BROWN'S CREEK WATERSHED DISTRICT
2024 WATER MONITORING SUMMARY

Prepared for:

Brown's Creek Watershed District
Preserving the integrity of the watershed for future generations

Prepared by:

Washington Conservation District

ACKNOWLEDGMENTS

Several agencies and individuals were directly involved in many aspects of this project including data collection and analysis, as well as technical and administrative assistance.

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The BCWD and WCD would also like to thank those volunteers and landowners who assist with data collection and allow property access.

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

Bi-weekly	Every two weeks
CaCO3	Calcium Carbonate
CAMP	Citizen-Assisted Lake Monitoring Program
cfs	cubic feet per second
Chl-α	Chlorophyll-α
BCWD	Brown's Creek Watershed District
DO	Dissolved Oxygen
EIMS	Environmental Information Management System
E. coli	*Escherichia coli*
FAV	Final Acute Value
IESF	Iron Enhanced Sand Filter
MCES	Metropolitan Council Environmental Services
mg/L	milligrams per liter
MN DNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MPN	most probable number
NTU	nephelometric turbidity units
OHWL	Ordinary High Water Level
Ortho-P	Ortho-phosphorus
THPP	Trout Habitat Preservation Project
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSI	Trophic State Index
TSMP	Trout Stream Mitigation Project/Diversion Structure
TSS	Total Suspended Solids
µg/L	micrograms per liter
µm	micrometers
µmhos/cm	micromhos per centimeter
VSS	Volatile Suspended Solids
WCD	Washington Conservation District

2024 Brown's Creek Watershed District Baseline Water Quality Monitoring

MONITORING SUMMARY

This report focuses on the summary of lake and stream water quality data collected by the Washington Conservation District (WCD) in 2024. References will also be made to the Brown's Creek and Long Lake 2020 Trend Analysis completed by Brown's Creek Watershed District's engineer, Emmons & Olivier Resources, Inc. (EOR). Additional information on the natural and cultural resources, improvement projects, and challenges related to water resources within the Brown's Creek Watershed District (BCWD) can be found in the BCWD 2017-2026 Watershed Management Plan, the 2010 Brown's Creek Biota TMDL, and past monitoring summaries.

The drought conditions observed in 2021-2023 continued into the beginning of 2024 with some of the lowest snow totals ever recorded in the state. Spring conditions were somewhat cooler than average, with overnight freezing temperatures persisting into mid-April. However, a warm, largely snow-free winter caused most lakes to lose the little ice cover that formed by the first week of March; a full month earlier than median ice-out dates. Contrary to most years, due to the lack of snow cover and drought at the end of 2023, water levels in streams and lakes in the District were at their lowest immediately after ice-out with no recharge from snowmelt. Spring conditions were very wet, with May and June combining to be 5.52 inches of precipitation above the thirty year average. This was contrasted by extremely dry late summer and fall conditions, where September and October were some of the driest ever recorded, with just 2.69 inches of precipitation combined. Overall, annual precipitation was 5.75 inches greater than the thirty year average of 33.9 inches. Warm air temperatures also impacted water conditions, although only one day over 90 ^{o}F was recorded by the National Weather Service in Stillwater. Ice-in was somewhat delayed due to fluctuating warm and cold temperatures and rain extending into December. The wet and warm conditions in 2024 are generally reflected in poorer water quality conditions than previous years.

Lake Monitoring

BCWD monitored eighteen basins for nutrients, chlorophyll-α, Secchi disk transparency, temperature and dissolved oxygen profiles, elevation, and user perception rankings. Bass Lake East, Bass Lake West, Benz Lake, Goggins Lake, Jackson WMA (Sinnits) Pond, Kismet Basin, Long Lake, Lynch Lake South, Masterman Lake, Plaisted Lake, South School Section Lake, and Woodpile Lake were monitored every other week, while Brewer's Pond, Heifort's Pond, July Avenue Wetland, Lynch Lake North, North School Section Lake, and Pat Lake were monitored every four weeks by WCD staff. Volunteers also monitored Brewer's Pond and Heifort's Pond

every four weeks on an offset schedule with WCD, such that samples were collected every other week.

Five lakes experienced a slight decline in water quality as measured by lake grade over the previous year. Six lakes experienced an improvement in lake grade; Benz Lake, Heifort's Pond, Kismet Basin, Lynch Lake South, Masterman Lake, and Woodpile Lake. Bass Lake West, Goggins Lake, July Ave Wetland, Long Lake, and South School Section Lake declined in grade from the year prior, and all other lakes maintained their lake grade.

Of the eighteen lakes monitored, July Ave Wetland and Lynch Lake North summer averages exceeded (were poorer than) state impairment thresholds for total phosphorus, chlorophyll-α, and Secchi disk transparency. South School Section Lake exceeded the impairment threshold for total phosphorus and chlorophyll-α. Brewer's Pond and Heifort's Pond exceeded the impairment threshold for chlorophyll-α and Secchi disk transparency. Lynch Lake South exceeded the impairment threshold for Secchi disk transparency.

Peak elevation for the year on most lakes occurred in August. In 2024 four basins had elevations above their Ordinary High Water (OHW) level, for part or all of the monitoring season.

Stream and Stormwater Monitoring

Brown's Creek

Consistent with past years, Brown's Creek was monitored at four locations; Highway 15, McKusick Road, Stonebridge, and the Outlet. Automated storm composite and manual grab samples during storm and base flow conditions were collected at all sites and analyzed for nutrients, sediment, metals, and *Escherichia coli* (*E.coli*). Continuous (15 minute) stage, discharge, temperature, dissolved oxygen (DO), turbidity, and specific conductivity were collected at all four stations, and continuous pH was also collected at McKusick Road, Stonebridge and the Outlet.

<u>Nutrients & Discharge</u>

The total discharge to the St. Croix River in 2024 was 261,552,581 cubic feet of water, as recorded at the Outlet. The total phosphorus (TP) and total suspended solids (TSS) loads to the St. Croix River at the Outlet were 2,563 pounds of phosphorus (0.554 lbs/ac) and 507,151 pounds of sediment (109.68 lbs/ac), as calculated by Metropolitan Council Environmental Services (MCES). These were near the long term average load since load calculations began in 2000. The sampling strategy at the Outlet was changed by MCES in 2017 to a manual grab collected on the same weekday every other week, and composite samples collected in major storm events. This change in sampling method has resulted in an apparent shift to lower annual loads, as the strategy is not biased towards runoff events as it was in the past, and the method

used to calculate annual loads was altered to comply with MCES standard operating procedures. The creek exceeded the state standard of 0.100 mg/L of TP for six of 26 applicable sample, but was below the standard for most of the year. The creek met the TMDL goal of 23 mg/L of TSS during base flow, but exceeded the state standard of 10 mg/L from April 1 to September 30 in May through August for a total of five of 12 applicable samples. TSS loading was greater than the TMDL goal of 74 pounds per acre, primarily due to the wet spring conditions. Additionally, in-water construction work as part of the streambank and floodplain restoration project along Neal Avenue contributed to the higher TP and TSS loads. Loading and conditions at individual sites are discussed in greater detail later in this summary.

Metals

No metals exceedances were recorded at the Outlet. A small number of chronic level exceedances of lead and cadmium were recorded at the upstream monitoring stations. The number and severity of metals standards exceedances in 2024 was again low compared to past years.

Bacteria

Samples taken during base flow at each station were above state standards for *E.coli*. Based on long term monitoring, bacteria concentrations at all stations are above the standard June through September, and at McKusick Road in the month of May. Sufficient data has not been collected at Highway 15, McKusick Road, or Stonebridge to compare to the standard in April.

Temperature & Dissolved Oxygen

Temperature and dissolved oxygen regimes were most suitable for trout survival at McKusick Road, Stonebridge and the Outlet. Although the threat level threshold of 18.3 ºC was exceeded at McKusick Road, Stonebridge, and the Outlet 40, 49, and 15 days, respectively, as measured by daily average temperature, the critical level threshold at which trout could not survive of 23.9 ºC was never exceeded at any site. The number of threat level exceedances at all sites near the average over the last ten years when a full season of data was available. Dissolved oxygen concentrations were better than the state standard of 7 mg/L as a daily minimum for the entire season at the Outlet, and were poorer than the standard only one day at Stonebridge. McKusick Road was poorer than the standard 29 days, partially due to the in-water restoration work around Neal Avenue. Highway 15 is not suitable for trout during summer months due to low dissolved oxygen and warm temperatures. In past years McKusick Road has not typically had favorable conditions for both temperature and dissolved oxygen, but it is hoped increased shading and bank stabilization resulting from the restoration work will improve conditions in this reach. The upper reaches of the creek around Highway 15 have been found to contain invasive curly-leaf pondweed, which will hinder trout suitability by slowing the water, allowing for warmer temperatures and sediment deposition over spawning gravel.

Turbidity

Continuous turbidity and specific conductivity were monitored at each of the four stations on the creek. Average daily turbidity exceeding the TMDL goal of 10 NTU ranged from 12.9% to 34.5% of the days monitored across the four monitoring stations. In 2024 Stonebridge was the most turbid site, with 34.5% of the days monitored exceeding the 10 NTU goal. Turbidity conditions were heavily influenced by the in-water restoration work during the summer months, which caused daily spikes in turbidity when construction activities were occurring. These spikes were of the same magnitude as major storm events, and are reflected in load data. Specific conductivity data are not discussed, but are available upon request.

Biology

The MN DNR has a management plan to stock 1,000 yearling rainbow trout in the creek each spring. Due to difficulties of raising brown trout at state hatcheries to target size, the agency shifted to stocking rainbow trout in 2019. Stillwater Area High School and the Minnesota Trout Unlimited – Trout in the Classroom program also raised and released several hundred fingerling rainbow trout into the creek. The rainbow trout thrive in similar conditions as brown trout, but grow faster and will provide better recreational opportunities to anglers.

Diversion Drainage

The diversion drainage was again monitored at the Trout Stream Mitigation Project (TSMP) Diversion Structure for nutrients, sediment, and metals, as well as continuous stage, velocity, discharge, and temperature. A secondary level logger installed at the diversion weir shows no water overtopped the weir in 2024. A very small volume of water directly discharges via a small hole in the base of the structure designed to allow groundwater base flow into Brown's Creek. Total discharge to McKusick Lake was 72,832,083 cubic feet of water; the second highest volume recorded since monitoring began in 2006. The TP load was 573 pounds (0.149 lbs/ac) and the TSS load was 230,855 pounds (59.88 lbs/ac). The TP and TSS loads were well below the ten year and all-time averages. The site met the state standard for 2B waters for TP and TSS, but has historically shown an extremely high storm loading rate. Erosional head cuts in the drainage tributaries have been identified as the source of the excessive loading rates through drone flights and surveys conducted by the District's engineer. Rock vanes and stabilization projects have been implemented by the District to reduce erosion and restore floodplain connectivity. Annual TSS and TP reductions as a result of these projects are estimated to be 70 pounds of sediment and 76 pounds of phosphorus per year. In 2024 beavers also constructed a series of dams upstream of the site first noted in July, further trapping sediment by reducing flow rate and improving floodplain connectivity. The high total discharge and below average nutrient loads provide evidence the restoration projects and natural processes resulting from beaver activity may be improving water quality conditions in the drainage. Concentrations of metals were again low in 2024. One chronic standard exceedance of copper and three chronic standard exceedances of lead were sampled, which are among the lowest ever recorded. Continuous temperature

monitoring was added to the site in 2024 to provide further data on how restoration and beaver activities are affecting habitat and water quality conditions in the drainage.

Long Lake Drainages

The Tributary to Long Lake at Marketplace Pond was monitored for nutrients, sediment, metals, and continuous stage and discharge, while the Tributary to Long Lake at 62nd Street was monitored for stage only. The total discharge to Long Lake at Marketplace Pond was 24,319,915 cubic feet, while the discharge at 62nd Street was estimated based on prior data at 3,294,857 cubic feet during the monitoring period. These were the greater than the long term average discharges for these sites. The tributary at Marketplace Pond contributed 157 pounds of phosphorus (0.383 lbs/ac) and 18,320 pounds of sediment (44.68 lbs/ac). Although not classified as a 2B water, the state standard for TP was exceeded during base flow conditions in May, and the TSS standard is being met at the Marketplace Pond for all samples at base flow. Storm events at the tributary at Marketplace Pond exceeded the maximum standard for copper four times, the chronic standard for copper once, the chronic standard for lead three times, and the maximum and chronic standards for zinc once each.

McKusick Wetland Outlet

McKusick Wetland Outlet was added to the monitoring network in 2017. The outlet was monitored at its discharge point to Brown's Creek 100 feet upstream of the McKusick Road site for continuous stage, discharge, and temperature, as well as nutrients, sediment, and metals. Discharge to Brown's Creek during the period of monitoring (April 24 to October 29) was calculated at 9,588,210 cubic feet. The TP load for this period contributed 165.5 pounds of phosphorus, while the TSS load contributed 4,788 pounds of sediment. Although not a 2B water, when compared to state standards for TP and TSS the site meets the standard for TSS, but was above the TP standard for every sample collected.

The Oak Glen Golf Course Irrigation Reuse project was completed in 2021, and directs flow from the wetland away from Brown's Creek to a pond to be used as irrigation water. This helps reduce thermal and nutrient loads to Brown's Creek and increases the suitability of the creek to support cold water species. The outlet appears to have had flow during the entire monitoring period. Continuous temperature data collected at the site show water discharged to the creek exceeded the TMDL threat level threshold 58.9% of the monitored period, and the critical level threshold 7.7% of the period.

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I. INTRODUCTION

Knowledge of the changes to water quality and quantity of our water resources through monitoring guides when, where, and how management activities should be implemented to protect or restore those resources. The Brown's Creek Watershed District (BCWD) utilizes monitoring and the data collected to make such decisions as outlined in its watershed management plan. In 2024 BCWD monitored 22 basins (lakes), four stations on Brown's Creek, a tributary to Brown's Creek, two stations in the Long Lake subwatershed, and one station in the diversion drainage at the Diversion Structure. A summary of monitoring locations and monitored parameters can be found in Table 1 and Figure 1.

The Washington Conservation District (WCD) also conducted special project and maintenance monitoring at several locations including the Iron Enhanced Sand Filter (IESF) on Morgan Avenue, Brown's Creek Rock Crib, Countryside Auto sediment chamber, McKusick Road sediment chambers, the Oak Glen Golf Course Irrigation Reuse project, lake shoreline surveys, and bathymetry data on Stillwater stormwater ponds. Comparable levels of data collection versus baseline sites occurred at each project, such as collection of continuous stage, discharge, and temperature, and measurement of sediment depths in complex monitoring situations. As this summary focuses on baseline monitoring data, special project monitoring will not specifically be discussed, although the locations of several projects are described. Individual monitoring summaries for each project will be prepared and made available in separate reports.

Table 1. Monitoring Site Location, Description, and Parameter(s) Monitored

Site Description	Map Site ID#	Site Name	General Site Location	Monitored Parameters
Stream Monitoring	**1**	Brown's Creek at Hwy 15	Hwy 15	Continuous Water Quality and Discharge; Water Quality Composite/Grab Samples
Stream Monitoring	**2**	Brown's Creek at McKusick Road	McKusick Road	Continuous Water Quality and Discharge; Water Quality Composite/Grab Samples
Stream Monitoring	**3**	Brown's Creek at Stonebridge Trail	Stonebridge Trail	Continuous Water Quality and Discharge; Water Quality Composite/Grab Samples
Stream Monitoring	**4**	Brown's Creek Outlet	Hwy 95 & 96	Continuous Water Quality and Discharge; Water Quality Composite/Grab Samples
Stream Monitoring	**5**	Brown's Creek Diversion	Neal Ave.	Discharge, Temperature, and Water Quality Composite/Grab Samples
Stream Monitoring	**6**	Tributary to Long Lake at 62nd St.	62nd St.	Stage
Stream Monitoring	**7**	Tributary to Long Lake at Marketplace Pond	Market Dr.	Discharge and Water Quality Composite/Grab Samples
BMP Effectiveness	**8**	Iron Enhanced Sand Filter (IESF)-1 Outlet	Morgan Ave. N.	Discharge and Water Quality Composite/Grab Samples
Stream Monitoring	**9**	McKusick Wetland Outlet	McKusick Road	Discharge, Temperature, and Water Quality Grab Samples
BMP Effectiveness	**10**	Brown's Creek Park Rock Crib (5 In-Crib Temperature Loggers and Outlet Discharge)	Neal Ave.	Discharge, Temperature, Sediment Depth and Maintenance Requirements
BMP Maintenance	**11**	McKusick Road and Countryside Auto Sediment Chambers	McKusick Road	Sediment Depth and Maintenance Requirements
BMP Effectiveness	**12**	Oak Glen Pond Water Reuse	McKusick Road	Stage
			DNR ID	
Lake Monitoring	**13**	Kismet Basin	82-033400	Water Quality Samples, Elevation
Lake Monitoring	**14**	Long Lake (North Basin)	82-002100	Water Quality Samples, Elevation
Lake Monitoring	**15**	Goggins Lake	82-007700	Water Quality Samples, Elevation
Lake Monitoring	**16**	South School Section Lake	82-015100	Water Quality Samples, Elevation
Lake Monitoring	**17**	Benz Lake	82-012000	Water Quality Samples, Elevation
Lake Monitoring	**18**	Masterman Lake	82-012600	Water Quality Samples, Elevation
Lake Monitoring	**19**	Woodpile Lake	82-013200	Water Quality Samples, Elevation
Lake Monitoring	**20**	Lynch Lake (North Basin)	82-004200	Water Quality Samples, Elevation
Lake Monitoring	**21**	Lynch Lake (South Basin)	82-004202	Water Quality Samples, Elevation
Lake Monitoring	**22**	Bass Lake (West)	82-012300	Water Quality Samples, Elevation
Lake Monitoring	**23**	Bass Lake (East)	82-012400	Water Quality Samples, Elevation
Lake Monitoring	**24**	July Avenue Pond	82-031800	Water Quality Samples, Elevation
Lake Monitoring	**25**	Pat Lake	82-012500	Water Quality Samples, Elevation
Lake Monitoring	**26**	Plaisted Lake	82-014800	Water Quality Samples, Elevation
Lake Monitoring	**27**	Jackson Wildlife Management Area Pond (Sinnits Pond)	82-030500	Water Quality Samples, Elevation
Lake Monitoring	**28**	Brewer's Pond	82-002200	Water Quality Samples, Elevation
Lake Monitoring	**29**	Heifort's Pond	82-048500	Water Quality Samples, Elevation
Lake Monitoring	**30**	North School Section	82-014900	Water Quality Samples, Elevation
Lake Monitoring	**31**	Highway 12 & Kimbro Pond	82-034900	Elevation
Lake Monitoring	**32**	Brown's Creek at Gateway Trail	82-030300	Elevation
Lake Monitoring	**33**	55th St. Pond	82-031600	Elevation
Lake Monitoring	**34**	Vanzwol Pond	82-012800	Elevation
Lake Monitoring	**35**	Marketplace Pond	N/A	Bathymetry
Lake Monitoring	**36**	62nd St. Pond	N/A	Bathymetry
Lake Monitoring	**37**	Wildwood Pines Pond	N/A	Bathymetry
Lake Monitoring	**38**	Washington Ave Pond	N/A	Bathymetry
Lake Monitoring	**39**	Clinic Pond 2	N/A	Bathymetry
Lake Monitoring	**40**	Tower Dr. Pond	N/A	Bathymetry

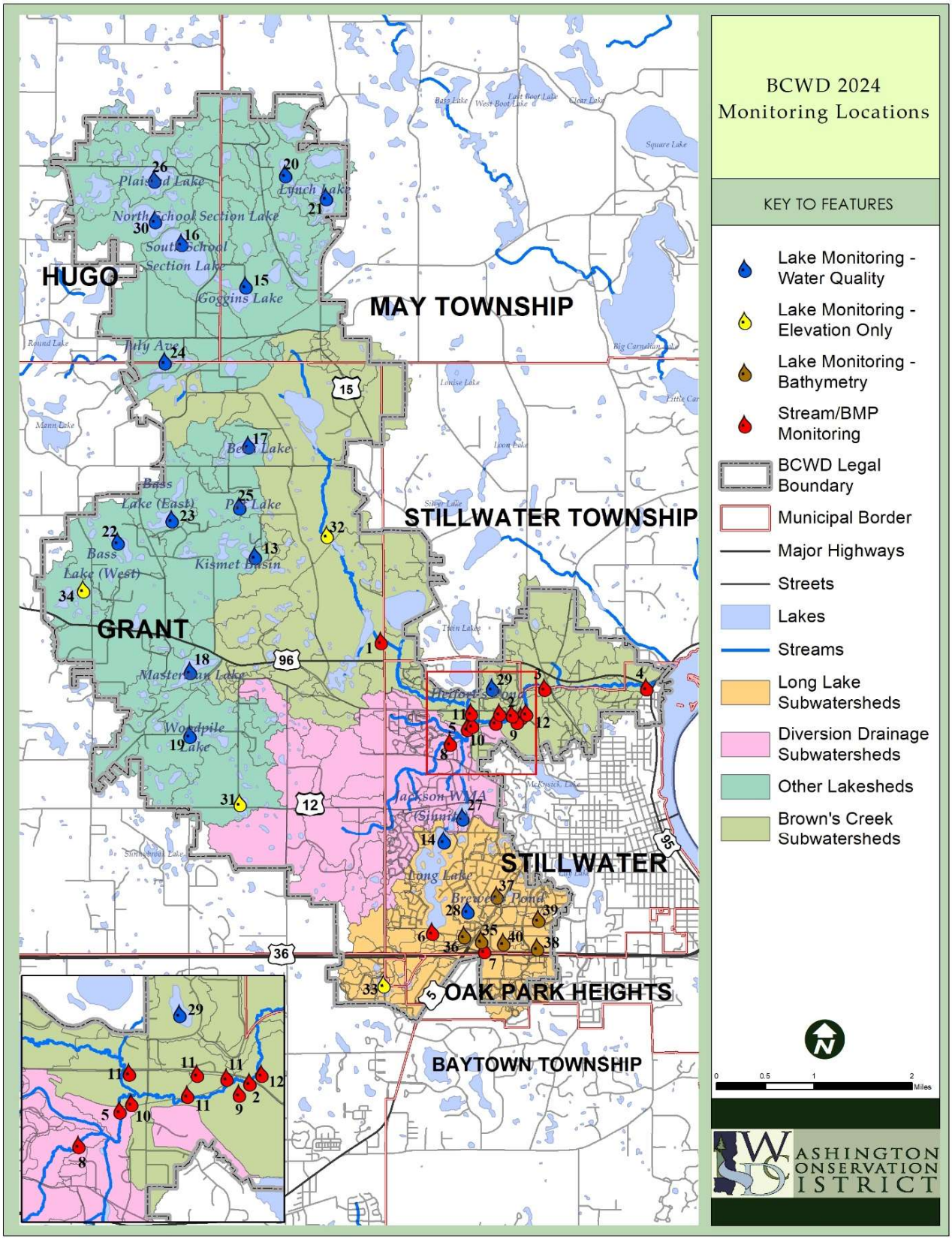

Figure 1. Brown's Creek Watershed District 2024 Sampling Locations

II. PURPOSE AND GOALS

BCWD uses a monitoring network to assess the quality of its water resources and maintains partnerships with the Minnesota Department of Natural Resources (MN DNR), Metropolitan Council, Washington Conservation District (WCD), Stillwater Area High School, and volunteers to collect and manage data. The general purpose of the baseline water monitoring program is to collect long term data to identify issues within the watershed and track changes towards meeting water quality goals described in the 2017-2026 Watershed Management Plan and the Brown's Creek TMDL Implementation Plan. The goals specific to this monitoring summary include the collection of useful data about the water resources of the District, production of an annual assessment of monitoring data, and the use of that data to determine the performance of District programs and regulations. Additional policies, goals, and implementation strategies related to monitoring data are more fully described in the watershed management plan.

III. LAKE MONITORING

III.A. Locations and Parameters

In 2024 water quality data were collected by the WCD on eighteen basins (lakes) (Table 1 and Figure 1). Each lake was sampled for total phosphorus (TP), total Kjeldahl nitrogen (TKN), chlorophyll-α, and Secchi disk transparency. A complete listing of nutrient and Secchi data by lake is available in Appendix A. One-meter increment temperature and dissolved oxygen profiles as well as a user perception ranking (physical and recreational suitability) were also recorded. These data are available via request or on the Metropolitan Council's Environmental Information Management System (EIMS) Water Quality Database website (https://eims.metc.state.mn.us).

III.B. Methods

Each basin was sampled April through October using a two-meter (6.56 feet) integrated surface water column sampler from a watercraft, except for Brewer's Pond and Heifort's Pond, which were sampled from the surface only using a bucket to match citizen volunteer protocols. Bass Lake East, Bass Lake West, Benz Lake, Goggins Lake, Jackson WMA (Sinnits) Pond, Kismet Basin, Long Lake, Lynch Lake South, Masterman Lake, Plaisted Lake, South School Section Lake, and Woodpile Lake were monitored bi-weekly, while Brewer's Pond, Heifort's Pond, July Avenue Wetland, Lynch Lake North, North School Section Lake, and Pat Lake were monitored every four weeks. Volunteers monitored Brewer's Pond and Heifort's Pond on an offset schedule with WCD so that samples were collected every other week. Chlorophyll-α samples were obtained by filtering water from the integrated sample through a 1.5 µm fiberglass filter using a hand pump. Samples collected for TP, TKN, and chlorophyll-α were analyzed by the Metropolitan Council Environmental Services Lab. The sampling methods above were developed by and consistent with Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). Measurements obtained during the sampling season were averaged to allow comparison of individual lake dynamics from year to year. Trend analysis for long term Secchi

disk transparency, TP, and chlorophyll-α (corrected for pheophytin) trends were completed using a Kendall's Tau statistical test, presented in Appendix A, and only data collected by professional agencies were used to assess for trends. All other data were quality assured, quality controlled, and reviewed by WCD staff. Detailed standard operating procedures used by WCD for water sampling, monitoring, and data management are available on the WCD website (https://www.mnwcd.org/water-monitoring).

III.C. Results and Discussion

III.C.1. Lake Grades

The lake water quality grading system was developed following the 1989 sampling season by Metropolitan Council. This grading system ranks water quality characteristics by comparing summer averages to those of other lakes specific to the metro area. The grading curve represents percentile ranges for the May through September averages of total phosphorus concentration, uncorrected trichromatic chlorophyll-α concentration, and Secchi disk transparency for 119 lakes sampled from 1980 to 1988, and the ranges were re-confirmed in 2000 using more recent data. Percentile ranges for each parameter can be found in Table 2. A benefit of the lake grade system is that it was developed specifically for lakes in the metro area, and serves as a convenient way to compare water quality between lakes. Current grades for each lake can be found in Figure 2, and the latest ten years of grades for each lake can be found in Appendix A. In addition, comparison of June through September water quality averages (total phosphorus concentration, pheophytin-corrected chlorophyll-α, and Secchi disk transparency) will be made to state eutrophication standards for each lake as the Minnesota Pollution Control Agency (MPCA) uses this timeframe to assess impairment status. Beginning in 2019 volunteer data collected through the CAMP program on Brewer's Pond and Heifort's Pond were incorporated into lake grade and summer averages. June through September averages and impairment thresholds can be found in Table 3.

Table 2. Lake Grade Ranges

Grade	Percentile	TP (µg/L)	Chl-α (µg/L)	Secchi (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

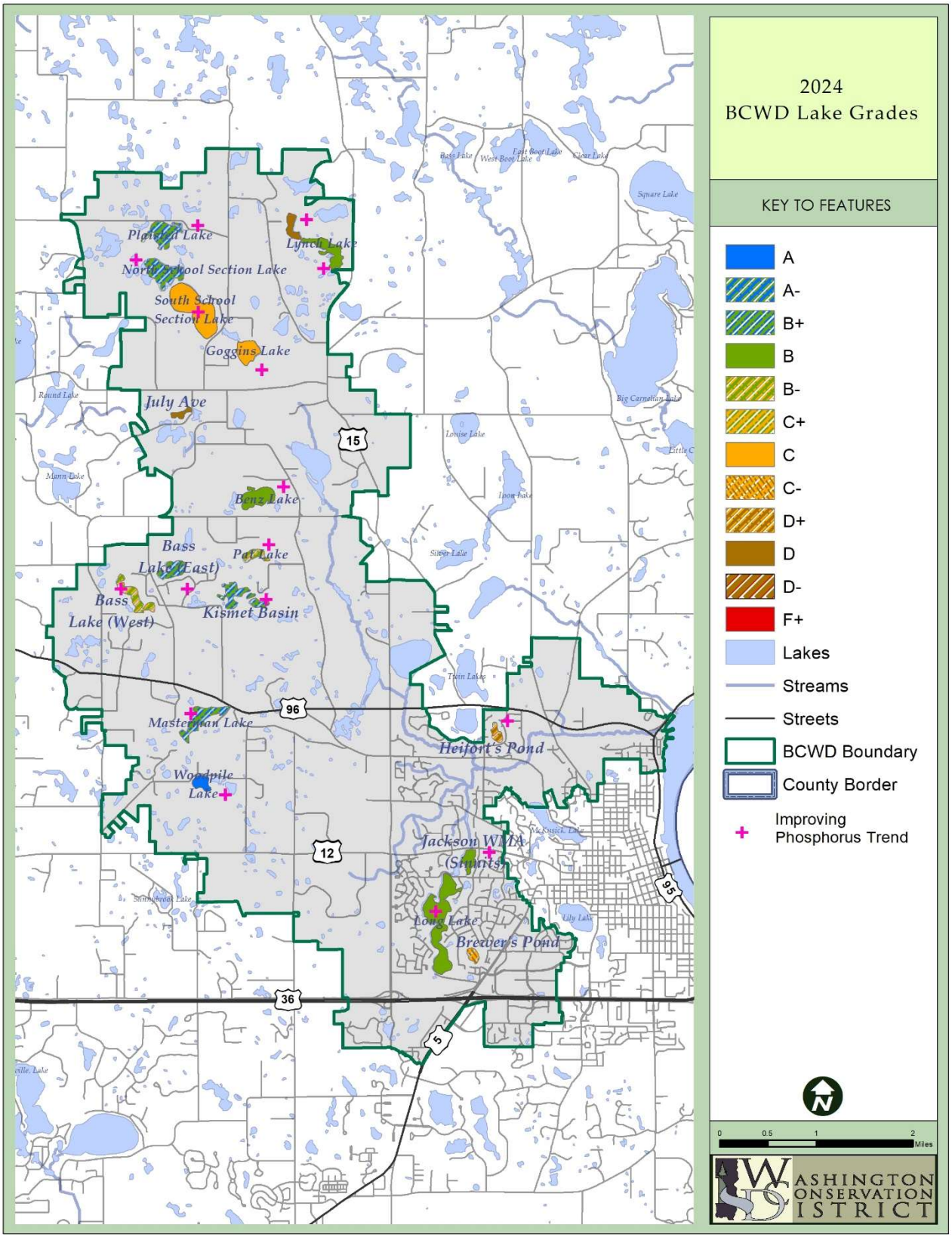

Figure 2. Brown's Creek Watershed District 2024 Lake Grades

Table 3. Impairment Thresholds and June Through September Average 2024 Parameters

Lake	Total Phosphorus (mg/L)	Pheophytin Corrected Chlorophyll-α (µg/L)	Secchi (meters)	Total Kjeldahl Nitrogen (mg/L)
Impairment Threshold- Shallow	*0.060*	*20.0*	*1.00*	*N/A*
Impairment Threshold- Deep	*0.040*	*14.0*	*1.40*	*N/A*
Eco-Region Value	*0.023-0.050*	*5.0-22.0*	*1.5-3.2*	*0.60-1.20*
Bass East	0.032	5.3	2.19	0.97
Bass West	0.031	1.9	1.87	0.91
Benz	0.024	5.1	1.39	0.77
Brewer's	0.042	35.3	0.80	1.69
Goggins	0.049	19.6	1.43	1.12
Heifort's	0.052	43.0	0.64	1.77
Jackson WMA	0.025	2.2	1.44	0.56
July Ave	0.096	73.0	0.50	2.21
Kismet	0.022	7.8	1.32	0.74
Long	0.032	4.9	2.45	0.93
Lynch North	0.120	46.8	0.55	1.81
Lynch South	0.029	7.2	0.85	0.85
Masterman	0.022	3.7	1.32	0.76
North School Section	0.024	7.7	2.44	0.66
Pat	0.047	8.6	1.83	0.70
Plaisted	0.023	3.6	2.19	0.66
South School Section*	0.041	36.7	1.45	1.24
Woodpile*	0.019	4.6	3.27	0.84

Exceeds impairment threshold

*Indicates deep lake. All others are classified as shallow.

Lake grades held stable for most lakes in the District when compared to 2024. Six lakes experienced an improvement in lake grade; Benz Lake, Heifort's Pond, Kismet Basin, Lynch Lake South, Masterman Lake, and Woodpile Lake. Bass Lake East, Brewer's Pond, Jackson WMA (Sinnits) Pond, Lynch Lake North, North School Section Lake, Pat Lake, and Plaisted Lake maintained their grade from the year prior, and all other lakes declined in lake grade. 2024 had warm temperatures and the drought conditions of the previous years ended. 2024 did have an increased period of open water from early spring ice out, which can encourage algal growth, as seen in 2021.

The most notable shift in lake grade occurred on Long Lake with continued improvements in water quality from an F+ grade in 2016, to a B grade in 2024. This appears to be the result of lower chlorophyll-α concentrations and higher water clarity, which may be the product of a robust community of aquatic vegetation. South School Section Lake also continues to respond positively to treatments to remove curly-leaf pondweed. The lake was treated in 2017 and May of 2021, and has improved from a D+ grade in 2018 to a B grade in 2021-2022, but has since been declining receiving a B- in 2023, and a C in 2024, which is the historic average. The decline to a D+ grade in 2018 after the initial treatment was likely the result of a release in nutrients stored in the curly-leaf pondweed, before the remaining vegetative community recovered. Curly-leaf pondweed was also found in a small area of Goggins Lake near the connection between Goggins Lake and South School Section Lake. Goggins Lake was also

treated for curly-leaf pondweed in 2021. In 2024 Goggins received a C, a slight improvement from the historic average of a C-.

III.C.2. Total Phosphorus

Phosphorus is a major nutrient involved in eutrophication and is generally associated with the growth of aquatic plants and algal blooms. Common sources of phosphorus include runoff from agricultural fields, livestock areas, urban areas, lakeshore lawns and improperly operating septic systems. In most lakes in this region, phosphorus is the least available nutrient; therefore, its abundance or scarcity controls the extent of algal growth. Algal growth in turn affects the clarity of the water and light penetration, and can control the extent of aquatic vegetation by shading out plants. The phosphorus flow path through the watershed can be found in Appendix C.

