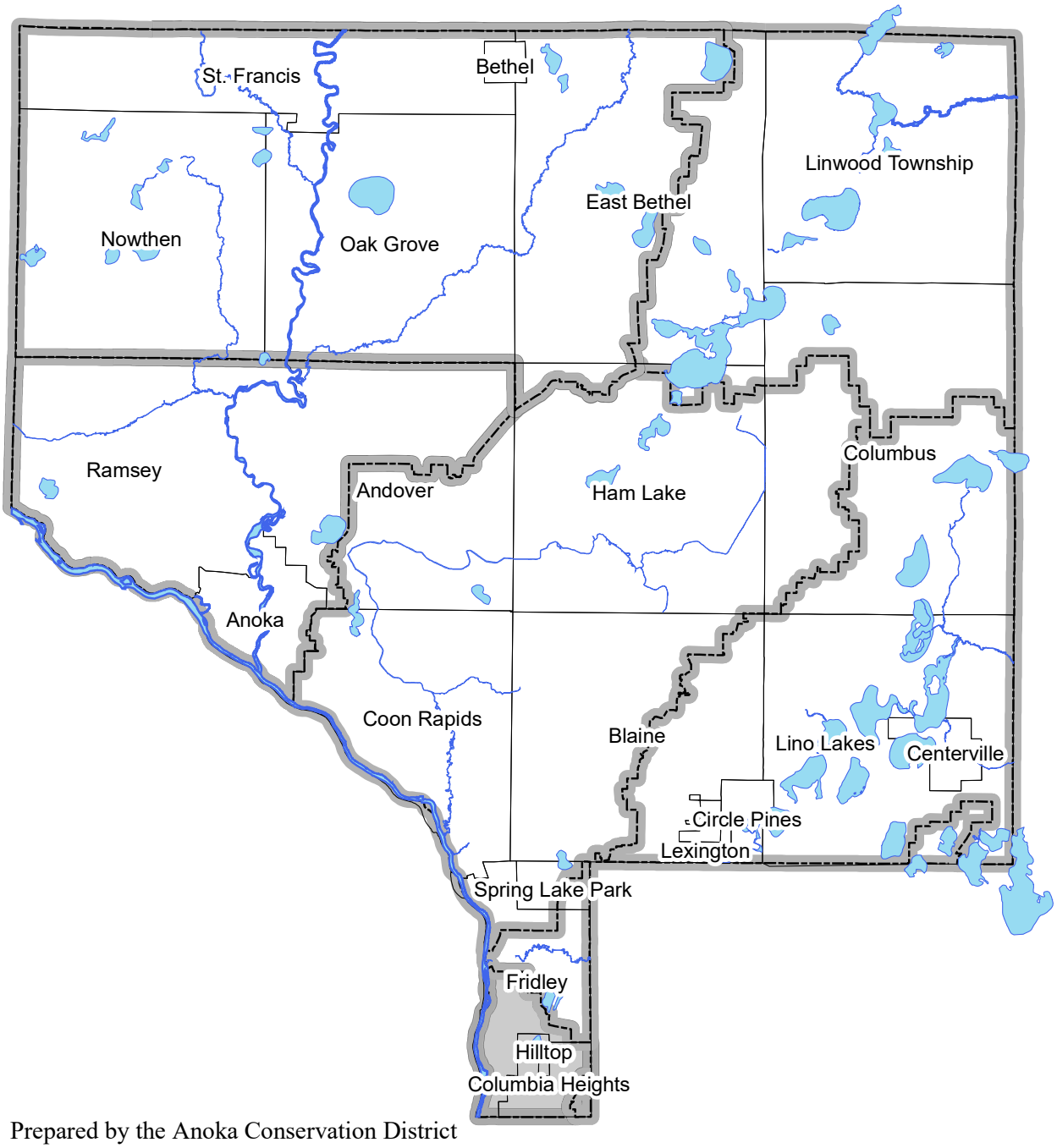
Draft Excerpt from the 2022 Anoka Water Almanac

