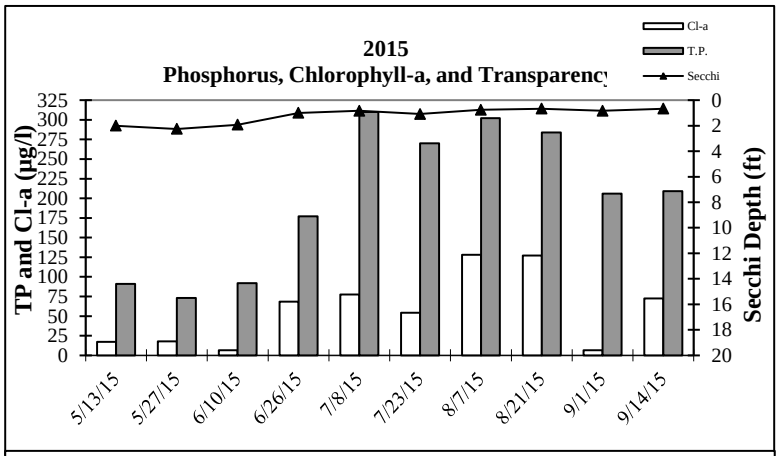
Discussion

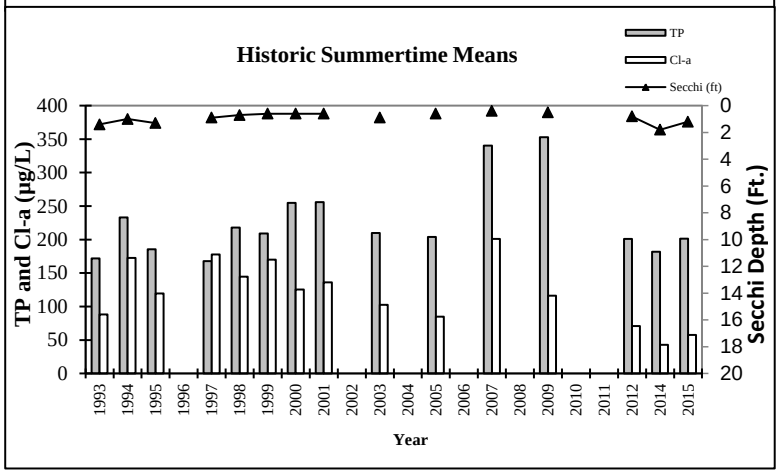
Typo Lake, along with Martin Lake downstream, were the subject of TMDL study by the Anoka Conservation District which was approved by the State and EPA in 2012. This study documented the source of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. Some factors impacting water quality on Typo Lake include rough fish, high phosphorus inputs from a ditched wetland west of the lake, and lake sediments. A carp barrier project between Martin and Typo lakes has been approved and funded. The first barrier was installed in 2014 with contractors set to install the final three in 2015/2016.

Typo Lake Water Quality Results

Typo Lake		Date	5/13/2015	5/27/2015	6/10/2015	6/26/2015	7/8/2015	7/23/2015	8/7/2015	8/21/2015	9/1/2015	9/14/2015			
2015 Water Quality Data		Time	14:20	12:20	13:00	12:45	12:35	12:45	10:55	11:40	11:55	12:50			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	8.35	8.48	8.90	8.88	9.15	8.72	8.18	8.53	8.10	8.58	8.59	8.10	9.15
Conductivity	mS/cm	0.01	0.280	0.274	0.257	0.308	0.314	0.259	0.275	0.304	0.250	0.294	0.282	0.250	0.314
Turbidity	FNRU	1	19.50	20.70	37.50	77.90	82.90	104.00	136.00	135.00	126.00	116.00	86	20	136
D.O.	mg/l	0.01	10.05	8.73	11.27	10.95	11.51	8.15	5.77	10.93	8.14	9.96	9.55	5.77	11.51
D.O.	%	1	99%	96%	140%	142%	140%	104%	67%	121%	103%	115%	112%	67%	142%
Temp.	°C	0.1	13.6	18.1	24.4	26.5	23.2	26.8	22.5	20.0	24.4	19.2	21.86	13.60	26.82
Temp.	°F	0.1	56.5	64.5	75.8	79.7	73.8	80.3	72.5	23.7	75.9	66.5	71.4	23.7	80.3
Salinity	%	0.01	0.13	0.13	0.12	0.15	0.15	0.13	0.13	0.14	0.12	0.13	0.1	0.1	0.2
Cl-a	ug/l	0.5	17.1	17.8	6.4	68.4	77.6	54.1	128.0	127.0	6.4	72.6	57.5	6.4	128.0
T.P.	mg/l	0.010	0.091	0.073	0.092	0.177	0.310	0.270	0.302	0.284	0.206	0.209	0.201	0.073	0.310
T.P.	ug/l	10	91	73	92	177	310	270	302	284	206	209	201	73	310
Secchi	ft	0.1	2.0	2.3	1.9	1.0	0.8	1.1	0.8	0.7	0.8	0.7	1.2	0.7	2.3
Secchi	m	0.1	0.6	0.7	0.6	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.4	0.2	0.7
Field Observations															
Physical			1.0	2.0	3.0	4.0	4.00	4.00	5.0	4.0	2.0	3.0	3.2	1.0	5.0
Recreational			1.0	2.0	2.0	2.0	2.00	1.00	4.0	3.0	2.0	3.0	2.2	1.0	4.0

Typo Lake Water Quality Results





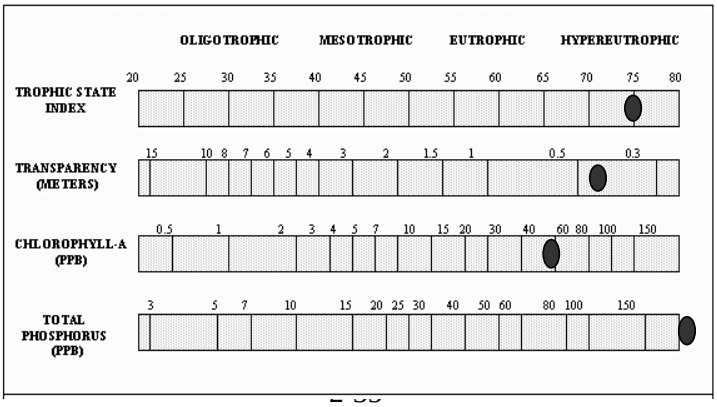
Typo Lake Historic Summertime Mean Values

Agency	CLMP	CLMP	MPCA	MPCA	MPCA	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD	ACD
Year	1974	1975	1993	1994	1995	1997	1998	1999	2000	2001	2003	2005	2007	2009	2012	2014	2015
TP			172.0	233.0	185.6	168.0	225.7	202.1	254.9	256.0	209.8	204	340.5	353.0	201.0	182.0	201.4
Cl-a			88.1	172.8	119.6	177.8	134.7	67.5	125.3	136.0	102.5	84.7	200.9	116.2	70.7	42.8	57.5
Secchi (m)	0.23	0.27	0.43	0.29	0.38	0.27	0.21	0.25	0.18	0.19	0.3	0.2	0.1	0.1	0.2	0.6	0.4
Secchi (ft)	0.2	0.3	1.4	1.0	1.3	0.9	0.7	0.8	0.6	0.6	0.9	0.6	0.4	0.5	0.8	1.8	1.2
Carlson's Tropic State Indices																	
TSIP			78	83	79	78	82	81	83	82	81	81	88	89	81	79	81
TSIC			75	81	78	82	79	72	74	77	76	74	83	77	72	68	70
TSIS	81	79	72	78	74	79	82	80	86	85	77	83	93	93	83	67	73
TSI			75	81	77	79	81	78	81	81	78	79	88	86	79	71	75

Typo Lake Water Quality Report Card

Year	1974	1975	1993	1994	1995	1997	1998	1999	2000	2001	2003	2005	2007	2009	2012	2014	2015
TP			F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Cl-a			F	F	F	F	F	D	F	F	F	F	F	F	D	C	D
Secchi	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Overall			**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**D-**	**F**

Carlson's Trophic State Index



Martin Lake

Linwood Township, Lake ID # 02-0034

Background

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

2015 Results

In 2015 Martin Lake had poor water quality compared to other lakes in the North Central Hardwood Forest Ecoregion (NCHF), receiving a C letter grade. This eutrophic lake has chronically high total phosphorus and chlorophyll-a. In 2015 total phosphorus averaged 92.6 µg/L, slightly above the lake's historical average of 92.1 µg/L and well above the impairment threshold of 60 µg/L. Chlorophyll-a was the second lowest observed in the lakes monitored history at 17.8 µg/L. Average Secchi transparency was only 3.4 feet in 2015 but slightly better than the historical average. ACD staff's subjective perceptions of the lake were that "high" algae made the lake less than desirable for swimming from July through September.

Trend Analysis

Fourteen years of water quality data have been collected by the Minnesota Pollution Control Agency (1983), Metropolitan Council (1998, 2008), and ACD (1997, 1999-2001, 2003, 2005, 2007, 2009, 2012, 2014, 2015). Citizens monitored Secchi transparency 17 other years. Anecdotal notes from DNR fisheries data indicate poor water quality back to at least 1954. A water quality change from 1983 to 2015 is detectable with statistical tests (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,11}$=10.74, p=<0.01). In previous assessments if the oldest year of data (1983) was excluded, there was no longer a statistically significant trend. 2015 is the first year where the exclusion does not change the trend from being statistically significant (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth; $F_{2,10}$=5.82, p=0.021). However, further examination of the data (one-way ANOVAs on the individual response variables) TP, Cl-a, and Secchi depth reveals that no water quality parameter alone has changed significantly, and the direction of their changes is mixed.

Discussion

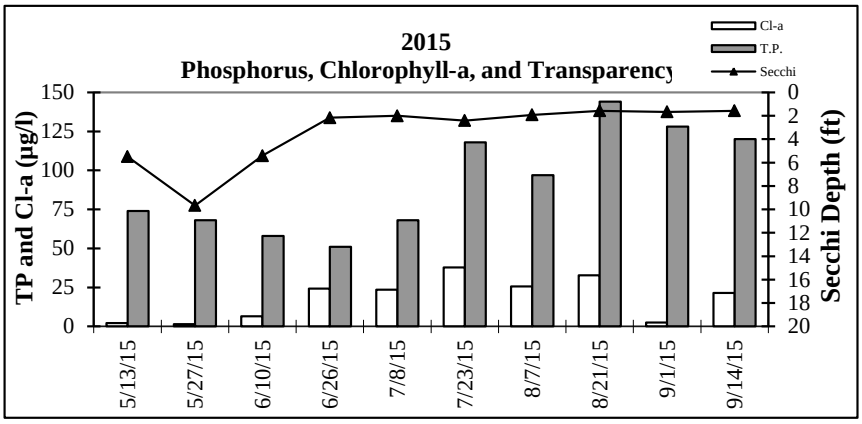
Martin Lake, along with Typo Lake upstream, were the subject of an TMDL study by the Anoka Conservation District that was approved by the State and EPA in 2012. This study documented the source of nutrients to the lake, the degree to which each is impacting the lake, and put forward lake rehabilitation strategies. Water from Typo Lake and internal loading (carp, septic systems, sediments, etc) are two of the largest negative impacts on Martin Lake water quality. A carp barrier project between Martin and Typo lakes has been approved and funded. The first barrier was installed in 2014 with contractors set to install the final two in 2015/2016.

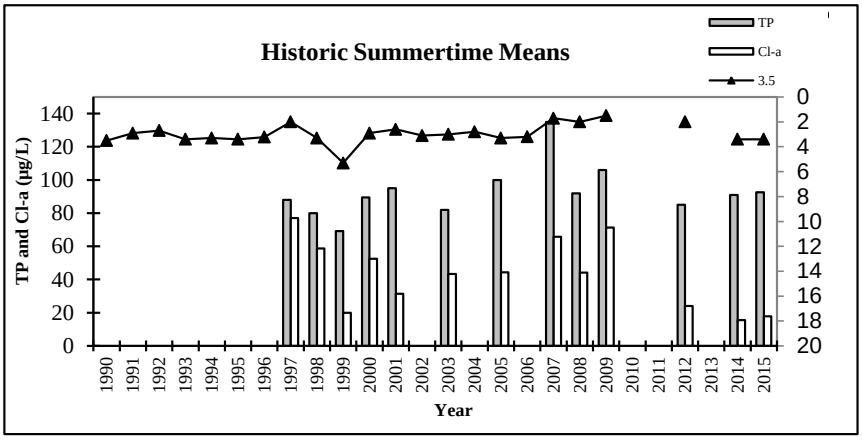
2015 Martin Lake Water Quality Data

Martin Lake

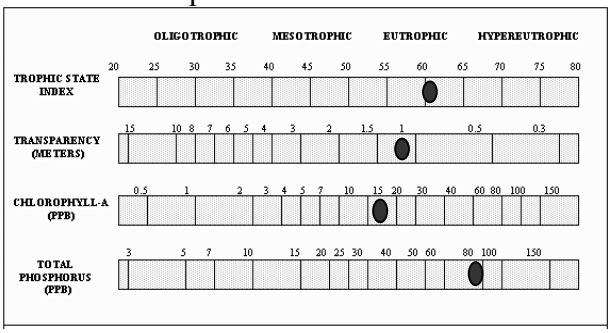
2015 Water Quality Data		Date:	5/13/2015	5/27/2015	6/10/2015	6/26/2015	7/8/2015	7/23/2015	8/7/2015	8/21/2015	9/1/2015	9/14/2015			
		Time:	14:50	12:45	13:40	13:10	13:10	13:15	11:15	12:50	12:15	13:15			
	Units	R.L.*	Results	Results	Results	Results	Results	Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1	7.78	7.63	8.00	8.46	7.98	8.71	7.83	7.28	8.37	8.28	8.03	7.28	8.71
Conductivity	mS/cm	0.01	0.311	0.312	0.298	0.331	0.348	0.291	0.338	0.370	0.305	0.336	0.324	0.291	0.370
Turbidity	FNRU	1	4.60	0.80	5.60	25.80	23.40	35.80	34.21	51.40	52.70	45.40	27.97	0.80	52.70
D.O.	mg/l	0.01	8.08	7.55	8.67	10.56	6.04	10.39	6.12	5.30	10.96	7.44	8.11	5.30	10.96
D.O.	%	1	81%	81%	107%	128%	73%	132%	73%	60%	130%	85%	95%	60%	132%
Temp.	°C	0.1	15.0	17.3	24.0	25.0	23.4	26.0	23.9	21.5	22.6	20.0	21.9	15.0	26.0
Temp.	°F	0.1	59.0	63.1	75.2	77.0	74.1	78.8	74.9	70.8	72.6	68.0	71.4	59.0	78.8
Salinity	%	0.01	0.15	0.15	0.14	0.16	0.17	0.14	0.16	0.18	0.15	0.16	0.16	0.14	0.18
Cl-a	ug/L	0.5	2.1	1.4	6.4	24.2	23.5	37.7	25.6	32.8	2.5	21.4	17.8	1.4	37.7
T.P.	mg/l	0.010	0.074	0.068	0.058	0.051	0.068	0.118	0.097	0.144	0.128	0.120	0.093	0.051	0.144
T.P.	ug/l	10	74	68	58	51	68	118	97	144	128	120	92.6	51	144
Secchi	ft		5.5	9.7	5.4	2.2	2.0	2.4	1.9	1.6	1.7	1.6	3.4	1.6	9.7
Secchi	m		1.7	2.9	1.7	0.7	0.6	0.7	0.6	0.5	0.5	0.5	1.0	0.5	2.9
Field Observations															
Physical			1.0	2.0	2.0	3.0	3.0	4.0	3.0	3.0	3.0	3.0	2.7	1.0	4.0
Recreational			1.0	1.0	1.0	1.0	1.0	1.0	3.0	2.0	3.0	3.0	1.7	1.0	3.0