The state impairment threshold for total phosphorus (TP) is 0.060 mg/L in shallow lakes (generally greater than 50 acres and less than 15 feet deep, or more than 80% littoral area) and 0.040 mg/L in deeper lakes. In 2024 July Avenue Wetland, Lynch Lake North, and South School Section Lake summer average TP concentrations exceeded impairment standards (Table 3).

Trend analyses were completed on lakes where eight or more years, with at least six years occurring in the last ten years, of TP measurements had been collected to determine if lakes are improving, declining, or stable in terms of average summer TP. A two-tailed Kendall's Tau statistical test was completed using a p-value of <0.05 to determine statistical significance of the trend. Bass Lake East, Bass Lake West, Benz Lake, Goggins Lake, Heifort's Pond, Jackson WMA (Sinnits) Pond, Kismet Basin, Long Lake, Lynch Lake North, Lynch Lake South, Masterman Lake, North School Section Lake, Pat Lake, Plaisted Lake, South School Section Lake, and Woodpile Lake have improving trends for TP, meaning the average summer TP concentration is decreasing (Figure 2 and Appendix A). No statistically significant trend exists on July Avenue Wetland or Brewer's Pond. South School Section Lake shifted from no trend in recent years to an improving TP trend starting in 2022. The Brown's Creek and Long Lake 2020 Trend Analysis completed by the District's engineer, Emmons & Olivier Resources, Inc. (EOR) also show an improving short term trend from 2011-2020, and a statistically significant improving trend over the long term, from 1995-2020, on Long Lake.

III.C.3. Chlorophyll-α

Chlorophyll-α is a photosynthetic compound found in algae and aquatic plants, and is a direct indicator of algal productivity. Lakes with high chlorophyll-α concentrations are often eutrophic or hypereutrophic. These lakes tend to have excessive algal growth, shading out rooted plants. Lakes with low chlorophyll-α concentrations can be mesotrophic or even oligotrophic, and tend to have more rooted plants to take up phosphorus, rather than phosphorus being used by algae within the water column which produces more chlorophyll-α.

The impairment threshold for chlorophyll-α is 20 µg/L in shallow lakes and 14 µg/L in deeper lakes. Brewer's Pond, Heifort's Pond, July Avenue Wetland, Lynch Lake North, and South School Section Lake summer average concentrations exceeded the impairment threshold (Table 3).

Trend analyses were completed on lakes where eight or more years, with at least six years occurring in the last ten years, of chlorophyll-α measurements had been collected to determine if lakes are improving, declining, or stable in terms of algal productivity. A two-tailed Kendall's Tau statistical test was completed using a p-value of <0.05 to determine statistical significance of the trend. Bass Lake East, Benz Lake, Goggins Lake, Heifort's Pond, Jackson WMA (Sinnits) Pond, Kismet Basin, Long Lake, Lynch Lake North, Lynch Lake South, Masterman Lake, North School Section Lake, Pat Lake, Plaisted Lake, and Woodpile Lake show statistically significant long term trends for improving chlorophyll-α concentrations, meaning less algae is being produced (Appendix A). No statistically significant trends were present on Bass Lake West, Brewer's Pond, July Avenue Wetland, or South School Section Lake. No lakes showed an increasing trend for chlorophyll-α concentration. EOR's trend analysis also shows a short term improving trend and a statistically significant long term improving trend on Long Lake.

III.C.4. Transparency

The measurement of depth of light penetration using a Secchi disk provides a simple measure of water transparency, or clarity. It can also serve as a proxy for turbidity in the water, as well as an indication of the trophic state of the lake. A reduction in water transparency is usually the result of turbidity composed of suspended sediments, organic matter and/or phytoplankton (algae). Several lakes in the district, such as Benz Lake and Masterman Lake, are clearer than they are deep, meaning an accurate measure of transparency cannot be achieved because the disk rests on the lake bottom or is obscured by vegetation instead of reaching a depth where it is no longer visible. This can give the false appearance of low water clarity when considering average transparency, when in reality the true Secchi depth is much higher. Lakes which experience this phenomenon are noted in the summary points sections of Appendix A.

The impairment threshold for Secchi disk transparency is 1.00 meter in shallow lakes and 1.40 meters in deep lakes. Brewer's Pond, Heifort's Pond, July Avenue Wetland, Lynch Lake North, and Lynch Lake South summer average transparencies were poorer than the state standard (Table 3).

Trend analyses were completed on lakes where eight or more years, with at least six years occurring in the last ten years, of Secchi disk measurements had been collected to determine if lakes are improving, declining, or stable in terms of average summer clarity. A two-tailed Kendall's Tau statistical test was completed using a p-value of <0.05 to determine statistical significance of the trend. Goggins Lake, Long Lake, Lynch Lake North, Lynch Lake South,

North School Section Lake, and Woodpile Lake show statistically significant long term trends for improving water clarity (Appendix A). No significant trends have been observed on Brewer's Pond, Heifort's Pond, Pat Lake or South School Section Lake. Bass Lake East, Bass Lake West, Benz Lake, Jackson WMA (Sinnits) Pond, Kismet Basin, Masterman Lake, and Plaisted Lake are too shallow to determine an accurate trend, since the lakes are often clearer than they are deep. July Avenue Wetland is the only lake exhibiting a declining trend for clarity. EOR's trend analysis shows an improving short term trend and a statistically significant long term improving trend on Long Lake.

III.C.5. Total Kjeldahl Nitrogen

Total Kjeldahl nitrogen (TKN) measures the sum of ammonia and organic nitrogen present in the water column. An abundance of this nutrient can lead to excess plant growth and increase the rate of eutrophication, especially if it is the limiting nutrient in a lake. Sources of TKN are similar to those of TP. Although eutrophication standards do not exist at this time for TKN, June through September averages can be compared to the North Central Hardwood Forest ecoregion to assess if lakes may have excessive amounts of nitrogen. The ecoregion range for TKN is 0.60-1.20 mg/L. Brewer's Pond, Heifort's Pond, July Avenue Wetland, Lynch Lake North, and South School Section Lake were poorer than the ecoregion range, while Bass Lake East, Bass Lake West, Benz Lake, Goggins Lake, Kismet Basin, Long Lake, Lynch Lake South, Masterman Lake, North School Section Lake, Pat Lake, Plaisted Lake, and Woodpile Lake were within the ecoregion range (Table 3). Jackson WMA (Sinnits) Pond was better than the ecoregion range.

III.C.6. Temperature and Dissolved Oxygen

In addition to surface water measurements, temperature and dissolved oxygen data were recorded during each sampling event. Temperature and dissolved oxygen were recorded at one-meter increments from the surface to the lake bottom. The data collected from these profiles are housed by WCD and are available upon request, or are available via the MPCA website (https://webapp.pca.state.mn.us/wqd/surface-water).

These data show the extent of summer stratification and are useful in identifying the thermocline (the layer of water in which the temperature rapidly declines), if one exists. As a lake stratifies, the water column becomes more stable and mixing is less likely to occur. If mixing occurs during the growing season, benthic nutrients become available and can result in increased algal production. As a rule of thumb, shallow lakes are constantly mixed by wind, wave action, and precipitation, while lakes deeper than 20 feet often stratify. Shallow lakes can loosely stratify if they are protected from wind, during calm weather periods, or if enough algae and aquatic plants exist near the surface to block out solar radiation near the bottom.

In 2024 Bass Lake East, Bass Lake West, Brewer's Pond, Goggins Lake, Long Lake, Lynch Lake South, Pat Lake, and Woodpile Lake stratified to some degree during the monitoring

season. These lakes may have benefited from reduced internal loading due to the lack of mixing of nutrient-rich waters near the lake bottom. Details on the depth of the thermocline for each lake that stratified can be found in Appendix A. The other ten lakes in the district did not significantly stratify in 2024, meaning nutrients from internal loading were available for algal growth during the entire growing season.

III.C.7. Elevations

Lake elevations rose throughout early and mid-monitoring season due to precipitation events which contrasted the previous years' drought conditions. Peak elevation for the year on every lake occurred in August, rising after several storm events. In 2020, twelve basins maintained elevations above their regulated Ordinary High Water (OHW) level. In contrast, only four basins were above their OHW during 2024; Heifort's Pond, North School Section Lake, Plaisted Lake, and South School Section Lake. Elevation charts for each lake monitored can be found in Appendix A or using the MN DNR's Lake Finder (http://www.dnr.state.mn.us/lakefind/index.html).

IV. STREAM AND STORMWATER MONITORING

IV.A. Locations and Parameters

In 2024, BCWD monitored four stations on Brown's Creek, two stations in the Long Lake subwatershed, one station at the Diversion Structure in the diversion drainage, and one tributary to Brown's Creek (Table 1 and Figure 1). The stations on Brown's Creek were located at Manning Avenue (Highway 15), McKusick Road, Stonebridge Trail (Stonebridge), and the intersection of Minnesota State Highways 95 & 96 (the Outlet). The two tributaries to Long Lake were monitored at 62nd Street and the Marketplace Pond. The tributary to Brown's Creek (McKusick Wetland Outlet) was monitored approximately 100 feet upstream of the McKusick Road station.

The four stations on Brown's Creek were monitored for continuous (15 minute) stage and discharge, total phosphorus (TP), dissolved phosphorus, total Kjeldahl nitrogen (TKN), total suspended solids (TSS), volatile suspended solids (VSS), copper, nickel, lead, zinc, cadmium, chromium, chloride, calcium, magnesium, nitrate, nitrite, ammonia, hardness, and *Escherichia coli* (*E.coli*). These sites were also monitored for continuous temperature, dissolved oxygen, specific conductivity, and turbidity, and continuous pH at Stonebridge and the Outlet. The Outlet was additionally sampled for sulfate, alkalinity, and ortho-phosphorus. The Tributary to Long Lake at Marketplace Pond was monitored for continuous stage and discharge, TP, dissolved phosphorus, TKN, TSS, VSS, copper, nickel, lead, zinc, cadmium, chromium, chloride, calcium, magnesium, nitrate, nitrite, ammonia, and hardness. The Tributary to Long Lake at 62nd Street was monitored for continuous stage only. The station at the Diversion Structure was monitored for continuous stage, discharge, and temperature, and TP, dissolved phosphorus, TKN, TSS,

VSS, copper, nickel, lead, zinc, cadmium, chromium, chloride, calcium, magnesium, nitrate, nitrite, ammonia, and hardness. An additional level logger was placed at the base of the diversion structure weir to determine if water overtopped it and was discharged directly to Brown's Creek. A tributary to Brown's Creek, McKusick Wetland Outlet, was monitored for continuous stage, discharge, and temperature, and TP, dissolved phosphorus, TKN, TSS, VSS, copper, nickel, lead, zinc, cadmium, chromium, chloride, calcium, magnesium, nitrate, nitrite, ammonia, and hardness. Continuous precipitation was monitored at Highway 15 and the tributary to Long Lake at Marketplace Pond.

IV.B. Methods

The Highway 15, McKusick Road, Stonebridge, Outlet, Marketplace Pond, and Diversion Structure monitoring stations utilized automated water quality samplers consisting of a stage/velocity sensor, data logger, bottle carousel containing 24 sample bottles, strainer, intake tubing, solar panel, deep cycle marine battery, and steel enclosure. Discharge was calculated using a rating curve based on permanent staff gauges at Highway 15, McKusick Road, Stonebridge, and the Outlet, while discharge at Marketplace Pond and the Diversion Structure was calculated using an area-velocity relationship. Continuous precipitation data were collected at Highway 15 and Marketplace Pond using tipping bucket rain gauges to assist in loading calculations, but are not discussed in this summary. The samplers were programmed to collect automated flow weighted storm composite samples triggered by a rise in stage. Manual grab samples were taken during storm conditions if it was determined the automated sampler had malfunctioned or had not yet been installed. Monthly manual grab samples during base flow conditions were attempted at these sites, although the Tributary to Long Lake at Marketplace Pond is often dry or stagnant during non-event periods. *E.coli* samples were collected at the time as the base grab samples when possible. Continuous temperature, dissolved oxygen, specific conductivity, and turbidity at the four stations on Brown's Creek were collected using long term deployed sondes, and secondary temperature loggers were deployed to fill data gaps created by malfunctions of the primary sonde. Sondes were also used to collect continuous pH at McKusick Road, Stonebridge and the Outlet. Stand-alone temperature loggers were used to collect temperature data at the Diversion Structure and McKusick Wetland Outlet.

It must be noted the sampling strategy at the Outlet, at the direction of Metropolitan Council Environmental Services's (MCES) Watershed Outlet Monitoring Program (WOMP), was changed to a manual grab sample on the same day every other week regardless of flow conditions, and the composite sampler was to be programmed to capture only major events. MCES installed a new data logger and refrigerated sampler in 2019, and four storm composite samples were collected in 2024. Some analytes such as metals, sulfate, ortho phosphorus, alkalinity, and hardness were changed to be analyzed quarterly. The goal of this strategy is to create a more robust dataset that is better suited for long term statistical trend analysis and impairment assessment. However, the change in sampling methods causes an apparent shift to

lower nutrient loading totals due to differences in load calculation methods, as well as the timing of samples with respect to precipitation events. A limitation of grab sampling is the sample occurs at a discrete point in time and often misses the peak load which is most likely to occur on the rising limb or at the peak flow of a storm. This can lead to artificially low loading estimates, whereas composite sampling captures multiple samples throughout the storm and can provide more accurate data for loading calculations but is less appropriate for trend analysis due to bias and variation in each storm event.

The Tributary to Long Lake at 62nd Street station was monitored using a stage sensor only, and discharge during the monitoring period was estimated based on stage and discharge data collected in previous years. The McKusick Wetland Outlet station was monitored using a stage/velocity sensor, and discharge was calculated using an area-velocity relationship. Similar to other stations, monthly manual grab samples were collected during base flow conditions, and grab samples were attempted during storm events.

All samples collected were analyzed by the MCES Lab and reviewed by WCD staff. All continuous data were quality assured, quality controlled, and analyzed by WCD staff, with the exception of the Outlet stage, discharge, and loading, which were reviewed and analyzed by MCES. More detailed standard operating procedures used by WCD and MCES for water sampling, monitoring, and data management are available upon request.

IV.C. Results and Discussion

IV.C.1. Brown's Creek

Brown's Creek is classified as a 2A water by the State of Minnesota, meaning it is designated for aquatic life and recreation, and should support a cold water fishery, aquatic life, and their habitats. The creek is listed as impaired by the MPCA due to a lack of cold water fish assemblages and low scores for indices of biological integrity (IBI) as described in the 2010 Brown's Creek Biota TMDL, and two reaches are impaired for *E.coli*. The stressors identified which contribute to these conditions are high total suspended solids (TSS), high temperature, low dissolved oxygen, high copper concentrations, and high nitrate-nitrite concentrations. The lower reaches of the creek where groundwater inputs help to cool the stream do support a trout fishery with some natural reproduction, and is annually stocked by the MN DNR. The following sections will make comparisons between the parameters monitored and state standards for 2A waters as described in the Minnesota Administrative Rules Part 7050.0222, as well as recommendations and goals set forth in the TMDL study. A summary of the standards and goals can be found in Table 4**.**

Table 4. State Standards for 2A and 2B Waters and Brown's Creek Biota TMDL Goals

Parameter	Class 2A Waters	Class 2B Waters	TMDL Goal
Total Phosphorus (TP)	0.100 mg/L	0.100 mg/L	N/A
Total Suspended Solids (TSS)	10 mg/L (Apr 1 to Sept 30)	30 mg/L (Apr 1 to Sept 30)	23 mg/L (10 NTU equivalent)
Chloride (Chronic)	>230 mg/L	>230 mg/L	N/A
Dissolved Oxygen (Daily Minimum)	7 mg/L	5 mg/L	7 mg/L
pH	<6.5 or >8.5	<6.5 or >8.5	N/A
Temperature	N/A	N/A	18.3 ºC (Threat), 23.9 ºC (Critical)

1a. Discharge

Total discharge was nearly the same as the year prior at each station on Brown's Creek. The total amount of water discharged to the St. Croix River as measured at the Outlet was 261,552,581 cubic feet, and was slightly lower than average over the last ten years. Calculated discharge for each site can be seen in Table 9. The Brown's Creek and Long Lake 2020 Trend Analysis completed by EOR shows there is a statistically significant increasing trend in overall streamflow at all stations except the Outlet, after construction of the Diversion Structure. Base flow also shows a statistically significant increasing trend at all sites except the Outlet. Increased base flow is considered beneficial for cooling the stream and maintaining dissolved oxygen concentrations.

According to the National Weather Service (NWS) station in Stillwater the total precipitation for 2024 was 39.67 inches; 5.75 inches above the thirty year average. Precipitation was well above average in May, June, and August, with a combined departure of +8.27 inches during these months. This was followed by an extremely dry late summer and fall, with a combined departure in September and October of -3.44 inches. The most significant precipitation event occurred August 5, where storm total of 2.60 inches of precipitation was recorded.

1b. Phosphorus & Sediment

The total phosphorus (TP) and total suspended solids (TSS) loads increased at all sites when compared to 2023 (Table 9, Figure 3, and
Figure **4**). The TP load discharged to the St. Croix River at the Outlet was 2,563 pounds, which equates to 0.554 pounds per acre of watershed land. For reference, the load at the Outlet was at the median value since calculations began in 2000. The state standard for TP is 0.100 mg/L; manual grab samples exceeded the standard for sites from May into September due to the wet conditions. Nutrient water chemistry results for each site and sample can be found in Table 5-Table 8. TP flow weighted mean concentrations show a significant decreasing trend over the most recent ten year period at Stonebridge and the Outlet according to EOR's trend analysis. There are no significant long term trends, although the overall pattern for TP concentrations appears to be improving in the lower

reaches of the creek. Short term trends show statistically significant improving conditions at Stonebridge and the Outlet.

The TSS load exported to the St. Croix River was 507,151 pounds, or 109.68 pounds per acre of watershed land. For reference, the TMDL goal for the creek is 74 pounds per acre. This is a departure from conditions observed during the droughts from 2021-2023, when the creek did meet the TMDL goal. It is important to note that in-stream construction activities as part of the streambank and floodplain restoration project on Neal Avenue contributed to high TSS concentrations, and the impact to the creek is temporary and the long term benefits of the project are expected to outweigh these impacts. While the state standard for TSS is 10 mg/L from April 1 to September 30, the target concentration identified in the TMDL is 23 mg/L. The target concentration specific to Brown's Creek of 23 mg/L correlates to the former state standard for turbidity of 10 NTU, but has since been replaced by the river eutrophication standards which use TSS concentration to assess impairment status. The state TSS standard was exceeded at the Outlet for May through August. The TMDL goal of 23 mg/L was met at all sites under base flow conditions, and the annual flow weighted mean concentration (annual load divided by annual discharge) at the Outlet was 31.1 mg/L. Site and sample specific results can be found in Table 5-Table 8. No statistically significant long term trends in TSS exist at any station according to EOR's trend analysis. However, the most recent ten year period does show significant trends for decreasing flow weighted mean concentrations for TSS at McKusick Road, Stonebridge, and the Outlet.

A summary of site specific total loads and loading per acre of watershed area can be found in Table 9 and detailed loading tables describing hourly intervals for the year can be found in Appendix B. Discrete measurements of dissolved oxygen, temperature, pH, specific conductivity, and transparency can also be found in Appendix B. TP concentrations and loads moving on flow paths through the watershed can be seen in Appendix C.

Table 5. Brown's Creek at Highway 15 2024 Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	*E. coli* (mpn/100 mL)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L _CaCO3)
Storm Composite	4/16/2024 22:53	4/17/2024 13:11	39	23	1.37	0.236	0.071								12.1	<0.06	0.24	<0.06	
Storm Composite	4/29/2024 4:55	4/30/2024 2:06	12	7	0.76	0.068	<0.050		<0.00100	<0.00050	<0.00050	<0.00500	<0.00010	<0.00250	14.8	<0.06	<0.20	<0.06	137
Storm Composite	5/21/2024 19:32	5/22/2024 19:17	83	49	2.87	0.279	0.062		0.00180	0.00140	0.00150	0.00910	<0.00010	<0.00250	10.0	<0.06	<0.20	<0.06	130
Storm Composite	6/4/2024 20:15	6/5/2024 13:06	113	68	3.34	0.339	0.085		0.00290	0.00160	0.00170	0.01140	<0.00010	0.00280	7.9	<0.06	<0.20	<0.06	131
Storm Composite	6/18/2024 21:43	6/20/2024 6:02	78	46	2.30	0.279	0.078								7.9	<0.06	<0.20	<0.06	
Storm Composite	6/28/2024 11:43	6/28/2024 20:09	66	40	1.01	0.310	0.088		0.00140	0.00140	0.00110	0.00640	0.00010	<0.00250	10.7			<0.06	165
Storm Composite	7/22/2024 18:01	7/23/2024 9:03	137	80	2.87	0.449	0.085		0.00200	0.00140	0.00210	0.01150	<0.00010	0.00270	11.0	<0.06	0.34	<0.06	157
Storm Grab	8/6/2024 13:14	8/6/2024 13:14	29	18	1.40	0.196	0.086		<0.00100	0.00090	0.00053	<0.00500	<0.00010	<0.00250	9.3	<0.06	<0.20	<0.06	129
Base Grab	5/20/2024 14:10	5/20/2024 14:10	10	7	0.74	0.109	0.047	427							14.7	<0.06	0.24	<0.06	
Base Grab	6/26/2024 14:01	6/26/2024 14:01	8	6	1.77	0.218	0.148	138							15.9	<0.06	<0.20	<0.06	
Base Grab	7/25/2024 13:20	7/25/2024 13:20	5	3	0.62	0.120	0.074	278							11.6	<0.06	0.25	<0.06	
Base Grab	8/29/2024 8:25	8/29/2024 8:25						365											
Base Grab	9/3/2024 9:37	9/3/2024 9:37	4	3	0.58	0.080	0.074								15.2	<0.06	0.25	<0.06	
Base Grab	9/24/2024 9:07	9/24/2024 9:07	5	3	0.44	0.067	0.029	172							15.1	<0.06	0.36	<0.06	
Base Grab	10/21/2024 14:14	10/21/2024 14:14	5	3	0.42	0.057	0.027	84							15.2	<0.06	0.30	<0.06	

Exceeds Water Quality Standard
No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Table 6. Brown's Creek at McKusick Road 2024 Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	*E. coli* (mpn/100 mL)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L _CaCO3)
Storm Composite	4/29/2024 4:09	4/29/2024 19:20	26	11	0.93	0.107	<0.050		0.00110	0.00086	<0.00050	<0.00500	<0.00010	<0.00250	21.2	<0.06	<0.20	<0.06	150
Storm Composite	5/21/2024 17:25	5/22/2024 17:06	188	56	2.64	0.427	0.085		0.00310	0.00270	0.00220	0.01190	0.00012	0.00390	15.3	<0.06	<0.20	<0.06	126
Storm Composite	6/4/2024 19:25	6/4/2024 23:25	456	141	4.43	0.726	0.091		0.00690	0.00500	0.00540	0.03510	0.00015	0.00700	15.5	<0.06	0.22	<0.06	138
Storm Composite	6/18/2024 21:52	6/19/2024 22:37	69	27	1.83	0.299	0.120								18.2	<0.06	<0.20	<0.06	
Storm Composite	7/22/2024 18:20	7/23/2024 1:17	387	141	5.50	0.762	0.076		0.00900	0.00710	0.00620	0.03090	0.00020	0.01070	19.0	<0.06	0.40	<0.06	167
Storm Composite	8/5/2024 12:10	8/6/2024 0:23	1,670	183	5.51	0.742	0.094		0.00880	0.00750	0.00580	0.03060	0.00023	0.01130	17.9	<0.06	0.26	<0.06	156
Base Grab	5/20/2024 14:39	5/20/2024 14:39	8	4	0.58	0.087	0.042	345							24.2	<0.06	0.31	<0.06	
Base Grab	6/26/2024 14:33	6/26/2024 14:33	15	8	1.13	0.222	0.154	291							22.5	<0.06	0.25	<0.06	
Base Grab	7/25/2024 13:33	7/25/2024 13:33	9	5	0.68	0.124	0.080	613							19.5	<0.06	0.32	<0.06	
Base Grab	8/29/2024 8:45	8/29/2024 8:45						1,046											
Base Grab	9/3/2024 10:11	9/3/2024 10:11	7	3	0.60	0.135	0.070								25.3	<0.06	0.27	<0.06	
Base Grab	9/24/2024 9:28	9/24/2024 9:28	5	<3	0.41	0.088	0.051	308							23.7	<0.06	0.41	<0.06	
Base Grab	10/21/2024 14:45	10/21/2024 14:45	<3	<3	0.23	0.063	0.045	83							23.9	<0.06	0.38	<0.06	

Exceeds Water Quality Standard
No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Table 7. Brown's Creek at Stonebridge 2024 Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	*E. coli* (mpn/100 mL)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L _CaCO3)
Storm Composite	4/16/2024 18:26	4/17/2024 13:01	125	43	2.27	0.428	0.056								21.0	<0.06	0.31	<0.06	
Storm Composite	4/29/2024 7:18	4/30/2024 5:08	108	34	1.79	0.307	<0.050		0.00290	0.00180	0.00130	0.01270	0.00015	<0.00250	21.8	<0.06	0.28	<0.06	154
Storm Composite	5/21/2024 17:56	5/22/2024 5:29	315	98	3.44	0.582	0.075		0.00560	0.00390	0.00350	0.02420	0.00019	0.00610	14.9	<0.06	<0.20	<0.06	132
Storm Composite	6/4/2024 19:36	6/4/2024 22:04	299	111	5.07	0.732	0.078		0.00690	0.00450	0.00470	0.02630	0.00013	0.00640	11.8	<0.06	0.20	<0.06	124
Storm Composite	6/18/2024 22:04	6/19/2024 4:11	125	45	2.24	0.347	0.100								16.6	<0.06	<0.20	<0.06	
Storm Grab	6/26/2024 14:20	6/26/2024 14:20	107	25	4.31	0.302	0.156	276							22.5	<0.06	0.25	<0.06	
Storm Composite	7/22/2024 19:26	7/22/2024 21:21	424	144	5.96	0.785	0.088		0.00970	0.00730	0.00610	0.03160	0.00170	0.01080	13.4	<0.06	0.45	<0.06	133
Storm Composite	8/5/2024 18:20	8/5/2024 21:38	663	233	8.05	0.854	0.096		0.01190	0.00880	0.00720	0.03650	0.00024	0.01490	15.0	<0.06	0.25	<0.06	140
Base Grab	5/20/2024 15:03	5/20/2024 15:03	7	3	0.59	0.079	0.045	210							25.5	<0.06	0.32	<0.06	
Base Grab	7/25/2024 13:00	7/25/2024 13:00	9	5	0.73	0.128	0.074	461							19.5	<0.06	0.34	<0.06	
Base Grab	8/29/2024 8:55	8/29/2024 8:55						980											
Base Grab	9/3/2024 9:22	9/3/2024 9:22	9	4	0.66	0.128	0.068								26.2	<0.06	0.26	<0.06	
Base Grab	9/24/2024 9:37	9/24/2024 9:37	3	<3	0.39	0.090	0.056	194							23.6	<0.06	0.40	<0.06	
Base Grab	10/21/2024 13:36	10/21/2024 13:36	3	<3	0.22	0.067	0.046	154							27.3	<0.06	0.36	<0.06	

Exceeds Water Quality Standard
No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Table 8. Brown's Creek Outlet 2024 Primary Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	Sulfate (mg/L)	Ortho P (mg/L as P)	Alkalinity (mg/L_CaCO3)	*E. coli* (mpn/100 mL)
Scheduled Grab	1/4/2024 10:33	1/4/2024 10:33	3	<3	0.24	0.055	<0.050		0.021		84
Scheduled Grab	1/17/2024 11:01	1/17/2024 11:01	6	<3	0.22	<0.050	<0.050		0.018		56
Scheduled Grab	1/31/2024 11:10	1/31/2024 11:10	4	<3	0.23	<0.050	<0.050		0.022		22
Scheduled Grab	2/14/2024 10:46	2/14/2024 10:46	3	<3	0.20	<0.050	<0.050		0.019		26
Scheduled Grab	2/27/2024 9:57	2/27/2024 9:57	3	<3	0.18	<0.050	<0.050		0.017		24
Scheduled Grab	3/13/2024 9:40	3/13/2024 9:40	4	<3	0.24	<0.050	<0.050	8.29	0.016	191	18
Scheduled Grab	3/27/2024 9:51	3/27/2024 9:51	7	<3	0.64	0.062	0.052		0.036		43
Scheduled Grab	4/10/2024 9:37	4/10/2024 9:37	10	3	0.71	0.086	0.053		0.031		19
Scheduled Grab	4/25/2024 9:05	4/25/2024 9:05	<3	<3	0.40	<0.050	<0.050		0.020		13
Scheduled Grab	5/8/2024 8:40	5/8/2024 8:40	6	3	0.68	0.062	0.033		0.019		68
Storm Composite	5/21/2024 17:49	5/22/2024 3:15	228	73	3.58	0.489	0.066				
Scheduled Grab	5/22/2024 12:47	5/22/2024 12:47	93	34	1.63	0.290	0.098		0.072		1,553
Storm Composite	6/4/2024 20:26	6/5/2024 5:01	195	73	3.87	0.620	0.106				
Scheduled Grab	6/5/2024 9:24	6/5/2024 9:24	75	33	2.08	0.319	0.128	1.71	0.100	98	1,986
Storm Composite	6/18/2024 22:40	6/18/2024 23:27	316	107	4.84	0.731	0.097				
Scheduled Grab	6/20/2024 8:29	6/20/2024 8:29	39	16	0.88	0.230	0.127		0.102		231
Scheduled Grab	7/18/2024 8:40	7/18/2024 8:40	14	6	0.47	0.121	0.068		0.057		225
Scheduled Grab	7/31/2024 8:30	7/31/2024 8:30	9	5	0.49	0.112	0.066		0.055		435
Storm Composite	8/5/2024 12:58	8/5/2024 23:14	287	109	5.80	0.585	0.083		0.065		
Scheduled Grab	8/12/2024 8:35	8/12/2024 8:35	<3	<3	0.55	0.092	0.065		0.054		81
Scheduled Grab	8/28/2024 8:51	8/28/2024 8:51	41	14	1.20	0.195	0.089		0.050		1,414
Scheduled Grab	9/10/2024 9:01	9/10/2024 9:01	5	<3	0.32	0.081	0.046	6.74	0.039	208	261
Scheduled Grab	9/25/2024 8:27	9/25/2024 8:27	5	3	0.35	0.076	0.045		0.039		84
Scheduled Grab	10/8/2024 14:51	10/8/2024 14:51	<3	<3	0.26	0.060	0.039		0.033		61
Scheduled Grab	10/22/2024 9:02	10/22/2024 9:02	<3	<3	0.24	0.062	0.042		0.034		41
Scheduled Grab	11/6/2024 13:54	11/6/2024 13:54	4	<3	0.42	0.066	0.037		0.031		56
Scheduled Grab	11/21/2024 10:00	11/21/2024 10:00	9	4	0.59	0.074	0.038		0.031		133
Scheduled Grab	12/4/2024 10:30	12/4/2024 10:30	6	5	0.33	0.057	0.025	8.98	0.027	190	47
Scheduled Grab	12/18/2024 10:00	12/18/2024 10:00	6	<3	0.30	0.052	0.032		0.020		28
Scheduled Grab	12/31/2024 10:00	12/31/2024 10:00	5	<3	0.50	0.070	0.039		0.032		272

Exceeds Water Quality Standard

Table 9. Brown's Creek Historic Loading- Latest Ten Years

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Brown's Creek at Highway 15										
Discharge (cf)	97,159,132	152,081,358	135,660,983	129,764,024	201,962,562	148,727,410	117,049,943	98,760,517	94,107,164	100,591,203
Total pounds of Phosphorus exported	1,450	1,736	831	1,182	1,406	1,072	690	567	659	838
TP (lbs/ac/yr)	0.410	0.492	0.235	0.335	0.398	0.303	0.195	0.161	0.187	0.237
Total pounds of TSS exported	211,364	239,237	105,900	132,765	136,203	128,722	46,409	59,093	52,665	91,374
TSS (lbs/ac/yr)	59.84	67.73	29.98	37.59	38.56	36.44	13.14	16.73	14.94	25.87
Brown's Creek at McKusick Road										
Discharge (cf)	152,913,065	229,482,654	192,485,489	179,429,476	340,391,004	234,134,803	196,267,817	163,409,449	163,853,967	158,481,122
Total pounds of Phosphorus exported	2,248	3,059	1,766	1,602	4,062	2,204	1,386	1,282	1,432	1,803
TP (lbs/ac/yr)	0.562	0.765	0.442	0.401	1.016	0.551	0.347	0.321	0.358	0.451
Total pounds of TSS exported	728,640	1,646,798	638,650	404,296	978,014	471,464	234,226	172,292	189,377	508,266
TSS (lbs/ac/yr)	182.21	411.80	159.70	101.10	244.56	117.90	58.57	43.08	47.36	127.10
Brown's Creek at Stonebridge										
Discharge (cf)	Not Calculated	224,138,246	232,701,338	225,604,711	368,848,809	235,850,584	192,272,282	168,072,167	164,126,900	173,826,291
Total pounds of Phosphorus exported	Not Calculated	2,778	2,229	1,946	3,948	2,186	1,556	1,363	1,372	1,781
TP (lbs/ac/yr)	Not Calculated	0.663	0.532	0.465	0.942	0.522	0.371	0.325	0.327	0.425
Total pounds of TSS exported	Not Calculated	1,187,547	718,290	515,386	825,635	437,876	256,270	241,966	173,619	488,806
TSS (lbs/ac/yr)	Not Calculated	283.49	171.47	123.03	197.10	104.53	61.18	57.76	41.45	116.69
Brown's Creek Outlet										
Discharge (cf)	241,784,443	284,583,206	278,020,037	267,105,859	447,411,048	386,269,467	249,448,143	220,440,000	219,500,000	261,552,581
Total pounds of Phosphorus exported	3,156	3,514	2,275*	2,315*	4,833*	4,289*	1,566*	1,219*	1,494*	2,563*
TP (lbs/ac/yr)	0.683	0.760	0.492	0.501	1.045	0.928	0.339	0.264	0.323	0.554
Total pounds of TSS exported	1,119,632	1,114,674	498,032*	400,729*	1,286,424*	1,137,017*	317,962*	172,589*	251,417*	507,151*
TSS (lbs/ac/yr)	242.13	241.06	107.71	86.66	278.21	245.89	68.76	37.32	54.37	109.68
	*Sampling regime and load estimation method changed									