Chapter 7: Mississippi Watershed



Prepared by the Anoka Conservation District

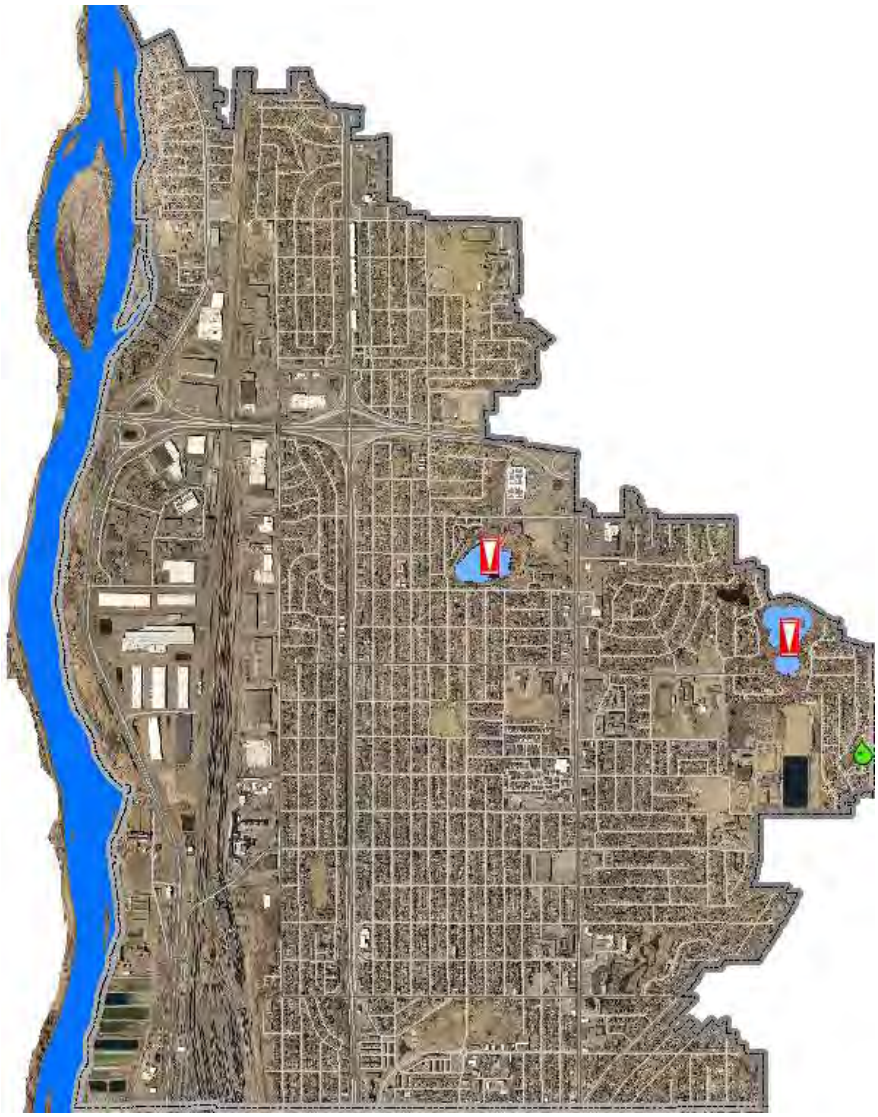
Table of Contents

Recommendations

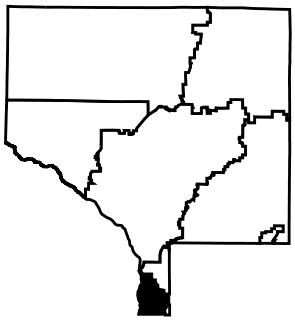
- Continue to monitor water levels on Highland and Sullivan Lakes annually.
- Continue to monitor water levels on Highland and Sullivan Lakes every third year.
- Implement practices identified in the Highland and Sullivan SRA report to benefit the water quality of these two lakes. Both lakes have extremely poor water quality, are impaired for nutrients and recreation, and have popular parks adjacent to them utilized by many visitors.

Water Monitoring Map

Mississippi Watershed Management Organization
Anoka County portion



Anoka County



Lake Levels

Partners: MWMO, ACD, MN DNR, volunteers

Description: Water level monitoring in lakes. Current year's, as well as historical data is available on the Minnesota DNR website using the "LakeFinder" feature (www.dnr.mn.us.state\lakefind\index.html).

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

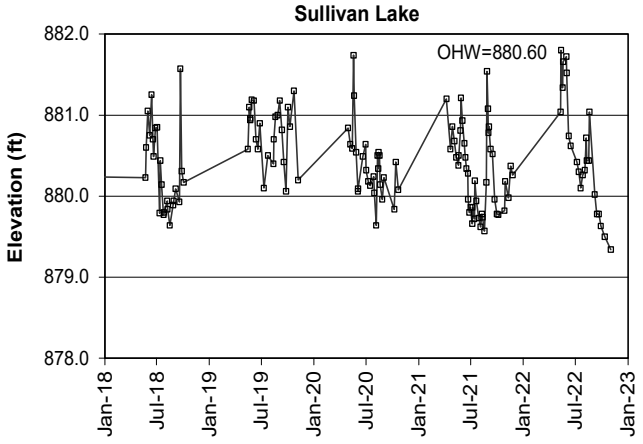
Locations: Sullivan/Sandy Lake, Highland Lake

Results: Weekly water levels were measured throughout the open-water season by volunteers. Water levels on Sullivan Lake typically fluctuate rapidly, bouncing by half a foot in response to individual rainfall events. This is due to the volume of stormwater directed to the lake compared to the small basin size. In 2022, Sullivan water levels fluctuated more than recent years, spanning 2.46 feet between the minimum and maximum seasonal elevations. This was due to dry/drought conditions. Water levels in Sullivan Lake reached the lowest levels since 2018. Water levels in Highland Lake fluctuated 0.64 feet throughout the 2022 season. Due to drought, water levels were the lowest levels recorded since 2013.