Martin Lake Water Quality Results





Carlson's Trophic State Index



Martin Lake Summertime Annual Mean

Agency	CLMP	ACD	MC	ACD	ACD	ACD	CLMP	ACD	CLMP	ACD	ACD	ACD	CAMP	CAMP	ACD	ACD	ACD
Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2014	2015
TP		88.0	80.0	61.7	89.4	95.4		81.9		100.0		135.0	92.0	106.0	85.0	91.0	92.6
Cl-a		77.0	58.8	18.0	52.5	31.4		43.3		44.3		65.8	44.1	71.4	24.1	15.5	17.8
Secchi (m)	1.0	0.6	1.0	1.8	0.9	0.8	0.9	0.9	0.9	1.0	1.0	0.5	0.6	0.4	0.6	1.0	1.0
Secchi (ft)	3.2	2.0	3.3	5.3	2.9	2.6	3.1	3.0	2.8	3.3	3.2	1.7	2.0	1.5	2.0	3.4	3.4

Carlson's Tropic State Indices

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

Martin Lake Water Quality Report Card

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2014	2015
TP		D	D	C	D	D		D		D		D	D	D	D	D	D
Cl-a		D	D	B	C	C		C		C		D	C	D	C	B	B
Secchi	D	F	D	C	D	D	D	D	D	D	D	F	F	F	F	D	D
Overall		**D**	**D**	**C**	**D**	**D**		**D**		**D**		**D**	**D**	**D**	**D**	**C**	**C**

Aquatic Invasive Vegetation Mapping

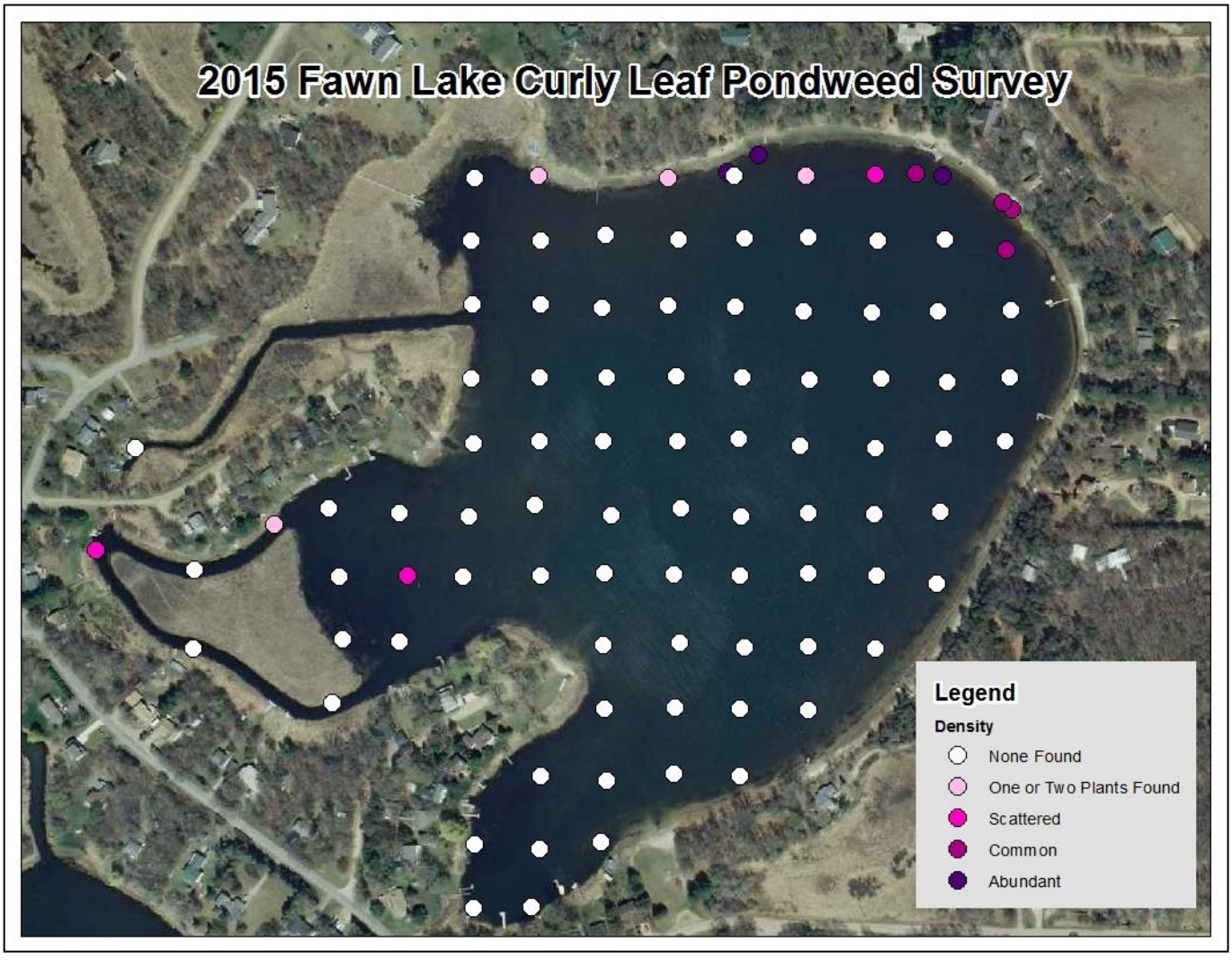
Description: The Anoka Conservation District (ACD) was contracted through the Sunrise River Watershed Management Organization (WMO) to conduct an aquatic invasive vegetation survey.

Purpose: To map out the presence of aquatic invasive vegetation throughout Fawn Lake. Curly-leaf Pondweed is present in Fawn Lake. This survey will provide a sense of the vegetation quality in the lake as well as mark areas of concern which may require further attention in the future. Early detection and rapid response is crucial for minimizing the impacts of invasive species.

LOCATIONS: FAWN LAKE

Results: A map is presented below. These survey points map the areas sampled as well as any areas of interest or concern. Curly-leaf Pondweed is still present but not to nuisance levels. Overall, Fawn Lake contained a large variety of healthy-native vegetation.

2015 Fawn Lake Aquatic Invasive Vegetation Survey



Stream Water Quality

Description: Stream water quality is monitored with grab samples on eight occasions throughout the open water season including immediately following four storms and four times during baseflow. The selected are the farthest downstream limits of the Sunrise River Watershed Management Organization's jurisdictional area. Parameters monitored include water level, pH, conductivity, turbidity, transparency, dissolved oxygen, phosphorus, total suspended solids. This data can be paired with stream hydrology monitoring to do pollutant loading calculations.

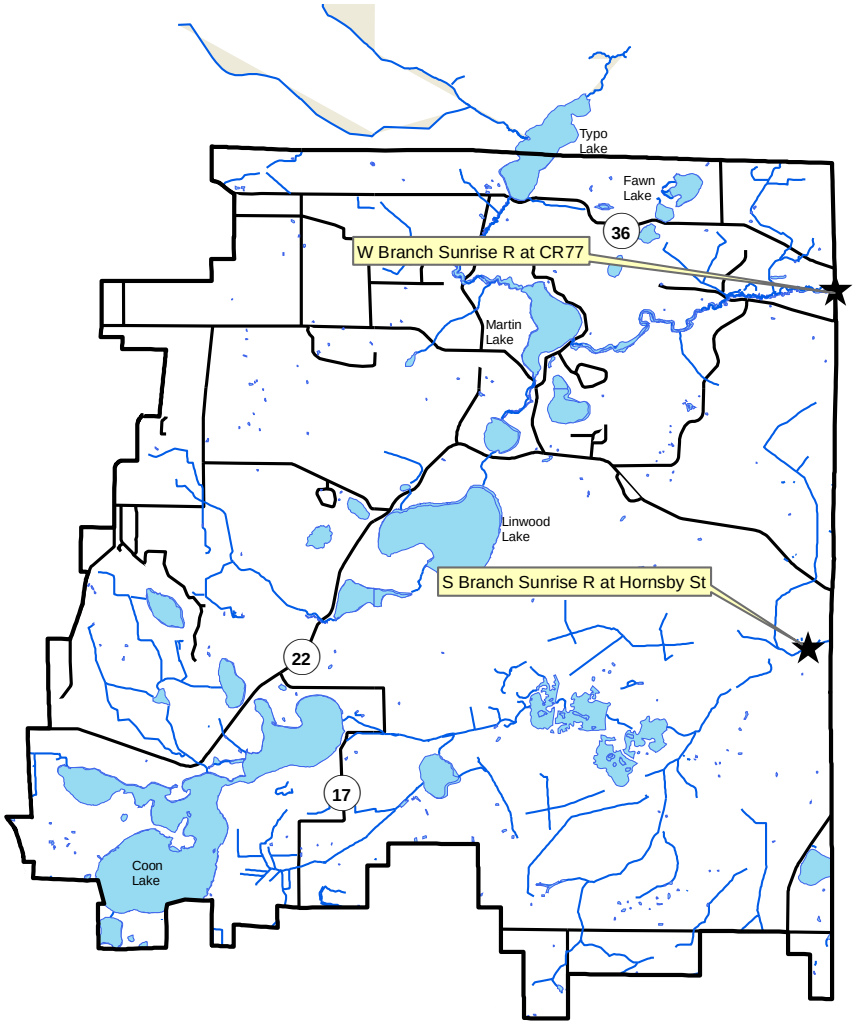
Purpose: To detect water quality trends and problems, and diagnose the source of problems.

Locations: West Branch of Sunrise River at CR 77

South Branch of Sunrise River at Hornsby St

Results: Results are presented on the following pages.

Sunrise Watershed Stream Water Quality Monitoring Sites



Stream Water Quality Monitoring

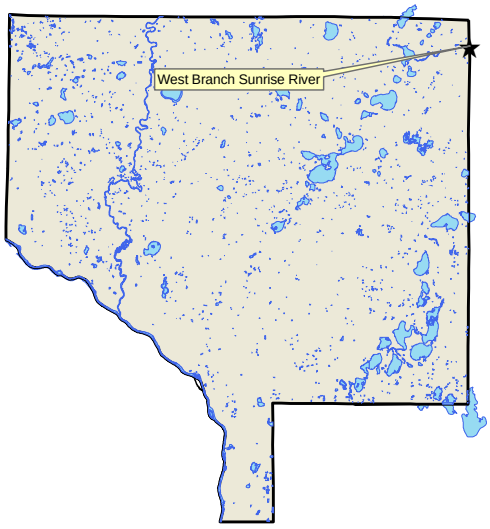
WEST BRANCH SUNRISE RIVER

at Co Road 77, Linwood Township

STORET SiteID = S001-424

Years Monitored

2001, 2003, 2006, 2012, 2015



Background

This monitoring site is the bottom of this watershed in Anoka County, at the Chisago County border. Upstream, this river drains through Boot, Linwood, Island, Martin, and Typo Lakes. The Sunrise River Watershed Management Organization monitors this site because it is at the bottom of their jurisdictional area. Flows in the West Branch of the Sunrise River are often around 70 cfs, but range from 15 cfs to near 200 cfs.

This segment of the river is listed by the MN Pollution Control Agency as impaired for turbidity and for poor fish and invertebrate communities. A TMDL study was completed in 2013.

Methods

In 2001, 2003, 2006, 2012, and 2015 the West Branch of the Sunrise River ws monitored at County Road 77 (Lyons St). This location is the boundary between Anoka and Chisago Counties. It is also the farthest downstream point within the Sunrise River Watershed Management Organization's jurisdiction.

The river was monitored by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, dissolved oxygen, and salinity. Parameters tested by water samples sent to a state-certified lab included total phosphorus, and total suspended solids. Water level is monitored continuously in the open water season and a rating curve has been developed to calculate flows from those water level records.

Summary

Summarized water quality monitoring findings and management implications include:

- Dissolved pollutants, as measured by conductivity and chlorides, are at low and healthy levels.

  Management discussion: Road deicing salts are a concern region-wide. They are measurable in area streams year-round, including in the Sunrise River. While they may be low here, excessive use should be avoided.

- Phosphorus was seen at acceptable levels. This was large decrease from when last monitored in 2012. Even so, when state water quality standards are developed for phosphorus in streams, the West Branch of the Sunrise River may exceed it.

  Management discussion: Management in upstream lakes will help reduce phosphorus in the river.

- Suspended solids and turbidity were well below state water quality standards. There was a large decrease from 2012 results.

  Management discussion: Efforts to reduce suspended material in upstream lakes will help decrease turbidity and suspended solids throughout the Sunrise River.

- pH was within the range considered normal and healthy for streams in this area.
- Dissolved oxygen (DO) was typically within the range considered normal and healthy. Only on one sampling occasion in 2015 did DO drop below 5 mg/L, which was during a storm event.

  Management discussion: Low dissolved oxygen is likely impacting aquatic life and focusing more into this issue would be important to overall stream health.

Results and Discussion

This reach of the West Branch of the Sunrise River has an impaired invertebrate and fish community according to the MPCA. There was one invert sample taken for this determination. The invertebrate monitoring crew sampled overhanging vegetation and macrophytes and did not sample the stream bed. The stream bed is difficult to sample because sediments are deep and unconsolidated. There were two fish samples taken at County Road 77, and another right upstream. The fish visits were scored against a low gradient Index of Biotic Integrity (IBI), which is appropriate for this river. The status of this impairment may change once Minnesota adopts a TALU (tiered aquatic life use) framework when examining water quality standards.

A Total Maximum Daily Load (TMDL) study for this river reach and was completed in 2013. It is part of a larger Sunrise River Watershed Restoration and Protection Project (WRAPP) led by the Chisago Soil and Water Conservation District and MN Pollution Control Agency. Local entities should become involved in this project as it will determine causes of the turbidity and biotic impairments and set forth measures needed to correct them.