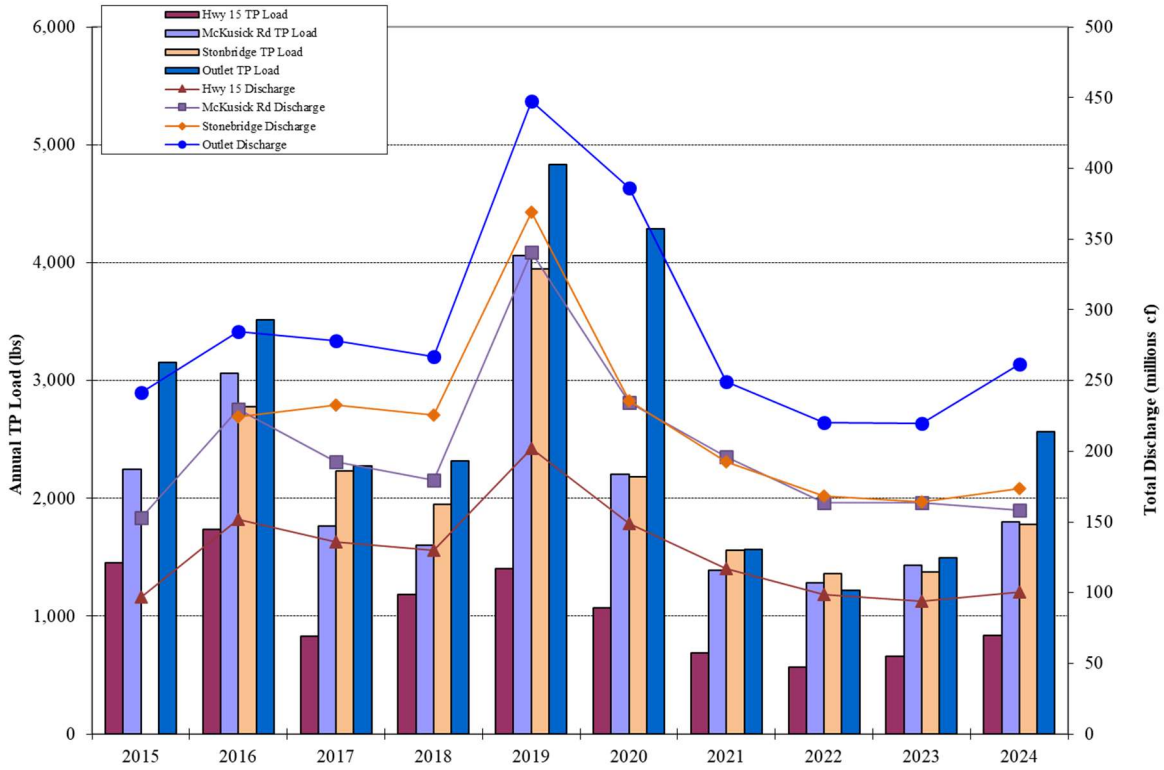

Figure 3. Brown's Creek Phosphorus Loading- Latest Ten Years

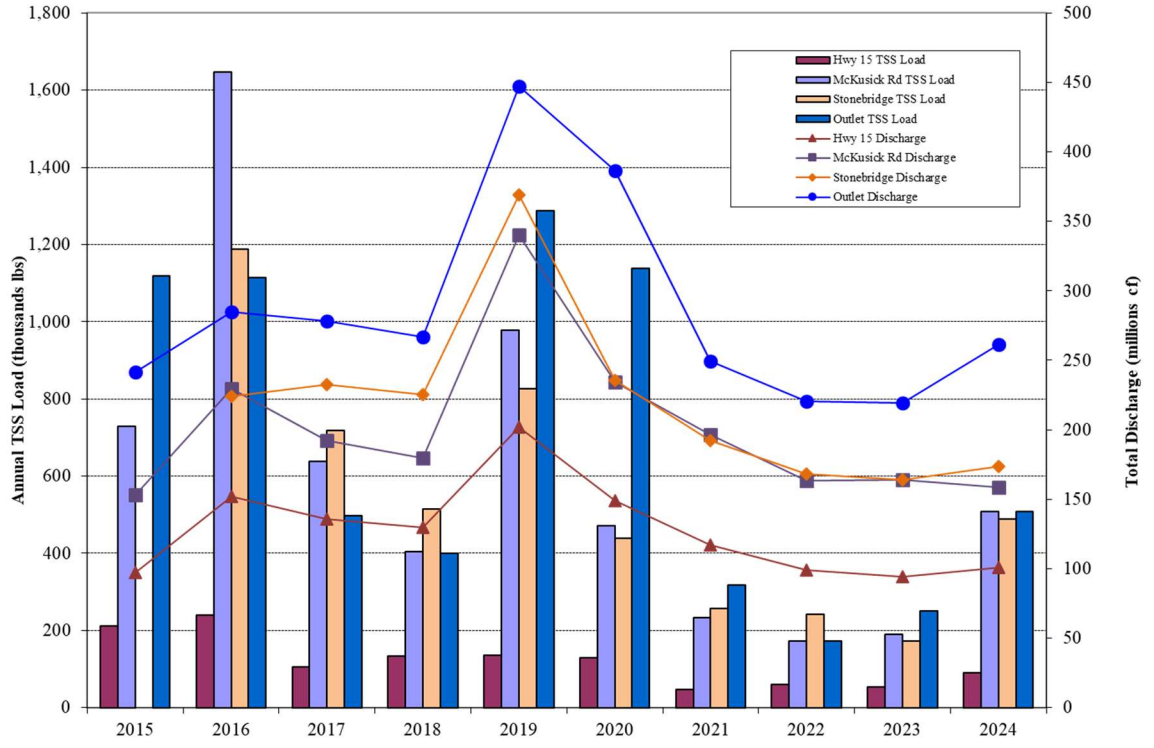

Figure 4. Brown's Creek Sediment Loading- Latest Ten Years

1c. Metals

One of the stressors identified in the TMDL study is high concentrations of copper, which are harmful to aquatic life. Additionally, other metals such as lead and zinc can be toxic to aquatic organisms. Standards for such metals are variable based on the hardness of the water which affects the level of toxicity a given concentration has. Under soft water conditions (low hardness) metals are more readily taken up by aquatic organisms, increasing the toxicity of the concentrations of metals in the water. Calculation of metals standards are described in the Minnesota Administrative Rules Part 7050.0222 and are divided into three categories of toxicity; chronic, maximum, and final acute value (FAV). The chronic standard protects organisms from long term exposure to a pollutant with minimal effects, the maximum standard from short term exposure with no or little mortality, and the FAV is the concentration at which mortality can be expected.

Heavy metals exceedances for each site and sample can be found in Table 5-Table 7, and Table 10. A small number of chronic level exceedances of lead and cadmium were detected at McKusick Road and Stonebridge, and no exceedances were detected at Highway 15 and the Outlet. The number and severity of metals exceedances in 2024 was again low compared to past years.

Chloride concentrations have not exceeded the state standard for chronic exposure of 230 mg/L, but the trend analysis completed by EOR shows there are statistically significant increasing loads for chloride at all monitoring stations. For reference, the highest chloride concentration recorded on the creek occurred at the Outlet on January 17 at 31.4 mg/L. Unlike many other pollutants, chloride has no natural attenuation once it is in water, and there are no known cost-effective ways to treat water contaminated with chloride. The District should continue to investigate ways to promote reductions in salt use and smart salt management, especially for water softener and road de-icing applications.

Table 10. Brown's Creek Outlet 2024 Secondary Chemistry Results

Sample Type	Start	End	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L_CaCO3)
Scheduled Grab	1/4/2024 10:33	1/4/2024 10:33							30.6	<0.06	1.42	<0.06	
Scheduled Grab	1/17/2024 11:01	1/17/2024 11:01							31.4	<0.06	1.27	<0.06	
Scheduled Grab	1/31/2024 11:10	1/31/2024 11:10							29.5	<0.06	1.16	<0.06	
Scheduled Grab	2/14/2024 10:46	2/14/2024 10:46							28.3	<0.06	1.10	<0.06	
Scheduled Grab	2/27/2024 9:57	2/27/2024 9:57							28.8	<0.06	1.09	<0.06	
Scheduled Grab	3/13/2024 9:40	3/13/2024 9:40	<0.00100	<0.00050	<0.00050	<0.00500	<0.00010	<0.00300	29.6	<0.06	0.91	<0.06	246
Scheduled Grab	3/27/2024 9:51	3/27/2024 9:51							29.4	<0.06	0.82	0.08	
Scheduled Grab	4/10/2024 9:37	4/10/2024 9:37							24.9	<0.06	0.52	<0.06	
Scheduled Grab	4/25/2024 9:05	4/25/2024 9:05							27.7	<0.06	0.66	<0.06	
Scheduled Grab	5/8/2024 8:40	5/8/2024 8:40							25.7	<0.06	0.25	<0.06	
Storm Composite	5/21/2024 17:49	5/22/2024 3:15	0.00580	0.00400	0.00330	0.03350	0.00017	0.00600		<0.06	<0.20	0.45	139
Scheduled Grab	5/22/2024 12:47	5/22/2024 12:47							16.2	<0.06	<0.20	<0.06	
Storm Composite	6/4/2024 20:26	6/5/2024 5:01	0.00640	0.00400	0.00360	0.03480	0.00042	0.00600		<0.06	0.26	0.73	141
Scheduled Grab	6/5/2024 9:24	6/5/2024 9:24	0.00230	0.00170	0.00140	0.00850	<0.00010	<0.00300	15.0	<0.06	<0.20	<0.06	126
Storm Composite	6/18/2024 22:40	6/18/2024 23:27	0.00880	0.00570	0.00530	0.06710	0.00018	0.00900		<0.06	0.25	1.18	159
Scheduled Grab	6/20/2024 8:29	6/20/2024 8:29							25.2	<0.06	<0.20	<0.06	
Scheduled Grab	7/18/2024 8:40	7/18/2024 8:40							27.2	<0.06	0.73	<0.06	
Scheduled Grab	7/31/2024 8:30	7/31/2024 8:30							28.2	<0.06	0.72	<0.06	
Storm Composite	8/5/2024 12:58	8/5/2024 23:14	0.00830	0.00600	0.00480	0.03810	0.00015	0.01000	19.0	<0.06	0.37	0.21	172
Scheduled Grab	8/12/2024 8:35	8/12/2024 8:35							25.9	<0.06	0.65	<0.06	
Scheduled Grab	8/28/2024 8:51	8/28/2024 8:51							20.8	<0.06	0.31	<0.06	
Scheduled Grab	9/10/2024 9:01	9/10/2024 9:01	<0.00100	<0.00050	<0.00050	<0.00500	<0.00010	<0.00300	28.9	<0.06	0.76	<0.06	257
Scheduled Grab	9/25/2024 8:27	9/25/2024 8:27							28.0	<0.06	0.76	<0.06	
Scheduled Grab	10/8/2024 14:51	10/8/2024 14:51							29.6	<0.06	0.79	<0.06	
Scheduled Grab	10/22/2024 9:02	10/22/2024 9:02							29.0	<0.06	0.64	<0.06	
Scheduled Grab	11/6/2024 13:54	11/6/2024 13:54							29.9	<0.06	0.46	<0.06	
Scheduled Grab	11/21/2024 10:00	11/21/2024 10:00							27.6	<0.06	0.47	<0.06	
Scheduled Grab	12/4/2024 10:30	12/4/2024 10:30	<0.00100	<0.00050	<0.00050	<0.00500	<0.00010	<0.00300	31.4	<0.06	1.10	<0.06	248
Scheduled Grab	12/18/2024 10:00	12/18/2024 10:00							30.1	<0.06	1.17	<0.06	
Scheduled Grab	12/31/2024 10:00	12/31/2024 10:00							30.3	<0.06	0.90	0.10	

No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

1d. Bacteria (*E.coli*)

The sites on Brown's Creek are not meeting the state standard for *E.coli* for nearly all months regulated by the standard, and two reaches of the creek have been listed as impaired for bacteria. A summary table by month and site can be found in Table 11. The standard is defined as follows, and is based on the latest ten years of data as per MPCA protocol:

"*Not to exceed 126 organisms per 100 milliliters as a geometric mean of not less than five samples representative of conditions within any calendar month, nor shall more than ten percent of all samples taken during any calendar month individually exceed 1,260 organisms per 100 milliliters. The standard applies only between April 1 and October 31.*"

Table 11. Monthly Geometric Means of *E.coli*- Latest Ten Years

Site	April	May	June	July	August	September	October
Highway 15	Insufficient Data	102	279	223	379	236	91
McKusick Road	Insufficient Data	137	402	695	430	232	84
Stonebridge	Insufficient Data	120	286	498	380	192	96
Brown's Creek Outlet	19	108	389	340	183	224	80
Diversion	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data
Trib at 62nd St	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data	Insufficient Data

Exceeds geometric mean of 126 #/100mL from not less than 5 samples in a calendar month

10% of samples taken in the last 10 years exceed 1,260 #/100mL (Doesn't necessarily exceed geometric mean standard)

Previous studies have excluded human borne *E.coli* as a significant source of bacteria, indicating failing septic systems and illegal straight pipes are not contributing to the high levels of bacteria. Likely sources of bacteria include large congregations of geese around the McKusick Road area, beavers and muskrat in the upper reaches of the creek, and nearby livestock operations. Further studies will focus on species of wildlife and livestock to determine sources of bacteria. The trend analysis completed by EOR has shown statistically significant long term trends for decreasing *E.coli* concentrations at McKusick Road and Stonebridge, and an increasing trend at the Outlet over the most recent ten year period.

1e. Temperature & Dissolved Oxygen

The 2010 Brown's Creek Biota TMDL indicates a threat level temperature of 18.3 ºC and a critical level temperature of 23.9 ºC for trout survivability. The threat level impact as defined as physiological stress, reduced growth, and egg mortality. The critical level impact is defined as the point at which direct mortality can be expected. For the purposes of this summary, daily average temperatures are used to determine if impact levels have been reached.

Consistent with previous years, multi-parameter sondes were deployed at all four stations on the creek. Due to battery and logger malfunctions in years prior, secondary temperature

loggers were deployed to minimize gaps in the temperature data created by the primary loggers. However, these gaps will still exist in the dissolved oxygen period of record, as no secondary dissolved oxygen sensors were available.

The number of daily average threat level temperature exceedances in the creek in 2024, when excluding years with significant data gaps, were slightly better than average when compared to the last ten years (Table 12). The number of threat level exceedances recorded at the Outlet were slightly better than the median value when compared to the period of record extending back to 2006. No daily average temperature at any site exceeded the critical level temperature. According to the NWS station in Stillwater air temperatures were in excess of 90 ^{o}F only one day of the season.

A Riparian Shading Study was completed in 2018 and describes the relationship of thermal loading via solar radiation and shade producing objects along the stream corridor. The study identified the least shaded (less than 60% shaded) reaches of the creek as immediately downstream of Highway 15, immediately west of Millbrook Park, a reach between Millbrook Park and McKusick Road, and the reach flowing through Oak Glen Golf Course north of McKusick Road. This study and the increase in the number of threat level temperature exceedances moving downstream from McKusick Road to Stonebridge indicate the buffer strip installations within the golf course have not reached full maturity. They are expected to provide up to 80% shade coverage when the final growth is achieved. The full Riparian Shading Study report is available on the District's website. Warmer creek temperatures in 2024 are also likely influenced by the removal of buckthorn and other undesirable vegetation along the reach around Neal Avenue, where vegetation was stripped for the streambank and floodplain restoration project. Temporary impacts will likely show higher temperatures in the McKusick and Stonebridge reaches until the revegetation with native grasses, shrubs, and trees reaches maturity several years from now.

In 2022 and 2023 some of the coolest temperatures ever recorded in the creek were observed in spite of warm, dry summers. This was especially encouraging given the conditions, and may indicate other thermal load reduction practices including riparian shade restorations, the Brown's Creek Park Rock Crib, and surface water diversions such as the Diversion Drainage and the Oak Glen Golf Course Irrigation Reuse projects are positively impacting the creek.

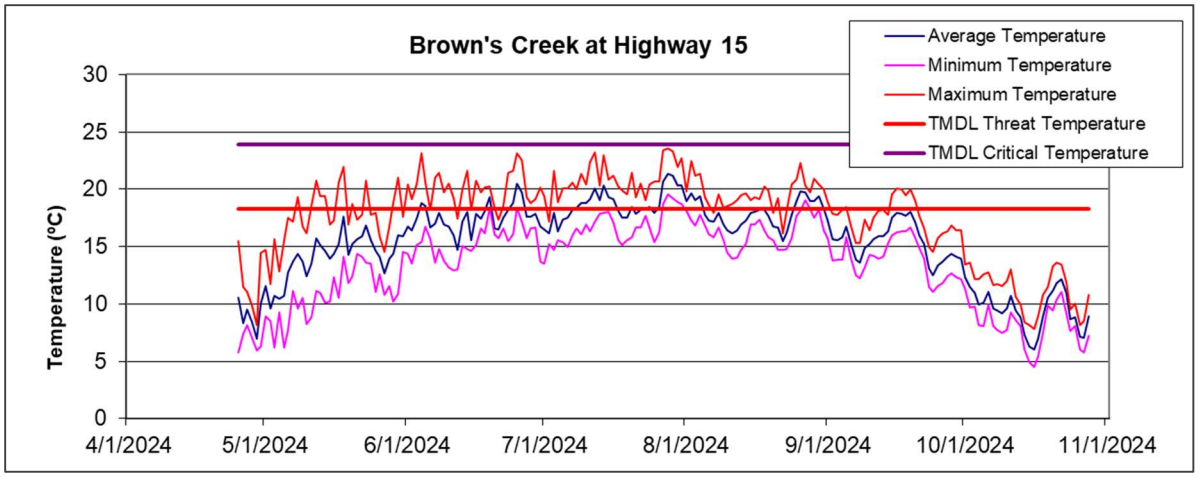

Figure 5. Brown's Creek at Highway 15 2024 Daily Temperature Summary

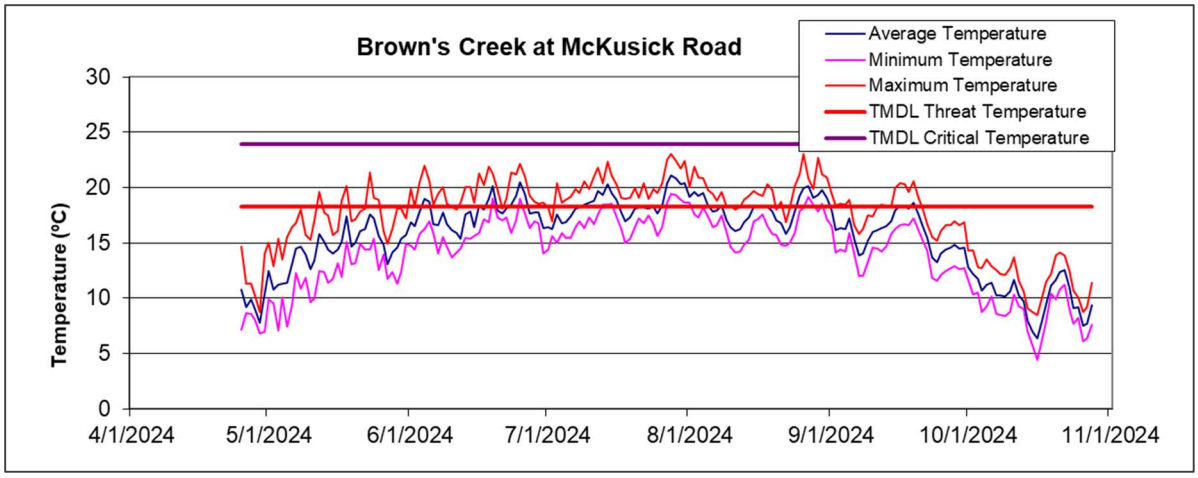

Figure 6. Brown's Creek at McKusick Road 2024 Daily Temperature Summary

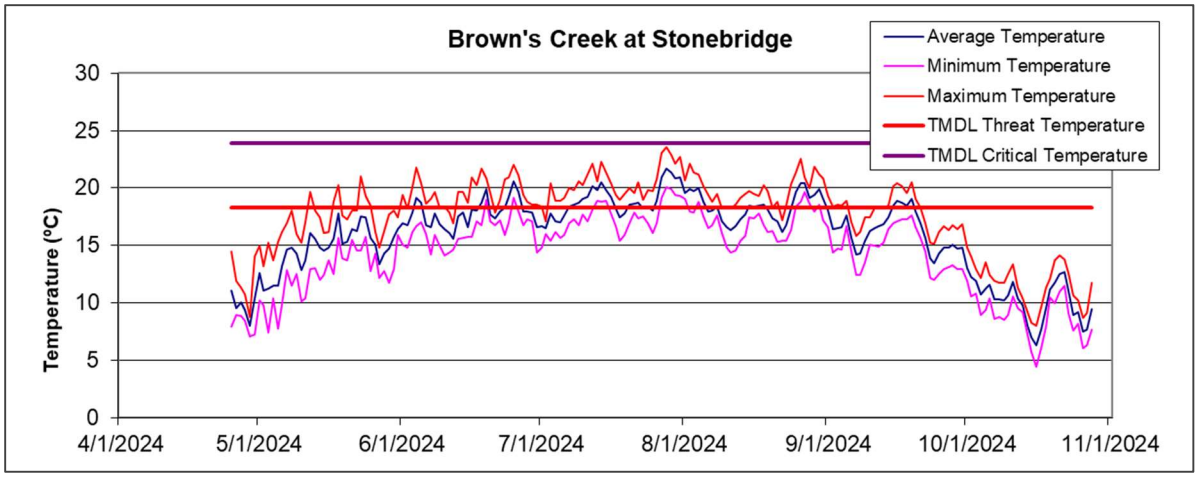

Figure 7. Brown's Creek at Stonebridge 2024 Daily Temperature Summary

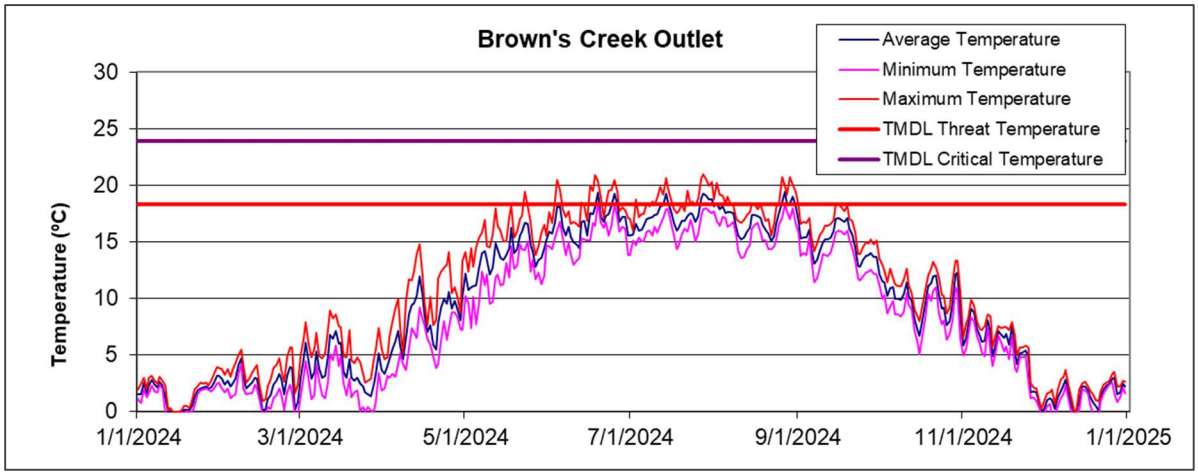

Figure 8. Brown's Creek Outlet 2024 Daily Temperature Summary

Table 12. Annual Occurrences of Brown's Creek Daily Average Temperature Greater than Threat and Critical Level Thresholds

	Exceedances at Highway 15		Exceedances at McKusick		Exceedances at Stonebridge		Exceedances at Outlet	
Year	18.3ºC	23.9ºC	18.3ºC	23.9ºC	18.3ºC	23.9ºC	18.3ºC	23.9ºC
2015	28*	0*	65	0	26*	0*	22	0
2016	14*	0*	17*	0*	71	0	35	0
2017	54	0	43	0	48	0	8	0
2018	61	0	54	0	66	0	19	0
2019	31	0	36	0	42	0	20	0
2020	38	0	42	0	48	0	23	0
2021	47	0	39	0	54	0	11	0
2022	28	0	31	0	37	0	6	0
2023	34	0	35	0	49	0	4	0
2024	33	0	40	0	49	0	15	0

* Based on severely limited period of record

The state standard for dissolved oxygen in 2A waters is 7 mg/L as a daily minimum. Logger malfunctions somewhat limited the period of record at Highway 15 and McKusick Road. Oxygen concentrations at Highway 15 were below the state standard 82.9% of the days monitored, and are unsuitable for trout survival (Table 13, Figure 9). The data collected show daily swings high above 7 mg/L at Highway 15 due to intense macrophyte growth, but drops well below the threshold at night.

Dissolved oxygen levels at McKusick Road tended to be poorer than previous years, with 29 days being worse than the state standard. Again, this is likely influenced by the in-stream restoration work around Neal Avenue.

Stonebridge continues to exhibit better conditions for trout survival, with only one day monitored below the dissolved oxygen standard. However, temperatures at Stonebridge were above the threat level temperature threshold nine days more than McKusick Road, indicating a slightly higher level of temperature stress as the creek flows through the golf course (Table 12 and Figure 7). Increased shading in the Oak Glen Golf Course buffer area and restoration project around Neal Avenue are expected to cool the water between the McKusick Road and Stonebridge sites, as well as increase oxygen levels.

Table 13. Daily Minimum Dissolved Oxygen Exceedances

Site	Days Monitored	Dissolved Oxygen Daily Minimum Below 7 mg/L	Percent of Days Exceeded	Record Completeness
Highway 15	123	102	82.9%	72.8%
McKusick Road	142	29	20.4%	84.0%
Stonebridge	168	1	0.6%	99.4%
Outlet	169	0	0.0%	100.0%

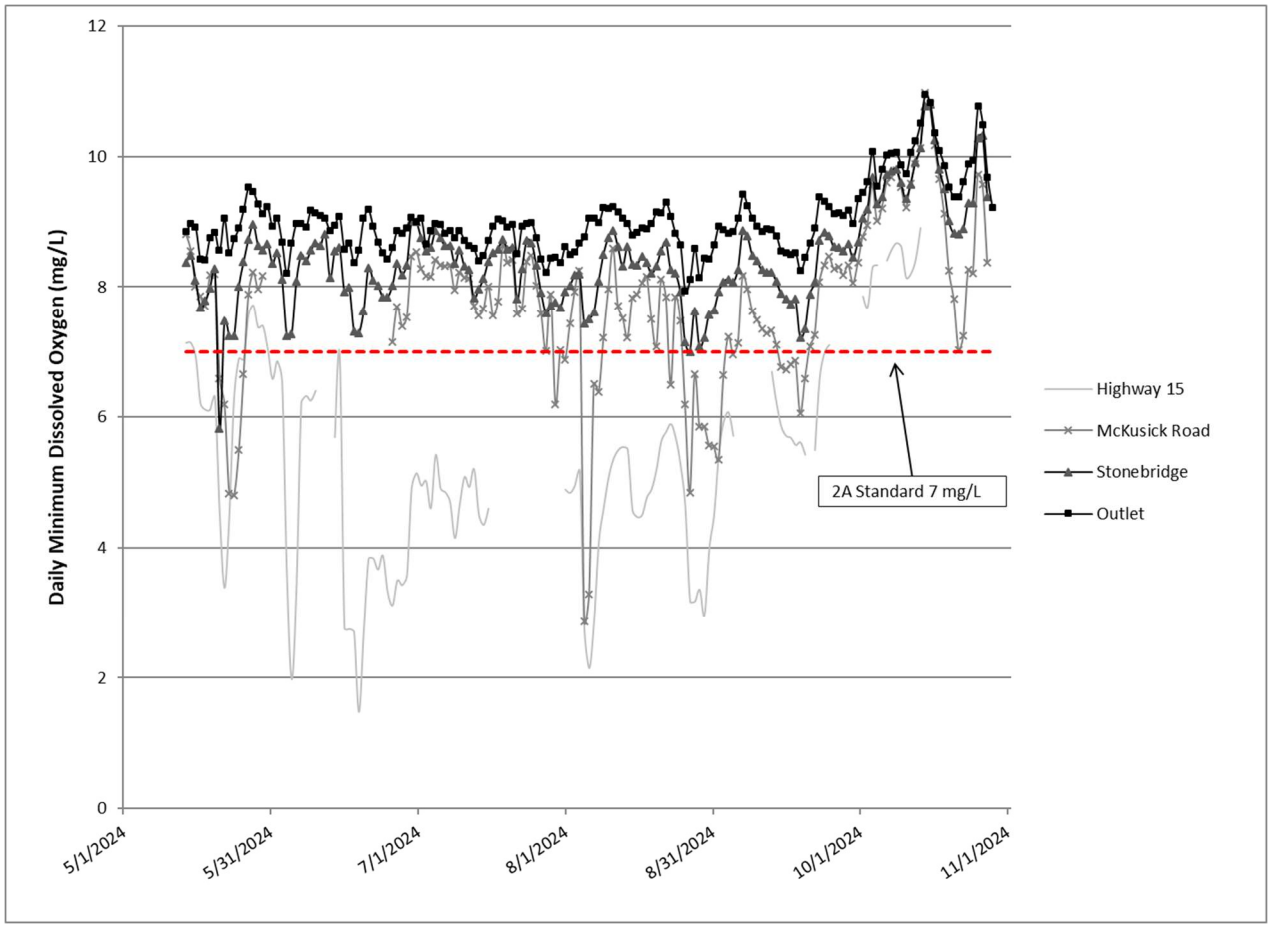

Figure 9. Daily Minimum Dissolved Oxygen in Brown's Creek

The Outlet continues to be the best location on Brown's Creek for trout survival. The average daily temperature exceeded the threat level threshold only fifteen days during the season (Table 12). This is due to cold groundwater inputs in the gorge upstream of the Outlet and a robust tree canopy to shade the stream. Daily minimum oxygen concentrations were suitable for trout for the entire season (Figure 9 and Appendix B).

The trend analysis completed by EOR shows there is a statistically significant long term cooling trend at the Outlet, and a long term cooling pattern at Stonebridge that is not statistically significant. The study also shows a long term statistically significant warming trend at McKusick Road. Dissolved oxygen concentrations show no statistically significant trends at any site, except the Outlet since construction of the Diversion Structure.

1f. Turbidity & Specific Conductivity

Turbidity and specific conductivity can be helpful for determining the amount of particles and dissolved materials in a stream. Turbidity measures the amount of light scattered by particles such as suspended sediment, phytoplankton, and bacteria while specific conductivity measures electrical conductance of the water and is influenced by the amount

of dissolved ions in the water. Excess turbidity can be detrimental to trout, since they are primarily sight feeders. It also typically indicates a high sediment load which can clog gills and cover spawning areas.

Continuous turbidity and specific conductivity were monitored at all four stations on Brown's Creek. Turbidity sensors on the multi-parameter sondes have the tendency to be covered by bedload sediment during storm events and can be fouled by algae growth on the sensor itself, and as such gaps in the record exist at some sites. To account for fouling continuous turbidity data were converted to a daily average where at least three quarters of a day was successfully logged for comparison to a 10 NTU threshold which correlates to the TMDL goal of 23 mg/L of TSS. Specific conductivity data are not discussed in this report as they do not directly apply to state standards or TMDL goals, but are available upon request. Turbidity data is also used to evaluate sediment and nutrient loading in the creek. A summary of days successfully monitored for turbidity at each site can be found in Table 14 and average daily turbidity can be viewed in Figure 10.

Table 14. Brown's Creek Turbidity Standard Exceedances

Site	Days Monitored	Days Over 10 NTU	Percent of Days Exceeded	Record Completeness
Highway 15	140	18	12.9%	82.8%
McKusick Road	142	42	29.6%	84.0%
Stonebridge	168	58	34.5%	99.4%
Outlet	169	38	22.5%	100.0%

It is worth noting the creek tends to meet the 10 NTU goal during nearly all periods of base flow, indicating the majority of sediment and other sources of turbidity are being contributed during storm events (Figure 10). Turbidity was also significantly influenced by the in-stream restoration work around Neal Avenue. During construction activities, daily spikes in turbidity of the same magnitude as heavy precipitation events were evident at McKusick Road and Stonebridge. These periods were also accounted for in the loading tables found in Appendix B. The highest daily average turbidity at Highway 15, McKusick Road, Stonebridge, and the Outlet were recorded during storms on June 5 (37 NTU), August 6 (132 NTU), August 27 (72 NTU), and August 27 (67 NTU), respectively.