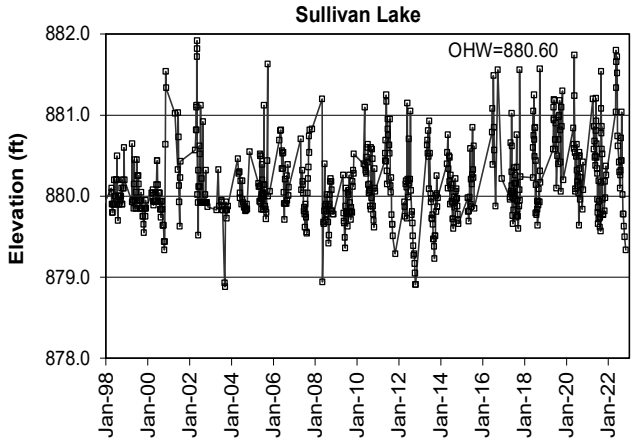
Highland and Sullivan Lake each have controlled outlet structures in place which help manage water levels and help control how high water elevations can reach in order to prevent flooding.

Ordinary High Water Levels (OHW) are listed for each lake on the graph below. Any work performed below this elevation requires a DNR permit.

Sullivan/Sandy Lake Levels last 5 years



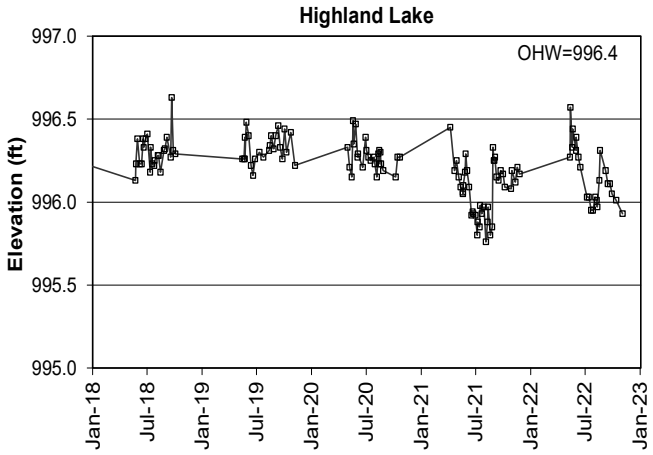
Sullivan/Sandy Lake Levels last 25 years



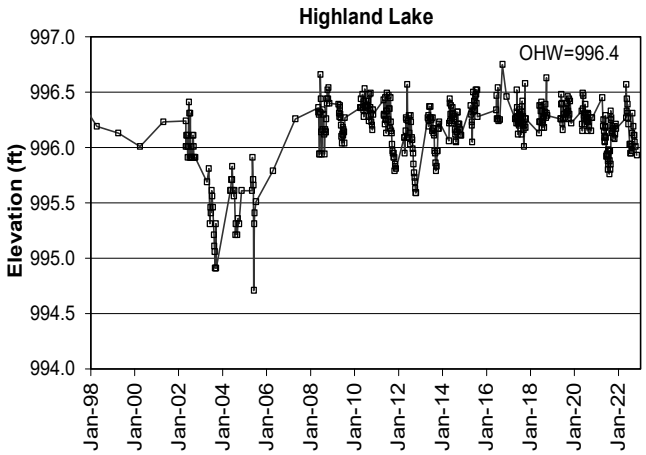
Sullivan/Sandy Lake level 5-year summary

Lake	Year	Average	Min	Max
Sullivan	2018	880.29	878.93	881.57
	2019	880.77	880.06	881.30
	2020	880.38	879.64	881.74
	2021	880.30	879.57	881.54
	2022	880.54	879.34	881.80
	5-year	880.46	878.93	881.80

Highland Lake Levels last 5 years



Highland Lake Levels last 25 years



Highland Lake level 5-year summary

Lake	Year	Average	Min	Max
Highland	2018	996.30	996.13	996.63
	2019	996.32	996.16	996.48
	2020	996.28	996.15	996.49
	2021	996.07	995.76	996.45
	2022	996.16	995.93	996.57
	5-year	996.23	995.76	996.63

Lake Water Quality

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

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

Locations: Sullivan/Sandy Lake and Highland Lake

Results: Detailed data 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 methods and additional information on interpreting lake data.