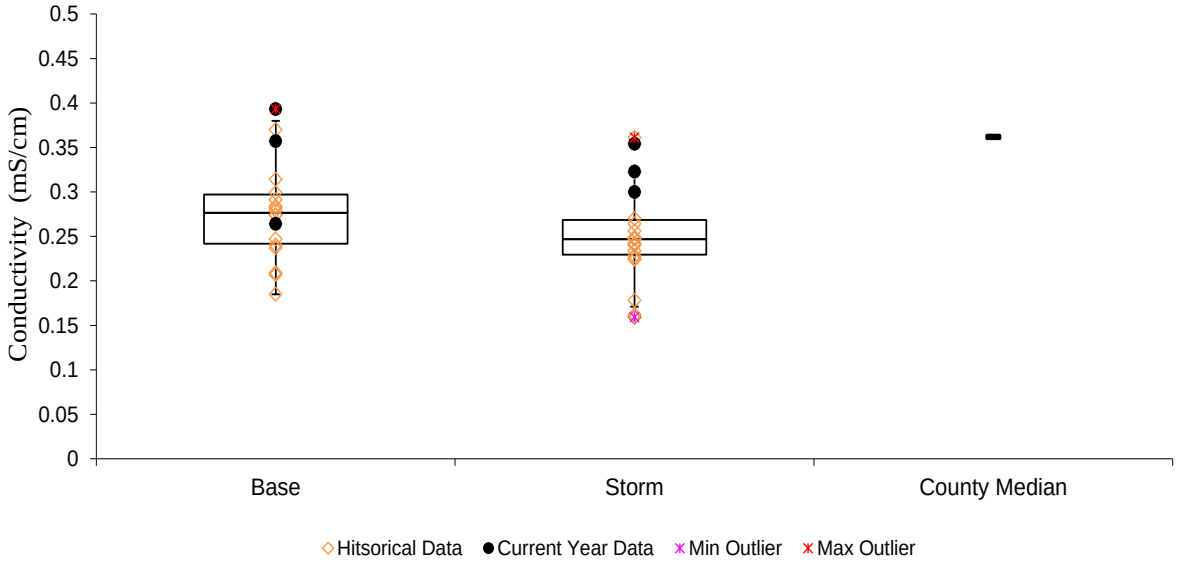
Conductivity and chlorides

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

Conductivity was acceptably low in the West Branch of the Sunrise River. Median conductivity across all years was 0.252 mS/cm. This is notably lower than the median for 34 Anoka County streams of 0.362 mS/cm. Conductivity was slightly lower during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. High baseflow conductivity has been observed in many other area streams too, studied extensively, and the largest cause is road salts that have infiltrated into the shallow aquifer.

Chlorides were not tested in 2015 but 1n 2012 chloride results parallel those found for conductivity. Median chloride levels in the West Branch of the Sunrise River across all years are the same as the median for Anoka County streams of 12 mg/L. The levels observed are much lower than the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L. The primary reason for low chloride levels in this river is low road densities in the watershed, and therefore less use or road deicing salts.

Conductivity during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



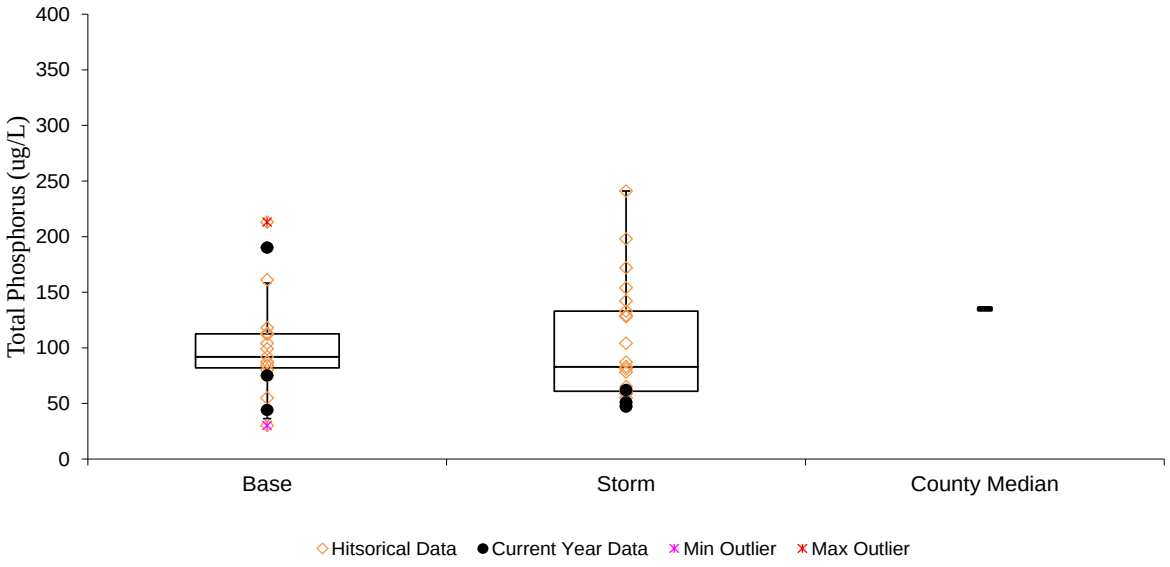
Total Phosphorus

Total phosphorus (TP), a nutrient, is one of the most common pollutants in our region, and can be associated with urban runoff, agricultural runoff, wastewater, and many other sources. Total phosphorus in the West Branch of the Sunrise River is within the acceptable range. The median TP for Anoka County streams is 135 ug/L which is similar to the state water quality standard. The median phosphorus concentration in the West Branch of the Sunrise River across all years was 87.0 ug/L, and in 2015 alone was 63.5 ug/L which was a large decrease from

2012 monitoring results. 7 of 40 samples (17.5%) from all years had TP higher than 150 ug/L and two of these samples were higher than 200 ug/L.

These phosphorus levels are common for the area. In the case of the West Branch of the Sunrise River, phosphorus levels are, at least in part, reflective of conditions of Martin Lake about 3 miles upstream from the sampling site. Martin Lake is impaired for excess phosphorus, with a summertime average of 100 ug/L during the last 10 years. Water quality improvements to Martin Lake will benefit the river downstream. Installation of a carp barrier project between Martin and Typo lakes has begun and improvements to the water quality of the Sunrise River should be seen in the future.

Total phosphorus during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Turbidity and Total Suspended Solids (TSS)

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

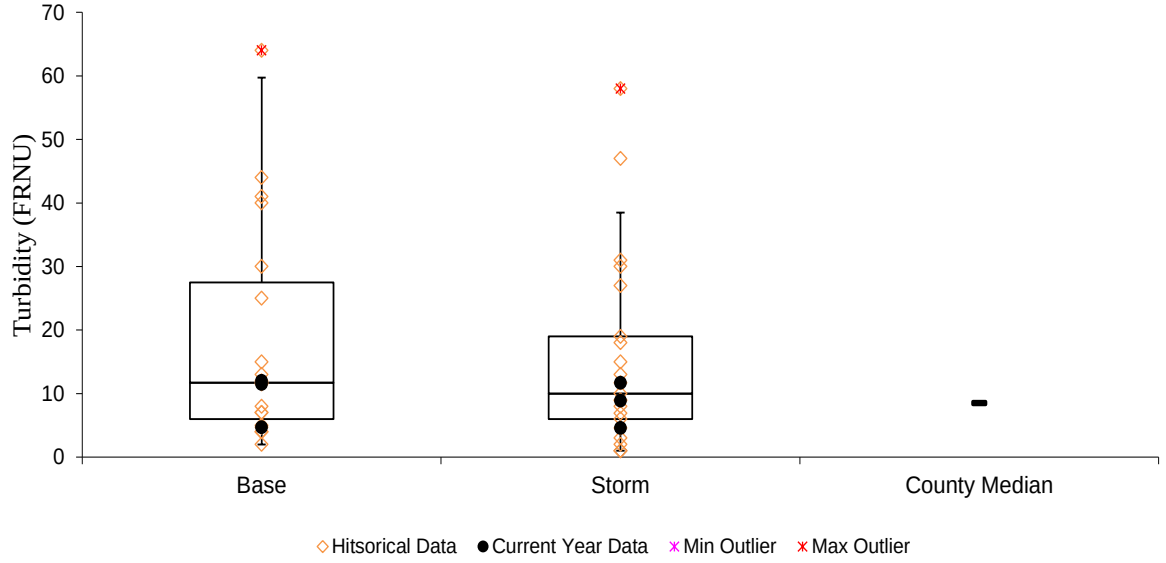
It is important to note the suspended solids can come from sources in and out of the river. Sources on land include soil erosion, road sanding, and others. Riverbank erosion and movement of the river bottom also contributes to suspended solids. A moderate amount of this "bed load" is natural and expected.

The West Branch of the Sunrise River has been declared as "impaired" for excess turbidity by the MN Pollution Control Agency. Their threshold is 25 NTU turbidity. If a river exceeds this value on three occasions and at least 10% of all sampling events, then it is declared impaired for turbidity. Based on all years of data, the West Branch

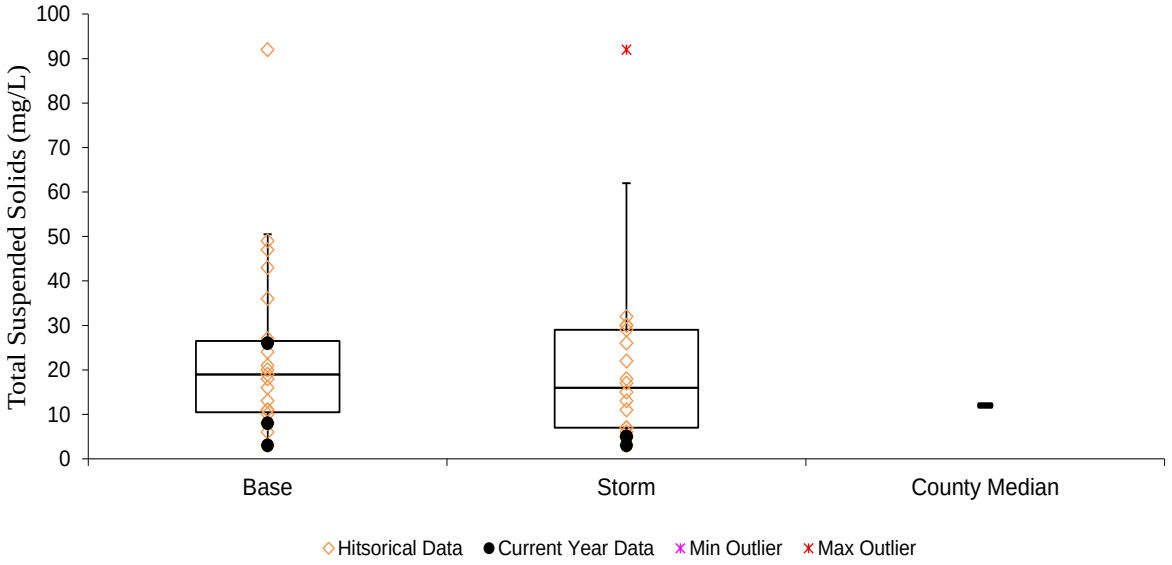
of the Sunrise River has exceeded 25 NTU turidity on 10 of 40 sampling occassions (25%). But in 2015 all eight samples had turbidity lower than 25 NTU, and the maximum was only 11.7 NTU.

The most obvious source of turbidity is algae from upstream lakes. Three of the four immediately upstream lakes are impaired for excessive nutrients and high algae. They include Linwood, Martin, and Typo Lakes. The river sampling site is just 3 miles downstream from Martin Lake. The intervening area between the lake and sampling site is a wide floodplain fringe and forests with little human impacts that would be expected to add sediment to the river. Therefore, efforts to reduce suspended material in the river should focus on the upstream lakes. It is also worth noting that this section of the river has unconsolidated bottom material which can move around and contribute to turbidity.

Turbidity during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Total suspended solids during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



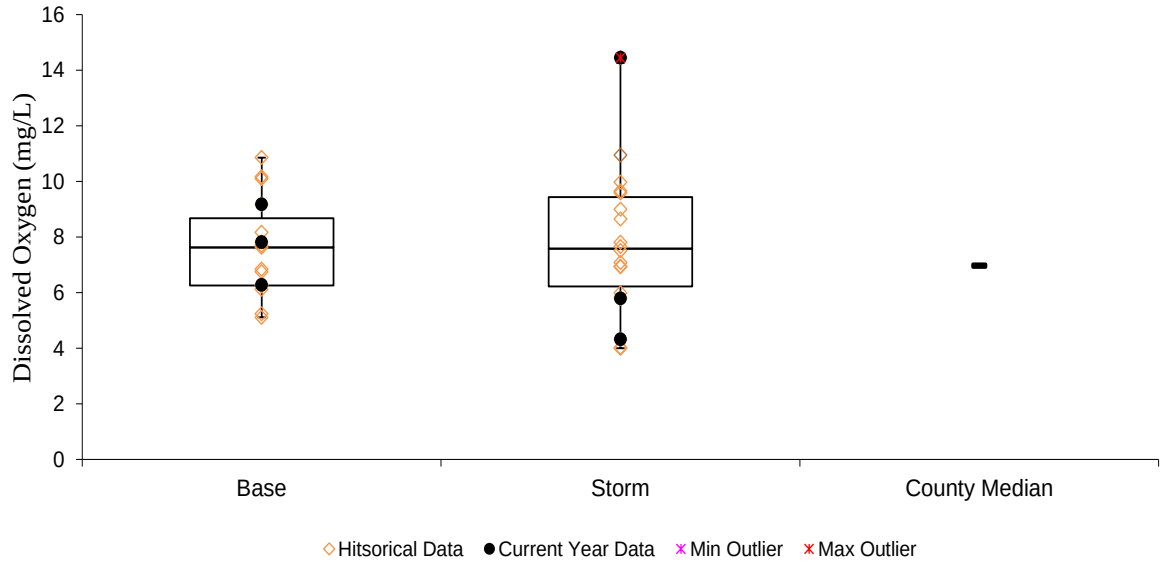
Dissolved Oxygen

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

For the West Branch of the Sunrise River there are two datasets to consider. First, spot measurements were taken with the other water quality monitoring described in this report. Dissolved oxygen has been found at less than 5 mg/L on three different occasions. All were during storm events, occurring in 2003, 2012 and 2015. Secondly, MPCA took around-the-clock DO measurements for eight days in 2012. They found DO dipped below 5 mg/L every morning.

The river has been designated as impaired for poor fish and invertebrate communities. Low dissolved oxygen could definitely contribute to or cause this impairment. The Sunrise River TMDL study should provide further diagnosis of the low DO and corrective measures.