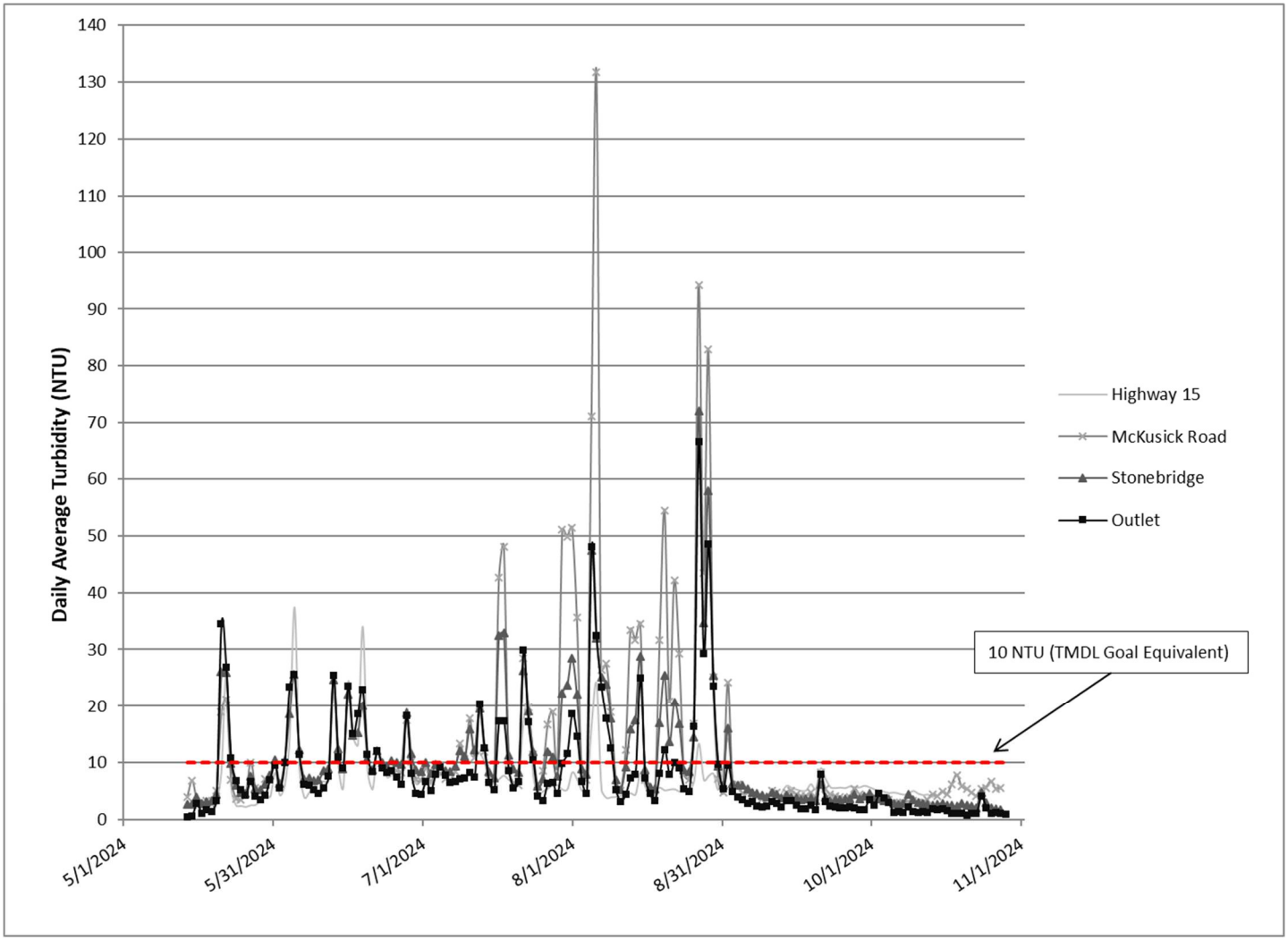

Figure 10. Brown's Creek Daily Average Turbidity

1g. Fisheries & Aquatic Invasive Species

Brown's Creek currently supports a brown and rainbow trout fishery dependent upon stocking in the lower reaches of the creek. Brown trout have been shown to have a limited amount of natural reproduction, and rainbow trout rely on stocking efforts. In 2020 the MN DNR switched from stocking brown trout to rainbow trout because they are easier to produce, grow larger and faster, and are stocked at a size that provides better recreational opportunity to anglers. Additionally, neither species is native to Minnesota, but they are considered naturalized and non-deleterious, and provide ecosystem and recreational benefits where native brook trout cannot survive. MN DNR has a management plan to stock 1,000 yearling rainbows at the Outlet annually. Stillwater Area High School (SAHS) and the Minnesota Trout Unlimited – Trout in the Classroom program also reared and stocked several hundred fingerling rainbow trout into the stream.

Fish and macroinvertebrate sampling conducted by the District's engineer and SAHS have identified many varieties of organisms present in the creek that need high quality, well oxygenated water to survive, such as rainbow darters. Results of fish and macroinvertebrate samplings can be found on the District's website or are available upon request.

Field staff continue to observe heavy growth of invasive curly-leaf pondweed in the upper reaches of the creek at Highway 15 and above McKusick Road. Dense mats of vegetation can alter flow rates, nutrient transport in the stream, hinder efforts to make stream improvements by slowing the water, and create conditions for warmer temperatures and increased sediment deposition on potential spawning areas. The BCWD should continue to work with partners to limit, prevent, or manage the spread of curly-leaf pondweed downstream.

IV.C.2. Diversion Drainage

The Trout Stream Mitigation Project (TSMP), also known as the Diversion Structure, has been functioning since 2003 to divert warm water flows away from Brown's Creek through McKusick Lake to the St. Croix River (Table 1 and Figure 1). Diverting the water away from the creek protects it from additional thermal and sediment loads, improving conditions for trout and other cold water organisms. However, the water diverted away from the creek impacts its receiving waters: McKusick Lake and the wetland complex at the inlet to the lake. Therefore, monitoring is important to determine the load of pollutants discharged to the lake.

2a. Discharge

Discharge doubled from the year prior to 72,832,083 cubic feet exported to McKusick Lake, due to a wet spring and summer (Table 16). This volume of water is the second highest recorded since monitoring began in 2006. No water overtopped the Diversion Structure in 2024. The structure was designed to divert events up to the 1.5-year storm event under fully developed conditions. Since 2014 there have been five known events during which water has overtopped the structure and discharged directly to Brown's Creek, ranging from a few hours to a half-day. Although noteworthy, the volume of direct discharges has been minimal and have only occurred during major storm events, and likely have little impact on thermal and nutrient loads in the creek when the creek is already high with runoff. More importantly, the structure diverts the significantly warmer base flow and all moderate and minor runoff events in the drainage away from the creek, reducing thermal loads to Brown's Creek.

2b. Phosphorus & Sediment

The TP load to McKusick Lake was 573 pounds, or 0.149 pounds of phosphorus per acre of watershed land (Table 16). The TP load was the near the median value when considering the latest ten years and all-time data since 2006, but is well below the all-time

average value of 908 pounds. Water flowing through the site met the 2B phosphorus standard at base flow for all of the samples collected, while storm event concentrations were much higher (Table 15). However, the trend analysis study shows statistically significant increasing concentrations of TP over both the short and long term in the drainage.

The TSS load was 230,855 pounds of sediment, equating to 59.88 pounds per acre of watershed land (Table 16). The state standard for 2B waters is 30 mg/L of TSS from April 1 to September 30. Water flowing through the site during this period met the standard during base flow conditions, and storm concentrations were much lower than prior wet years when concentrations sometimes exceeded 2,000 mg/L (Table 15). Despite the wet conditions, the TSS load was the third lowest in the last ten years and well below the long term average load of 554,361 pounds. No significant trends exist for TSS in the drainage.

The District has worked since 2018 to repair erosional head cuts and increase floodplain connectivity through the installation of rock vanes on the drainage tributaries. The practices are estimated to reduce the TP load by 76 pounds per year, and the sediment load by 70 tons per year. Additionally, beavers were again active in the drainage in 2024, creating dams between the IESF harvest pond and the monitoring site. The dams, when present, enhance floodplain connectivity and settling of nutrients while improving habitat, and a resulting reduction in TP and TSS loads is likely reflected in annual loads. Due to these considerations the District has opted to leave the dams in place when found. The relatively low TP and TSS loads paired with the second highest total discharge ever recorded may indicate the restoration efforts by the District and natural processes from beaver activity are having positive impacts on water quality in the drainage. The IESF upstream of the monitoring site also continues to operate to reduce TP loads in the drainage. Monitoring data from the IESF is analyzed by EOR and summarized in an annual maintenance memo for the filter.

Table 15. Brown's Creek Diversion 2024 Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L _CaCO3)
Storm Composite	4/16/2024 16:47	4/17/2024 0:42	90	27	2.23	0.373	0.058	0.00370	0.00290	0.00170	0.01600	0.00020	<0.00250	60.3	<0.06	0.73	<0.06	134
Storm Composite	5/21/2024 18:11	5/22/2024 6:11	186	53	2.18	0.432	0.081	0.00460	0.00420	0.00260	0.01370	0.00019	0.00400	40.9	<0.06	0.23	<0.06	99
Storm Composite	6/3/2024 5:43	6/3/2024 12:23	96	28	1.44	0.193	0.032	0.00260	0.00230	0.00140	0.00820	0.00020	<0.00250	70.6	<0.06	<0.20	<0.06	121
Storm Composite	6/4/2024 19:53	6/4/2024 23:34	1,080	336	4.68	0.905	0.064	0.01120	0.01110	0.00910	0.04380	0.00030	0.00970	51.8	<0.06	0.20	<0.06	121
Storm Composite	6/16/2024 2:29	6/16/2024 5:52	148	42	1.92	0.344	0.054	0.00400	0.00380	0.00240	0.01240	0.00018	0.00320	42.0			<0.06	111
Storm Composite	6/28/2024 6:34	6/28/2024 8:33	758	184	1.86	0.675	0.060	0.00870	0.00860	0.00710	0.03100	0.00030	0.00840	39.9			<0.06	158
Storm Composite	7/22/2024 18:31	7/22/2024 21:26	396	104	4.02	0.697	0.072	0.00800	0.00790	0.00570	0.03260	0.00024	0.00720	34.2	<0.06	0.40	<0.06	144
Storm Composite	8/5/2024 12:11	8/5/2024 23:28	234	57	2.91	0.483	0.072	0.00560	0.00640	0.00350	0.02070	0.00020	0.00510	26.3	<0.06	0.36	<0.06	123
Base Grab	5/20/2024 14:27	5/20/2024 14:27	6	3	0.60	0.080	0.044	<0.00100	0.00077	<0.00050	<0.00500	<0.00010	<0.00250	76.1	<0.06	0.23	<0.06	158
Base Grab	6/27/2024 13:56	6/27/2024 13:56	5	<3	0.58	0.073	0.040	<0.00100	0.00056	<0.00050	<0.00500	<0.00010	<0.00250	73.4	<0.06	<0.20	<0.06	90
Base Grab	7/25/2024 13:47	7/25/2024 13:47	3	<3	0.46	0.051	0.039	0.00130	0.00052	<0.00050	<0.00500	<0.00010	<0.00250	56.8	<0.06	<0.20	<0.06	79
Base Grab	9/3/2024 9:51	9/3/2024 9:51	3	<3	0.48	0.054	0.039	<0.00100	0.00054	<0.00050	<0.00500	<0.00010	<0.00250	38.9	<0.06	<0.20	<0.06	73
Base Grab	9/24/2024 9:18	9/24/2024 9:18	3	<3	0.46	0.073	0.044							42.2	<0.06	0.28	<0.06	136
Base Grab	10/21/2024 14:30	10/21/2024 14:30	3	<3	0.37	0.065	0.023	<0.00100	0.00070	<0.00050	<0.00500	<0.00010	<0.00250	46.6	<0.06	0.32	<0.06	295

Exceeds Water Quality Standard
No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Table 16. Brown's Creek Diversion Historic Loading- Latest Ten Years

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Brown's Creek Diversion Structure										
Discharge (cf)	46,276,327	70,780,581	39,625,672	45,453,990	112,468,888	68,165,935	46,792,341	41,610,620	35,622,586	72,832,083
Total pounds of Phosphorus exported	1,837	1,574	784	964	3,598	760	446	389	367	573
TP (lbs/ac/yr)	0.447	0.408	0.203	0.250	0.933	0.197	0.116	0.101	0.095	0.149
Total pounds of TSS exported	1,008,346	1,533,496	596,382	505,314	2,707,186	246,238	401,069	75,429	74,875	230,855
TSS (lbs/ac/yr)	261.57	397.79	154.70	131.08	702.25	63.87	104.01	19.57	19.42	59.88

2c. Metals

Heavy metals exceedances at the Diversion site can be seen in Table 15. The export of water high in metals to McKusick Lake and its wetland complex are particularly concerning due to the potential to destroy aquatic life in a short period of time, as opposed to nutrient or sediment loading which typically degrades habitat and populations of aquatic life over time. The chronic standard for copper was exceeded once, and three chronic standard exceedances for lead were recorded. The number and severity of exceedances of metals standards in the drainage were again among the lowest observed since metals analysis began in 2007. Improvements made to reduce erosion and the natural settling of sediments that may have metals bound to them in beaver impoundments are the most likely drivers of this. In most cases, severe exceedances of metals are associated with extreme TSS concentrations in this drainage. Sources of metals in the drainage may include improperly disposed wastes, such as deep cycle batteries. The combination and concentration of metals observed over time appear to point to this as a possible source. The District has allocated funds to conduct sediment coring and soil analysis to identify nutrient and metals hotspots in the drainage.

2d. Temperature

A stand-alone temperature logger was added to the monitoring site in 2024 to provide additional characterization of habitat and water quality conditions in the drainage. The drainage tends to be much warmer than Brown's Creek, and further collection of these data may provide insights on how restoration practices and beaver activity affect conditions in the drainage. Recorded daily average temperatures can be found in (Figure 11). Although the drainage is effectively disconnected from Brown's Creek as a receiving water, daily average temperatures at McKusick Road are included for reference.

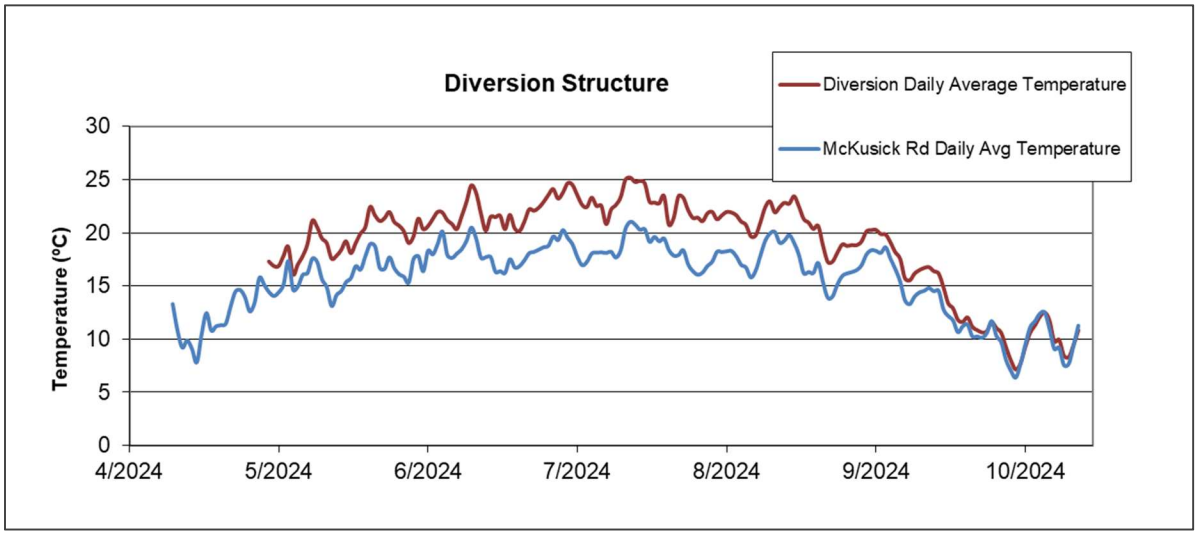

Figure 11. Diversion Drainage 2024 Daily Average Temperature

IV.C.3. Long Lake Drainage

The tributaries to Long Lake at 62nd St. and Marketplace Pond drain a high percentage of impervious surface and developed areas upstream of Long Lake (Table 1 and Figure 1). For the purposes of this report, the Tributary to Long Lake at Marketplace Pond will be compared to 2B water quality standards. The Tributary at Marketplace Pond is not classified as a 2B water, although its receiving water, Long Lake, is. The Tributary at 62nd Street will not be compared to state standards as water chemistry sampling at the site ceased following the 2016 monitoring season; only stage has been recorded since. The water discharged to Long Lake directly affects the quality of the lake, which has had significant issues caused by excess nutrients. Water from Long Lake makes its way downstream to Jackson WMA (Sinnits) Pond, the diversion drainage, McKusick Lake and its wetland complex, and eventually to the St. Croix River. Monitoring subwatershed contributions to Long Lake can help determine locations for targeted management, as well as track improvements made upstream.

3a. Discharge

Annual discharge to Long Lake from the tributary at Marketplace Pond was 24,319,915 cubic feet. Only stage data was collected at the tributary at 62nd Street, and discharge was estimated during the period of logged data based on stage and discharge data from 2014. Data from 2014 was used because it covered the widest range of observed stages and was representative of the average of other years of data collection. Discharge outside of logged data was not estimated, although the total volume outside of the period of record is likely negligible as the site freezes in the winter. Discharge to Long Lake from the tributary at 62nd Street was estimated at 3,294,857 cubic feet (Table 18). Flow in both systems is almost entirely event based, and flow often ceases during dry or winter conditions.

3b. Phosphorus & Sediment

The TP load at Marketplace Pond was 0.383 pounds per acre for a total of 157 pounds of phosphorus, and the TSS load was 44.68 pounds per acre for a total of 18,320 pounds of sediment (Table 18). It appears the tributary at Marketplace Pond is meeting the standard of 30 mg/L of TSS at base flow, but was above the 0.100 mg/L TP standard for two of five base flow samples (Table 17). Although storm composite samples are generally not compared to state standards, the concentrations of TSS were often below the standard, and the TP concentrations were well above the standard. It should be noted the tributary at Marketplace Pond flows through several small settling ponds before discharging to Long Lake, and some additional settling of sediment and uptake of nutrients likely occurs. Sampling of the tributary at 62nd Street ceased after the 2016 monitoring season.

3c. Metals

Heavy metal exceedances for the tributary at Marketplace Pond can be found in Table 17. There were one chronic and four max standard exceedances of copper, three chronic

standard exceedances of lead, and one max and one chronic standard exceedance of zinc recorded. The amount of heavy metals in the subwatershed is influenced by development and impervious surfaces, such as parking lots and Highway 36 where materials from vehicle leaks and brake dust tend to collect. The hardness of water in the subwatershed also tends to be very low, increasing the toxicity of metals. Metals contributed from this subwatershed have the potential to degrade aquatic life near the point of discharge to Long Lake before the water is fully integrated into the lake.

Table 17. Tributary to Long Lake at Marketplace Pond 2024 Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L _CaCO3)
Storm Composite	4/28/2024 21:06	4/29/2024 2:34	14	6	0.87	0.103	<0.050	0.00460	0.00094	<0.00050	0.01590	0.00011	<0.00250	160.0	<0.06	<0.20	0.07	31.9
Storm Composite	5/21/2024 17:31	5/21/2024 20:37	17	5	0.68	0.089	0.029	0.00480	0.00088	0.00053	0.01360	<0.00010	<0.00250	18.8	0.20	0.20	0.17	18.2
Storm Composite	5/31/2024 19:35	6/1/2024 4:12	13	5	0.62	0.094	0.045	0.00360	0.00080	<0.00050	0.00960	<0.00010	<0.00250	47.8			0.07	26.6
Storm Composite	6/4/2024 19:14	6/5/2024 0:18	7	3	0.67	0.076	0.040	0.00460	0.00079	<0.00050	0.01070	<0.00010	<0.00250	21.1	<0.06	0.22	0.13	21.7
Storm Composite	6/12/2024 23:59	6/13/2024 0:43	63	19	1.37	0.203	0.034	0.00630	0.00200	0.00160	0.03760	<0.00010	<0.00250	14.4	<0.06	0.36	0.43	24.4
Storm Composite	6/28/2024 5:22	6/28/2024 7:00	17	7	0.51	0.116	0.055	0.00340	0.00091	<0.00050	0.01900	<0.00010	<0.00250	9.0			0.09	21.1
Storm Composite	7/13/2024 23:41	7/14/2024 1:18	20	7	0.85	0.121	0.036	0.00450	0.00110	0.00056	0.01870	<0.00010	<0.00250	9.7	<0.06	0.22	0.17	27.4
Storm Composite	7/22/2024 17:53	7/22/2024 19:02	43	14	1.08	0.154	0.033	0.00510	0.00160	0.00120	0.03710	<0.00010	<0.00250	6.8	<0.06	0.32	0.20	25.9
Storm Composite	8/5/2024 10:43	8/5/2024 14:22	10	5	0.94	0.119	0.030	0.00330	0.00083	<0.00050	0.01170	<0.00010	<0.00250	9.5	<0.06	<0.20	0.19	27.4
Base Grab	5/16/2024 8:46	5/16/2024 8:46	7	4	0.78	0.109	0.040	0.00360	0.00095	<0.00050	0.00690	<0.00010	<0.00250	82.6	<0.06	0.29	<0.06	36.9
Base Grab	6/27/2024 13:25	6/27/2024 13:25	<3	<3	0.69	0.090	0.066	0.00310	0.00093	<0.00050	<0.00500	<0.00010	<0.00250	27.1	<0.06	0.25	0.11	30.4
Base Grab	7/25/2024 14:07	7/25/2024 14:07	5	3	0.56	0.078	0.041	0.00240	0.00062	<0.00050	<0.00500	<0.00010	<0.00250	15.8	<0.06	<0.20	<0.06	33.7
Base Grab	9/3/2024 10:39	9/3/2024 10:39	7	5	0.68	0.083	0.074	0.00370	0.00069	<0.00050	0.00560	<0.00010	<0.00250	12.6	<0.06	<0.20	<0.06	27.9
Base Grab	9/16/2024 11:23	9/16/2024 11:23	<3	<3	0.66	0.117	0.075	0.00350	0.00072	<0.00050	<0.00500	<0.00010	<0.00250	28.3	<0.06	0.33	<0.06	39.4

Exceeds Water Quality Standard
No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Table 18. Long Lake Drainage Historic Loading- Latest Ten Years

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Tributary to Long Lake at Marketplace Pond										
Discharge (cf)	22,983,609	23,534,188	15,250,645	16,492,464	28,970,261	14,353,605	13,899,568	7,753,526	12,052,262	24,319,915
Total pounds of Phosphorus exported	137	137	77	70	150	83	121	79	121	157
TP (lbs/ac/yr)	0.335	0.333	0.187	0.170	0.367	0.202	0.296	0.192	0.294	0.383
Total pounds of TSS exported	15,797	18,278	15,162	16,473	15,882	10,645	9,593	7,112	12,870	18,320
TSS (lbs/ac/yr)	38.53	44.58	36.98	40.18	38.74	25.96	23.40	17.35	31.39	44.68
Tributary to Long Lake at 62nd Street										
Discharge (cf)	1,413,178	2,824,017	1,811,811*	957,234*	3,403,761*	2,842,101*	584,566*	274,469*	628,588*	3,294,857*
Total pounds of Phosphorus exported	32	49	NA	NA	NA	NA	NA	NA	NA	NA
TP (lbs/ac/yr)	0.056	0.086	NA	NA	NA	NA	NA	NA	NA	NA
Total pounds of TSS exported	6,115	20,956	NA	NA	NA	NA	NA	NA	NA	NA
TSS (lbs/ac/yr)	10.63	36.45	NA	NA	NA	NA	NA	NA	NA	NA
	*Flow not estimated outside of logged data									

IV.C.4. McKusick Wetland Outlet

The tributary to Brown's Creek at McKusick Wetland Outlet discharges water through a pipe approximately 100 feet upstream of the McKusick Road monitoring station from a wetland complex at the headwaters of McKusick Lake. Based on aerial photo evidence it may also provide a "short circuit" for warm, nutrient rich water diverted by the Diversion Structure to be introduced into Brown's Creek after flowing through the wetland complex at the headwaters of McKusick Lake. In 2021 the Oak Glen Golf Course Irrigation Reuse Project was completed, which redirects water from the outlet to a holding pond. This reduces warm, nutrient rich and oxygen poor inputs of water to Brown's Creek. Although not classified as a 2B water, for the purposes of this summary, the data collected will be compared to 2B TP and TSS standards.

4a. Discharge

Discharge at McKusick Wetland Outlet was calculated using an area velocity relationship during the period of recorded data. Periods of flow outside of recorded data were not estimated due to the site freezing during winter months. The recorded discharge to Brown's Creek was 9,588,210 cubic feet (Table 20). High water levels in Brown's Creek occasionally created backwater conditions at the site, making discharge calculations difficult during some periods. The outlet appeared to be flowing at least a small amount the entire monitoring period except for late September into early October. A significant portion of the stage and discharge data was lost between August 7 and September 3 due to a logger malfunction.

4b. Phosphorus & Sediment

The TP load during recorded data was estimated at 165.5 pounds of phosphorus, while the estimated TSS load was 4,788 pounds of sediment (Table 20). The concentrations of TSS and TP were not precipitation or stage dependent, indicating the wetland complex "pulses" nutrients following storm events. As such, TP and TSS loads were calculated by averaging samples with similar concentrations based on seasonality, and applying the average concentration to the recorded discharge for the time period, which is consistent with past years. One TSS sample on June 3 was excluded as an outlier. It is important to note the characteristics of the site and sampling strategy do not allow for load calculations as precise as other monitored strategies, i.e. composite sampling.

Samples collected show the site nearly always meets the 2B standard of 30 mg/L of TSS, but exceeded the standard of 0.100 mg/L of TP for every sample collected (Table 19). The water discharging from the wetland is generally low in suspended sediment and other materials, but quite high in phosphorus, a large fraction of which is often dissolved phosphorus. This is typical of wetlands, which break down organic materials while filtering particulate matter, but can have negative effects on receiving waters by contributing nutrients that are readily available to organisms like algae.

Table 19. McKusick Wetland Outlet 2024 Chemistry Results

Sample Type	Start	End	TSS (mg/L)	VSS (mg/L)	TKN (mg/L)	TP (mg/L)	Dissolved P (mg/L)	Copper (mg/L)	Nickel (mg/L)	Lead (mg/L)	Zinc (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Chloride (mg/L)	Nitrite N (mg/L)	Nitrate N (mg/L)	Ammonia Nitrogen (mg/L)	Hardness (mg/L _CaCO3)
Storm Grab	5/22/2024 12:26	5/22/2024 12:26	7	<6	1.14	0.264	0.166	<0.00100	0.00087	<0.00050	<0.00500	<0.00010	<0.00250	20.5	<0.06	<0.20	<0.06	102
Storm Grab	6/3/2024 15:31	6/3/2024 15:31	150	54	1.01	0.280	0.115	<0.00100	0.00059	<0.00050	<0.00500	<0.00010	<0.00250	40.6	<0.06	<0.20	<0.06	145
Base Grab	6/26/2024 14:46	6/26/2024 14:46	7	<7	0.9	0.395	0.273	<0.00100	0.00054	<0.00050	<0.00500	<0.00010	<0.00250	48.0	<0.06	<0.20	<0.06	155
Base Grab	7/23/2024 10:08	7/23/2024 10:08	6	<5	0.83	0.222	0.088	<0.00100	<0.00050	<0.00050	<0.00500	<0.00010	<0.00250	28.5	<0.06	<0.20	<0.06	131
Base Grab	7/31/2024 8:10	7/31/2024 8:10	14	<12	1.80	0.249	0.042	<0.00100	0.00110	<0.00050	0.00810	<0.00010	<0.00250	7.8	<0.06	<0.20	0.10	198
Storm Grab	8/6/2024 15:16	8/6/2024 15:16	<5	<5	1.06	0.241	0.142	0.00150	0.00150	<0.00050	<0.00500	<0.00010	<0.00250	26.2	<0.06	<0.20	<0.06	97
Base Grab	9/3/2024 10:19	9/3/2024 10:19	8	4	0.80	0.306	0.122	<0.00100	0.00053	<0.00050	<0.00500	<0.00010	<0.00250	40.8	<0.06	<0.20	<0.06	144

Exceeds Water Quality Standard
No Exceedance Determinable
Exceeds Chronic Standard
Exceeds Max Standard
Exceeds Final Acute Standard

Table 20. McKusick Wetland Outlet 2023 Discharge and Loading Estimates

Site	Period	Total Flow (cf)	Total Flow (ac-ft)	Average TP Concentration (mg/L)	TP Range (mg/L)	Average TSS Concentration (mg/L)	TSS Range (mg/L)	TP Load (lbs.)	TSS Load (lbs.)
McKusick Wetland Outlet	4/24-8/7	9147260	210.10	0.275	0.222-0.395	8	5-14	157.0	4,568
McKusick Wetland Outlet	9/3-10/29	440,950	10.13	0.306	0.306	8	8	8.4	220
Total		**9,588,210**	**220.23**					**165.5**	**4,788**

Table 21. McKusick Wetland Outlet Historic Loading Data

	2017	2018	2019	2020	2021	2022	2023	2024
McKusick Wetland Outlet								
Discharge (cf)	18,610,746	8,319,145	43,988,560	18,179,910	5,072,806	5,153,850	5,834,490	9,588,210
Total pounds of Phosphorus exported	298.2	138.5	453.1	284.6	68.3	69.1	115.1	165.5
Total pounds of TSS exported	9,055	5,072	13,275	10,927	2,327	2,868	3,870	4,788
Values reported are totals during the monitoring period only.								

4c. Temperature

Historic thermal data recorded at McKusick Wetland Outlet show temperatures roughly 2.5 ^{o}C higher, on average, than those recorded at McKusick Road during similar time periods. The wetland is warmed by solar radiation and frequently reaches high temperatures. Although the wetland outlet is not intended to be suitable for trout, when compared to TMDL thresholds of 18.3 ^{o}C (threat level) and 23.9 ^{o}C (critical level), water temperatures exceeded the thresholds 58.9% and 7.7%, respectively, of the monitoring period when flow was present. It is important to compare temperatures to these thresholds because they directly influence temperatures in Brown's Creek when discharged upstream of the McKusick Road site. Trout have been observed and stocked in the reach of Brown's Creek the wetland outlet discharges to, but only during spring and fall when water temperatures are cooler. Continuous temperature data can be seen in Figure 11, where temperature data has been removed during periods of zero water discharge, alongside the daily average temperature at McKusick Road.

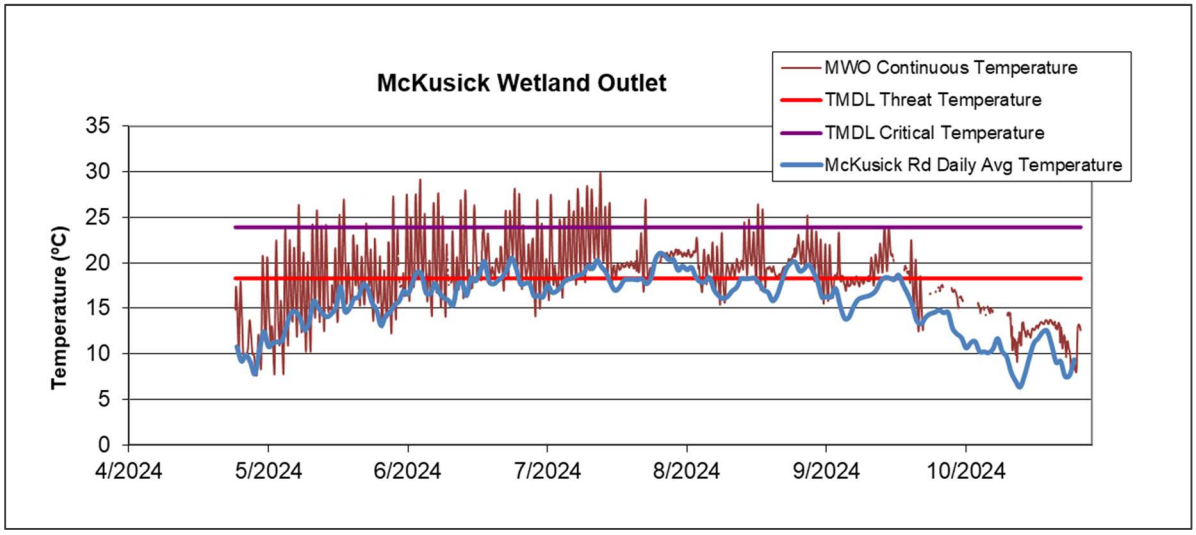

Figure 12. McKusick Wetland Outlet 2024 Continuous Temperature

V. RECOMMENDATIONS

- Continue chloride monitoring on lakes likely to be impacted by salt use.
- Perform macrophyte surveys on lakes that are lacking data.
- Continue collecting water quality and continuous discharge data at existing monitoring stations to track changes in the watershed and provide baseline data for modeling and other uses.
- Continue identifying salt use reduction strategies to limit chloride loading.
- Continue identifying cooperative opportunities with landowners to implement stream shading projects.
- Continue monitoring repairs to erosion issues in the diversion drainage to prevent degradation of McKusick Lake.
- Consider modifying sampling on Brown's Creek to match Metropolitan Council's WOMP program using unbiased sampling regimes as opposed to storm/event based sampling to allow for more rigorous statistical trend analysis.

APPENDIX A - WATER QUALITY DATA – BY LAKE

Brown's Creek Watershed Lakes: Bass East, Bass West, Benz, Brewer's Pond, Goggins, Heifort's Pond, Jackson WMA (Sinnits Pond), July Avenue, Kismet, Long (North Basin), Lynch North, Lynch South, Masterman, North School Section, Pat, Plaisted, South School Section, and Woodpile

Lake grades are assessed using the Metropolitan Council's lake grade system. Grades are determined based on May through September averages of total phosphorus concentration, uncorrected trichromatic chlorophyll-α concentration, and Secchi disk transparency.

The Minnesota Pollution Control Agency (MPCA) uses the June through September average to assess impairment status of a lake based on total phosphorus concentration, pheophytin-corrected chlorophyll-α concentration, and Secchi disk transparency. The MPCA sets lake eutrophication standards for aquatic life and recreation. The standard for TP is 0.040 mg/L for deep lakes and 0.060 mg/L for shallow lakes. In general, shallow lakes are defined as less than 15 feet deep, with greater than 80% littoral area, and less than 10 acres.