MWMO Lake Monitoring Sites

Sullivan/Sandy Lake

Lake ID # 02-0080

Background

Sullivan Lake, also known as Sandy Lake, is located in southcentral Anoka County. The lake has a surface area of 17 acres and reaches a maximum depth of 9 feet (2.7 m). A walking trail system/park circumscribes the lake. Adjacent to the public trail is a mix of residential and commercial use properties. The walking trail around the lake is used extensively, but the lake itself is used little for recreation and there is no formalized boat access to the water. The lake's watershed is highly urbanized, and the lake acts like a flow-through stormwater pond. The stormwater conveyance system, draining 433 acres of mostly residential and commercial areas of Columbia Heights and City of Fridley, discharges directly into Sullivan Lake. The lake is listed as "impaired by" the MN Pollution Control Agency for both nutrients and aquatic recreation. Water exiting this lake is discharged to the Mississippi River via additional subsurface conveyances.

Results 2022

Sullivan/Sandy Lake had poor water quality in 2022, similar to previous years. Water quality for all monitored years has received a D letter grade or worse. The lake is highly eutrophic, and phosphorus levels are commonly two to three times the State standard. By this measure, the lake is unsuitable for swimming during the entire growing season. Both total phosphorus and chlorophyll-a levels were higher in 2022 than they were in 2019 when the lake was last sampled. Total phosphorus exceeded the shallow lake state standard (60 µg/L) in all five sampling events in 2022, averaging 119.0 µg/L. Chlorophyll-a also was more than double the State standard (20 µg/L) in four out of five samples collected. Water clarity was also poor in 2022, averaging just below two feet. All three of these water quality measures became poorer as summer progressed. Past depth profiles indicate that dissolved oxygen is too low for most fish (<4 mg/L) below four feet, and is too low for most aquatic life (<1 mg/L) near the bottom. This is likely due to oxygen consumption by algal decomposition.

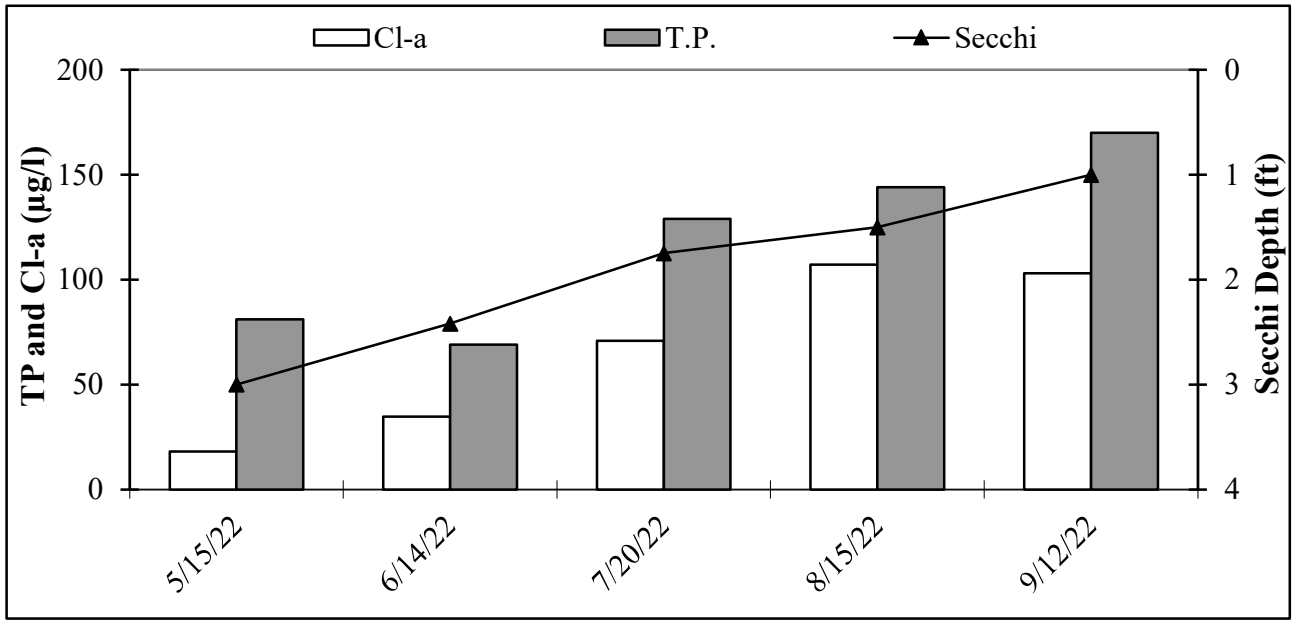
Trend Analysis

Sixteen years of water quality data have been collected by the Metropolitan Council (1993-2003) and the Anoka Conservation District (2004, 2005, 2013, 2016, 2019, 2022). There is no significant trend to overall water quality when considering phosphorus, chlorophyll-a, and Secchi transparency (repeated measures MANOVA with response variables TP, Cl-a, and Secchi depth, $F_{3,14}$=1.90, p<0.19). We examined each of the response variables separately using a one-way ANOVA to gain insight into if individual parameters are changing over time. Total phosphorus for the monitoring record through 2016 showed a significant increase in annual average concentrations ($F_{1,12}$=1.92, p=0.015), however average concentrations the last few years of monitoring (2019, 2022) were low enough to reduce the trend to non-significance ($F_{1,14}$=3.58, p=0.079). There is no significant trend over time for either Secchi transparency or chlorophyll-a.