Dissolved oxygen results during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

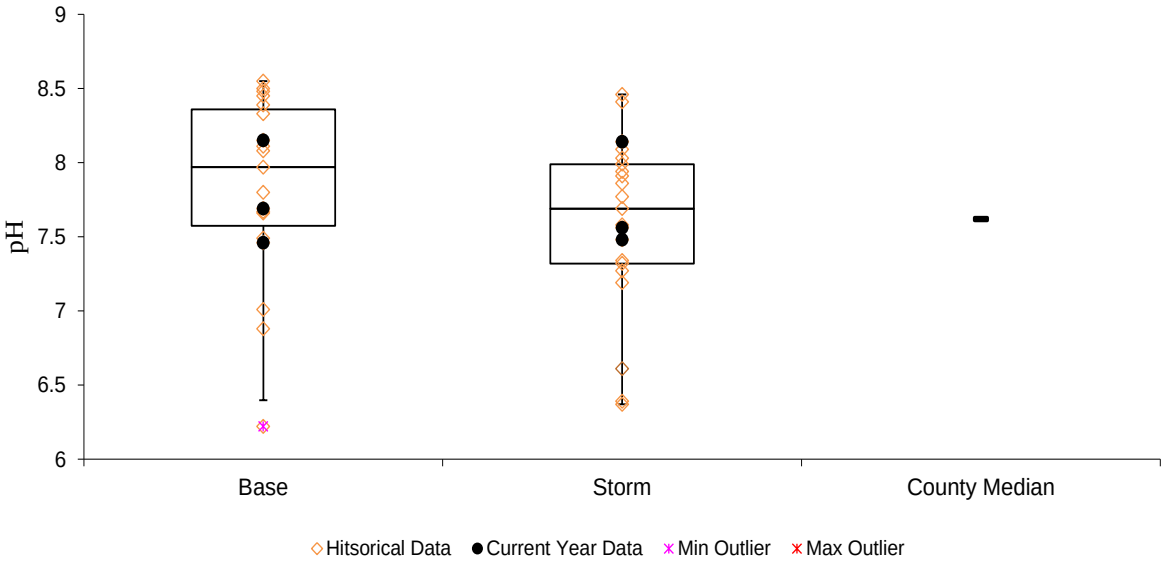


pH

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

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

pH results during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Recommendations

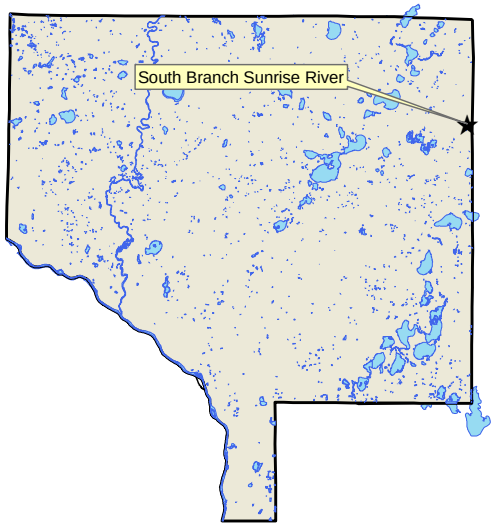
A Total Maximum Daily Load (TMDL) study was completed in 2013 to determine address impairments of this river. The study confirmed turbidity and aquatic life impairments. At this time, it appears that many of the issues in the river are best addressed by water quality improvement projects targeted at upstream lakes, however low dissolved oxygen may be an in-river problem.

SOUTH BRANCH SUNRISE RIVER

at Hornsby Street, Linwood Township

STORET SiteID = S005-640

Years Monitored
2012, 2015



Background

This monitoring site is the bottom of this watershed in Anoka County, at the closest accessible point to the Anoka-Chisago County boundary. Upstream, this river drains from Coon Lake and through the Carlos Avery Wildlife Management Area. The Sunrise River Watershed Management Organization monitors this site because it is at the bottom of their jurisdictional area.

2012 was the first year of water quality monitoring at this site. Other monitoring downstream has occurred. Hydrology (stage) monitoring has been done since 2009. No rating curve has been established.

The MN Pollution Control Agency has designated this site as "impaired" due to low dissolved oxygen. A TMDL study was completed in 2013.

Methods

Water Quality was monitored during by grab samples. Eight water quality samples were taken each year; half during baseflow and half following storms. Storms were generally defined as one-inch or more of rainfall in 24 hours or a significant snowmelt event combined with rainfall. Parameters tested with portable meters included pH, conductivity, turbidity, temperature, salinity, and dissolved oxygen. Parameters tested by water samples sent to a state-certified lab included total phosphorus, and total suspended solids. Water level is monitored continuously in the open water season. A rating curve has not been developed to calculate flows from those water level records.

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Results and Discussion

Summary

Water quality in the South Branch of the Sunrise River has several problems which appear linked. The river has already been designated as "impaired" by the MN Pollution Control Agency for low dissolved oxygen. Our monitoring also found high turbidity and phosphorus during baseflow and periods with low oxygen.

The issues of low oxygen, turbidity, and phosphorus appear to be related. Addressing them in concert may be helpful. The water has a notable reddish color during baseflow, when dissolved oxygen would be expected to be lowest. This color may be due to reduction of iron in soils. Iron in its reduced form is more mobile (hence the reddish water color) and less able to hold phosphorus. High turbidity and phosphorus coincide with low oxygen and baseflow. Low oxygen is likely due to decomposition in upstream wetlands, which might be described as "natural."

On October 23, 2012, when the stream channel held only intermittent pools of water, the water was even more intensely red, turbid, and had extremely high phosphorus. This result is consistent with the theory that iron-rich native soils are an important source of turbidity and phosphorus. It does not appear that watershed practices are to blame.

Summarized water quality results include:

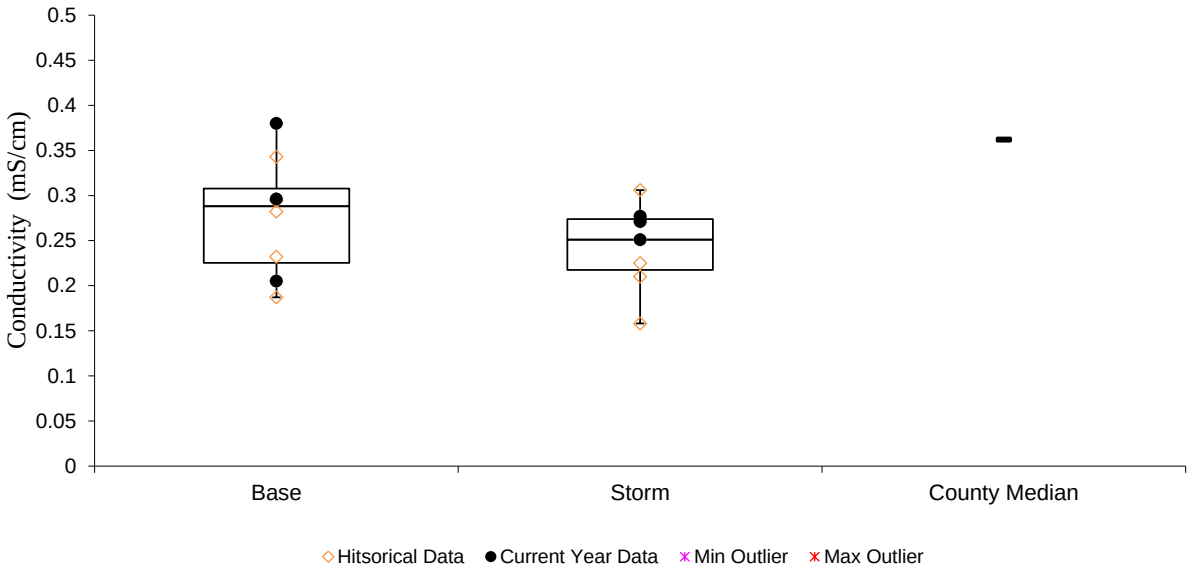
- Dissolved pollutants, as measured by conductivity and chlorides, are low.
- Phosphorus was seen at low levels and was a large decrease from 2012 results. Even so, when state water quality standards are developed for phosphorus in streams, the South Branch of the Sunrise River may exceed it.
- Suspended solids and turbidity were low during baseflow and higher during storm events. Twenty measurements, which we do not yet have, are required determine if it fails to meet state water quality standards. However the data to date suggest the site may fail to meet state standards. In 2015 five out of eight turbidity readings were above the state standard of 25 NTU.
- pH was within the range considered normal and healthy for streams in this area. Interestingly, pH was lower during baseflow than storms. This is the opposite of most streams since rain water is usually more acidic.
- Dissolved oxygen was alarmingly low. Five out of eight reading recorded DO levels below the state standard of 5 mg/L. This river reach is already listed by the State as "impaired" for low dissolved oxygen.

Conductivity and chlorides

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

Conductivity is low in the South branch of the Sunrise River. Conductivity was lowest during storms, suggesting that stormwater runoff contains fewer dissolved pollutants than the surficial water table that feeds the river during baseflow. Higher conductivity during baseflow suggests an impact from road deicing salts that have infiltrated to the shallow groundwater and feed the stream during baseflow.

Conductivity during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



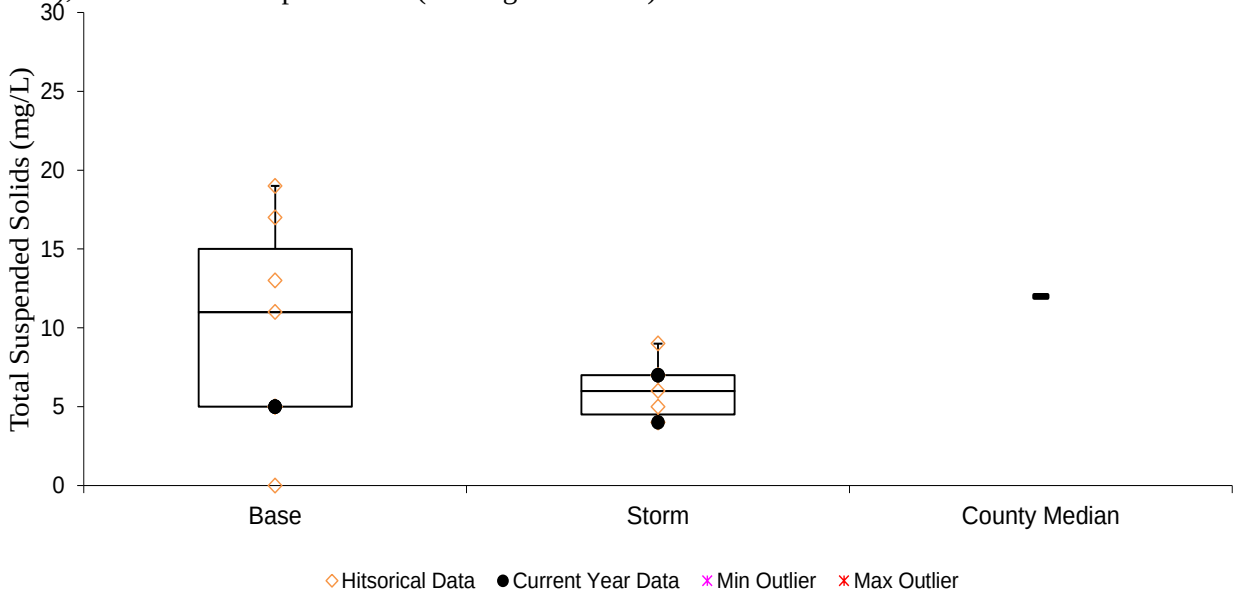
Chlorides were not monitored in 2015 but in 2012 Chlorides were low in the South Branch of the Sunrise River. The levels observed are much lower than the Minnesota Pollution Control Agency's (MPCA) chronic standard for aquatic life of 230 mg/L. This is likely because of low road densities (and therefore deicing salt use) in the watershed. Because of large expanses of public natural areas in the watershed, future increases in chlorides should be minimal.

Total Phosphorus

Total phosphorus (TP) in 2015 was lower during baseflow (average 69.75 ug/L) and higher during storms (average 110.25 ug/L). This is common of most streams, where watershed runoff contributes phosphorus. As described earlier, we've hypothesized that an important source of phosphorus and turbidity in this river is native soils and low oxygen. During baseflow conditions the water is often red, dissolved oxygen is low, and phosphorus is high. When oxygen is low, the iron in soils would become reduced. Reduced iron is more mobile (hence the red color) and less able to hold phosphorus.

A management implication of these findings is that if dissolved oxygen is kept higher, then turbidity and phosphorus should fall as well. However there will likely be challenges achieving higher oxygen. Decomposition within the vast wetlands and pools of the Carlos Avery Wildlife Management Area upstream is likely the cause of low oxygen.

Total phosphorus during baseflow and storm conditions Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Turbidity and Total Suspended Solids (TSS)

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

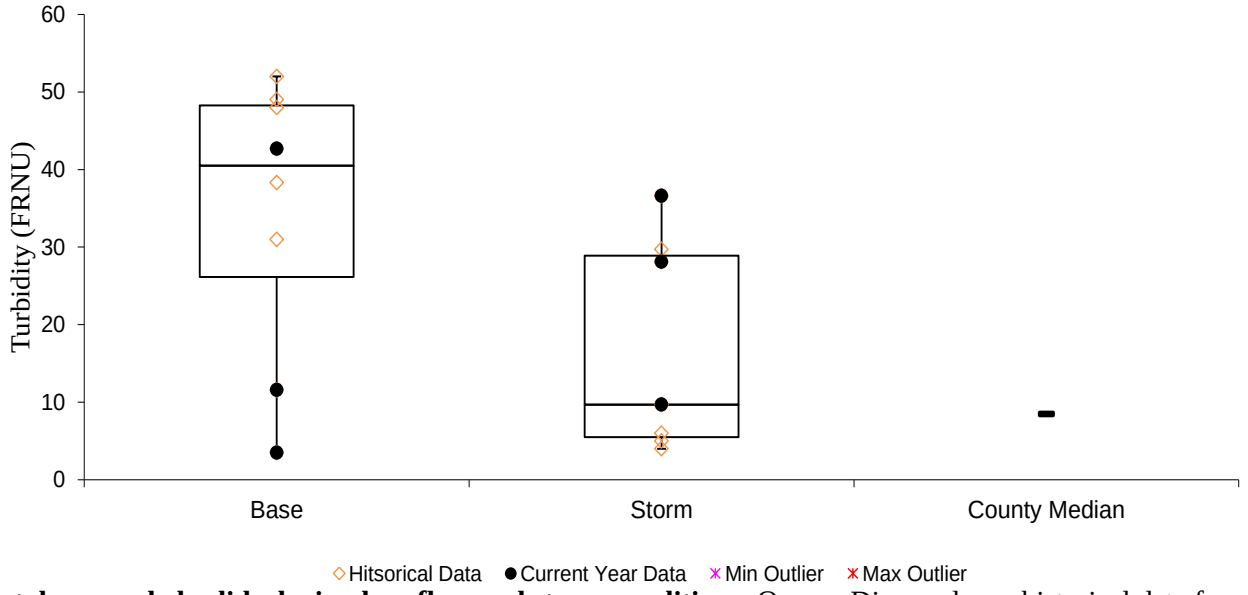
Turbidity and TSS were lower during baseflow, and higher during storms. This was the opposite when last monitored in 2012. During baseflow, average turbidity was 24.02 FNRU, while it was 26.02 FNRU during storms. Average TSS during baseflow was 5 mg/L, and 6.75 mg/L during storms.

The South Branch of the Sunrise River would likely be designated as "impaired" for turbidity if more data existed. The state water quality standard is based on turbidity; TSS can be used as a surrogate if turbidity is not available. The threshold for impairment is at turbidity of 25 FNRU. If 10% and at least 3 of all measurements exceed this value, the river is impaired. At least 20 measurements are required, but only 15 have been taken at this site.