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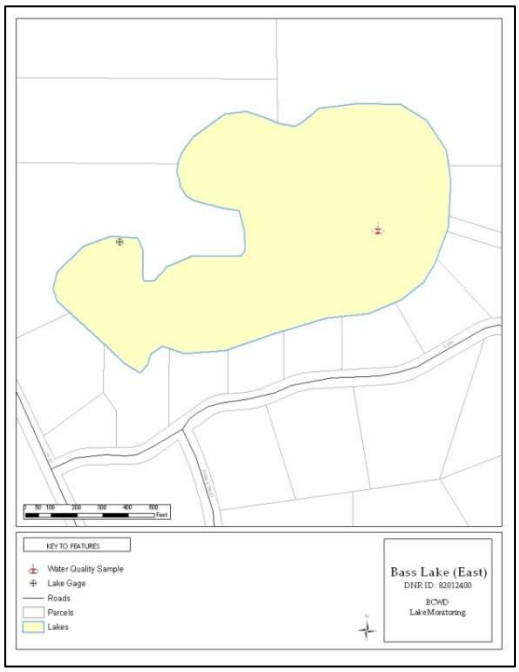
Bass Lake (East)

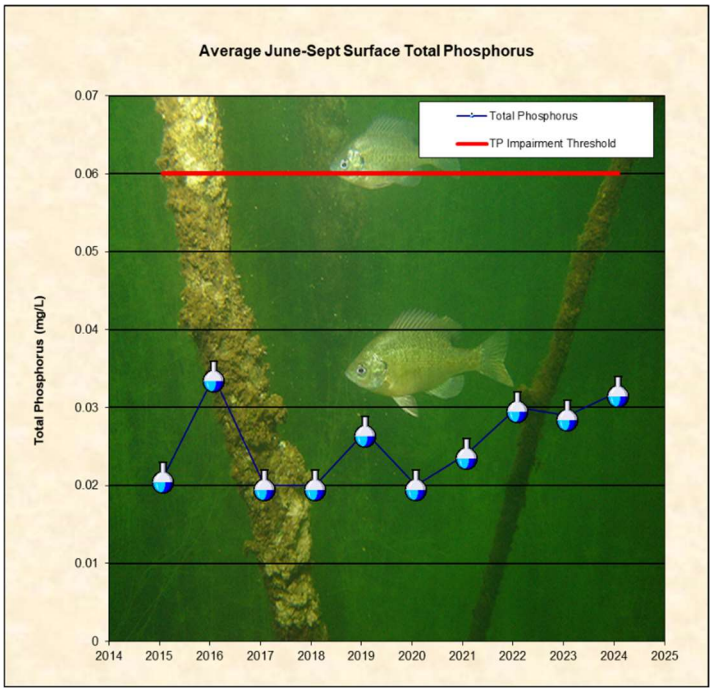
2024 Lake Grade: B+

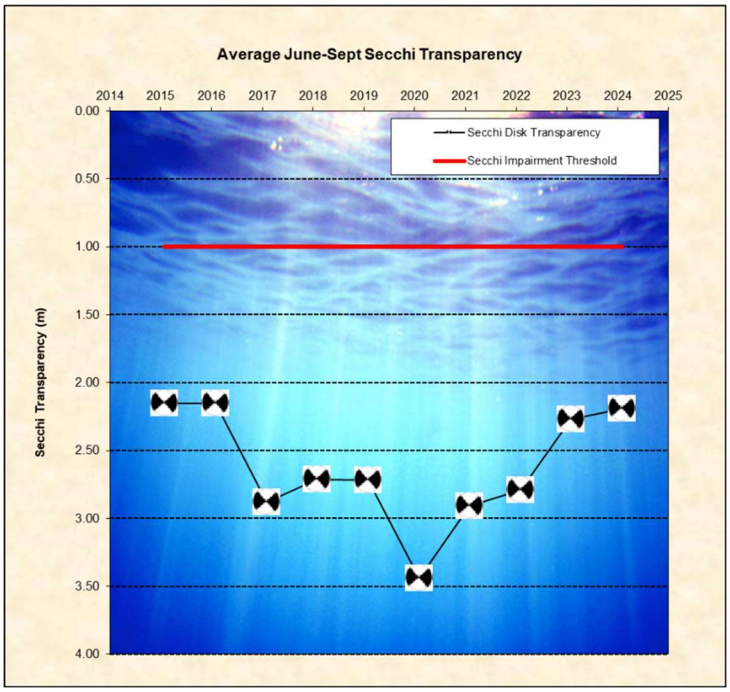
- DNR ID #: 820124
- Municipality: City of Grant
- Location: Section 10, T30N-R21W
- Lake Size: 29 Acres
- Maximum Depth (2024): 18 ft.
- Ordinary High Water Mark: 960.20 ft.
- 100-Year High Water Level: 960.40 ft.
- 99% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as mesotrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for average total phosphorus and average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is rural/agricultural.
- The lake stratified in 2024 with a thermocline around 2 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





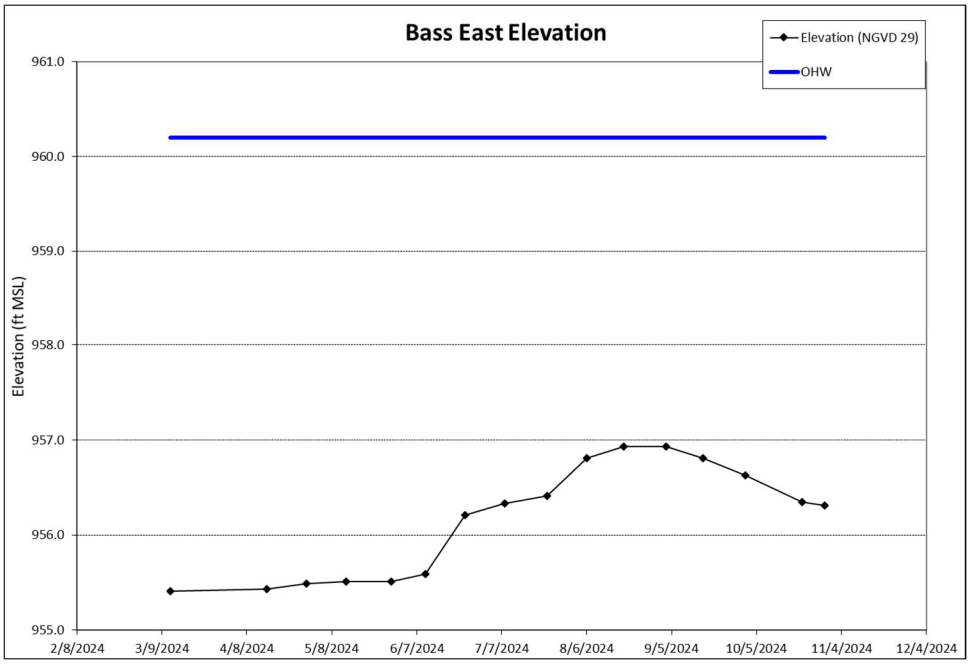
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 12:25	0.015	2.0	2.1	0.51	3.66	15.6	15.14
4/29/2024 10:35	0.017	2.6	2.1	0.49	3.81	11.2	9.22
5/13/2024 10:56	0.021	3.0	2.9	0.54	2.59	20.2	9.30
5/29/2024 10:42	0.030	2.0	1.6	0.70	2.13	19.8	6.81
6/10/2024 10:07	0.058	4.5	3.5	0.73	2.13	22.2	7.10
6/24/2024 11:44	0.040	5.3	4.5	2.64	1.68	24.5	9.22
7/8/2024 9:53	0.040	16.0	15.0	0.66	2.29	25.0	11.44
7/23/2024 9:46	0.023	2.7	2.1	0.75	2.13	25.7	9.82
8/6/2024 10:25	0.023	4.3	3.2	0.63	2.29	24.0	5.69
8/19/2024 10:16	0.024	4.5	4.3	0.67	2.29	24.9	11.04
9/3/2024 10:10	0.030	8.4	6.7	0.84	2.29	23.0	12.23
9/16/2024 9:43	0.020	3.9	3.2	0.81	2.44	24.1	12.81
10/1/2024 13:02	0.035	8.3	6.9	0.62	2.44	20.2	8.41
10/21/2024 10:54	0.024	20.0	21.0	0.68	2.13	13.9	14.24
2024 Average	0.029	6.3	5.7	0.81	2.45	21.0	10.18
2024 Summer Average	0.032	6.2	5.3	0.97	2.19	24.2	9.92

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	956.93	8/19/2024	955.41	3/12/2024	956.11

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

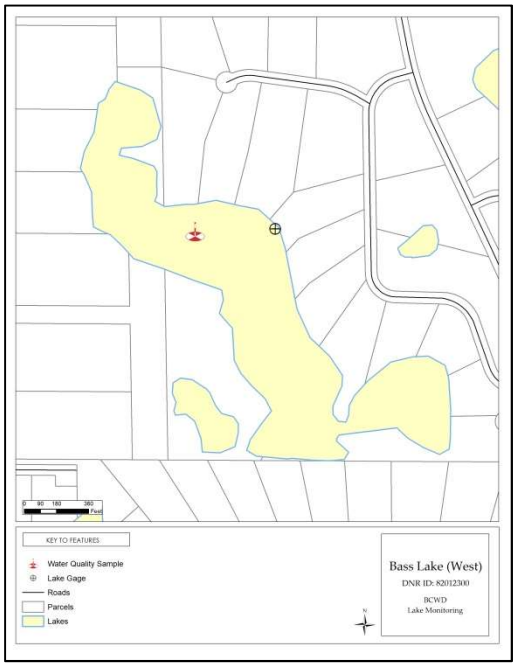


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	B	B	A	A	B	A	A	C	A
Chlorophyll-*a* (ug/l)	A	A	A	A	A	A	A	A	A	A
Secchi depth (ft)	B	B	B	B	A	B	B	B	B	C
Overall	**B+**	**B+**	**B+**	**A-**	**A**	**B+**	**A-**	**A-**	**B**	**B+**

Bass Lake (West)

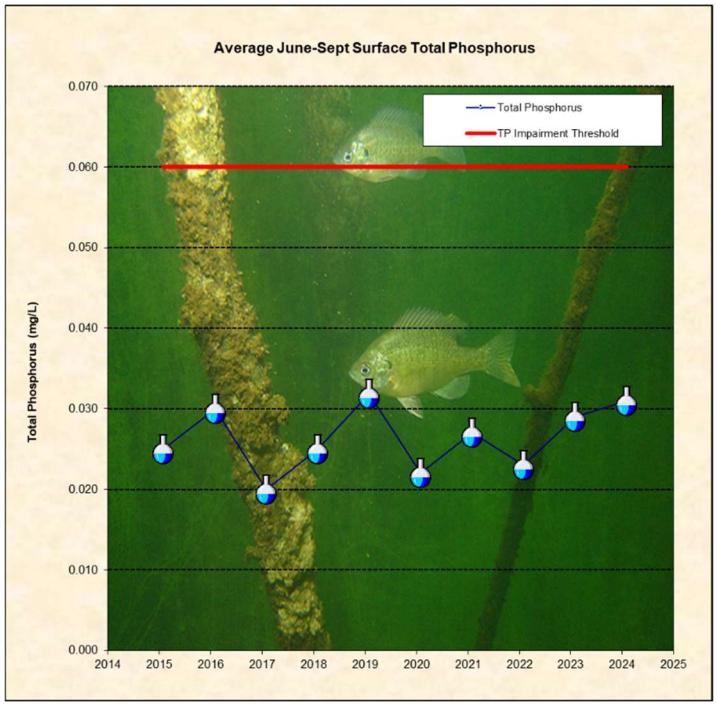
2024 Lake Grade: B-

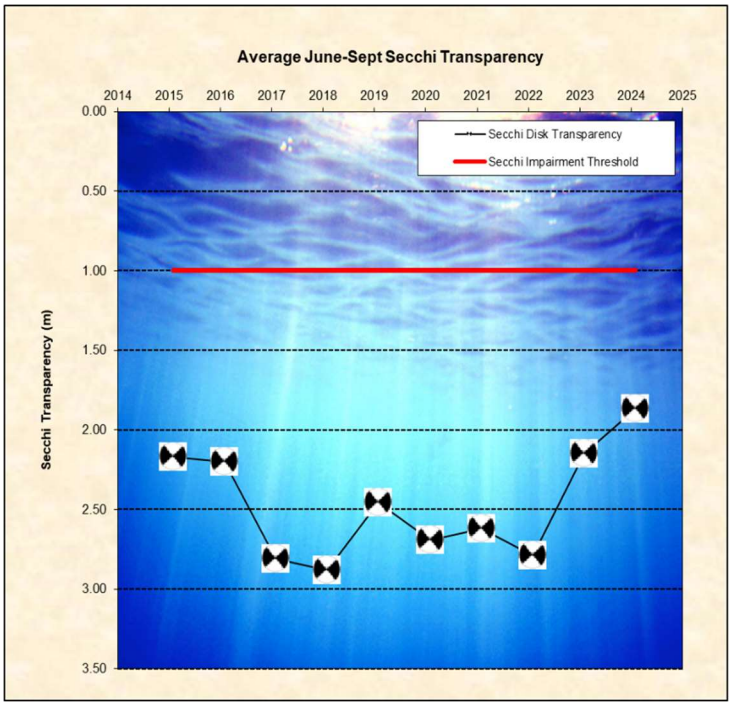
- DNR ID #: 820123
- Municipality: City of Grant
- Location: Section 10, T30N-R21W
- Lake Size: 72 Acres
- Maximum Depth (2024): 15 ft.
- Ordinary High Water Mark: 952.60 ft.
- 100-Year High Water Level: 955.90 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for average total phosphorus, no trend for average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is rural/agricultural.
- The lake stratified in 2024 with a thermocline between 2 and 3 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





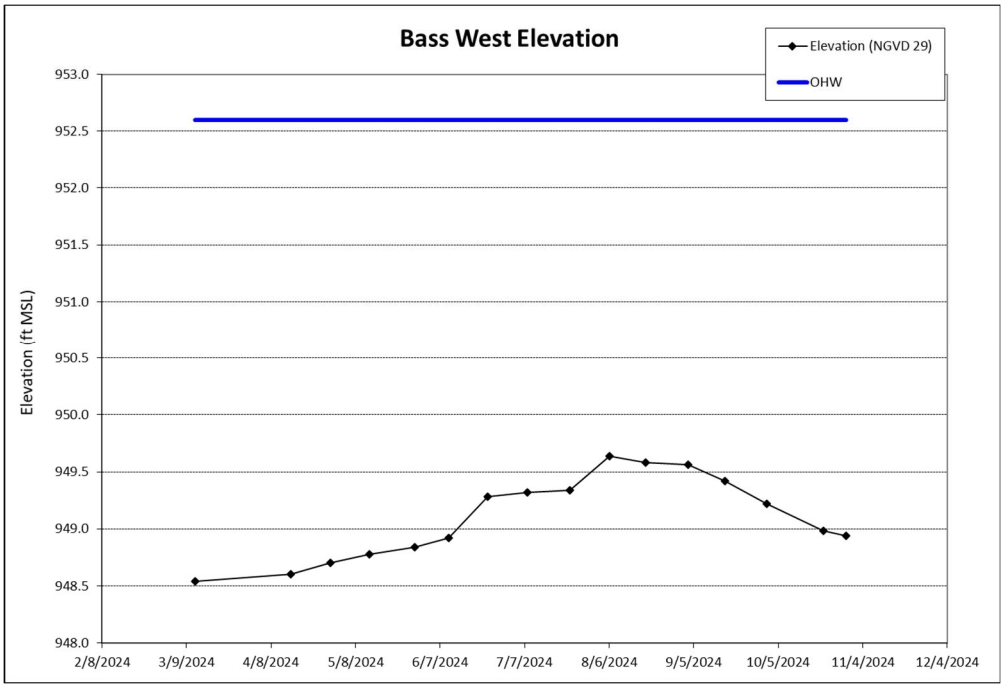
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 12:00	0.018	2.0	1.9	0.66	3.51	14.2	14.73
4/29/2024 11:02	0.018	3.7	2.7	0.51	3.11	11.3	9.44
5/13/2024 10:26	0.020	2.4	2.1	0.59	2.74	19.2	9.78
5/29/2024 10:08	0.022	2.3	2.1	0.58	3.35	19.5	7.50
6/10/2024 10:34	0.023	3.7	3.5	0.62	2.90	22.2	8.34
6/24/2024 11:16	0.027	5.3	4.8	1.59	2.44	23.4	8.70
7/8/2024 10:17	0.022	5.8	5.3	0.67	2.29	24.3	11.76
7/23/2024 10:12	0.026	8.3	8.8	0.74	2.13	25.4	9.53
8/6/2024 10:50	0.046	15.0	14.0	0.86	1.37	24.6	7.32
8/19/2024 9:53	0.043	20.0	18.0	1.09	1.07	24.2	12.17
9/3/2024 10:40	0.040	30.0	28.0	1.09	0.91	22.6	14.33
9/16/2024 10:06	0.024	6.9	5.6	0.88	1.83	24.1	11.92
10/1/2024 13:30	0.037	11.0	9.3	0.96	1.83	19.9	8.74
10/21/2024 11:22	0.019	3.2	2.7	0.79	3.51	13.6	12.63
2024 Average	0.028	8.5	7.8	0.83	2.36	20.6	10.49
2024 Summer Average	0.031	11.9	11.0	0.91	1.87	23.9	10.51

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	949.64	8/6/2024	948.54	3/12/2024	949.12

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

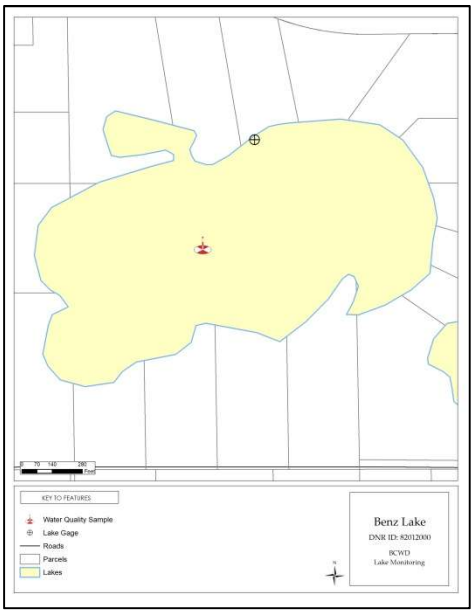


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	B	A	B	A	B	B	A	B	B
Chlorophyll-*a* (ug/l)	B	A	A	A	A	A	A	A	A	A
Secchi depth (ft)	C	B	B	B	A	B	B	B	B	C
Overall	**B-**	**B+**	**A-**	**B+**	**A**	**B+**	**B+**	**A-**	**B+**	**B**

Benz Lake

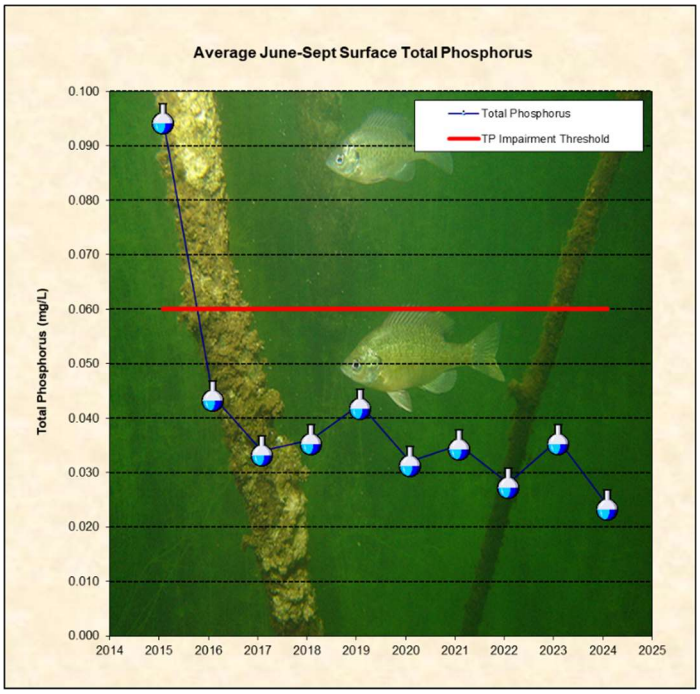
2024 Lake Grade: B

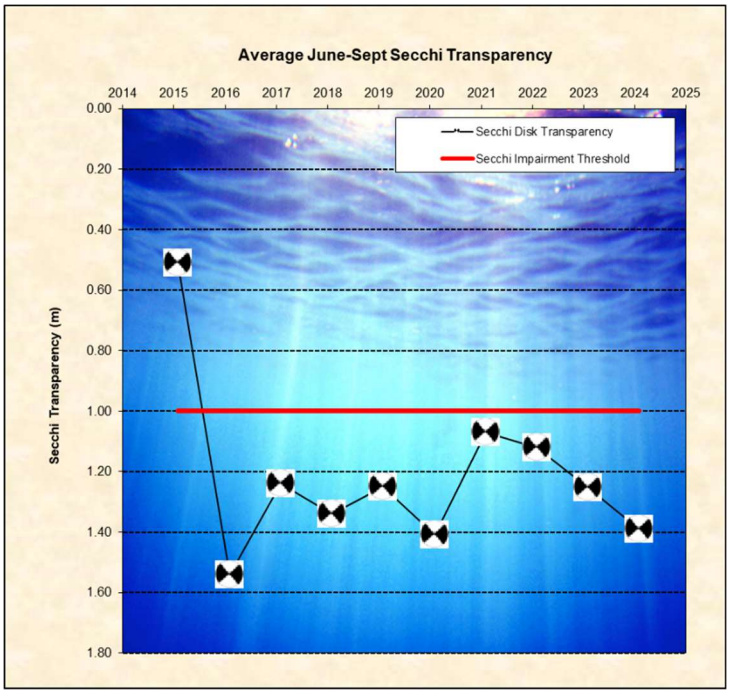
- DNR ID #: 820120
- Municipality: City of Grant
- Location: SE$^{1/4}$ Section 2, T30N-R21W
- Lake Size: 40 Acres
- Maximum Depth (2024): 7 ft.
- Ordinary High Water Mark: 958.90 ft.
- 100-Year High Water Level: 956.20 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for average total phosphorus and average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Benz Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.





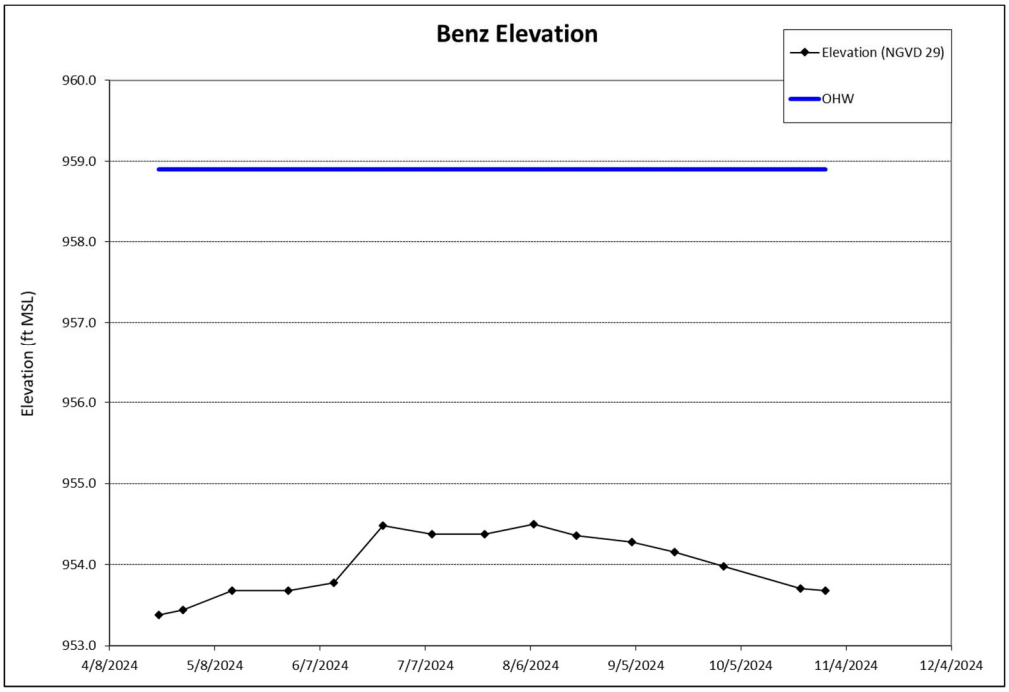
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 13:50	0.026	3.0	2.4	0.42	1.52	11.7	12.67
4/29/2024 11:30	0.024	2.5	1.9	0.43	1.52	10.7	9.13
5/13/2024 11:28	0.029	1.4	1.1	0.54	1.52	20.4	10.76
5/29/2024 11:11	0.043	10.0	9.1	0.60	1.52	20.8	9.22
6/11/2024 14:24	0.028	3.5	3.2	0.55	1.37	23.0	10.25
6/25/2024 9:35	0.028	11.0	10.0	1.51	1.37	25.0	10.98
7/9/2024 10:25	0.026	8.4	8.0	0.76	1.22	25.3	15.42
7/24/2024 9:43	0.027	7.0	6.4	0.69	1.52	24.3	9.62
8/7/2024 12:40	0.025	3.6	2.9	0.91	1.22	24.7	10.86
8/19/2024 11:15	0.023	3.0	2.4	0.71	1.37	25.1	14.33
9/4/2024 12:58	0.026	9.7	8.3	0.68	1.52	23.0	14.85
9/16/2024 11:00	0.019	2.3	1.9	0.62	1.52	24.4	16.99
9/30/2024 11:25	0.010	3.6	3.2	0.48	1.37	21.5	14.41
10/22/2024 9:09	0.017	5.1	5.1	0.54	1.22	14.0	16.23
2024 Average	0.025	5.3	4.7	0.67	1.41	21.0	12.55
2024 Summer Average	0.024	5.8	5.1	0.77	1.39	24.0	13.08

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	954.50	8/7/2024	953.38	4/22/2024	954.04

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

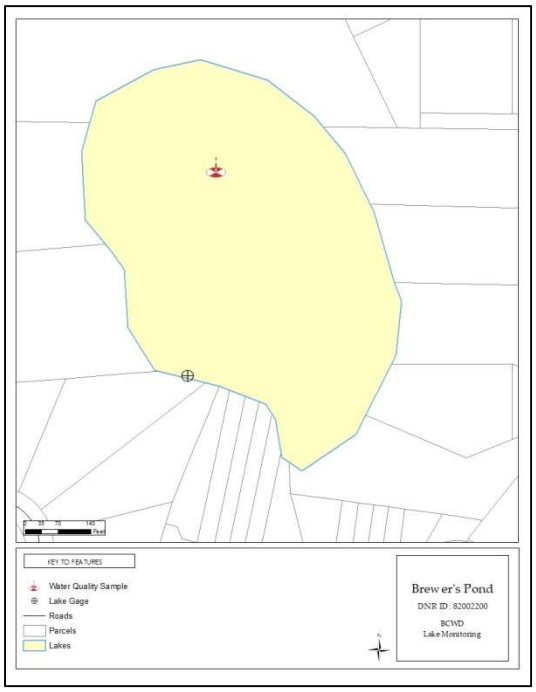


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	C	B	C	B	C	C	C	C	D
Chlorophyll-*a* (ug/l)	A	A	A	A	A	C	A	A	A	D
Secchi depth (ft)	C	C	D	D	C	C	C	D	C	F
Overall	**B**	**B-**	**B-**	**C+**	**B**	**C**	**B-**	**C+**	**B-**	**D-**

Brewer's Pond

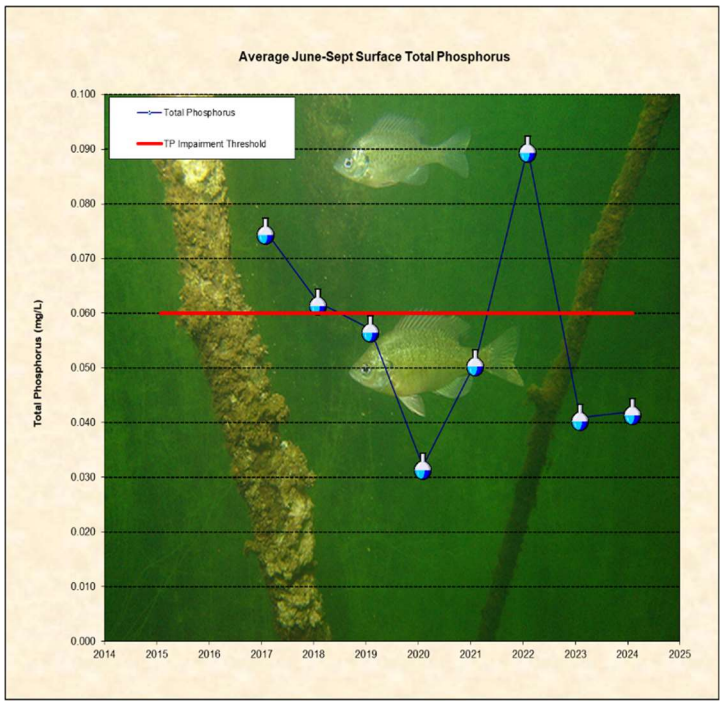
2024 Lake Grade: C-

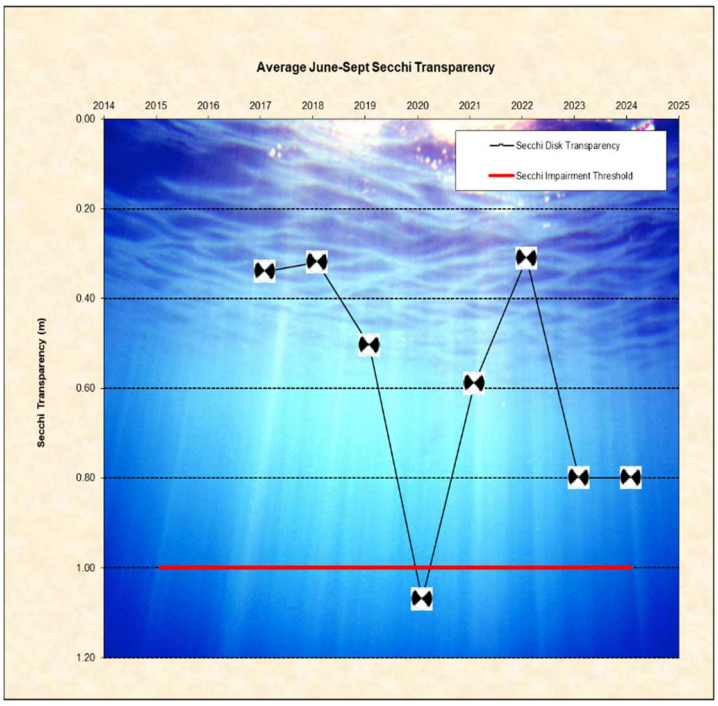
- DNR ID #: 820022
- Municipality: City of Stillwater
- Location: SE$^{1/4}$ Section 31, T30N-R20W
- Lake Size: 9 Acres
- Maximum Depth (2024): 15 ft.
- Ordinary High Water Mark: 891.90 ft.
- 100-Year High Water Level: 893.85 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is currently no trend for the average total phosphorus, average chlorophyll-α, and average Secchi transparency.
- The major land use is urban/residential.
- The lake stratified in 2024 with a thermocline around 3 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.





Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 14:18	0.043	8.2	6.9	1.97	1.07	15.4	13.94
4/25/2024 7:00	0.046	6.0	5.3	1.75	1.40	12.5	NA
5/13/2024 14:10	0.046	4.3	3.5	1.76	1.83	20.8	9.06
5/27/2024 7:00	0.042	16.0	14.0	1.59	1.30	19.7	NA
6/11/2024 12:22	0.038	12.0	11.0	1.42	1.22	22.1	9.17
6/24/2024 9:00	0.039	17.0	15.0	1.42	1.60	24.0	NA
7/8/2024 11:15	0.042	40.0	42.0	1.60	0.61	26.0	12.52
7/23/2024 7:15	0.044	47.0	47.0	1.76	0.80	25.2	NA
8/6/2024 11:50	0.044	50.0	50.0	1.67	0.61	24.9	11.18
8/23/2024 18:20	0.037	31.0	28.0	1.78	0.80	24.2	NA
9/3/2024 12:55	0.043	46.0	46.0	1.80	0.46	23.1	14.12
9/25/2024 8:30	0.040	45.0	46.0	1.92	0.50	20.3	NA
9/30/2024 13:13	0.049	34.0	33.0	1.88	0.61	21.5	12.93
10/18/2024 7:40	0.054	26.0	26.0	2.10	0.90	11.7	NA
2024 Average	0.043	27.3	26.7	1.74	0.98	20.8	11.85
2024 Summer Average	0.042	35.8	35.3	1.69	0.80	23.5	11.98

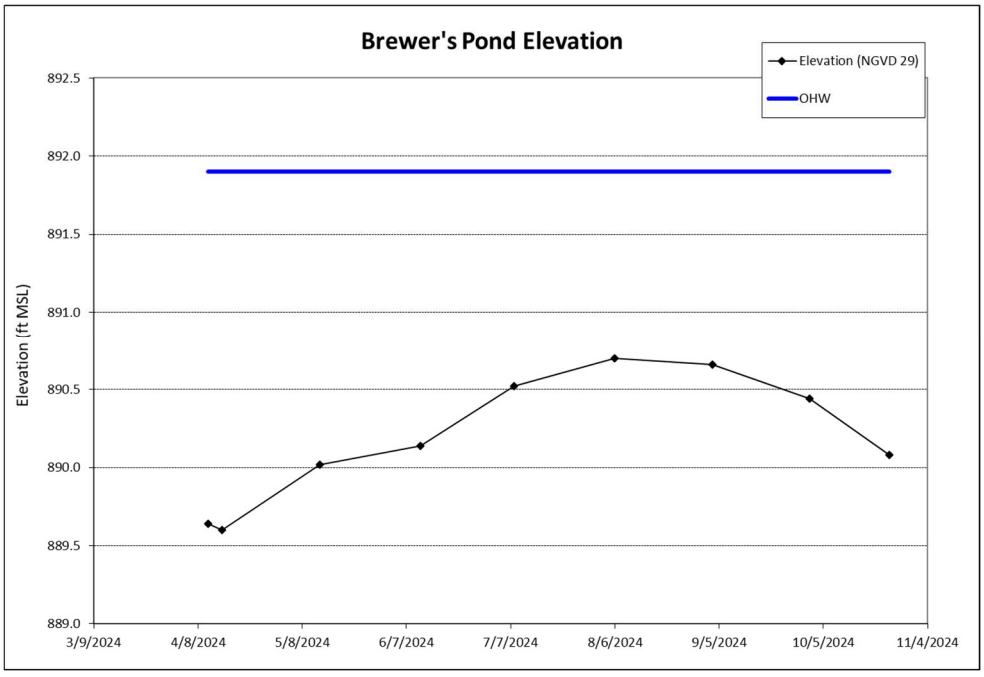
Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

Samples collected by a volunteer

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	890.70	8/6/2024	889.60	4/15/2024	890.22

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

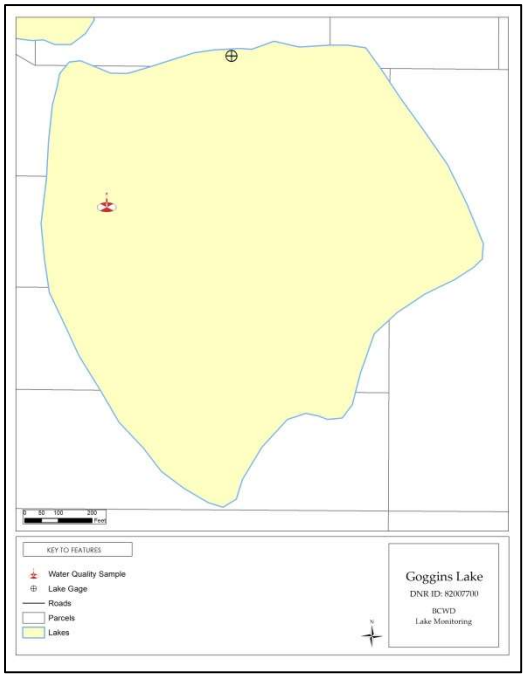


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	C	C	D	C	C	C	C	D	NA	NA
Chlorophyll-*a* (ug/l)	C	C	F	C	C	C	D	D	NA	NA
Secchi depth (ft)	D	D	F	F	D	F	F	F	NA	NA
Overall	**C-**	**C-**	**F+**	**D+**	**C-**	**D+**	**D**	**D-**	**NA**	**NA**