Discussion

Sullivan Lake's poor water quality is heavily influenced by the high-volume of stormwater entering the basin. Stormwater runoff in these urbanized areas commonly contain high concentrations of sediments, nutrients and other pollutants. When a small lake receives the majority of its water volume stormwater sources, it can't offer the dilution factor often observed in larger lakes. Capital improvement projects that could benefit Sullivan Lake, especially projects ranked high in the 2019 Subwatershed Assessment Analysis, should be explored. Stormwater retrofit approaches listed in the subwatershed report included various bioretention practices, installation of new stormwater ponds, iron-enhanced sand filters, modifications to existing stormwater ponds, and the implementation of hydrodynamic devices. Enhanced street sweeping can be cost-effective, depending on current sweeping regime.

2022 Results



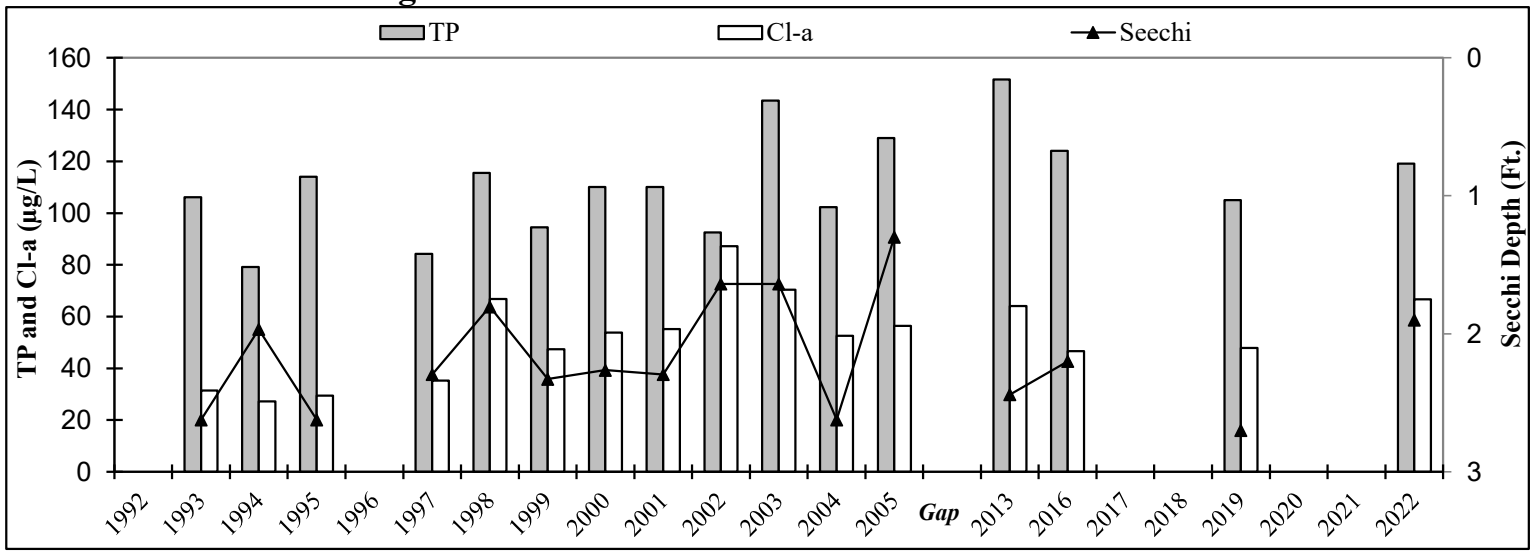
2022 Medians

pH		7.72
Specific Conductivity	mS/cm	0.70
Turbidity	NTU	30.80
D.O.	mg/l	10.14
D.O.	%	122.5
Temp.	°F	71.6
Salinity	%	0.3
Chlorides	mg/L	178.0
Cl-a	µg/L	70.8
T.P.	µg/l	129.0
Secchi	ft	1.8