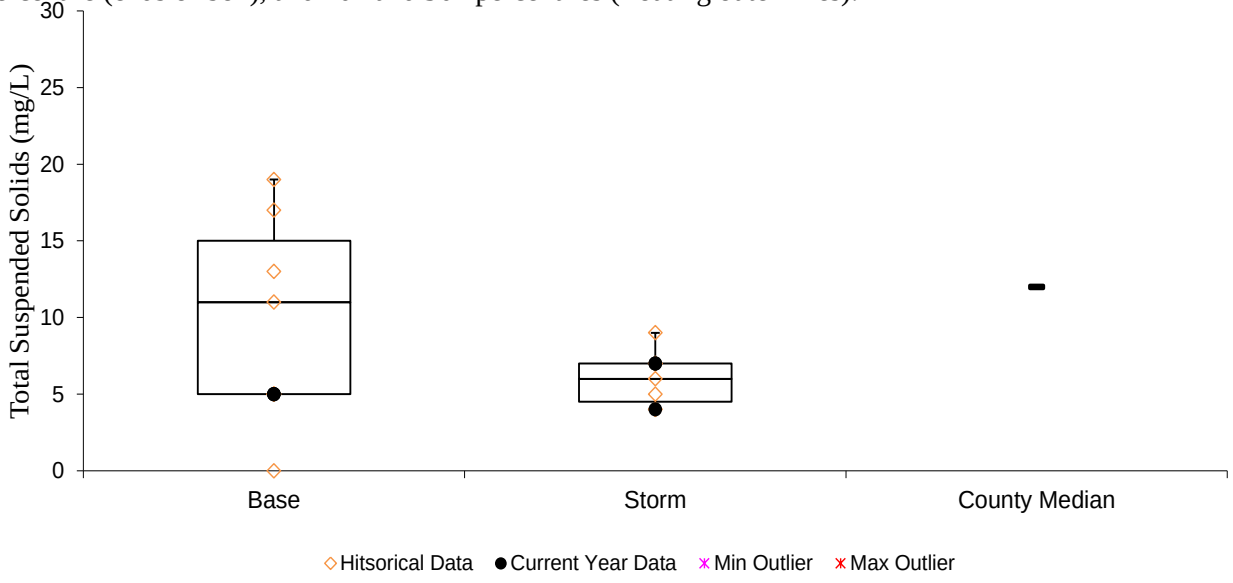
The cause of high turbidity, like high phosphorus, is likely iron-rich native soils in low oxygen conditions. Reduced iron is more mobile. The river is frequently a reddish color during baseflow and low oxygen conditions.

Another cause of turbidity may be the nature of the peat soils through which the river flows. Peat-soils when dried can be susceptible to crumbling easily. Their snow-flake like particles stay suspended in the water column.

Turbidity during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Total suspended solids during baseflow and storm conditions. Orange Diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

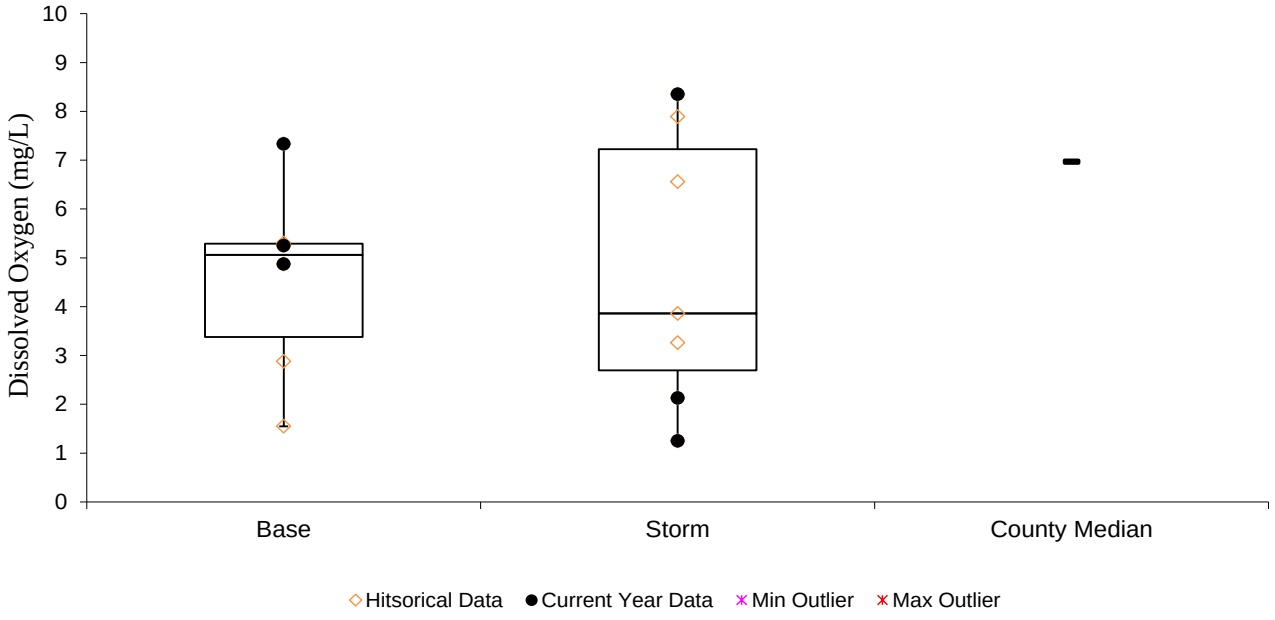


Dissolved Oxygen (DO)

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

The South Branch of the Sunrise River is already designated as "impaired" for low dissolved oxygen. In 2015 only 3 out of eight readings were not below the state standard. The lowest measurements were 1.25 and 2.88 mg/L were found. Another measurement of 3.26 mg/L is concerningly low. We speculate that decomposition in the vast wetlands and pools of the Carlos Avery Wildlife Management Area upstream consumes oxygen and is likely the cause of low oxygen downstream.

Dissolved oxygen results during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).

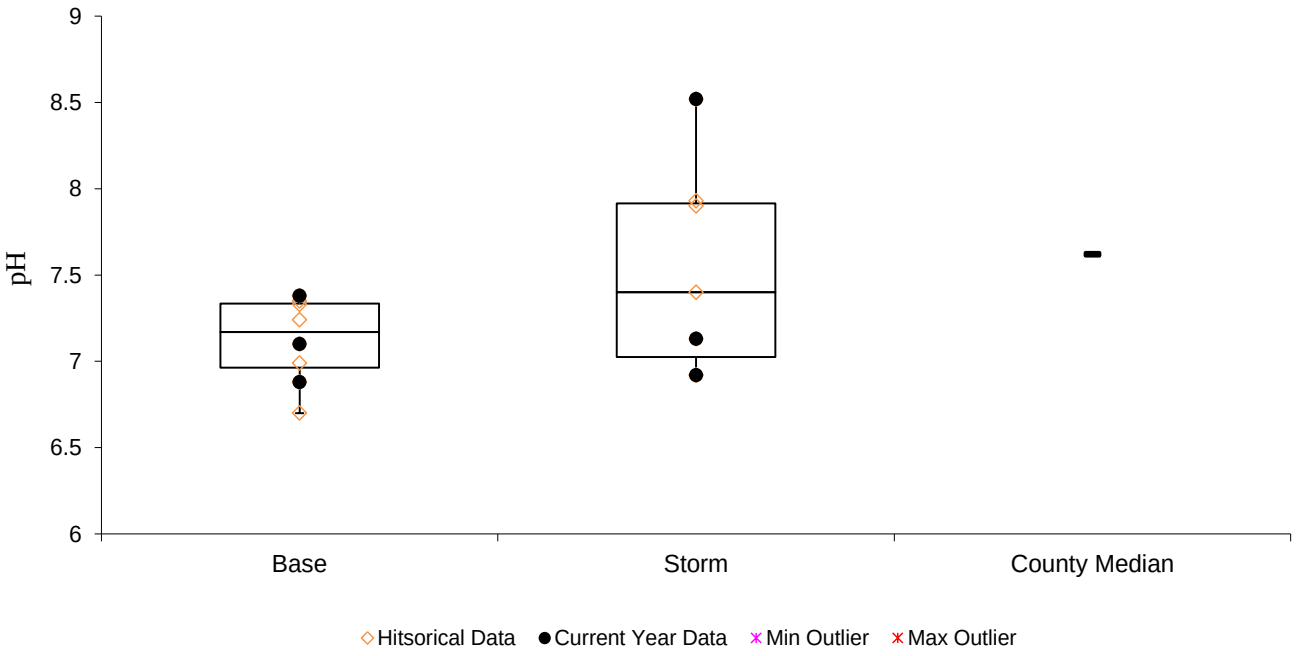


pH

pH refers to the acidity of the water. The Minnesota Pollution Control Agency's water quality standard is for pH to be between 6.5 and 8.5.

pH in the South Branch of the Sunrise River is within the acceptable range, however the results between storm and baseflow are the opposite of most streams. In most streams, pH lowers during storms due to the acidity of rainfall. At this river pH was higher during storms. The reason is not known.

pH results during baseflow and storm conditions. Orange diamonds are historical data from previous years and black circles are 2015 readings. Box plots show the median (middle line), 25th and 75th percentile (ends of box), and 10th and 90th percentiles (floating outer lines).



Recommendations

A Total Maximum Daily Load (TMDL) study was completed in 2013 to determine the impairments of this river. While presently this river's impairment is dissolved oxygen, we suggest that a focus should also be around improving turbidity and total phosphorus. These are high as well, and are most likely linked to the low oxygen problem.

Stream Hydrology

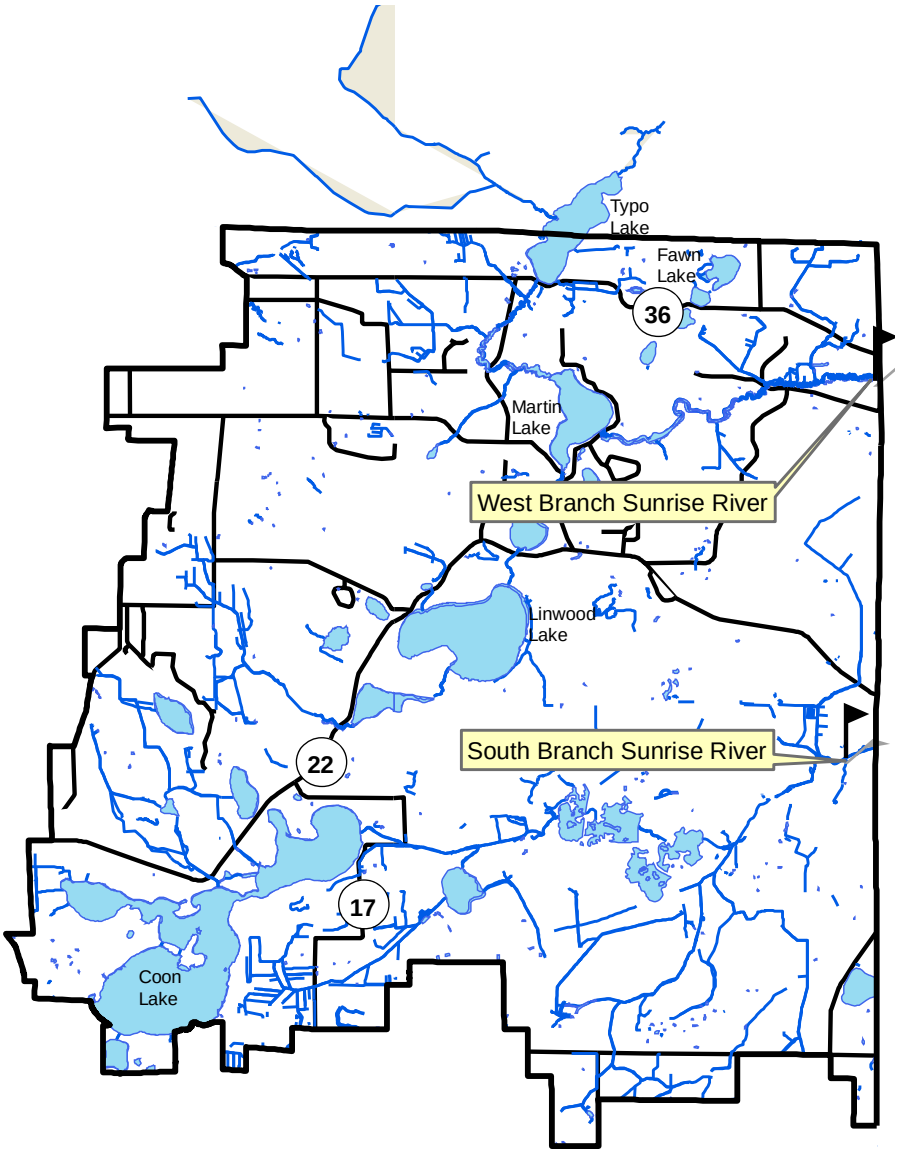
Description: Continuous water level monitoring in streams.

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

Locations: South Branch Sunrise River at Hornsby St NE

West Branch Sunrise River at Co Rd 77

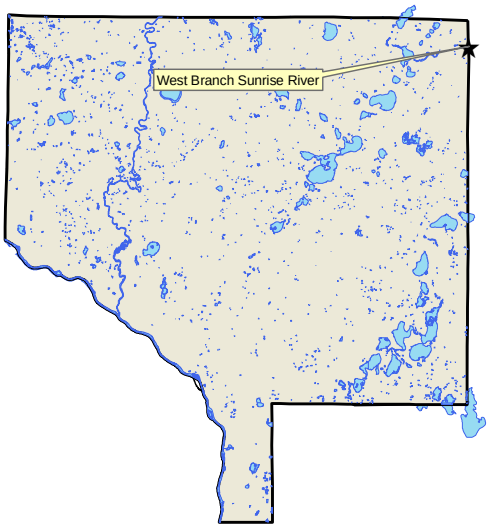
Sunrise Watershed Stream Hydrology Monitoring Sites



Stream Hydrology Monitoring

WEST BRANCH OF SUNRISE RIVER

At Co Rd 77, Linwood Township



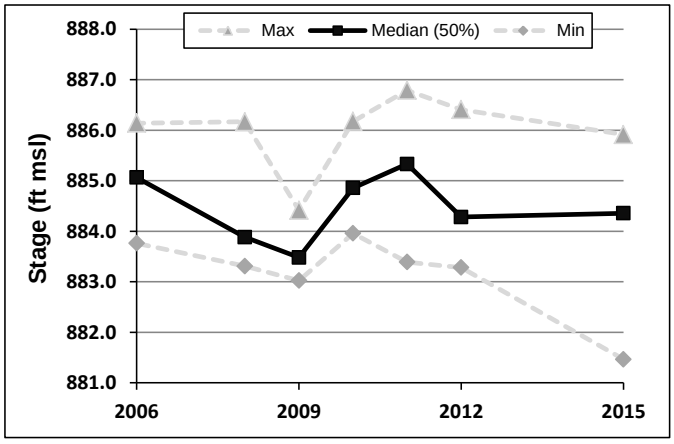
Notes

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

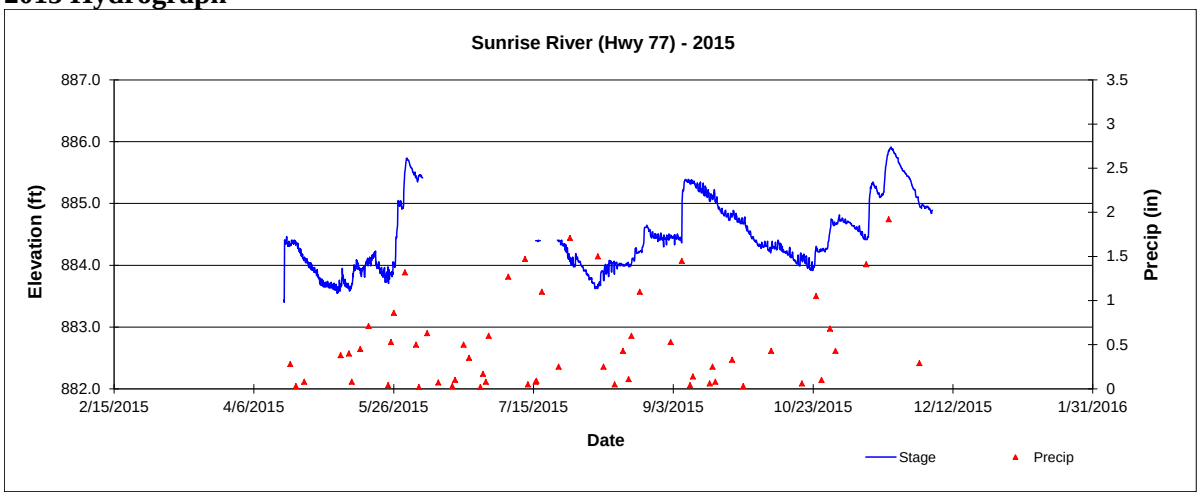
The rating curve to calculate flows (cfs) from stage data is:
Discharge (cfs) = $5.2509(\text{stage}-882.5)^2 + 10.88(\text{stage}-883.5) + 2.699$
$R^2=0.87$