Goggins Lake

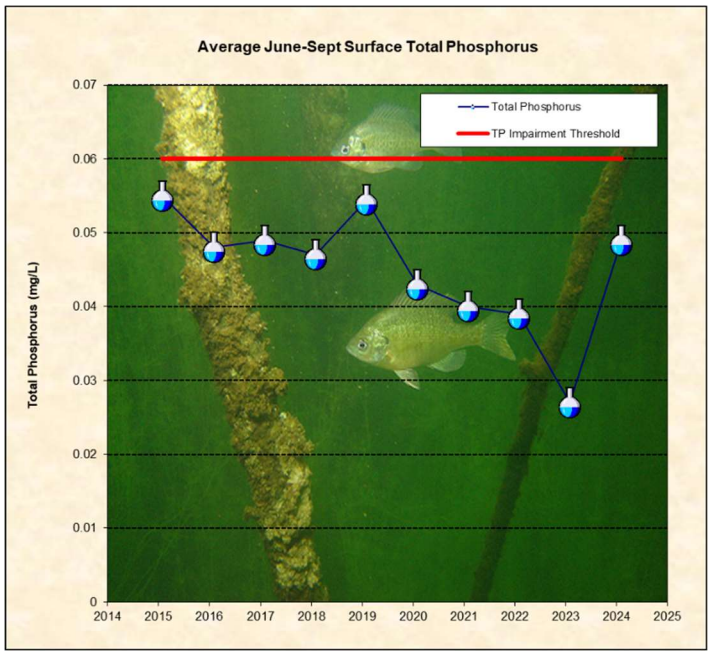
2024 Lake Grade: C

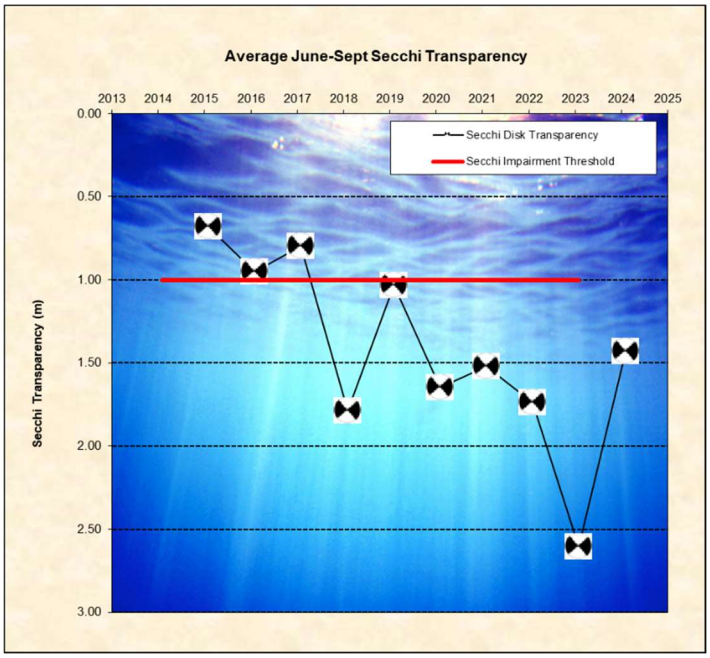
- DNR ID #: 820077
- Municipality: May Township
- Location: NW$^{1/4}$ Section 31, T31N-R20W
- Lake Size: 85 Acres
- Maximum Depth (2024): 15 ft.
- Ordinary High Water Mark: 966.50 ft.
- 100-Year High Water Level: 972.20 ft.
- 99% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus, average chlorophyll-α, and average Secchi transparency.
- The major land use is rural/agricultural.
- The lake stratified in 2024 with a thermocline around 3 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Goggins Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





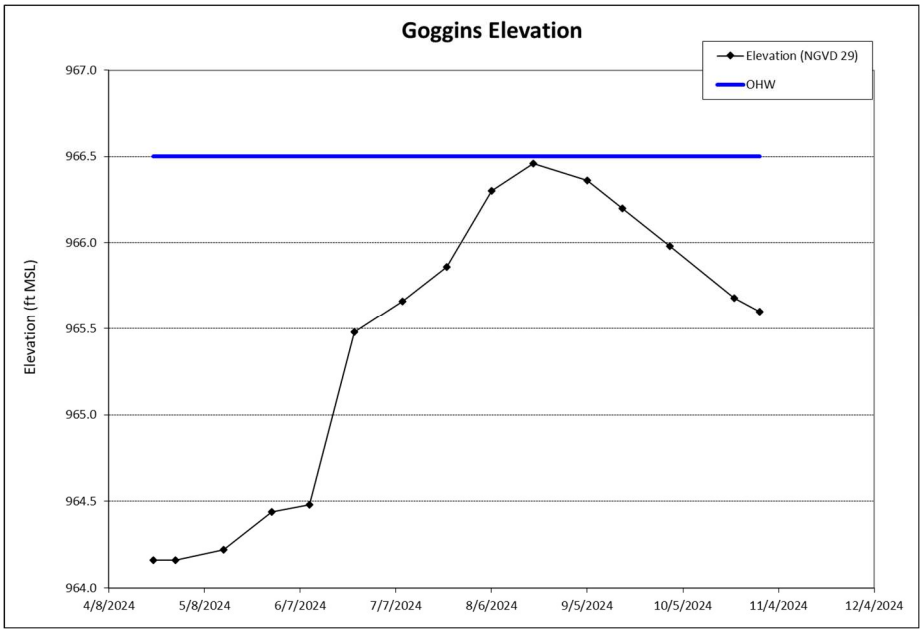
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 10:13	0.029	3.2	2.7	0.77	2.74	11.4	13.46
4/29/2024 14:00	0.038	8.0	6.7	0.95	2.13	10.7	9.74
5/14/2024 11:40	0.033	5.5	5.1	0.85	1.83	18.8	10.88
5/29/2024 14:55	0.040	5.0	4.0	0.89	2.44	21.7	9.33
6/10/2024 14:20	0.040	26.0	25.0	1.09	1.52	23.5	9.09
6/24/2024 14:03	0.067	48.0	49.0	1.30	0.76	24.6	13.62
7/9/2024 14:30	0.052	21.0	19.0	1.31	1.52	28.3	16.15
7/23/2024 13:25	0.047	14.0	13.0	1.04	1.52	25.2	9.73
8/6/2024 15:07	0.046	19.0	18.0	1.08	1.37	25.5	8.51
8/19/2024 13:40	0.047	12.0	11.0	1.15	1.98	26.4	12.91
9/5/2024 9:50	0.051	15.0	11.0	1.15	1.37	22.2	10.25
9/16/2024 13:45	0.039	12.0	11.0	1.05	1.37	24.8	16.06
10/1/2024 9:36	0.065	39.0	35.0	1.16	1.22	19.7	7.78
10/21/2024 14:17	0.047	26.0	25.0	1.13	1.37	14.4	14.07
2024 Average	0.046	18.12	16.82	1.07	1.65	21.2	11.54
2024 Summer Average	0.049	20.88	19.63	1.12	1.43	25.1	12.04

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	966.46	8/19/2024	964.16	4/29/2024	965.32

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

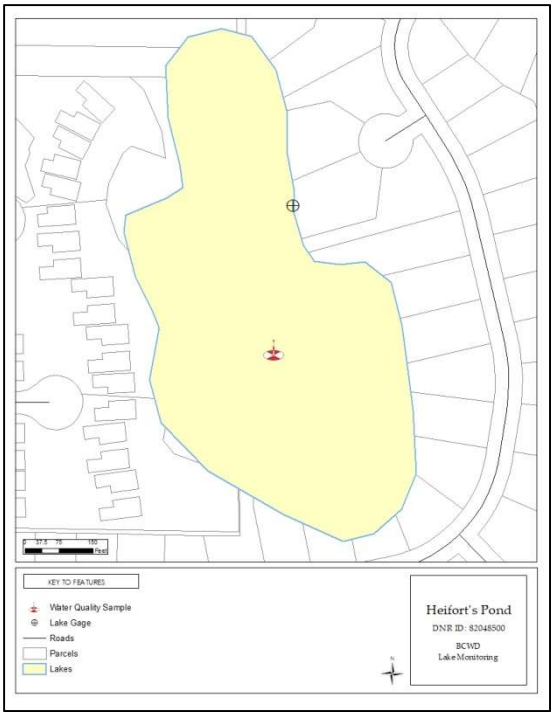


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	C	C	C	C	C	C	C	C	C	C
Chlorophyll-*a* (ug/l)	C	A	B	B	B	C	B	C	C	C
Secchi depth (ft)	C	B	C	C	C	C	C	D	D	F
Overall	**C**	**B**	**C+**	**C+**	**C+**	**C**	**C+**	**C-**	**C-**	**D+**

Heifort's Pond

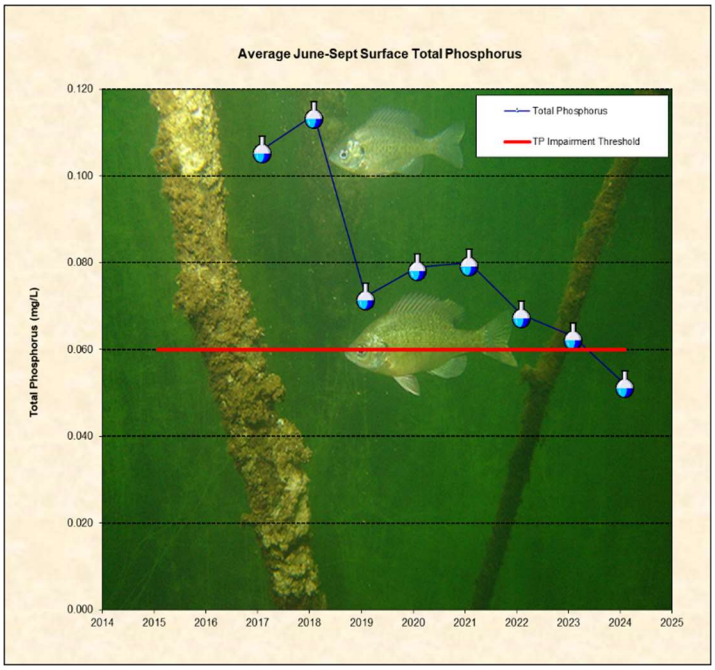
2024 Lake Grade: D+

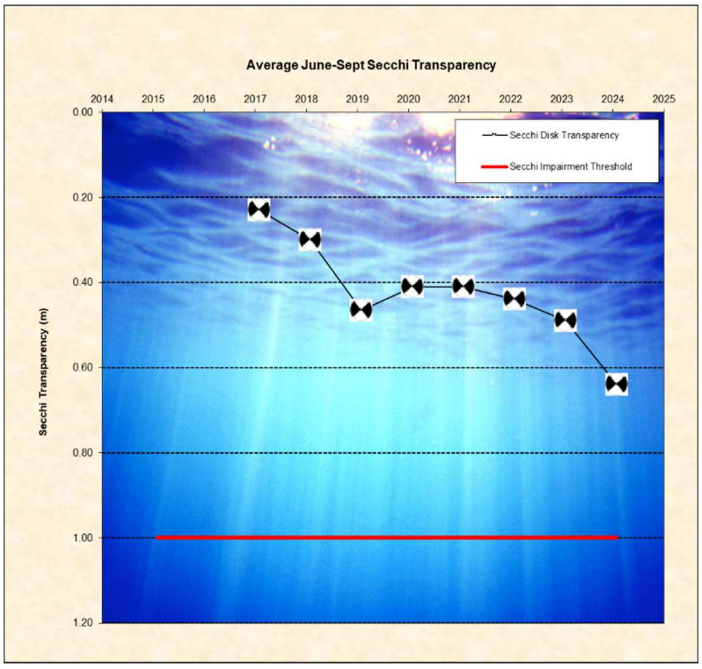
- DNR ID #: 820485
- Municipality: City of Stillwater
- Location: NW$^{1/4}$ Section 20, T30N-R20W
- Lake Size: 6 Acres
- Maximum Depth (2024): 8 ft.
- Ordinary High Water Mark: 883.9 ft.
- 100-Year High Water Level: 885.42 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and average chlorophyll-α, and no trend for the average Secchi transparency.
- The major land use is urban/residential.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.



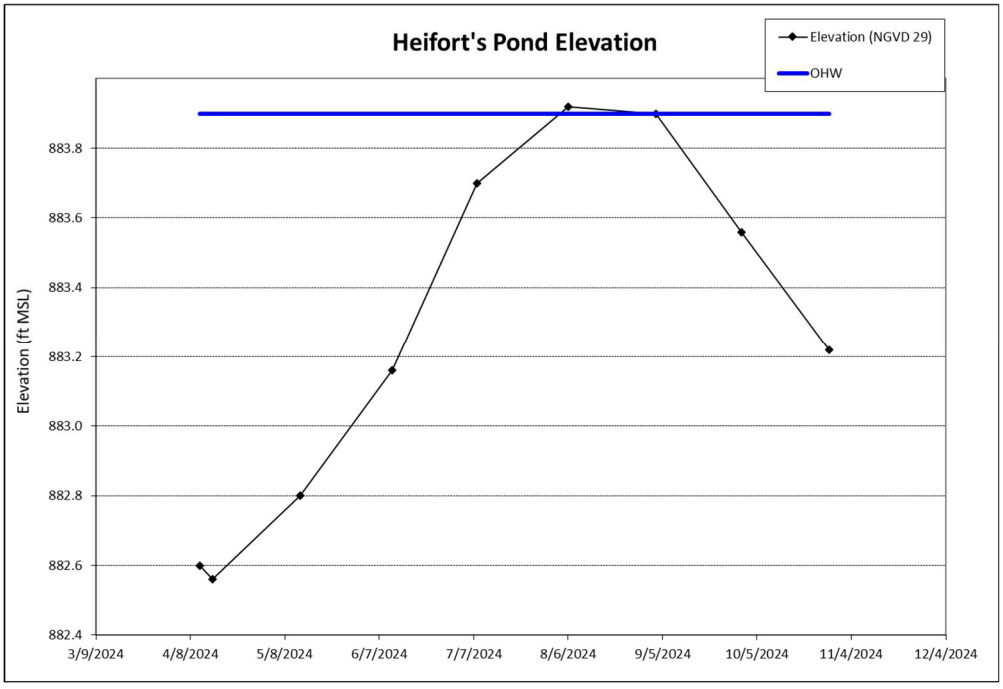


Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/24 13:40	0.068	46.0	46.0	2.44	0.30	16.1	16.41
5/1/24 15:51	0.063	40.0	36.0	1.80	0.60	16.0	NA
5/13/24 13:40	0.057	25.0	24.0	1.94	0.46	21.1	10.03
5/29/24 12:27	0.058	34.0	32.0	1.85	0.70	21.2	NA
6/11/24 12:58	0.041	25.0	24.0	1.60	0.61	22.4	9.80
6/26/24 11:15	0.039	20.0	18.0	1.31	1.00	26.1	NA
7/8/24 10:45	0.029	13.0	13.0	1.35	0.91	25.1	11.98
7/23/24 12:43	0.053	34.0	33.0	1.53	1.00	25.9	NA
8/6/24 11:20	0.058	64.0	59.0	1.86	0.30	23.8	8.40
8/20/24 11:40	0.054	46.0	47.0	1.71	0.70	24.7	NA
9/3/24 12:25	0.070	89.0	85.0	2.18	0.30	23.0	14.38
9/22/24 11:30	0.068	61.0	60.0	2.29	0.50	21.0	NA
9/30/24 12:45	0.059	50.0	48.0	2.08	0.46	20.9	15.44
10/16/24 12:17	0.062	40.0	36.0	1.94	0.60	11.9	NA
2024 Average	0.056	41.9	40.1	1.85	0.60	21.4	12.35
2024 Summer Average	0.052	44.7	43.0	1.77	0.64	23.7	12.00

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*
Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*
Samples collected by a volunteer

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	883.92	8/6/2024	882.56	4/15/2024	883.28

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

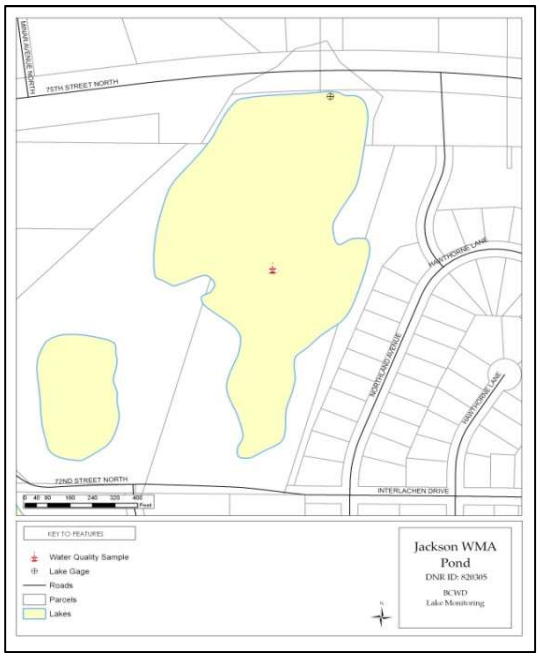


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	C	C	D	D	D	D	D	D	NA	NA
Chlorophyll-*a* (ug/l)	C	D	D	F	D	D	F	F	NA	NA
Secchi depth (ft)	F	F	F	F	F	F	F	F	NA	NA
Overall	**D+**	**D**	**D-**	**F+**	**D-**	**D-**	**F+**	**F+**	**NA**	**NA**

Jackson WMA (Sinnits) Pond

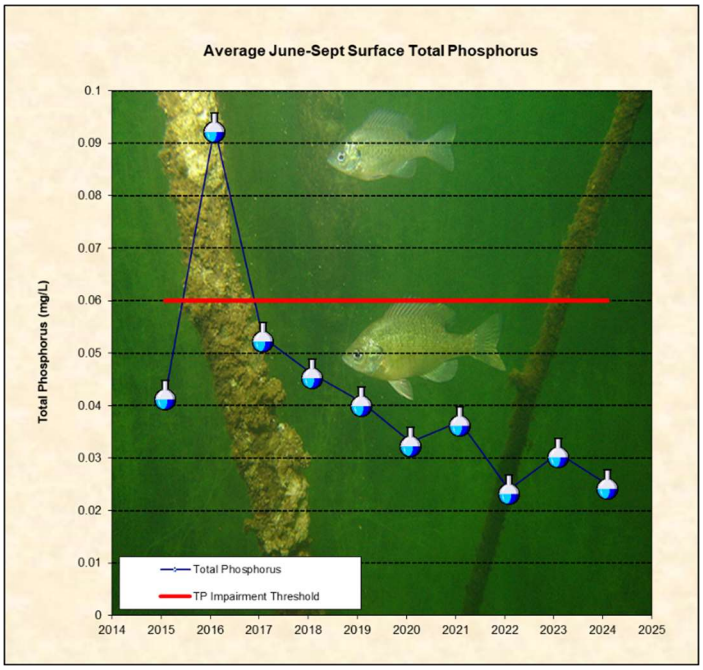
2024 Lake Grade: B

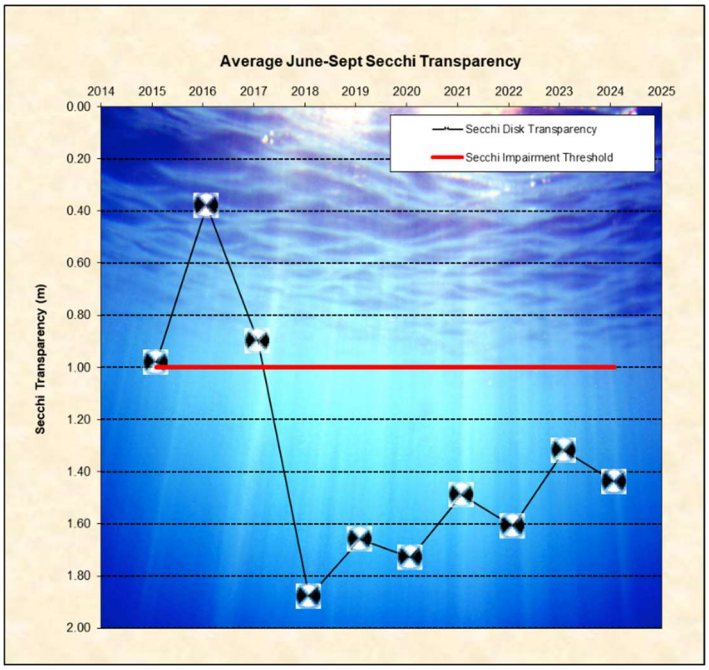
- DNR ID #: 820305
- Municipality: City of Stillwater
- Location: SE$^{1/4}$ Section 30, T30N-R20W
- Lake Size: 14.3 Acres
- Maximum Depth (2024): 7 ft.
- Ordinary High Water Mark: NA
- 100-Year High Water Level: NA
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for average total phosphorus and for average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is urban/residential.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





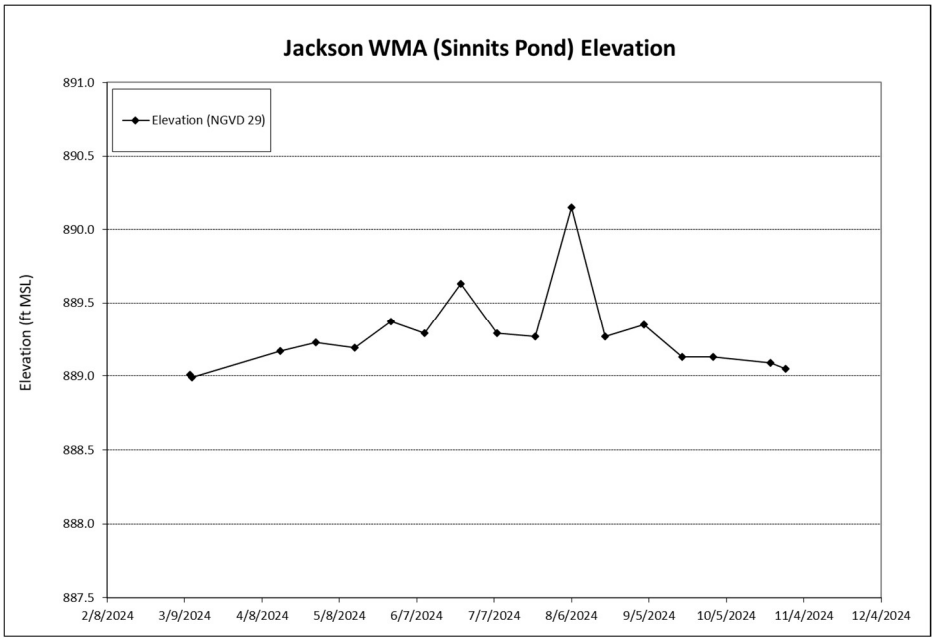
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 15:25	0.024	2.4	2.1	0.58	2.13	15.6	13.96
4/29/2024 15:10	0.023	4.3	2.9	0.53	1.83	11.8	9.54
5/14/2024 13:16	0.030	2.8	2.4	0.60	2.13	20.8	9.34
5/28/2024 11:38	0.032	5.9	5.1	0.65	1.83	19.3	6.93
6/10/2024 15:27	0.031	3.3	2.9	0.68	1.98	24.0	8.33
6/24/2024 13:28	0.033	3.3	2.9	0.67	1.68	24.8	7.22
7/8/2024 12:51	0.027	2.5	2.4	0.54	1.52	25.4	17.24
7/23/2024 15:12	0.021	2.4	2.7	0.53	1.07	25.9	15.42
8/6/2024 13:40	0.032	4.1	3.2	0.52	2.29	25.2	8.08
8/19/2024 14:45	0.024	1.2	1.0	0.61	0.76	27.3	15.80
9/3/2024 13:50	0.020	1.3	1.6	0.50	1.07	22.9	15.61
9/18/2024 14:03	0.019	2.0	1.9	0.54	0.91	24.7	16.73
9/30/2024 14:05	0.017	2.3	1.6	0.49	1.68	21.5	12.54
10/22/2024 11:34	0.018	3.1	2.7	0.53	1.68	14.5	13.29
2024 Average	0.025	2.9	2.5	0.57	1.61	21.7	12.15
2024 Summer Average	0.025	2.5	2.2	0.56	1.44	24.6	13.00

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	890.15	8/6/2024	888.99	3/12/2024	889.30

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

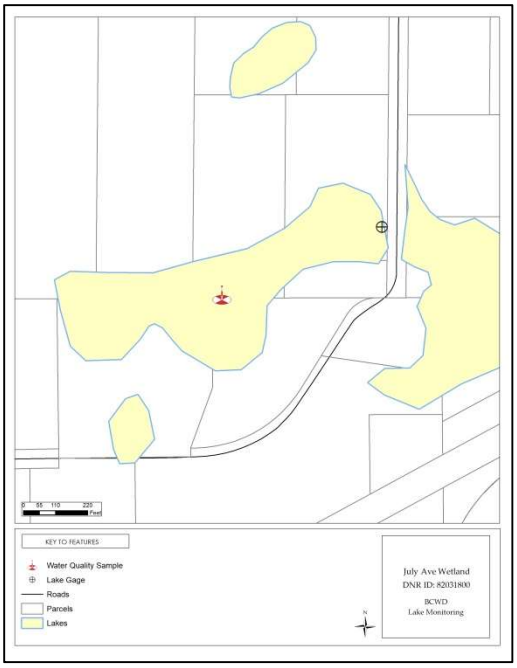


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	B	B	C	C	C	C	C	D	C
Chlorophyll-*a* (ug/l)	A	A	A	A	A	C	A	B	F	B
Secchi depth (ft)	C	C	C	C	C	C	C	D	F	D
Overall	**B**	**B**	**B**	**B-**	**B-**	**C**	**B-**	**C**	**F+**	**C**

July Ave Wetland

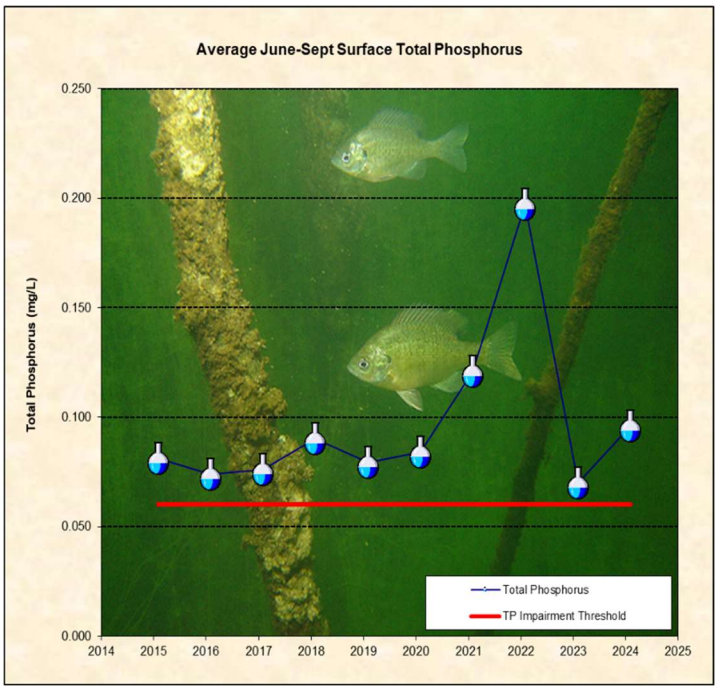
2024 Lake Grade: D

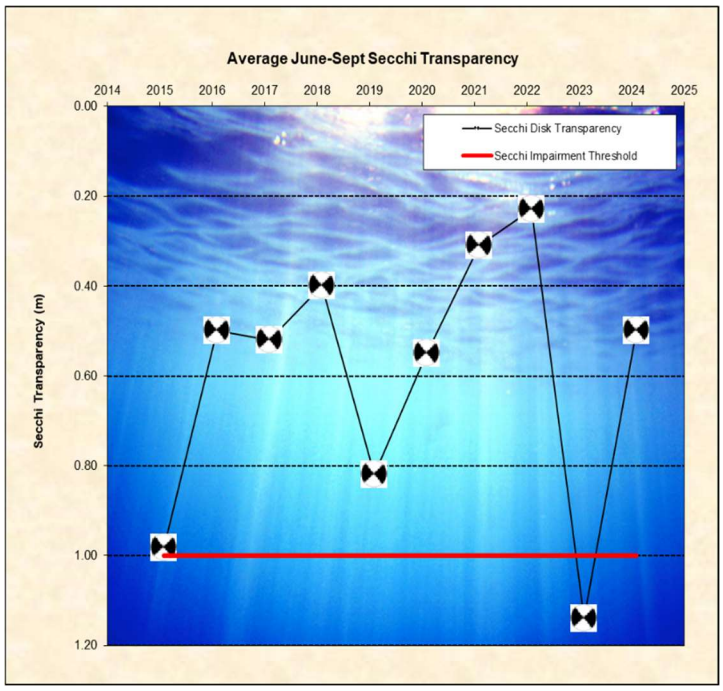
- DNR ID #: 820318
- Municipality: City of Grant
- Location: Section 3, T30N-R21W
- Lake Size: 12 Acres
- Maximum Depth (2024): 9 ft.
- Ordinary High Water Mark: NA
- 100-Year High Water Level: 979.20 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **declining** trend for the average Secchi transparency, and no trend for average total phosphorus and average chlorophyll-α.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.





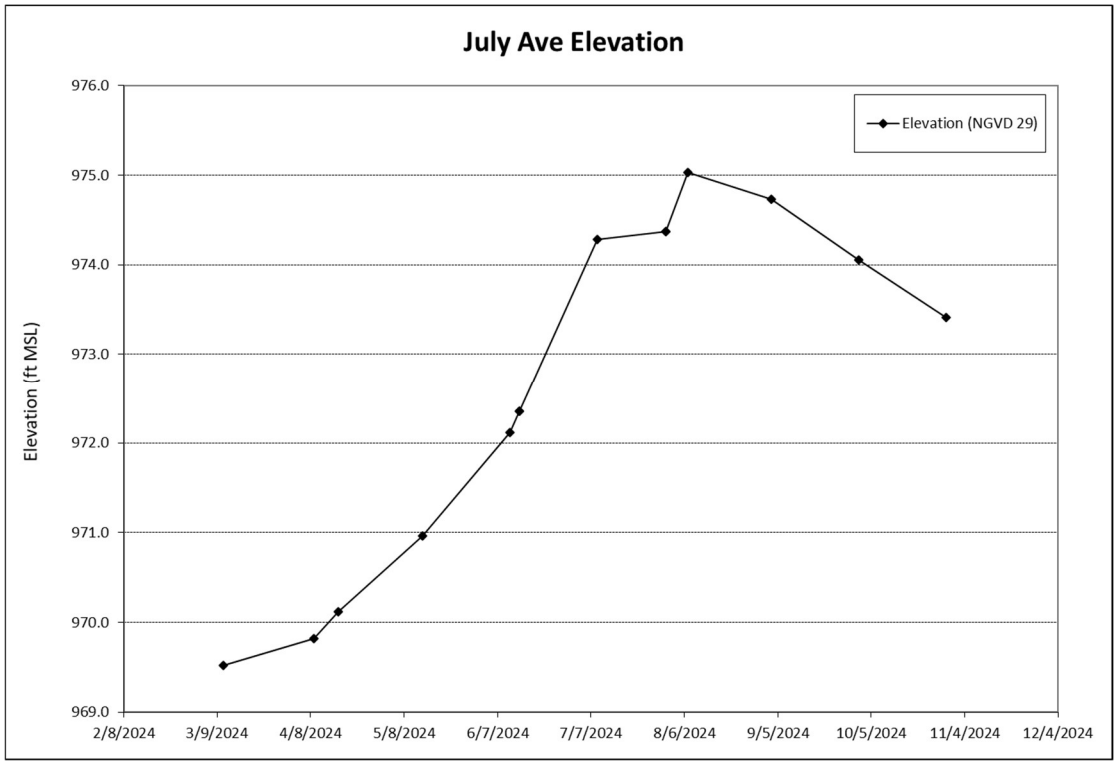
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 10:38	0.047	4.6	3.2	0.95	1.22	11.2	12.87
5/14/2024 8:33	0.064	13.0	12.0	1.13	1.07	19.7	8.53
6/11/2024 10:54	0.114	94.0	90.0	2.29	0.46	21.8	13.00
7/9/2024 10:52	0.105	130.0	130.0	3.10	0.30	26.3	21.23
8/7/2024 13:06	0.083	37.0	35.0	1.73	0.61	25.0	11.60
9/3/2024 11:11	0.080	48.0	37.0	1.70	0.61	22.3	9.78
10/1/2024 11:38	0.100	120.0	110.0	1.76	0.46	18.9	7.61
2024 Average	0.085	63.8	59.6	1.81	0.68	20.7	12.09
2024 Summer Average	0.096	77.3	73.0	2.21	0.50	23.9	13.90

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	975.03	8/7/2024	969.52	3/11/2024	972.50

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

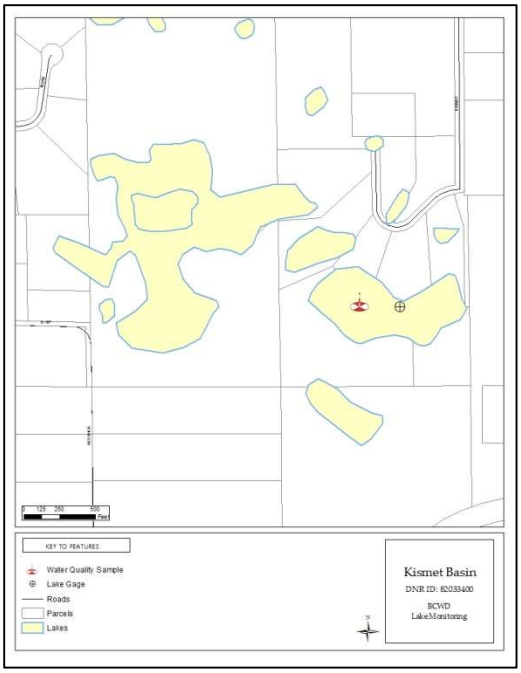


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	D	C	F	D	D	D	D	C	D	D
Chlorophyll-*a* (ug/l)	D	C	F	F	D	D	D	D	D	D
Secchi depth (ft)	D	C	F	F	F	D	F	F	F	F
Overall	**D**	**C**	**F**	**F+**	**D-**	**D**	**D-**	**D**	**D-**	**D-**