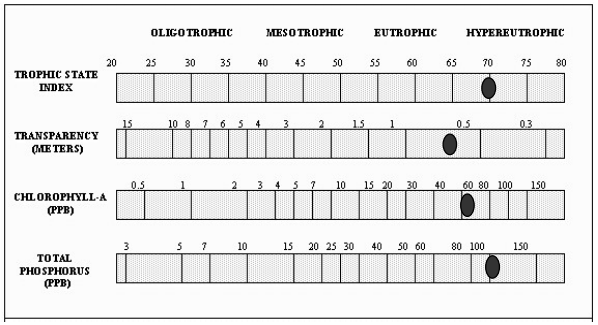
Sullivan Lake
2022 Water Quality Data

			Date	5/15/2022	6/14/2022	7/20/2022	8/15/2022	9/12/2022			
			Time	15:25	10:50	9:45	10:00	8:55			
	Units	R.L.*		Results	Results	Results	Results	Results	Average	Min	Max
pH				8.56	7.76	7.63	7.72	7.01	7.74	7.01	8.56
Specific Conductivity	mS/cm			0.811	0.704	0.778	0.564	0.345	0.640	0.345	0.811
Turbidity	FNRU			12.4	4.9	31.4	30.8	51.1	26	5	51
D.O.	mg/l			10.65	10.14	5.43	10.88	9.57	9.33	5.43	10.88
D.O.	%			123.9	122.5	70.1	130.4	109.4	111.3	70.1	130.4
Temp.	°C			21.06	22.49	26.12	22.01	20.35	22.41	20.35	26.12
Salinity	%	0.01		0.40	0.34	0.38	0.28	0.16	0.3	0.2	0.4
Chloride	mg/m³	0.1		209.0	178.0	199.0	134.0	76.2	159.2	76.2	209.0
Cl-a	mg/l	0.5		18.0	34.7	70.8	107.0	103.0	66.7	18.0	107.0
T.P.	mg/l	0.010		0.081	0.069	0.129	0.144	0.170	0.119	0.069	0.170
T.P.	ug/l	10		81	69	129	144	170	119	69	170
Secchi	ft	0.1		3.0	2.4	1.75	1.5	1.0	1.9	1.0	3.0
Physical				3.0	2.0	3.0	2.0	1.00	2.2	1.0	3.0
Recreational				5.0	2.0	3.0	3.0	3.00	3.2	2.0	5.0

Historical Annual Averages



Carlson's Trophic State Index



Grade	Percentile	TP (µg/L)	Cl-a (µg/L)	Secchi Disk (m)
A	< 10	<23	<10	>3.0
B	10 - 30	23 – 32	10 - 20	2.2 - 3.0
C	30 – 70	32 – 68	20 – 48	1.2 – 2.2
D	70 – 90	68 – 152	48 – 77	0.7 – 1.2
F	> 90	> 152	> 77	< 0.7

Historical Report Card

Year	TP	Cl-a	Secchi	Overall
1993	D		D	**D**
1994	D	C	F	**D**
1995	D	C	D	**D**
1997	D	C	D	**D**
1998	D	D	F	**D**
1999	D	C	D	**D**
2000	D	D	D	**D**
2001	D	D	D	**D**
2002	D	F	F	**F**
2003	D	D	F	**D**
2004	D	D	D	**D**
2005	D	D	F	**D**
2013	D	D	D	**D**
2016	D	C	D	**D**
2019	D	C	C	**D**
2022	D	C	F	**D**
State Standards	60 ug/L	20 ug/L	>3.3 ft	

Highland Lake

Lake ID # 02-0079

Background

Highland Lake is a shallow lake located in southcentral Anoka County, with a surface area of approximately 14 acres. The lake is located within Kordiak Park which is wooded and features a popular paved trail around the lake boundary. The basin bottom is silty and floating vegetation is heavily concentrated across most of the lake's surface. The contributing watershed to Highland lake is 140 acres of primarily residential land that drains directly through storm sewer discharge. There is no formal public boat access to the water and due to water quality the lake is unsuitable for swimming throughout the entire open-water season. Highland Lake is listed as "impaired" by the MN Pollution Control Agency for both nutrients and aquatic recreation.

Results 2022

In 2022 water quality was poor compared to other lakes in the region, receiving an F letter grade. This is the 9th consecutive monitoring year where Highland Lake has received an F letter grade. 2022 nutrient levels in the lake were within the range observed in previous years, however that range is wide and 2022 was on the poorer end. Total phosphorus levels in the lake were two to four times the state standard for shallow lakes (60 µg/L) on every sampling event in 2022, resulting in a seasonal average of 285.0 µg/L. Chlorophyll-a (Cl-a) exceeded the state standard (20 µg/L) on all five sampling events, including an individual reading of 356.0 µg/L recorded in September. The seasonal average for Cl-a (172.0 µg/L) far exceeded the state standard and was a large increase from the 2019 average (139.8 µg/L). Transparency averaged 1 foot.