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

Summary of All Monitored Years

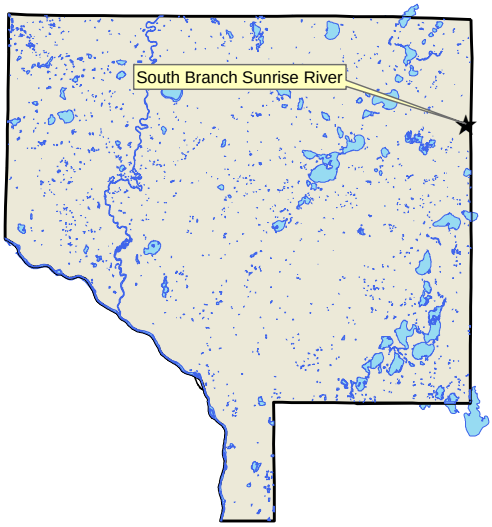


2015 Hydrograph



SOUTH BRANCH OF SUNRISE RIVER

At Hornsby St, Linwood Township

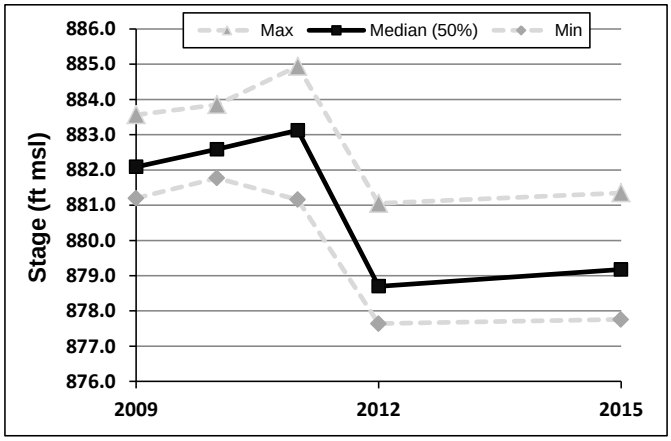


Notes

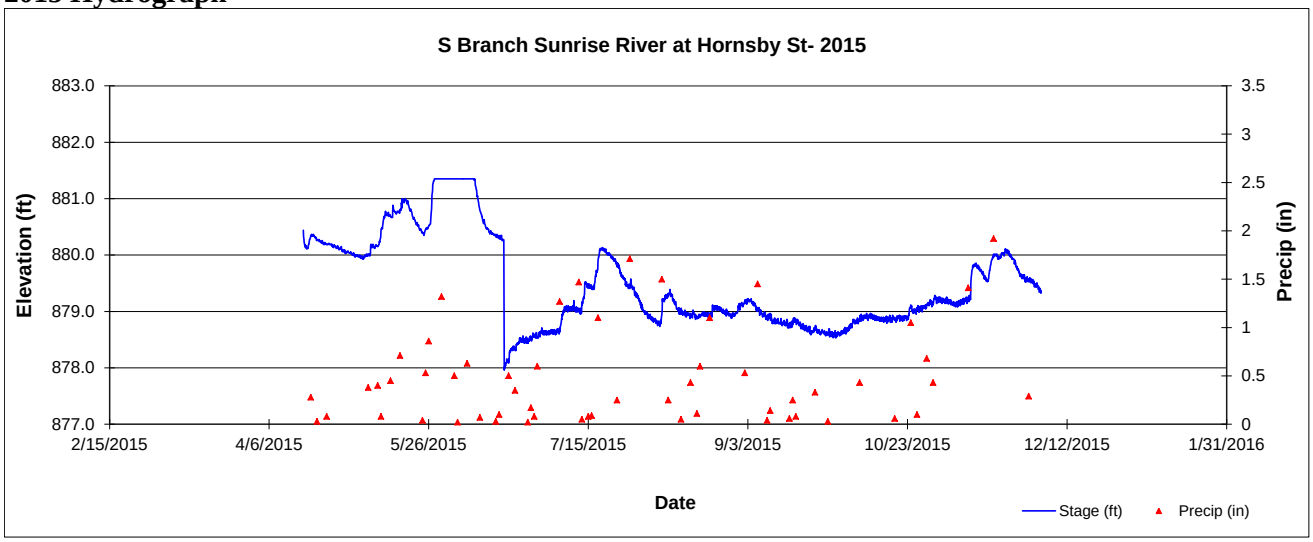
This monitoring site is the bottom of this watershed in Anoka County, at the closest accessible point to the Anoka-Chisago County boundary. Upstream, this river drains from Coon Lake and through the Carlos Avery Wildlife Management Area. The Sunrise River Watershed Management Organization monitors this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

No rating curve exists for this site.

Summary of All Monitored Years



2015 Hydrograph



Stream Rating Curves

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

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

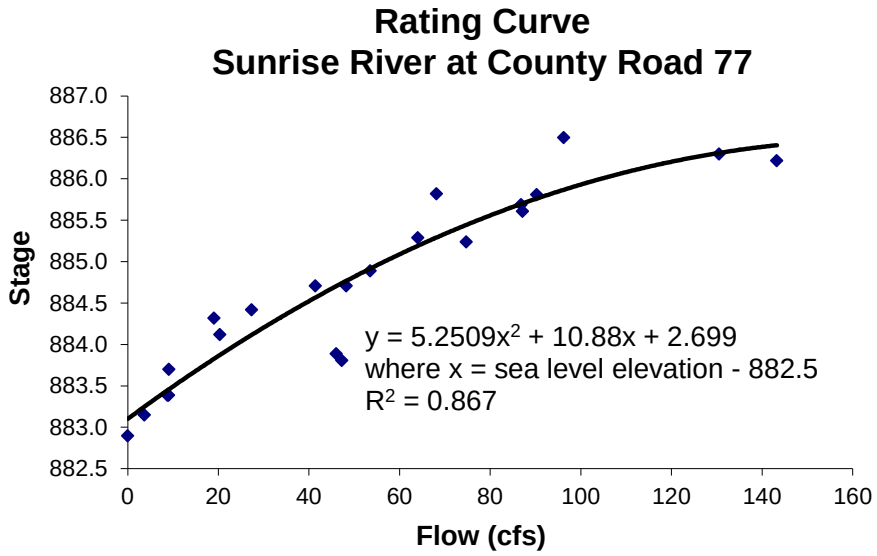
Locations: West Branch Sunrise River at County Road 77

North Inlet of Martin Lake (Typo Cr) at Typo Creek Drive

South Inlet of Martin Lake at West Martin Lake Drive

Data Creek at Typo Creek Drive

Results: Rating curves were developed for the sites listed above in previous years. In 2012 ACD staff discovered an error in the equations and corrected them. They also corrected all past hydrology records that used the equations. Below are the corrected rating curves.



Wetland Hydrology

Description: Continuous groundwater level monitoring at a wetland boundary, to a depth of 40 inches. County-wide, the ACD maintains a network of 19 wetland hydrology monitoring stations.

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

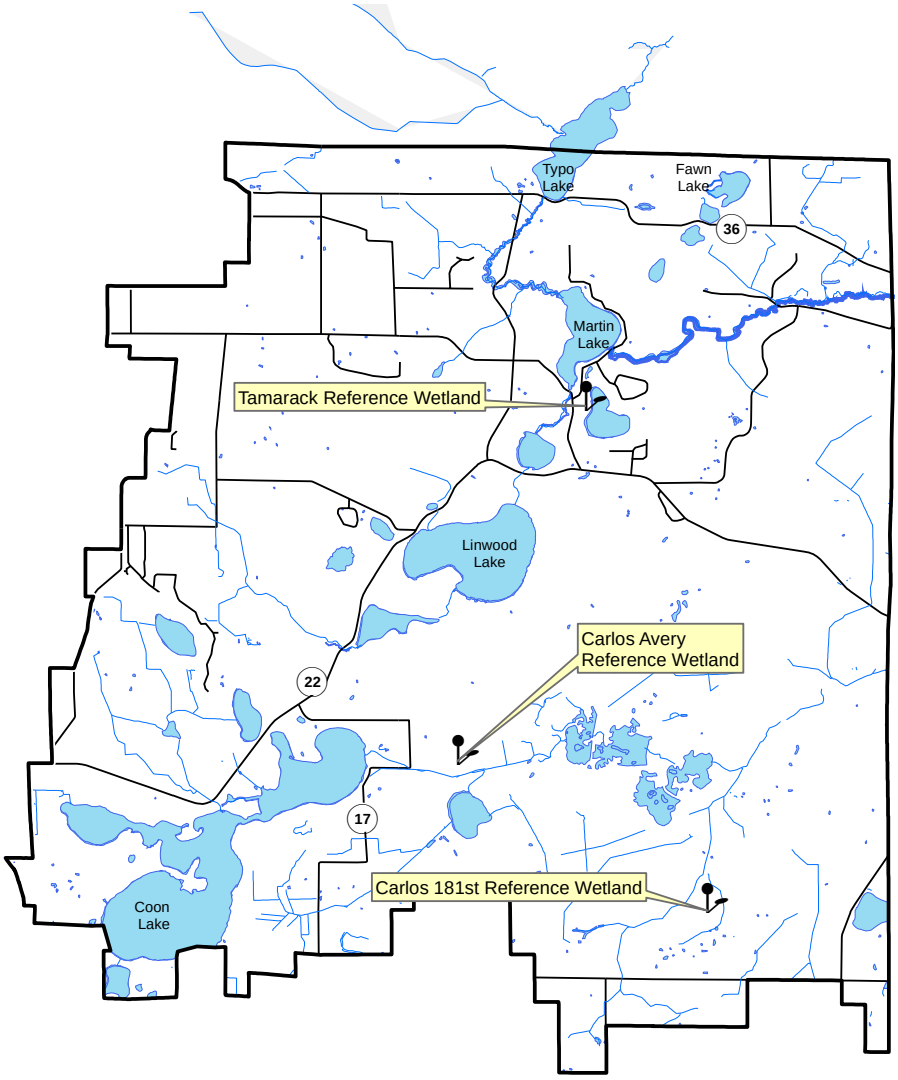
Locations: Carlos Avery Reference Wetland, Carlos Avery Wildlife Management Area, City of Columbus

Carlos 181st Reference Wetland, Carlos Avery Wildlife Management Area, City of Columbus

Tamarack Reference Wetland, Linwood Township

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

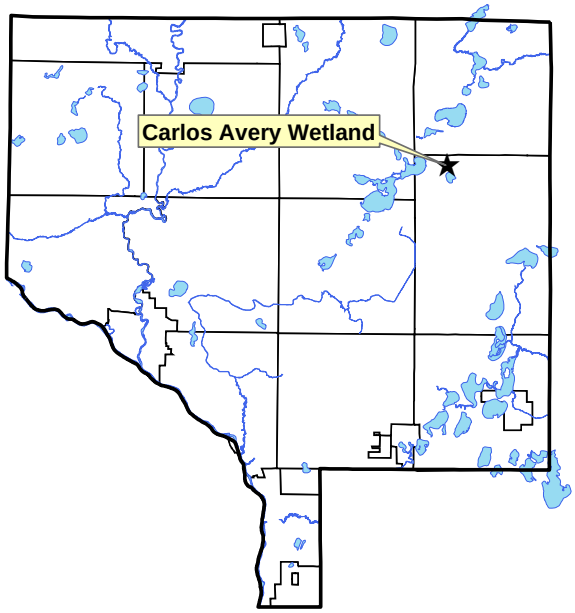
Sunrise Watershed Wetland Hydrology Monitoring Sites



CARLOS AVERY REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus

Site Information



Monitored Since: 1997

Wetland Type: 3

Wetland Size: >300 acres

Isolated Basin? No

Connected to a Ditch? Yes

Soils at Well Location:

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

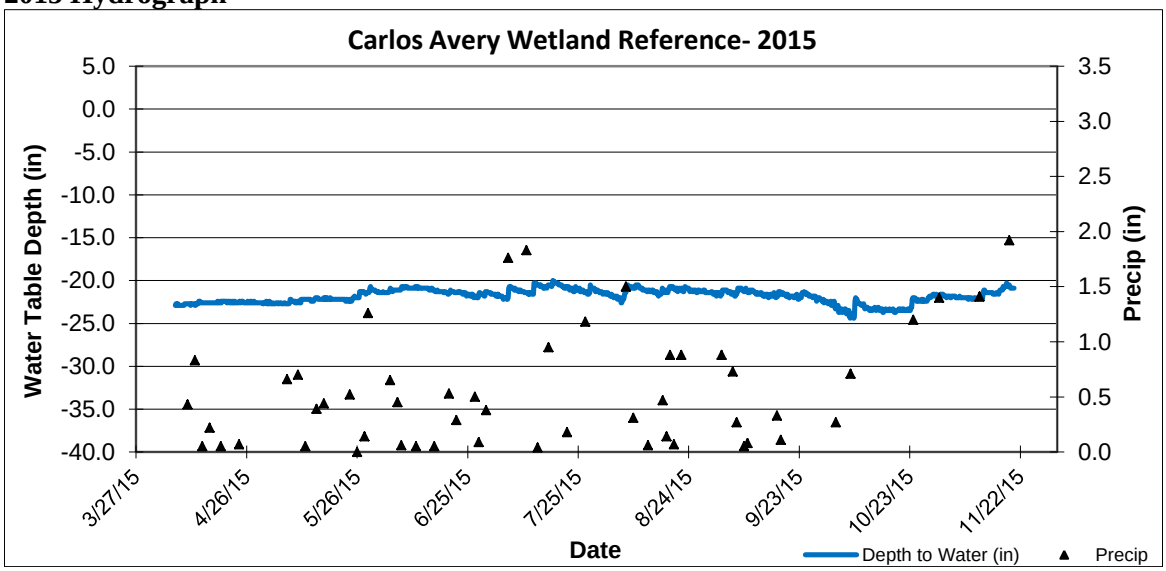
Surrounding Soils: Lino loamy fine sand

Vegetation at Well Location:

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

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

2015 Hydrograph



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

CARLOS 181ST REFERENCE WETLAND

Carlos Avery Wildlife Management Area, City of Columbus

Site Information

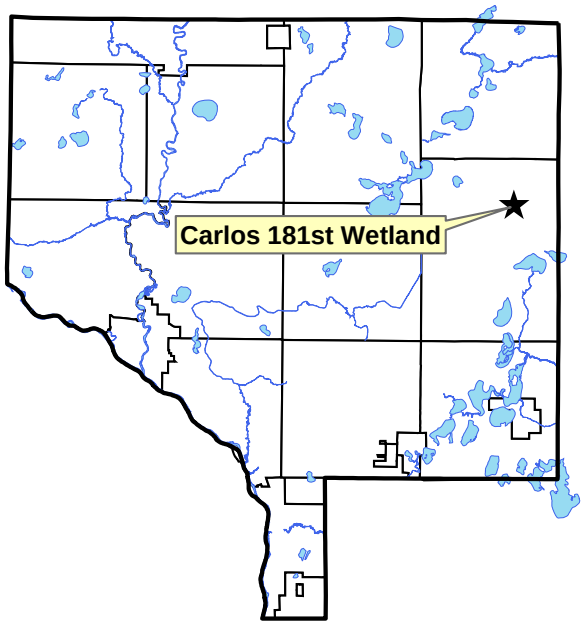
Monitored Since: 2006

Wetland Type: 2-3

Wetland Size: 3.9 acres (approx)

Isolated Basin? Yes

Connected to a Ditch? Roadside swale only



Soils at Well Location:

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

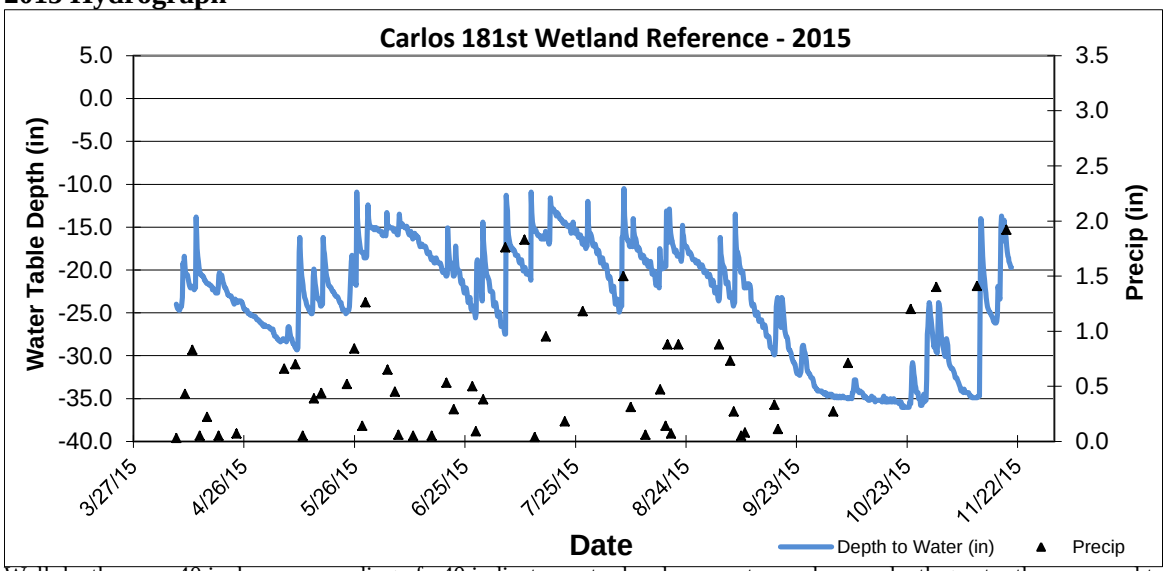
Surrounding Soils: Soderville fine sand

Vegetation at Well Location:

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

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

2015 Hydrograph



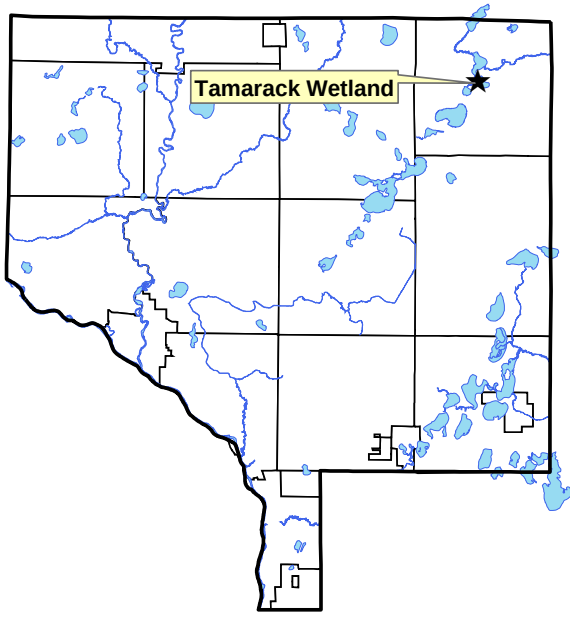
Well depths were 40 inches, so a reading of –40 indicates water levels were at an unknown depth greater than or equal to 40 inches.

Wetland Hydrology Monitoring

TAMARACK REFERENCE WETLAND

Martin-Island-Linwood Regional Park, Linwood Township

Site Information



Monitored Since: 1999

Wetland Type: 6

Wetland Size: 1.9 acres (approx)

Isolated Basin? Yes

Connected to a Ditch? No

Soils at Well Location:

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

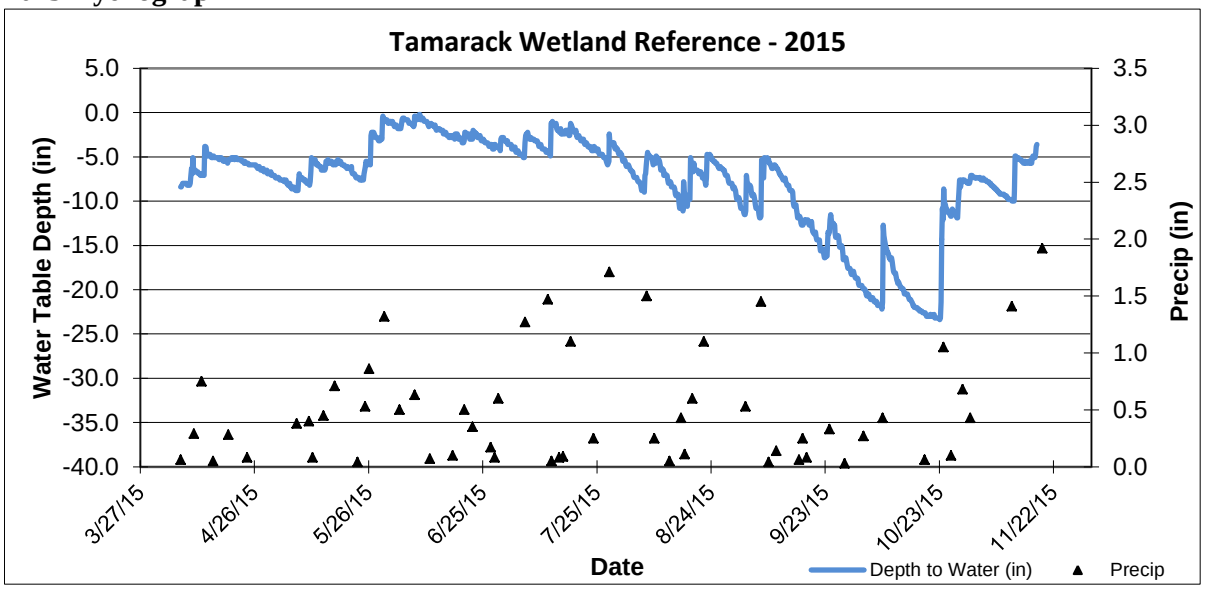
Surrounding Soils: Sartell fine sand

Vegetation at Well Location:

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

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

2015 Hydrograph



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

Water Quality Grant Fund

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

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

Locations: Throughout the watershed.

Results: Projects reported in the year they are installed. No projects were installed in 2015.

SRWMO Cost Share Fund Summary

2005 SRWMO Contribution	+	$1,000.00
2006 SRWMO Contribution	+	$1,000.00
2006 Expense - Coon Lake, Rogers Property Project	-	$ 570.57
2007 – no expenses or contributions		$ 0.00
2008 SRWMO Contribution	+	$2,000.00
2008 Expense - Martin Lake, Moos Property Project	-	$1,091.26
2009 SRWMO Contribution	+	$2,000.00
2010 SRWMO Contribution	+	$1,840.00
2011 SRWMO Contribution	+	$2,000.00
2012 SRWMO Contribution	+	$2,000.00
2012 Expense – Linwood Lake, Gustafson Property Project	-	$ 29.43
2012 Expense – Transfer to Martin-Typo Lakes Carp Barriers	-	$4,300.00
2013 – no expenses or contributions		$ 0.00
2014 SRWMO Contribution	+	$2,000.00
2015 SRWMO Contribution		$ 0.00
Fund Balance		**$7,848.74**

Coon Lake Area Stormwater Retrofits

Description: Four water quality improvement projects were installed in 2015 including two rain gardens, a new stabilized conveyance of stormwater flowing down Lincoln Drive and a lakeshore restoration**.** These projects, and two lakeshore restorations planned for 2016, were identified in a 2014 stormwater retrofit analysis study. The projects were funded by a State Clean Water Legacy Grant and local partners.

Purpose: To improve Coon Lake water quality.

Results: Installed two rain gardens and stabilized one stormwater conveyance.

Three water quality improvement projects were installed in 2015 including two rain gardens and a new stabilized conveyance of stormwater flowing down Lincoln Drive.

Coon Lake Beach Community Center rain garden

19511 East Tri Oak Circle NE lakeshore restoration

19303 East Front Blvd rain garden

Lincoln Avenue stormwater stabilization.

Carp Barriers Installation

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

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

Purpose: To improve water quality.

Results: In 2014 the SRWMO installed one carp barrier at the south inlet of Martin Lake. In 2015 three additional barriers were installed at the following locations: Typo Lake outlet, Martin Lakes' north inlet, and Martin Lake outlet. Construction will conclude in early 2016.

Martin Lake south inlet (completed 2014)

Typo Lake outlet (completion in early 2016)

Martin Lake outlet (completion in early 2016)

Martin Lake north inlet (completion in early 2016)

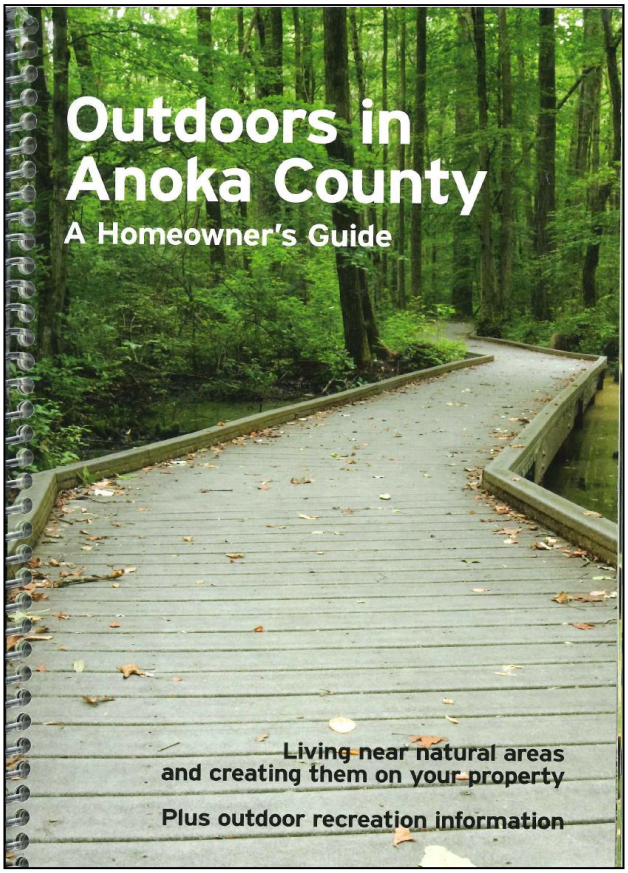
Lakeshore Landscaping Education

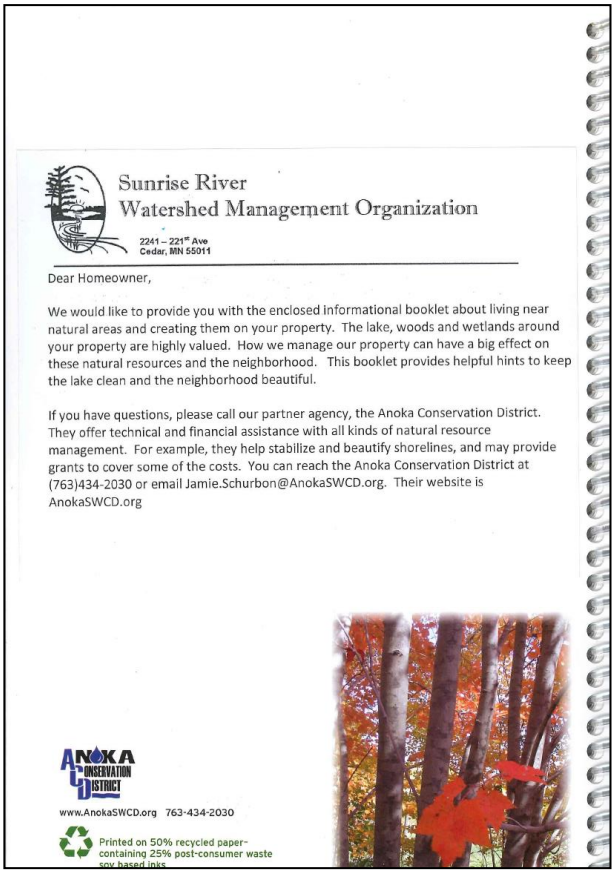
Description: One goal of the Sunrise River WMO is to encourage and facilitate lakeshore restorations with native plants. These projects, usually accomplished by homeowners with assistance from agencies like the SRWMO, are beneficial to overall lake health. By planting native plants at the shoreline runoff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

Purpose: To improve lake water quality and lake health.

Results: In 2015 an informational booklet entitled "Outdoors in Anoka County: A homeowners guide to natural spaces and creating them in your backyard" was distributed to lakeshore homeowners on; Coon, Martin, Typo, Linwood and Fawn Lake. A total of 670 booklets were distributed.

The Anoka Conservation District donated the booklets. A cover letter acknowledging the SRWMO and ACD was provided with each distributed booklet.




Sunrise River Watershed Management Organization

2241 – 221st Ave
Cedar, MN 55011

Dear Homeowner,

We would like to provide you with the enclosed informational booklet about living near natural areas and creating them on your property. The lake, woods and wetlands around your property are highly valued. How we manage our property can have a big effect on these natural resources and the neighborhood. This booklet provides helpful hints to keep the lake clean and the neighborhood beautiful.