Kismet Basin

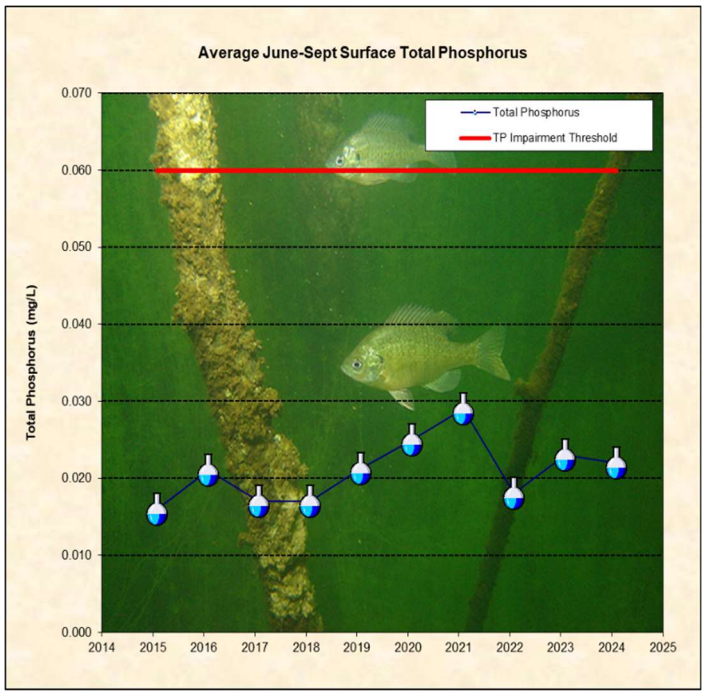
2024 Lake Grade: B+

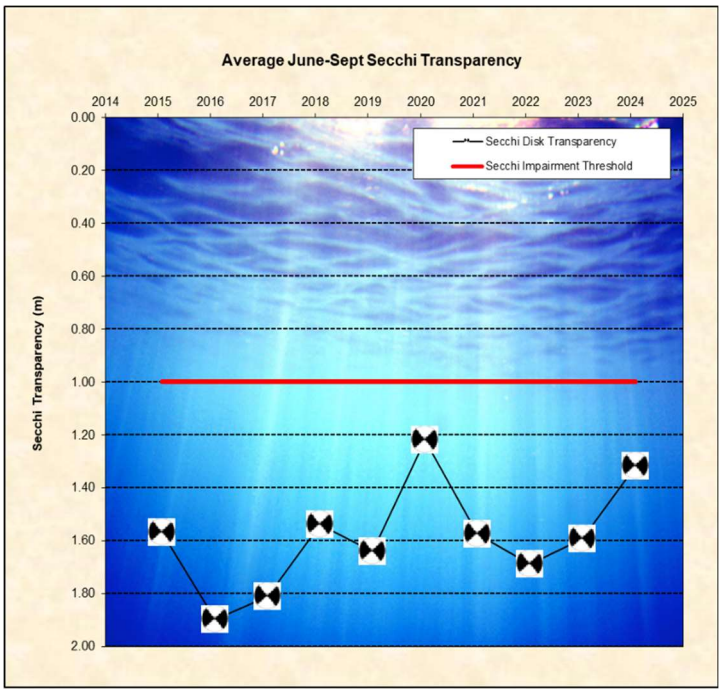
- DNR ID #: 820334
- Municipality: City of Grant
- Location: $S^{1/2}$ Section 11, T30N-R21W
- Lake Size: 70 Acres
- Maximum Depth (2024): 11 ft.
- Ordinary High Water Mark: 943.50 ft.
- 100-Year High Water Level: 944.90 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and the average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





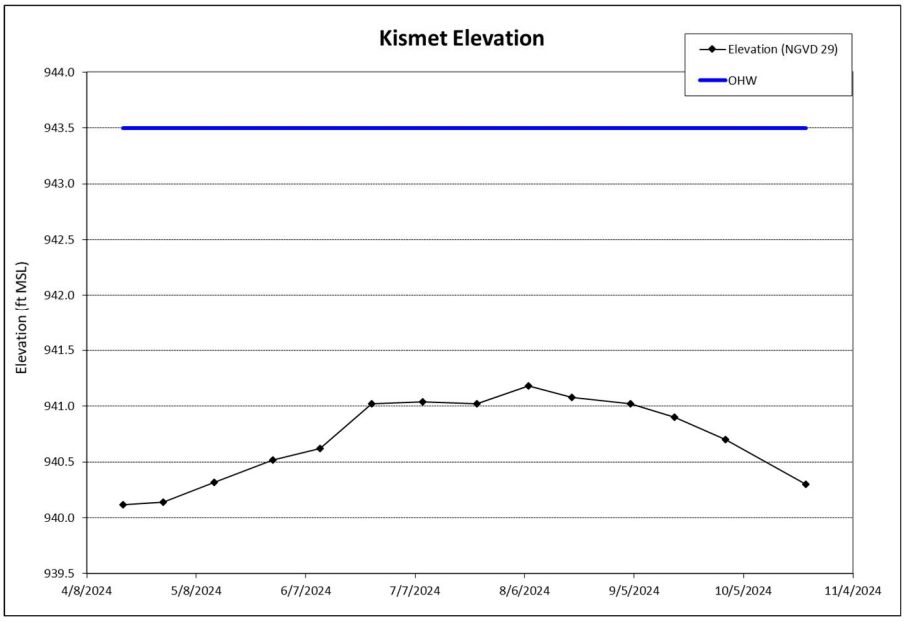
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 13:00	0.023	7.2	5.3	0.53	1.98	12.1	10.86
4/29/2024 11:55	0.017	3.9	3.5	0.46	1.83	11.4	7.98
5/13/2024 12:24	0.024	6.1	5.1	0.58	1.58	20.6	9.05
5/29/2024 11:45	0.021	4.9	4.0	0.60	1.07	19.9	8.19
6/11/2024 14:00	0.031	12.0	11.0	0.76	1.22	22.5	10.13
6/25/2024 9:09	0.025	11.0	10.0	1.77	0.76	24.4	10.39
7/9/2024 10:03	0.020	3.7	2.9	0.62	1.07	24.8	10.90
7/24/2024 10:09	0.028	19.0	17.0	0.49	1.07	23.6	5.21
8/7/2024 10:10	0.022	7.8	7.2	0.64	1.22	22.6	4.75
8/19/2024 10:50	0.022	7.2	6.7	0.67	1.37	23.6	9.40
9/4/2024 11:00	0.019	6.6	5.3	0.56	1.52	21.4	5.80
9/16/2024 10:38	0.017	3.5	2.1	0.59	1.83	23.2	9.57
9/30/2024 11:01	0.018	9.1	7.7	0.53	1.83	20.2	6.73
10/22/2024 9:36	0.022	9.8	8.5	0.64	1.83	13.7	10.59
2024 Average	0.022	8.0	6.9	0.67	1.44	20.3	8.54
2024 Summer Average	0.022	8.9	7.8	0.74	1.32	22.9	8.10

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	941.18	8/7/2024	940.12	4/18/2024	940.74

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

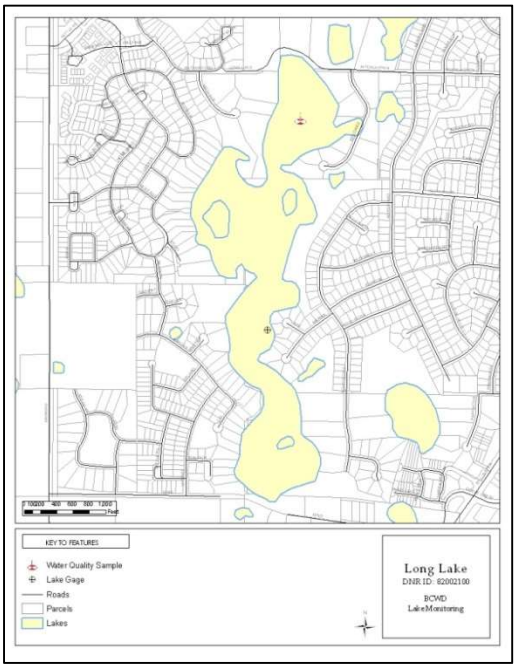


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	A	B	A	B	B	A	A	A	B	A
Chlorophyll-*a* (ug/l)	A	A	A	C	A	A	A	A	A	B
Secchi depth (ft)	C	C	C	C	C	C	C	C	C	C
Overall	**B+**	**B**	**B+**	**C+**	**B**	**B+**	**B+**	**B+**	**B**	**B**

Long Lake

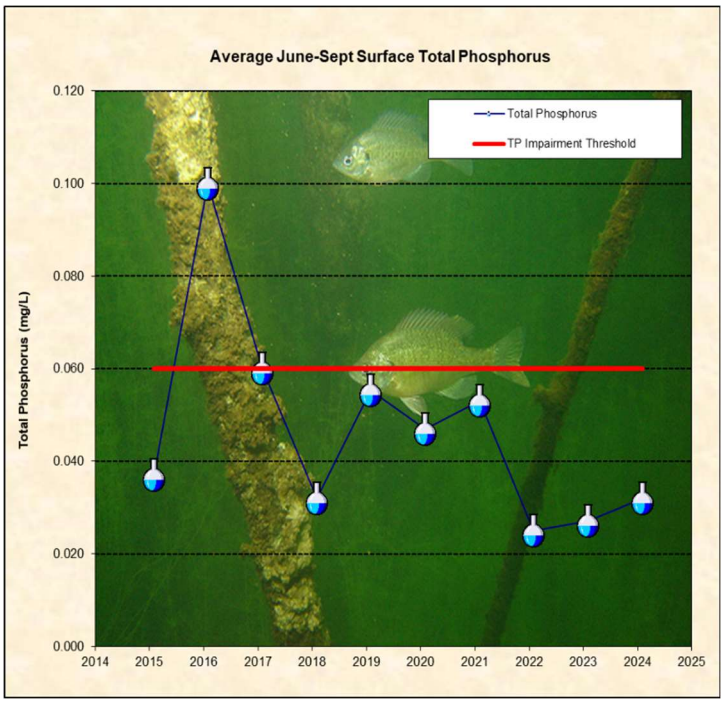
2024 Lake Grade: B

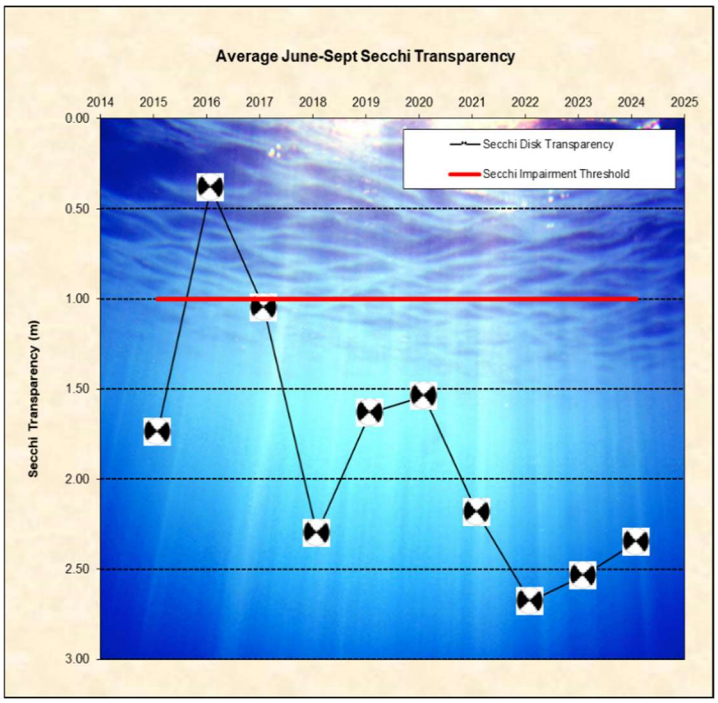
- DNR ID #: 820021
- Municipality: City of Stillwater
- Location: Section 30, T30N-R20W
- Lake Size: 110 Acres
- Maximum Basin Depth (2024): 21 ft.
- Ordinary High Water Mark: 891.50 ft.
- 100-Year High Water Level: 893.20 ft.
- 95% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as mesotrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average Secchi transparency, average chlorophyll-α, and average total phosphorus.
- The major land use is urban/residential.
- The lake stratified in 2024 with a thermocline around 2 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Long Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.





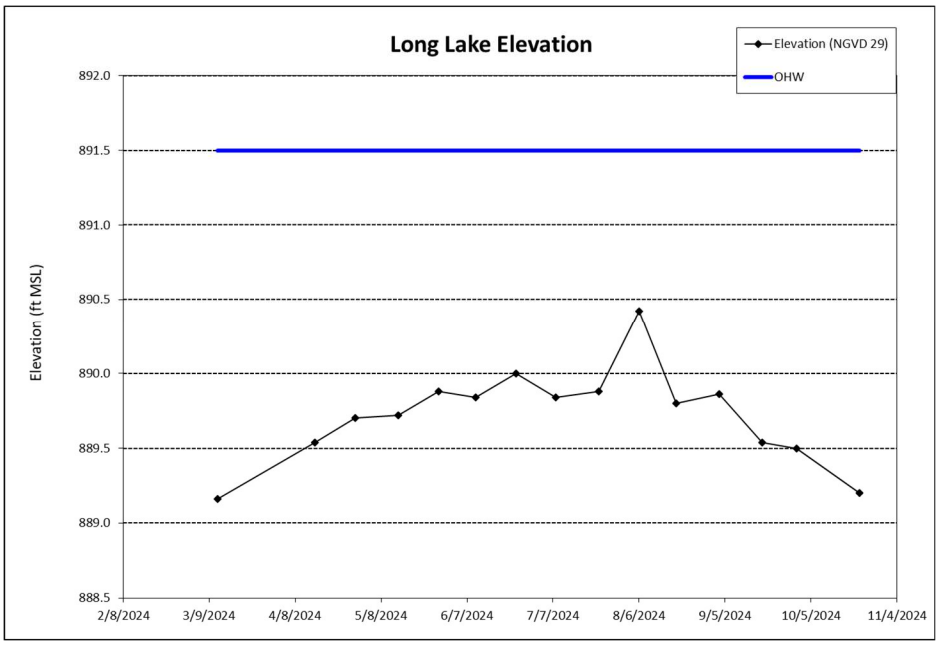
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 14:55	0.020	2.6	1.3	0.64	4.88	14.8	15.03
4/29/2024 14:47	0.020	3.4	2.4	0.49	3.81	11.8	9.48
5/14/2024 12:54	0.027	2.3	2.1	0.59	2.90	20.2	9.55
5/28/2024 10:40	0.044	9.1	8.0	0.67	1.52	19.3	6.52
6/10/2024 15:03	0.040	3.8	3.5	0.68	2.29	24.5	7.48
6/24/2024 13:05	0.045	8.6	6.9	3.69	1.52	24.6	8.97
7/8/2024 12:28	0.034	4.1	3.7	0.76	2.59	25.6	12.41
7/23/2024 14:15	0.026	4.9	4.8	0.44	2.13	26.1	11.31
8/6/2024 13:14	0.030	5.3	5.6	0.60	2.44	25.3	8.42
8/19/2024 14:24	0.032	6.8	6.1	0.64	2.44	26.3	13.51
9/3/2024 13:25	0.034	8.6	7.7	0.54	2.44	22.8	13.18
9/18/2024 13:40	0.021	2.6	2.4	0.50	2.59	24.2	14.97
9/30/2024 13:40	0.025	4.2	3.5	0.50	2.74	21.5	11.36
10/22/2024 11:05	0.027	10.0	9.6	0.59	2.59	14.2	13.11
2024 Average	0.030	5.5	4.8	0.81	2.63	21.5	11.09
2024 Summer Average	0.032	5.4	4.9	0.93	2.35	24.5	11.29

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	890.42	8/6/2024	889.16	3/12/2024	889.76

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

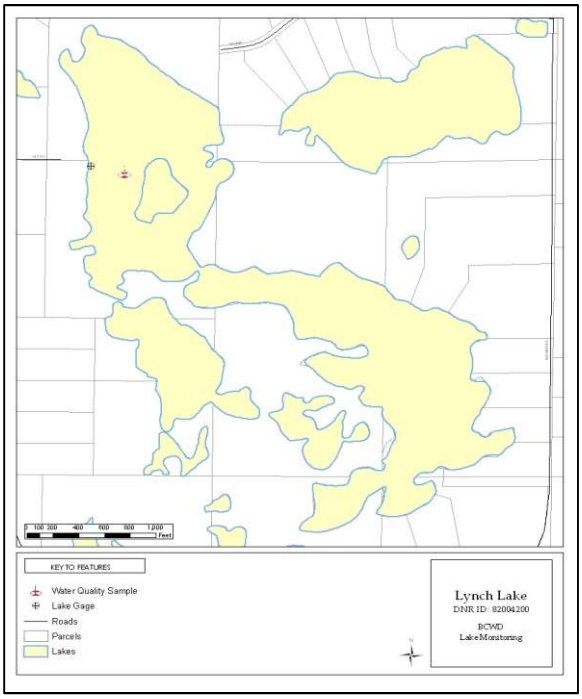


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	C	B	B	C	C	C	C	C	D	C
Chlorophyll-*a* (ug/l)	A	A	A	A	B	C	A	B	F	B
Secchi depth (ft)	B	B	B	B	C	C	B	D	F	C
Overall	**B**	**B+**	**B+**	**B**	**C+**	**C**	**B**	**C**	**F+**	**C+**

Lynch Lake – North Basin

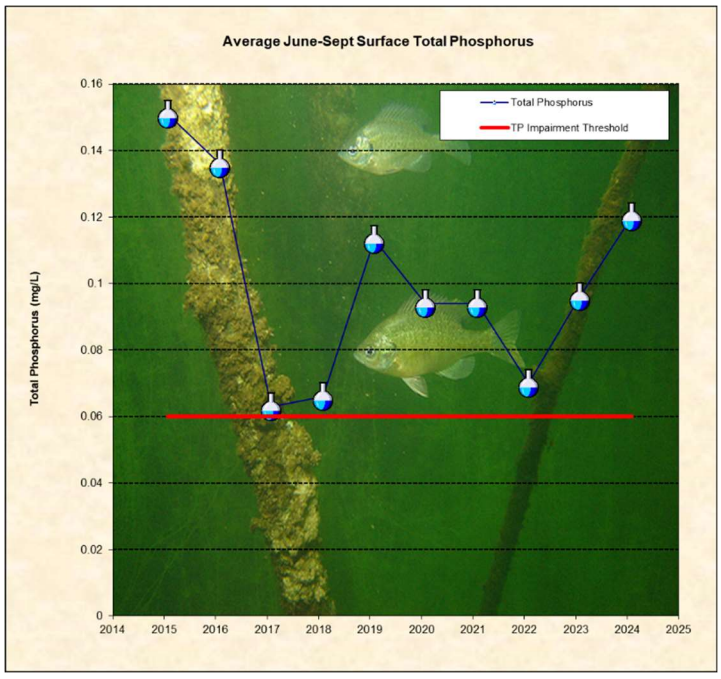
2024 Lake Grade: D

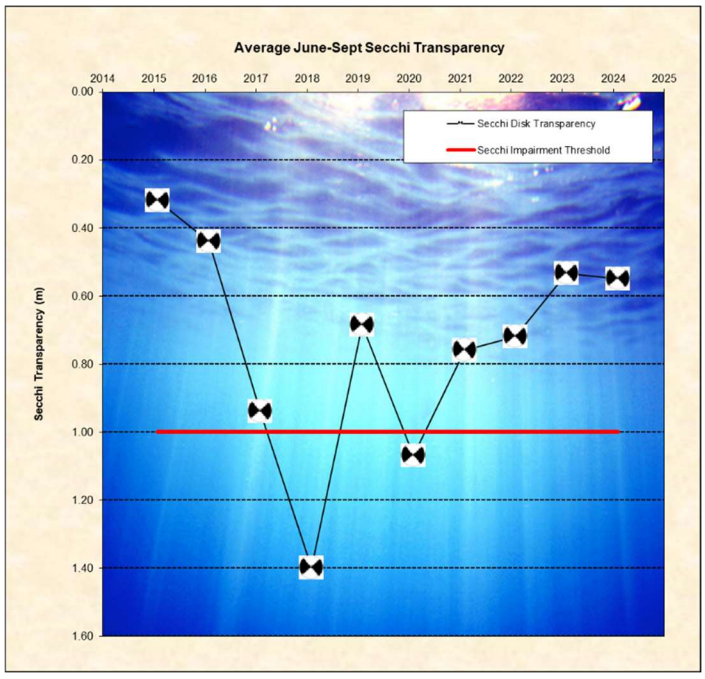
- DNR ID #: 820042
- Municipality: May Township
- Location: Section 30, T31N-R20W
- Lake Size: 87 Acres
- Maximum Depth (2024): 6 ft.
- Ordinary High Water Mark: 1005.30 ft.
- 100-Year High Water Level: 1008.10 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average Secchi transparency, average chlorophyll-α, and average total phosphorus.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lynch Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.





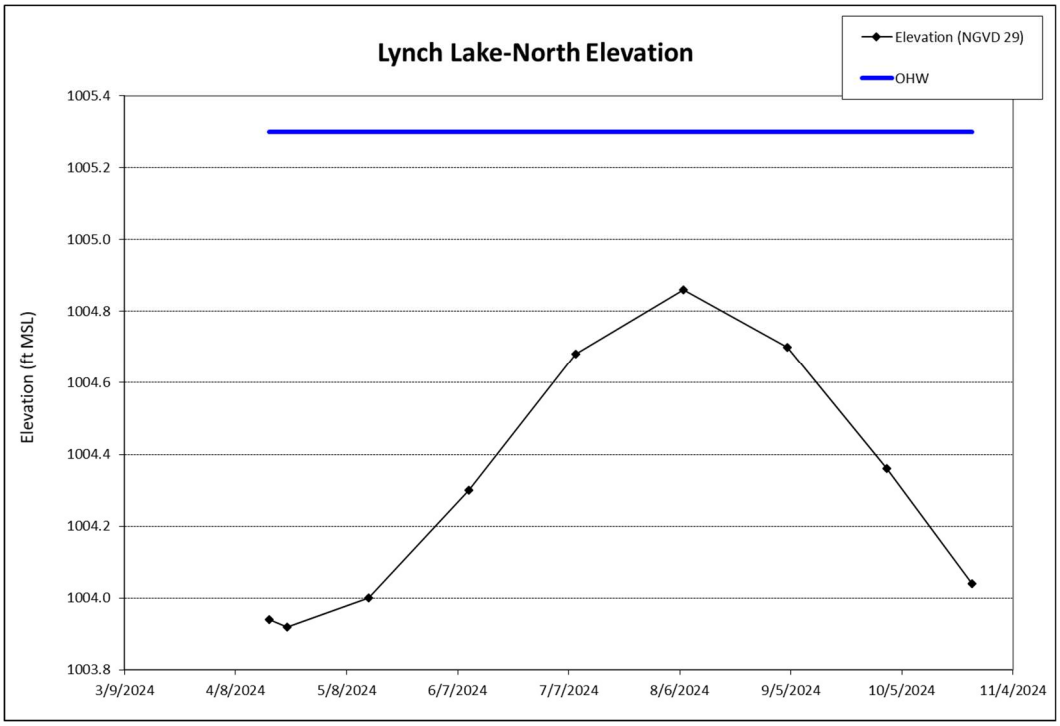
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 11:02	0.126	43.0	34.0	1.46	0.61	11.1	12.43
5/14/2024 9:00	0.126	54.0	48.0	1.70	0.30	18.7	8.92
6/10/2024 11:08	0.214	110.0	100.0	3.14	0.06	22.5	11.03
7/9/2024 11:12	0.083	16.0	14.0	1.27	0.76	24.8	14.09
8/7/2024 11:11	0.092	38.0	36.0	1.47	0.76	22.8	9.73
9/4/2024 9:48	0.089	42.0	37.0	1.36	0.61	20.4	11.05
10/1/2024 10:40	0.074	29.0	24.0	1.25	0.76	18.3	8.06
2024 Average	0.115	47.4	41.9	1.66	0.55	19.8	10.76
2024 Summer Average	0.120	51.5	46.8	1.81	0.55	22.6	11.48

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	1004.86	8/7/2024	1003.92	4/22/2024	1004.34

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

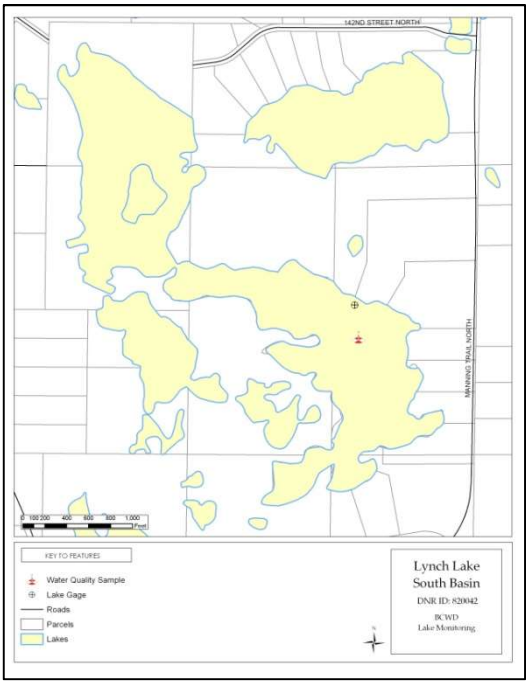


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	D	D	D	D	D	D	C	C	D	D
Chlorophyll-*a* (ug/l)	C	D	C	C	C	D	B	C	D	F
Secchi depth (ft)	F	D	D	D	D	D	C	D	F	F
Overall	**D**	**D**	**D+**	D+	D+	D	C+	C-	D-	F+

Lynch Lake – South Basin

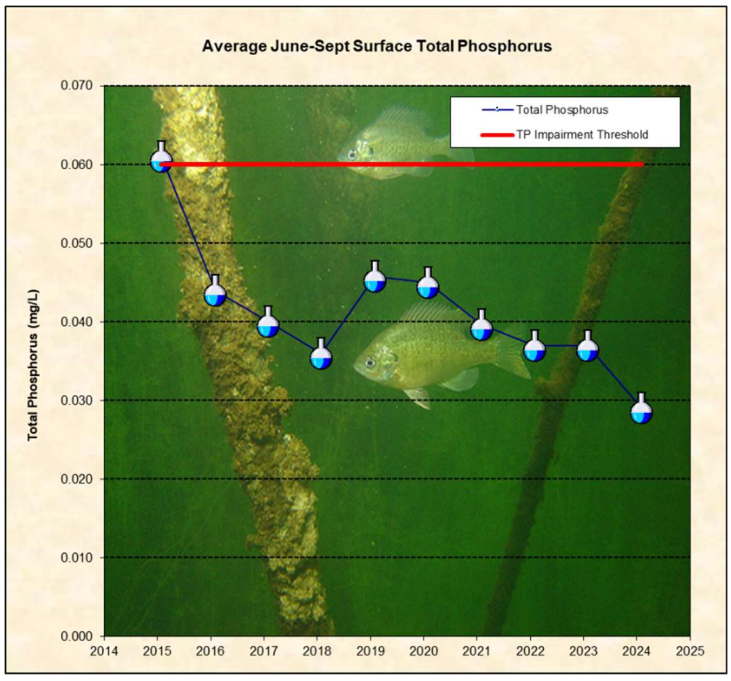
2024 Lake Grade: B

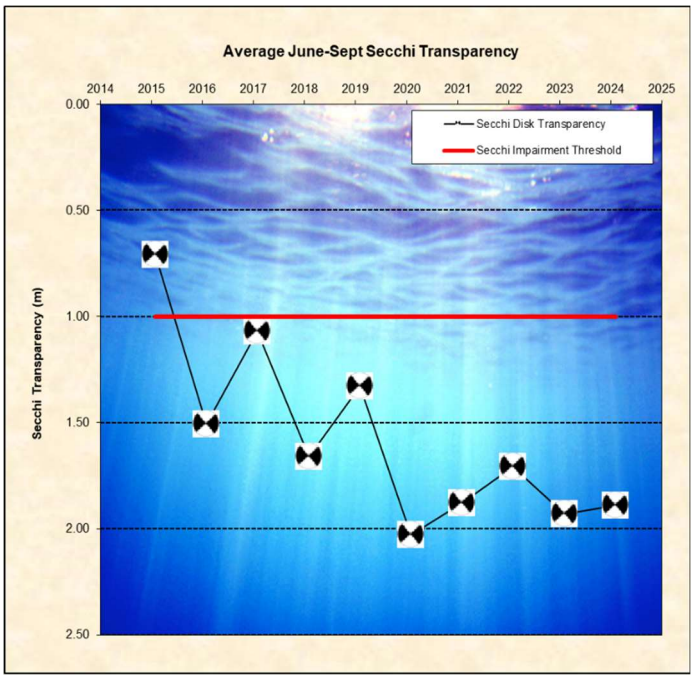
- DNR ID #: 820042
- Municipality: May Township
- Location: Section 30, T31N-R20W
- Lake Size: 87 Acres
- Maximum Depth (2024): 16 ft.
- Ordinary High Water Mark: 1005.30 ft.
- 100-Year High Water Level: 1008.10 ft.
- 99% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average Secchi transparency, average chlorophyll-α, and average total phosphorus.
- The major land use is rural/agricultural.
- The lake stratified in 2024 with the thermocline around 3 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lynch Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.





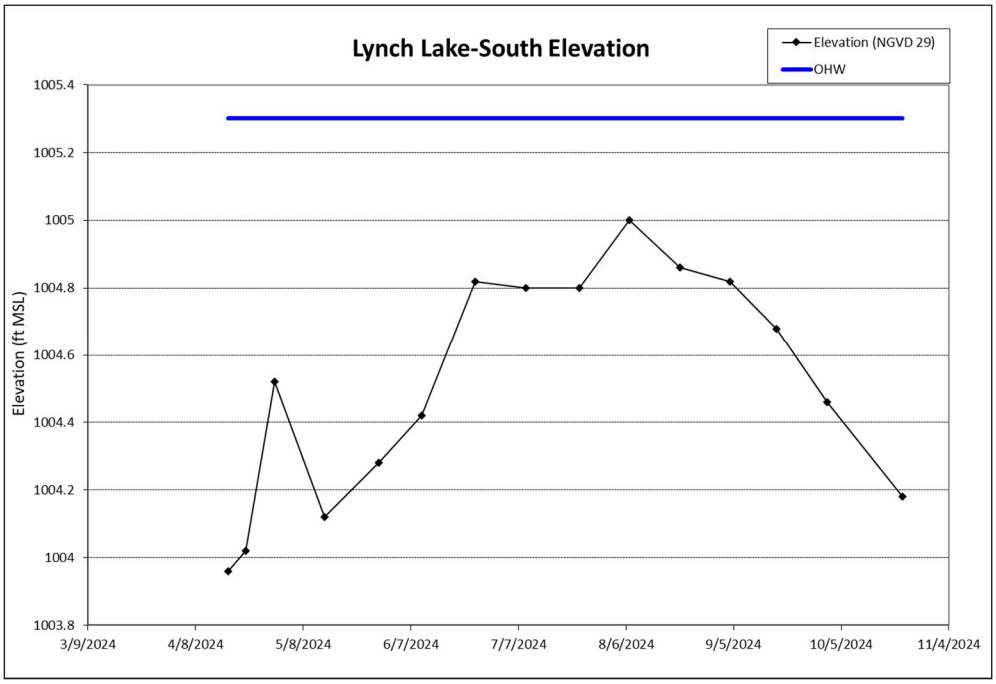
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 11:30	0.029	8.9	7.2	0.74	2.59	11.6	14.16
4/30/2024 9:14	0.036	7.8	6.4	0.76	2.44	11.2	9.71
5/14/2024 9:30	0.036	4.8	4.3	0.82	2.44	18.9	8.77
5/29/2024 13:10	0.036	8.3	6.9	0.80	1.98	20.6	8.91
6/10/2024 11:38	0.040	10.0	9.1	0.83	1.98	22.9	8.44
6/25/2024 10:52	0.036	10.0	9.6	1.30	1.68	24.5	10.71
7/9/2024 11:36	0.026	6.0	5.1	0.72	2.13	26.0	12.51
7/24/2024 10:45	0.025	9.4	8.8	0.68	1.98	25.3	10.72
8/7/2024 10:45	0.024	12.0	10.0	0.83	1.98	24.5	9.82
8/21/2024 10:40	0.030	9.1	7.5	0.85	1.83	23.9	10.50
9/4/2024 10:20	0.028	3.7	3.2	0.82	1.52	22.3	13.53
9/17/2024 8:54	0.024	6.2	4.5	0.73	1.98	23.4	13.04
10/1/2024 11:09	0.031	14.0	12.0	0.71	1.52	19.9	8.36
10/22/2024 10:18	0.026	9.0	8.0	0.81	2.13	14.0	11.70
2024 Average	0.031	8.5	7.3	0.81	2.01	20.6	10.78
2024 Summer Average	0.029	8.3	7.2	0.85	1.89	24.1	11.16

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	1005.00	8/7/2024	1003.96	4/17/2024	1004.51

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

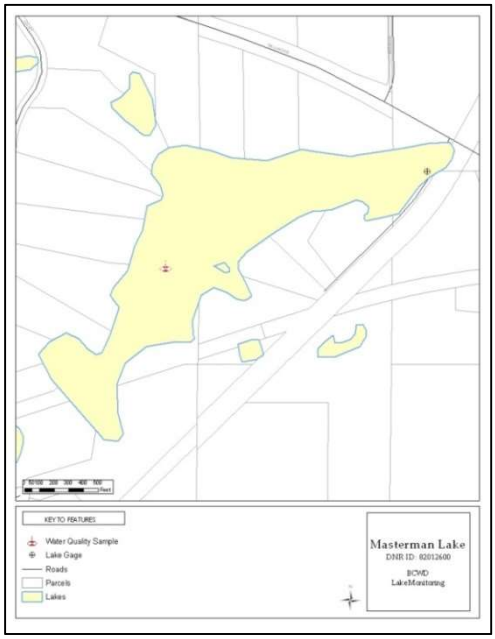


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	C	C	C	C	C	C	C	C	C
Chlorophyll-*a* (ug/l)	A	B	B	B	A	C	B	B	C	C
Secchi depth (ft)	C	C	C	C	C	C	C	D	C	D
Overall	**B**	**C+**	**C+**	**C+**	**B-**	**C**	**C+**	**C**	**C**	**C-**