Trend Analysis

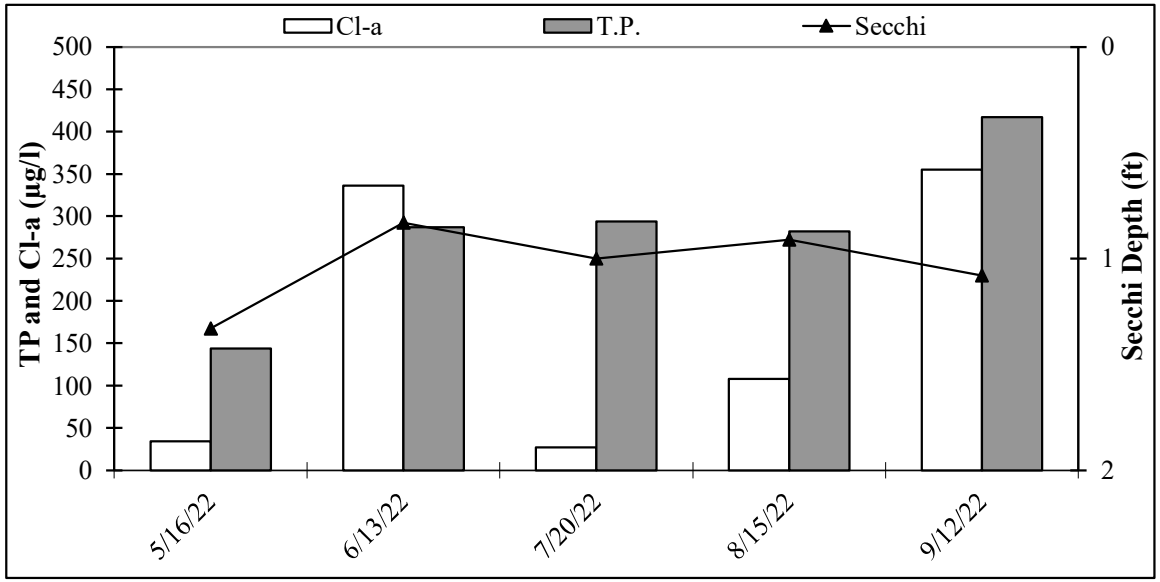
Eleven years of water quality data have been collected by the MPCA (2000-2007) and ACD (2016, 2019, 2022). This is a relativity small dataset to perform any meaningful statistical analysis. A repeated measures MANOVA was performed with response variables TP, Cl-a, and Secchi depth, ($F_{3,8}$=3.43, $p<0.10$) and each of the response variables separately, using a one-way ANOVA. None of these produced a trend of statistical significance but additional monitoring results would be helpful for more accurate analysis. A surficial look at the data appears to show that water quality steadily and dramatically deteriorated through the early 2000s. Recent results from 2016, 2019, and 2022 show maintenance of poor water quality.

2000 and 2001 had the best water quality. For example in 2000 total phosphorus averaged 104.0 µg/L. One might suspect that drought conditions (with less stormwater inflow) in these years contributed to better water quality, but that reasoning might be flawed. 2022 was also a drought year, but poor water quality was observed; much poorer than in 2000 or 2001.

Discussion

Highland Lake's poor water quality is likely related to the high volume of stormwater runoff that enters the basin. Stormwater from urbanized areas often have high concentrations of sediment, nutrients and other pollutants. The current stormwater infrastructure discharges directly into Highland Lake without much pollution treatment in surrounding neighborhoods. Capital improvements projects to the current stormwater infrastructure that could benefit Highland Lake should be explored, especially projects ranked high in the 2019 Subwatershed Assessment Analysis. Enhanced street sweeping can be cost-effective, depending on current sweeping regime.

2022 Results



2022 Medians

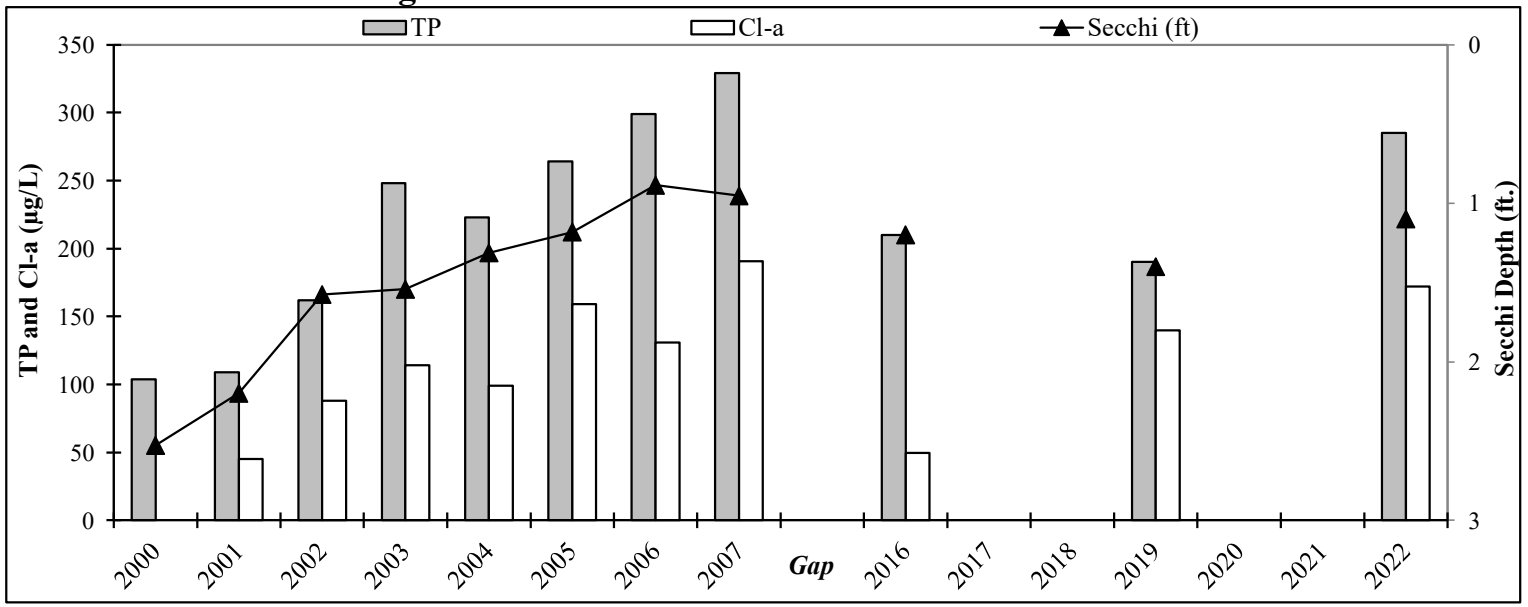
pH		7.51
Specific Conductivity	mS/cm	0.28
Turbidity	NTU	48.30
D.O.	mg/l	6.39
D.O.	%	64.00
Temp.	°F	69.44
Salinity	%	0.13
Chlorides	mg/L	53
Cl-a	µg/L	108.00
T.P.	µg/l	287.00
Secchi	ft	1.00