If you have questions, please call our partner agency, the Anoka Conservation District. They offer technical and financial assistance with all kinds of natural resource management. For example, they help stabilize and beautify shorelines, and may provide grants to cover some of the costs. You can reach the Anoka Conservation District at (763)434-2030 or email Jamie.Schurbon@AnokaSWCD.org. Their website is AnokaSWCD.org

ANOKA CONSERVATION DISTRICT

www.AnokaSWCD.org 763-434-2030

Printed on 50% recycled paper- containing 25% post-consumer waste soy based inks

Annual Education Publication

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

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

Results: In 2015 the SRWMO contracted with the ACD to write the annual newsletter and provide it to member communities for distribution in their newsletters. Topics for annual newsletter were discussed by the SRWMO Board; the Coon Lake Stormwater Retrofits Project was chosen.

SRWMO 2015 Newsletter Article:
Coon Lake Projects Installed to Improve Water Quality

Four projects were recently installed to improve water quality in Coon Lake, and two more are scheduled for spring. Two rain gardens, one roadside stabilization and one lakeshore restoration were built this summer. Two more lakeshore stabilizations will be completed in spring 2016. The projects are on lakeshore properties or roads.

All the projects stop erosion or reduce nutrient runoff into the lake. Each rain garden captures road runoff that otherwise would go directly into the lake. The roadside stabilization project at Lincoln Drive corrects an area that regularly washed out into the lake. The lakeshore restorations fix ongoing shoreline erosion and include native plant buffers to filter runoff.

Keeping these pollutants out of the lake will lead to less algae. "Coon Lake is not on the State's list of impaired waters, but it isn't that far from it either," says Jamie Schurbon, Water Resource Specialist at the Anoka Conservation District (ACD). "It is a priority to keep it in good condition."

In 2014 the ACD identified and ranked projects around the lake that would improve water quality. From that list the most cost effective projects were selected. Landowners were asked to voluntarily work with the conservation district. At the same time, the Sunrise River Watershed Management Organization (WMO) and ACD applied for a State Clean Water Fund grant, which was secured for $74,000.

CLEAN WATER LAND & LEGACY AMENDMENT

Major local funding to match the grant came from the Sunrise River Watershed Management Organization, which also helped initiate and guide the projects. Other sources of grant matching dollars included the Coon Lake Improvement District, Coon Lake Improvement Association and Coon Lake Beach Community Center. The Anoka Conservation District is overseeing the projects.

The Sunrise River WMO is a joint powers local unit of government through which East Bethel, Columbus, Ham Lake and Linwood collaborate. For more information about the Sunrise River Watershed Management Organization visit www.SRWMO.org or call Jamie Schurbon at 763-434-2030 ext. 12.

Photos were printed with the article, and are depicted on earlier pages of this report.

SRWMO Website

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

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

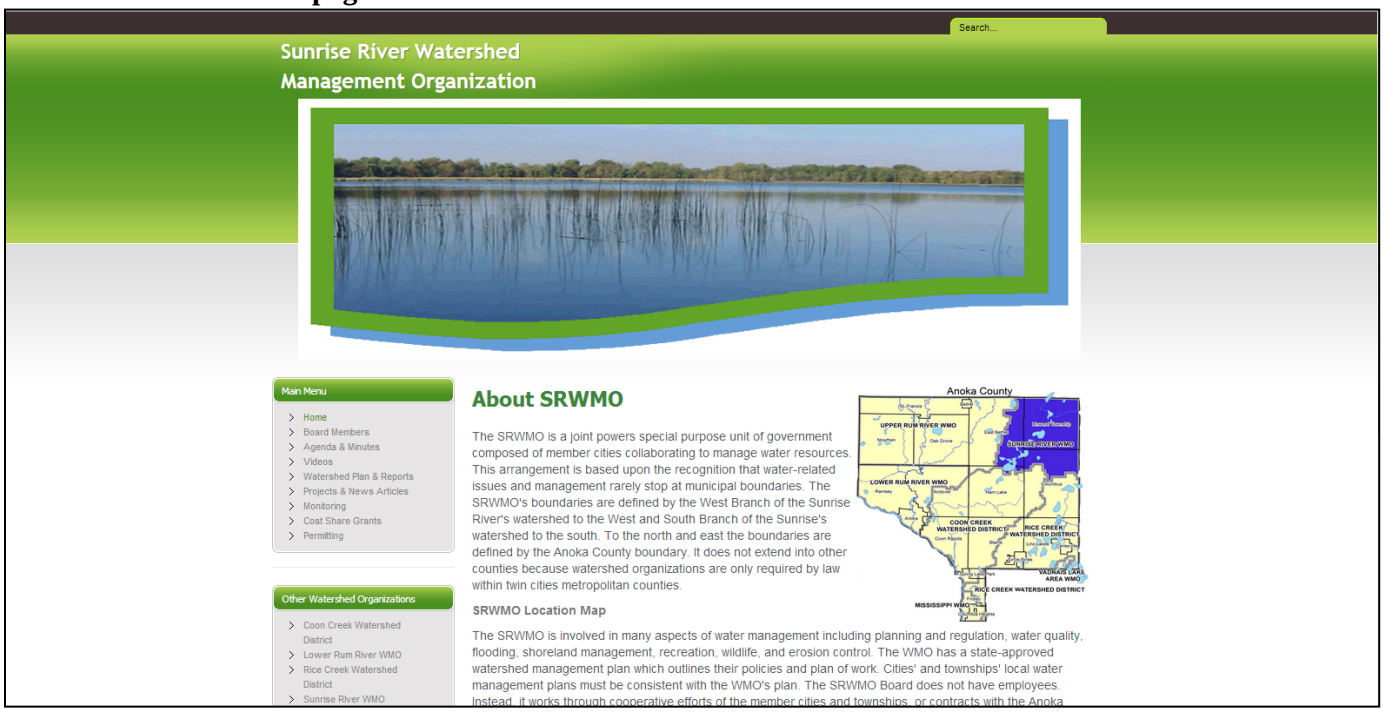
Location: www.SRWMO.org

Results: In 2013 ACD re-launched the SRWMO website.

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

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

SRMWO Website Homepage



Grant Searches and Applications

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

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

Results: In 2015 a State Clean Water Legacy Fund grant application was prepared and the grant was awarded. The $73,824 grant will fund a water quality project feasibility study for Ditch 20. Ditch 20 flows into Typo Lake, Martin Lake and the West Branch of the Sunrise River. It has been identified as a high priority area for nutrient reductions to benefit all these waterbodies. The feasibility study will be completed by 2017.

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

Abstract

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

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

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

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

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

SRWMO 2015 Annual Report to BWSR and State Auditor

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

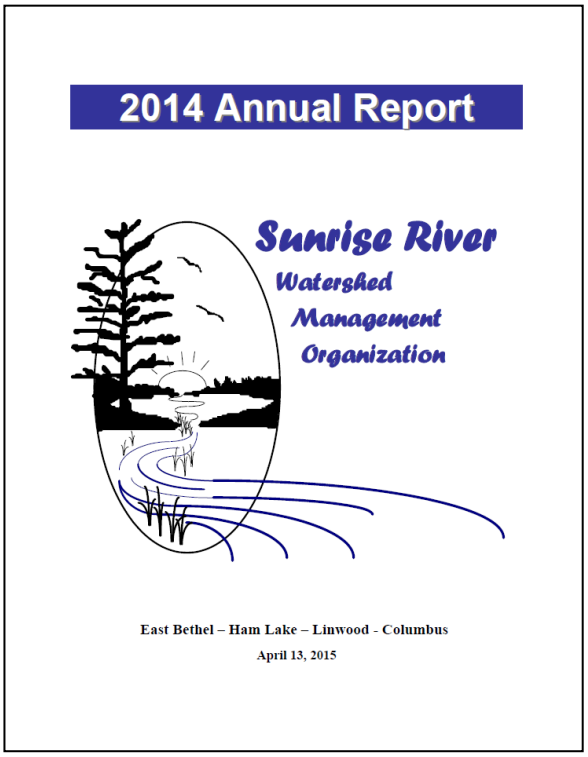
The SRWMO must also submit an annual financial report to the State Auditor. They accept unaudited financial reports for financial districts with annual revenues less than $185,000.

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

Locations: Watershed-wide

Results: Anoka Conservation District (ACD) assisted the SRWMO with preparation of a 2015 Sunrise River WMO Annual Report. ACD drafted the report and a cover letter. After SRWMO Board review the final draft was forwarded to BWSR in spring of 2015. A sufficient number of copies of the report were sent to each member community to ensure that each city council person and town board member would receive a copy. The report is available to the public on the SRWMO website.

Cover



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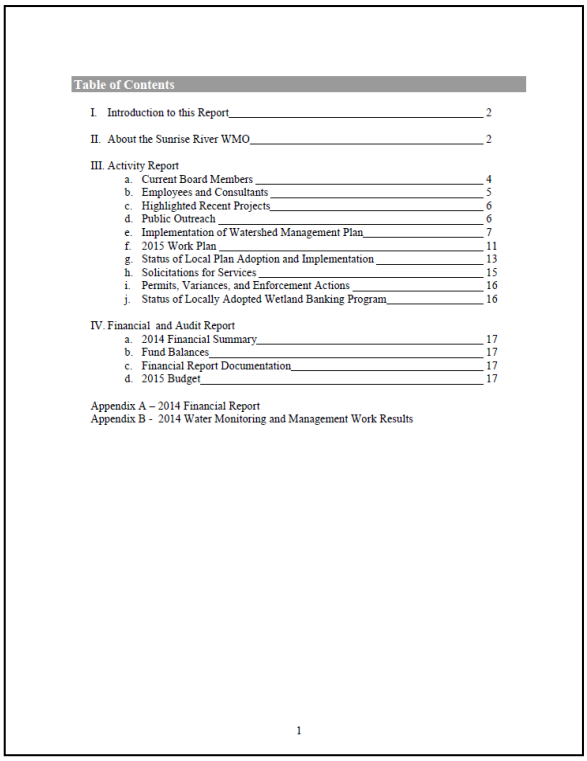

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On-call Administrative Services

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

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

Results: In 2015 a total of 31.5 hours of administrative assistance have occurred as of December 31.

The following tasks were accomplished:

- Reviewed proposed WMO boundary changes with the Rice Creek and Coon Creek Watershed Districts, corresponded with those entities and advised the SRWMO Board.
- Provided the SRWMO Board with information about changes to the Blue Thumb consortium, and advised them against continued membership.
- 2016 budget preparation and related questions from cities.
- Provide a draft records retention schedule for the WMO.
- Assist with preparation of materials for soliciting service bids.
- Discuss the WMO's mission with the Linwood Lake Association, and facilitate discussion with that lake group about weed treatments.
- Occasional inquiries from contractors and developers about any SRWMO permitting requirements.
- Correspond with the City of Ham Lake, per the WMO Board's direction, regarding Joint Powers Agreement changes. Calculated the financial impact of the proposed changes for each member community.
- Assisted the Secretary in handling a public data request.
- Answered Board member questions outside of meetings.
- Assist with meeting packet preparation.
- Assisted with rescheduling one WMO Board meeting.

Financial Summary

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

Sunrise River Watershed Financial Summary

Sunrise River Watershed	WMO Asst (no charge)	Volunteer Precip	Reference Wetlands	Ob Well	Lake Level	Lake Water Quality	Stream Level	Stream Water Quality	SRWMO Admin	SRWMO On-Call Admin	WMO Annual Rpts to State	SRWMO Outreach/Promo	WMO Website Maintenance	Martin/Typo Carp Bariers Grant Admin.	Martin/Typo Carp Bariers Project Mgmt.	Coon Lake Retrofit CWF - Admin	Coon Lake Retrofit CWF - Proj. Dev.	Coon Lake Retrofit CWF - Tech./Eng.	Fawn Lake CLP Mapping	Typo Wetlands Feasibilty Study	Total
Revenues																					
SRWMO	0	0	1725	0	1250	6500	1250	2800	329	2546	1035	2310	490	0	27149	0	0	21555	675	0	69614
State	0	0	0	320	0	0	0	0	0	0	0	0	0	0	236766	0	0	35894	0	7600	285299
Anoka Conservation District	0	0	88	0	0	0	0	0	0	0	0	0	0	0	0	634	0	0	0	0	721
Anoka Co. General Services	379	0	1176	0	0	0	0	0	0	0	0	0	0	4109	0	0	2311	0	162	613	11447
County Ag Preserves/Projects	0	0	0	0	0	818	0	0	0	0	0	0	0	0	0	0	0	0	0	0	818
Regional/Local	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Service Fees	0	0	46	0	0	960	97	0	0	0	0	0	0	0	5000	0	1410	2190	0	0	9704
BWSR Cons Delivery	0	0	0	0	339	1086	583	0	0	0	0	0	0	0	3742	0	0	0	0	0	5750
BWSR Cost Share TA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Local Water Planning	0	664	852	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1516
TOTAL	379	664	3887	320	1589	9365	1930	2800	329	2546	1035	2310	490	4109	272657	634	3721	59639	837	8213	384869
Expenses-																					
Capital Outlay/Equip	3	6	1110	3	14	68	17	14	3	20	3	14	3	35	83	5	32	205	7	71	1760
Personnel Salaries/Benefits	333	584	2378	282	1392	6908	1691	1380	289	2017	267	1432	275	3617	8518	558	3275	20901	737	7230	68666
Overhead	21	37	152	18	89	443	108	88	19	129	17	92	18	232	546	36	210	1339	47	463	4399
Employee Training	2	4	15	2	9	44	11	9	2	13	2	9	2	23	54	4	21	133	5	46	438
Vehicle/Mileage	5	8	34	4	20	99	24	20	4	29	4	21	4	52	122	8	47	301	11	104	987
Rent	14	24	99	12	58	286	70	57	12	84	11	59	11	150	353	23	136	866	31	300	2846
Program Participants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	262980	0	0	35494	0	0	298473
Program Supplies	0	0	99	0	8	1517	9	655	0	0	0	50	0	0	0	0	0	400	0	0	4926
McKay Expenses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	379	664	3887	320	1589	9365	1930	2224	329	2292	303	1676	312	4109	272657	634	3721	59639	837	8213	382495

Recommendations

- **Celebrate and promote the completion of the Martin and Typo Lakes carp barriers project**. Pursued commercial carp harvests to accelerate the benefits of the carp barriers.
- **Continue installation of stormwater retrofits around Coon and Martin Lakes where** completed studies have identified and ranked projects.
- **Continue efforts to secure grants.** A number of water quality improvement projects are being identified with more to come in 2017. Outside funding will be necessary for installation of most of these. These projects should be highly competitive for those grants.
- **Bolster lakeshore landscaping education efforts.** The SRWMO Watershed Management Plan sets a goal of 3 lakeshore restorations per year. Few are occurring. Fresh approaches should be welcomed.
- **Increase the use of web videos as an effective education and reporting tool.**
- **Continue the SRWMO cost share grant program** to encourage water quality projects. Consider refining the program to increase participation.
- **Encourage communities to report water quality projects to the SRWMO.** An overarching goal in the SRWMO Plan is to reduce phosphorus by 20% (986 lbs). State oversight agencies will evaluate efforts toward this goal. Both WMO and municipal project benefits should be counted.
- **Support the Ditch 20 (Data Creek) water quality improvement projects feasibility study.** The grant-funded project is led by the Anoka Conservation District but in need of local matching funds. The study will be completed in 2017.