Highland Lake
2022 Water Quality Data

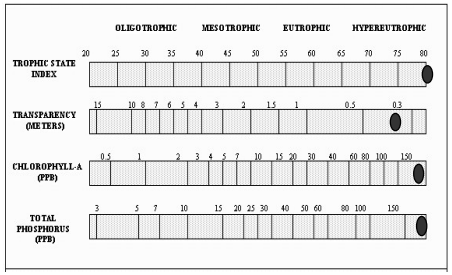
			Date:	5/16/2022	6/13/2022	7/20/2022	8/15/2022	9/12/2022			
			Time:	15:55	10:20	9:15	9:20	8:30			
	Units	R.L.*		Results	Results	Results	Results	Results	Average	Min	Max
pH		0.1		8.40	7.51	8.17	7.15	6.81	7.61	6.81	8.40
Specific Conductivity	mS/cm	0.01		0.300	0.281	0.293	0.274	0.225	0.275	0.225	0.300
Turbidity	FNRU	1		30.00	54.10	48.30	50.90	45.50	46	30	54
D.O.	mg/l	0.01		13.19	6.24	1.07	6.39	6.64	6.71	1.07	13.19
D.O.	%	1		155.4	70.6	11.9	60.5	64.0	72.5	11.9	155.4
Temp.	°C	0.1		22.37	20.80	22.91	19.49	17.40	20.59	17.4	22.9
Temp.	°F	0.1		72.3	69.4	73.2	67.1	63.3	69.1	63.3	73.2
Salinity	%	0.01		0.14	0.13	0.14	0.13	0.11	0.1	0.11	0.14
Cl-a	mg/m³	0.5		34.2	336.0	27.2	108.0	355.0	172.1	27.2	355.0
T.P.	mg/l	0.010		0.144	0.287	0.294	0.282	0.417	0.3	0.144	0.417
T.P.	ug/l	10		144	287	294	282	417	285	144	417
Chloride	mg/L			53.4	51.8	53.0	45.4	35.3	47.8	35	53
Secchi	ft	0.1		1.3	0.8	1.0	0.9	1.1	1.0	0.8	1.3
Physical				2	2.0	0.0	1.0	1.0	1.2	0.0	2.0
Recreational				1	1.0	0.5	1.0	2.0	1.1	0.5	2.0

*reporting limit

Historical Annual Averages



Carlson's Trophic State Index



Grade	Percentile	TP (µg/L)	Cl-a (µg/L)	Secchi Disk (m)
A	< 10	<23	<10	>3.0
B	10 - 30	23 – 32	10 - 20	2.2 - 3.0
C	30 – 70	32 – 68	20 – 48	1.2 – 2.2
D	70 – 90	68 – 152	48 – 77	0.7 – 1.2
F	> 90	> 152	> 77	< 0.7

Historical Report Card

Year	TP	Cl-a	Secchi	Overall
2000	D		D	**D**
2001	D	C	F	**D**
2002	F	F	F	**F**
2003	F	F	F	**F**
2004	F	F	F	**F**
2005	F	F	F	**F**
2006	F	F	F	**F**
2007	F	F	F	**F**
2016	F	D	F	**F**
2019	F	F	F	**F**
2022	F	F	F	**F**
Standards	60 ug/L	20 ug/L	>3.3 ft	