Masterman Lake

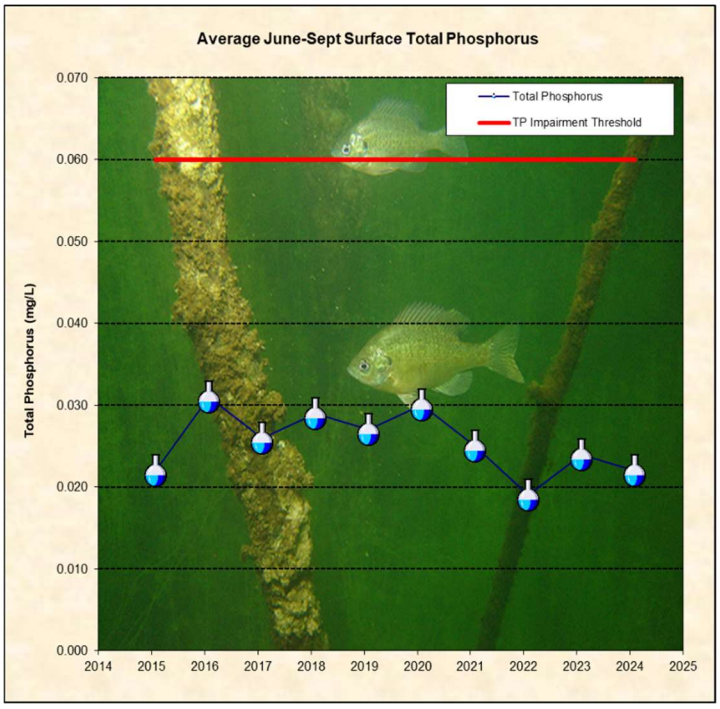
2024 Lake Grade: B+

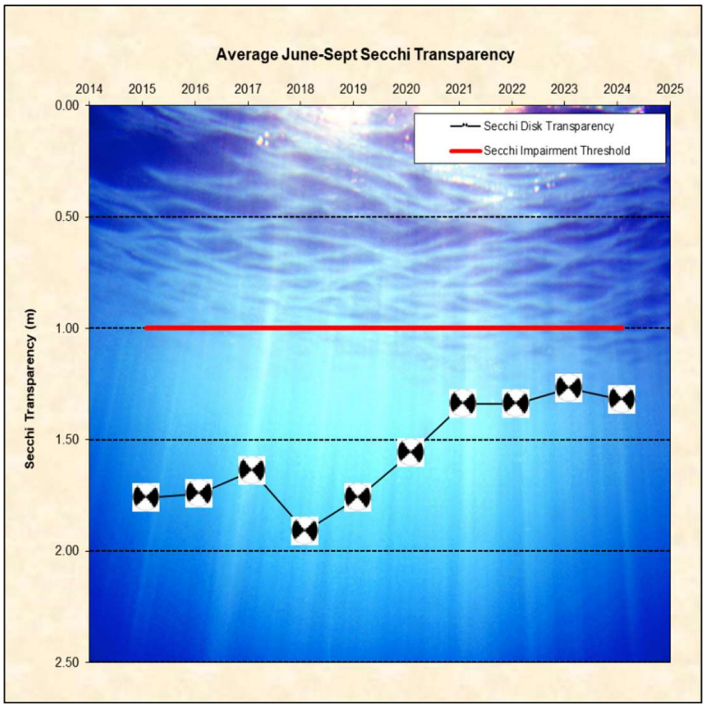
- DNR ID #: 820126
- Municipality: City of Grant
- Location: Section 23, T30N-R21W
- Lake Size: 40 Acres
- Maximum Depth (2024): 7 ft.
- Ordinary High Water Mark: 955.70 ft.
- 100-Year High Water Level: 955.90 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as mesotrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





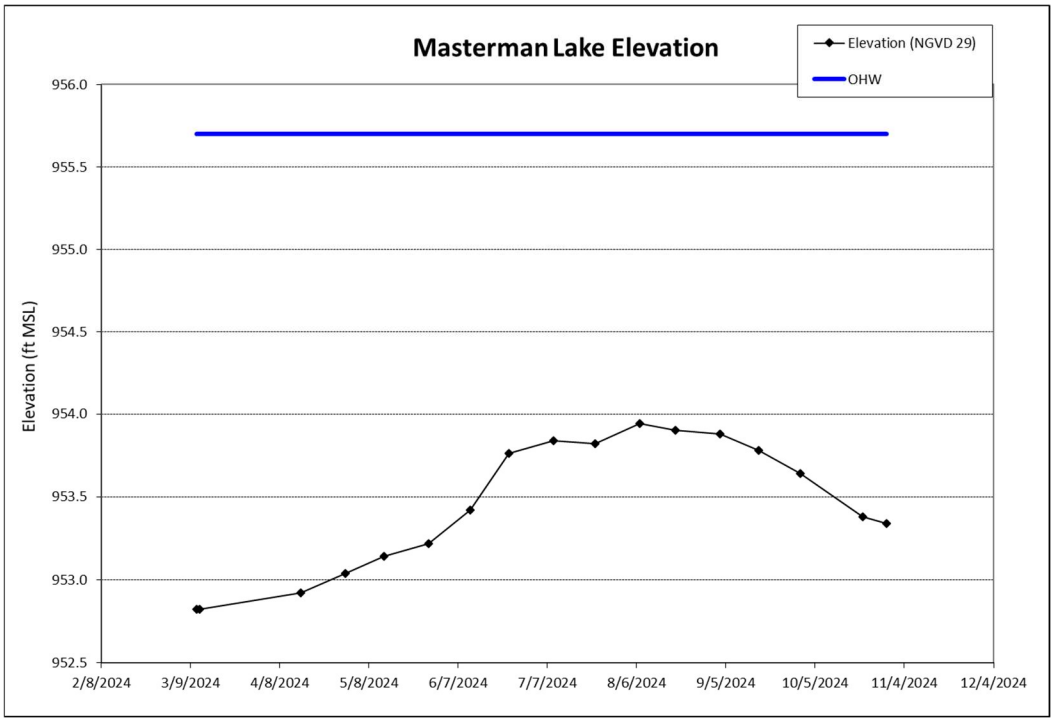
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 10:54	0.028	9.8	7.5	0.64	1.83	15.3	14.98
4/30/2024 8:40	0.031	11.0	9.1	0.67	1.52	11.1	9.73
5/13/2024 9:55	0.026	4.6	4.0	0.63	1.52	20.0	9.23
5/28/2024 10:02	0.021	3.9	3.2	0.58	1.52	18.7	7.39
6/11/2024 9:35	0.020	2.9	2.4	0.52	1.22	21.8	9.42
6/24/2024 10:48	0.019	4.8	4.5	2.15	1.22	23.2	8.48
7/9/2024 9:10	0.018	4.1	3.7	0.63	1.52	24.3	10.35
7/23/2024 10:37	0.018	5.2	4.3	0.61	1.37	25.0	7.57
8/7/2024 8:45	0.019	4.7	4.5	0.56	1.37	22.5	5.77
8/19/2024 9:30	0.051	5.8	4.8	0.76	1.37	23.5	9.46
9/3/2024 9:40	0.020	4.8	3.5	0.59	1.22	21.8	7.78
9/16/2024 11:28	0.015	3.4	2.4	0.53	1.37	24.0	11.89
9/30/2024 10:02	0.018	4.2	3.5	0.49	1.22	20.1	7.89
10/21/2024 11:55	0.018	8.1	8.0	0.59	1.52	13.9	12.77
2024 Average	0.023	5.5	4.7	0.71	1.41	20.4	9.48
2024 Summer Average	0.022	4.4	3.7	0.76	1.32	22.9	8.73

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	953.94	8/7/2024	952.82	3/12/2024	953.46

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

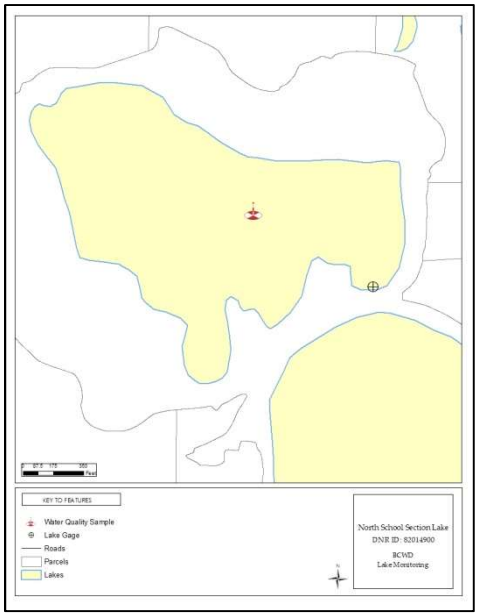


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	A	B	A	A	B	B	B	B	B	A
Chlorophyll-*a* (ug/l)	A	A	A	A	B	A	A	B	B	A
Secchi depth (ft)	C	C	C	C	C	C	C	C	C	C
Overall	**B+**	**B**	**B+**	**B+**	**B-**	**B**	**B**	**B-**	**B-**	**B+**

North School Section Lake

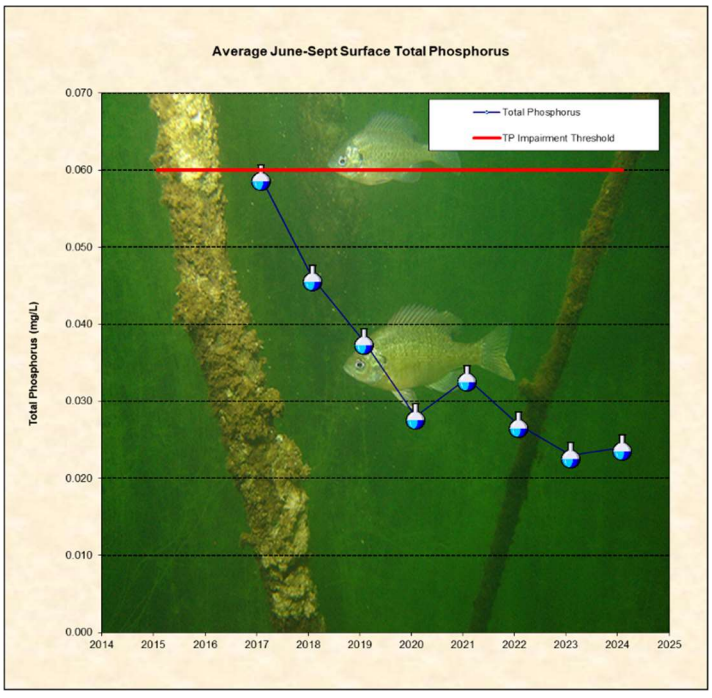
2024 Lake Grade: B+

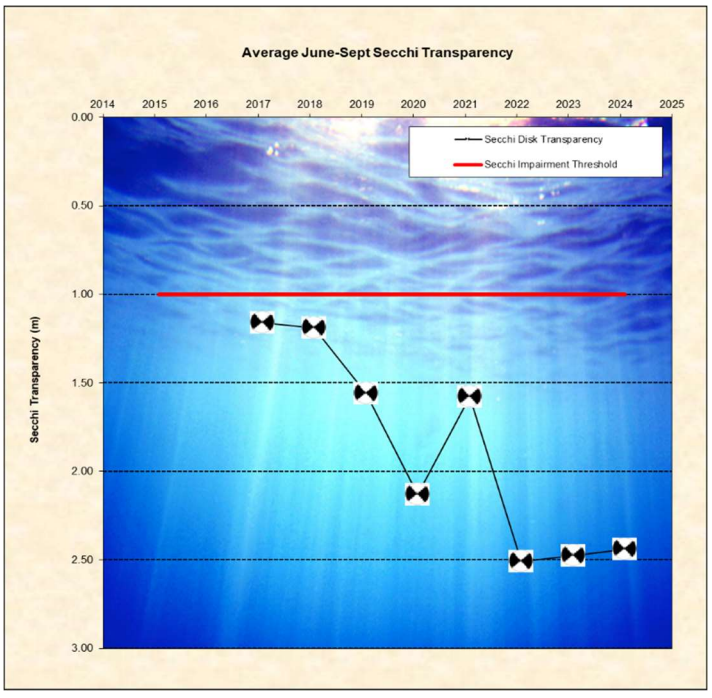
- DNR ID #: 820149
- Municipality: City of Hugo
- Location: SW ¼ Section 25, T31N-R21W
- Lake Size: 40 Acres
- Maximum Depth (2024): 12 ft.
- Ordinary High Water Mark: 963.2 ft.
- 100-Year High Water Level: 970.42 ft.
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as mesotrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average Secchi transparency, average chlorophyll-α, and average total phosphorus.
- The major land use is rural/agricultural.
- The North and South School Section basins were connected in 2024.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





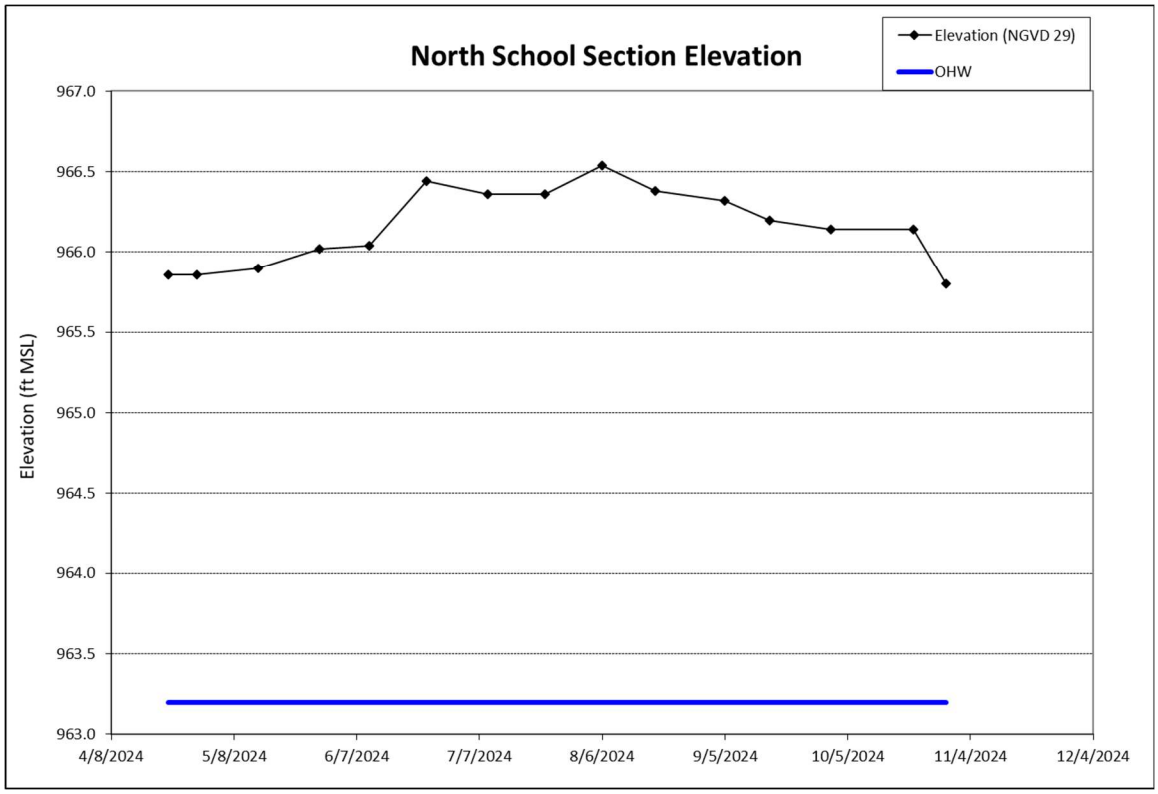
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 9:30	0.020	5.0	4.0	0.59	2.13	11.6	13.02
5/14/2024 11:05	0.020	1.1	1.3	0.61	3.35	18.7	11.04
6/10/2024 13:40	0.026	7.7	7.5	0.64	2.74	23.1	9.02
7/9/2024 13:55	0.017	11.0	11.0	0.58	2.29	27.4	14.59
8/6/2024 14:30	0.027	8.7	8.3	0.79	2.44	24.7	6.97
9/5/2024 9:15	0.025	5.4	4.0	0.63	2.29	21.2	9.64
10/1/2024 8:52	0.030	4.6	4.0	0.65	2.44	19.1	8.71
2024 Average	0.024	6.2	5.7	0.64	2.53	20.8	10.43
2024 Summer Average	0.024	8.2	7.7	0.66	2.44	24.1	10.06

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	966.54	8/6/2024	965.80	10/29/2024	966.19

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

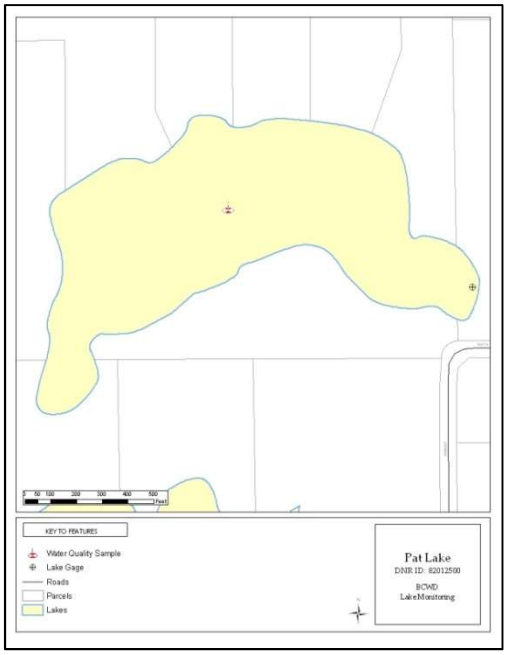


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	A	B	B	C	C	C	C	NA	NA
Chlorophyll-*a* (ug/l)	A	A	A	B	A	C	C	C	NA	NA
Secchi depth (ft)	B	B	B	C	B	C	C	C	NA	NA
Overall	**B+**	**B+**	**B+**	**B-**	**B**	**C**	**C**	**C**	**NA**	**NA**

Pat Lake

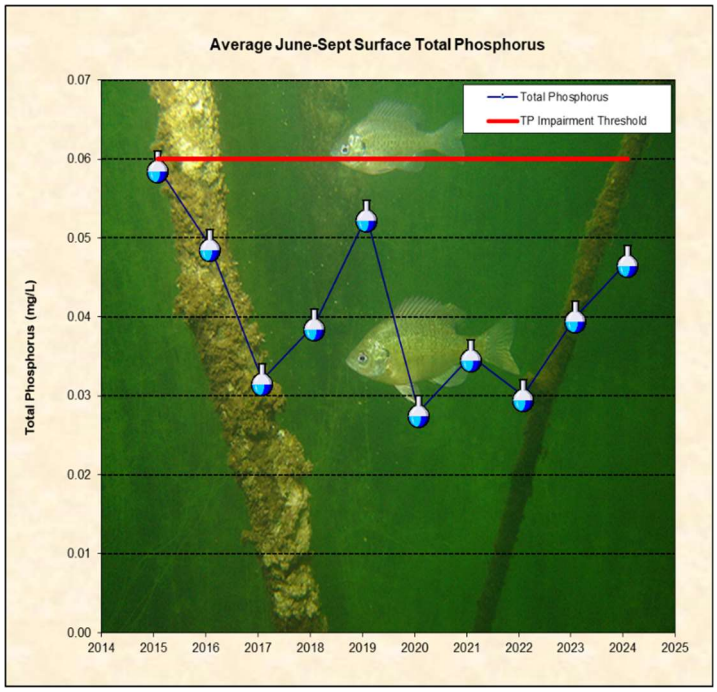
2024 Lake Grade: B-

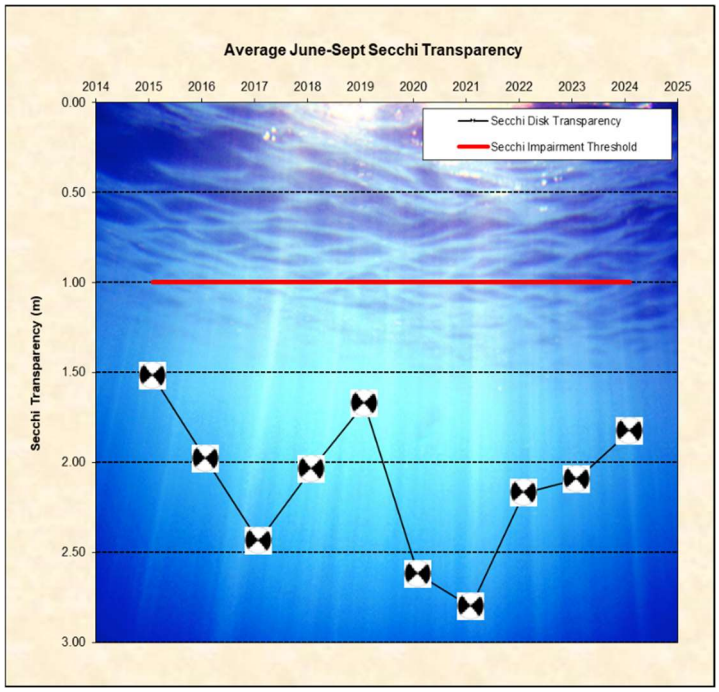
- DNR ID #: 820125
- Municipality: City of Grant
- Location: Section 11, T30N-R21W
- Lake Size: 20 Acres
- Maximum Depth (2024): 16 ft.
- Ordinary High Water Mark: 941.80 ft.
- 100-Year High Water Level: 949.10 ft.
- 99% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and average chlorophyll-α, and no trend for average Secchi transparency at this time.
- The major land use is rural/agricultural.
- The lake stratified in 2024 with a thermocline around 2 meters.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





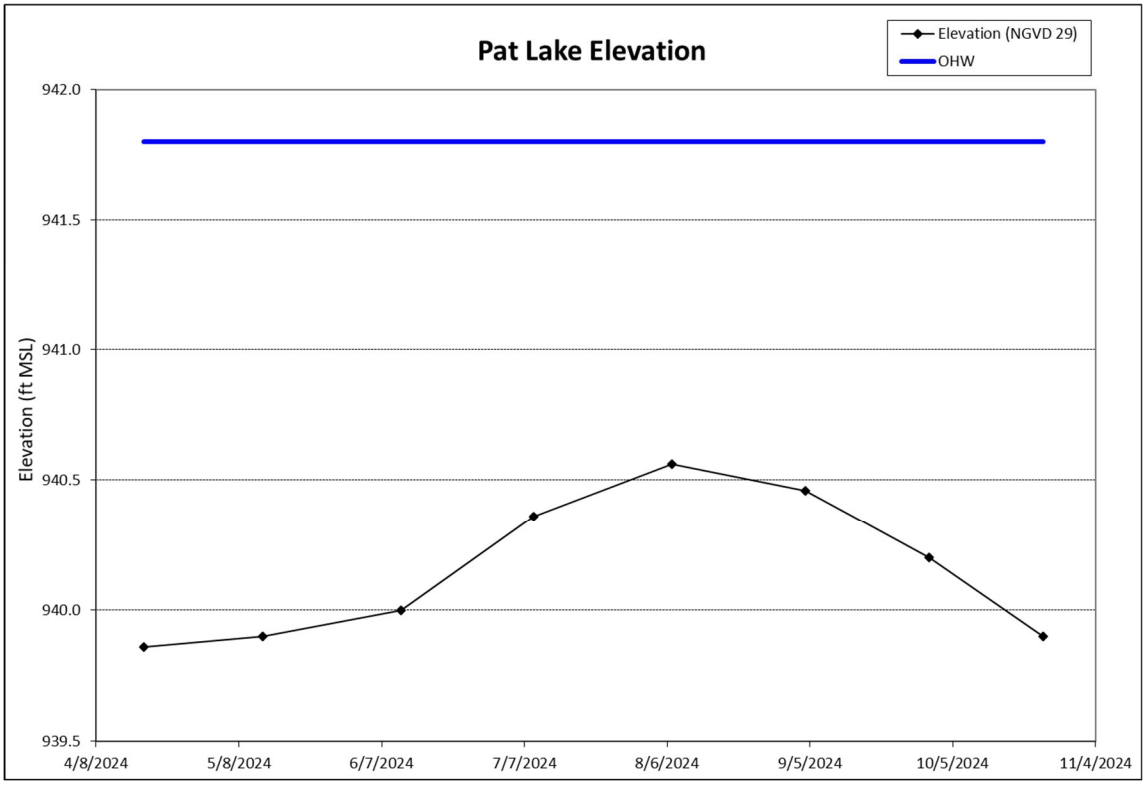
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 13:24	0.025	4.9	3.7	0.48	2.90	12.2	11.92
5/13/2024 11:57	0.025	2.7	2.4	0.56	3.05	20.4	9.17
6/11/2024 13:34	0.038	3.6	2.9	0.61	2.13	23.0	8.82
7/9/2024 9:40	0.064	11.0	11.0	0.78	2.13	25.5	12.03
8/7/2024 9:42	0.062	13.0	12.0	0.85	1.52	24.1	7.56
9/4/2024 11:27	0.030	7.8	6.1	0.63	1.37	22.7	9.77
9/30/2024 10:35	0.039	13.0	11.0	0.65	1.98	21.1	11.23
2024 Average	0.040	8.0	7.0	0.65	2.15	21.3	10.07
2024 Summer Average	0.047	9.7	8.6	0.70	1.83	23.3	9.88

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	940.56	8/7/2024	939.86	4/18/2024	940.19

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

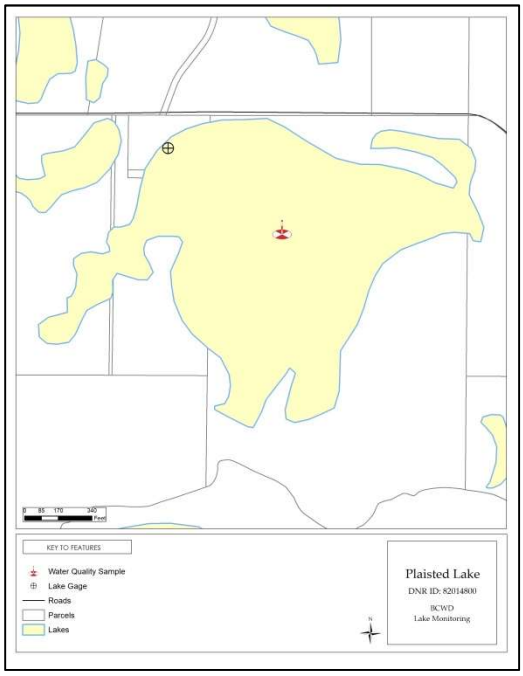


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	C	C	B	C	B	C	C	B	C	C
Chlorophyll-*a* (ug/l)	A	A	A	A	A	B	B	A	B	C
Secchi depth (ft)	C	C	B	B	B	C	C	B	C	C
Overall	**B-**	**B-**	**B+**	**B**	**B+**	**C+**	**C+**	**B+**	**C+**	**C**

Plaisted Lake

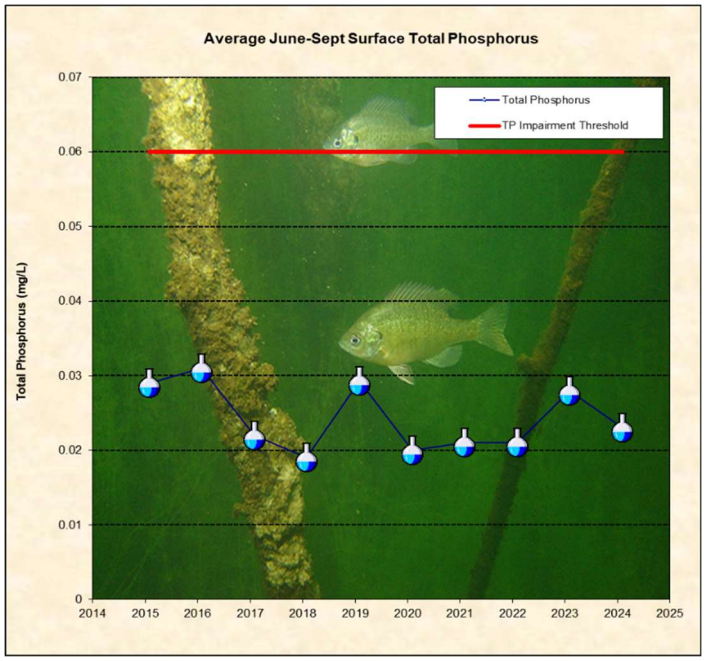
2024 Lake Grade: B+

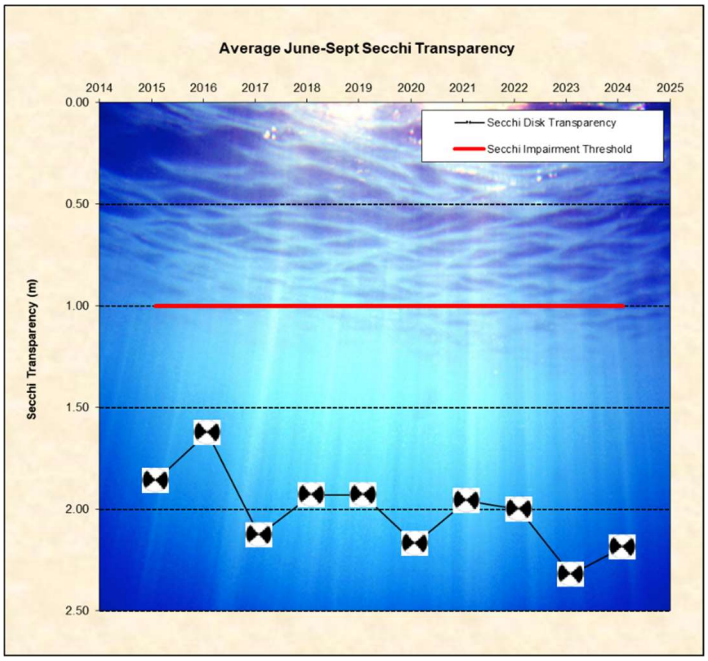
- DNR ID #: 820148
- Municipality: City of Hugo
- Location: Section 25, T31N-R21W
- Lake Size: 70 Acres
- Maximum Depth (2024): 11 ft.
- Ordinary High Water Mark: 966.00 ft.
- 100-Year High Water Level: NA
- 100% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as mesotrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus and average chlorophyll-α, and the trend for the average Secchi transparency is skewed due to vegetation limiting the transparency.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- This lake is categorized as shallow according to the Minnesota Pollution Control Agency's standards.
- Plaisted Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





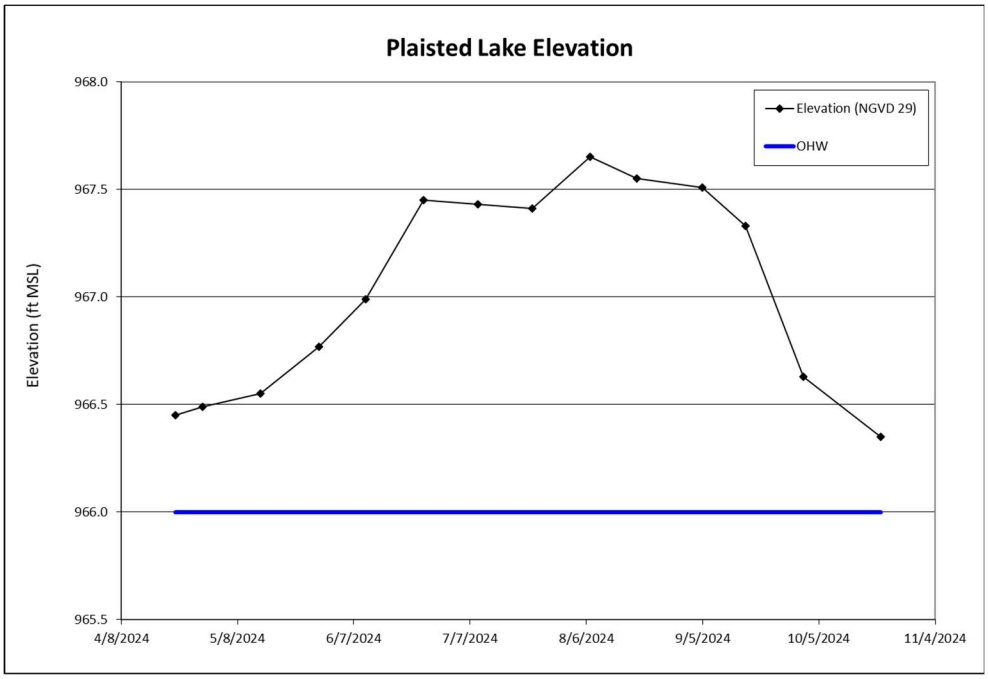
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 8:48	0.020	4.3	3.5	0.48	2.59	11.9	12.93
4/29/2024 13:06	0.026	4.8	3.7	0.50	2.59	11.1	9.40
5/14/2024 10:15	0.020	1.9	1.9	0.48	2.44	19.2	9.70
5/29/2024 13:50	0.023	1.9	1.6	0.47	2.29	20.6	7.71
6/10/2024 12:55	0.029	2.9	2.4	0.58	2.29	23.2	8.51
6/25/2024 10:20	0.024	3.7	2.9	1.58	2.44	24.5	8.84
7/9/2024 12:59	0.026	6.6	6.1	0.56	2.13	26.2	14.50
7/23/2024 11:45	0.026	7.5	7.2	0.52	2.13	25.7	11.77
8/7/2024 13:34	0.020	4.9	4.0	0.54	1.68	25.1	9.08
8/19/2024 12:43	0.027	2.8	3.2	0.58	2.44	25.4	12.14
9/5/2024 8:30	0.018	2.1	1.6	0.46	2.13	22.3	10.79
9/16/2024 12:50	0.016	2.0	1.3	0.46	2.29	24.3	13.66
10/1/2024 10:09	0.026	2.8	2.4	0.50	2.44	20.0	8.85
10/21/2024 13:22	0.022	7.9	7.2	0.54	2.59	14.2	13.23
2024 Average	0.023	4.0	3.5	0.59	2.32	21.0	10.79
2024 Summer Average	0.023	4.1	3.6	0.66	2.19	24.6	11.16

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	967.65	8/7/2024	966.35	10/21/2024	967.04

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

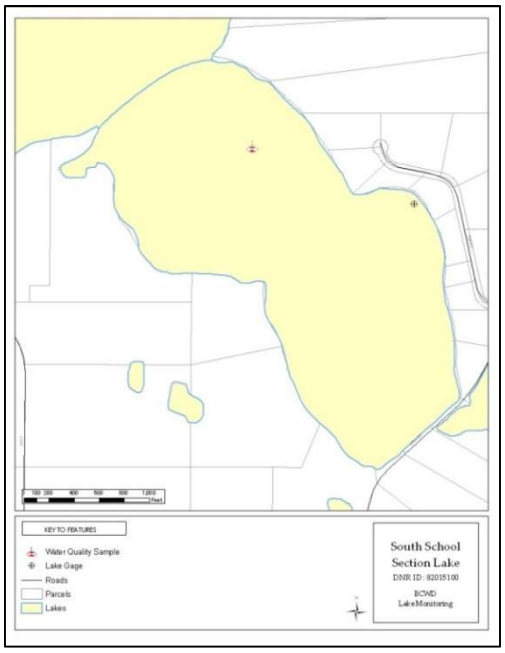


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	B	B	A	A	A	B	A	A	B	B
Chlorophyll-*a* (ug/l)	A	A	A	A	A	A	A	A	B	A
Secchi depth (ft)	B	B	C	B	B	C	C	C	C	C
Overall	**B+**	**B+**	**B+**	**A-**	**A-**	**B**	**B+**	**B+**	**B-**	**B**

South School Section Lake

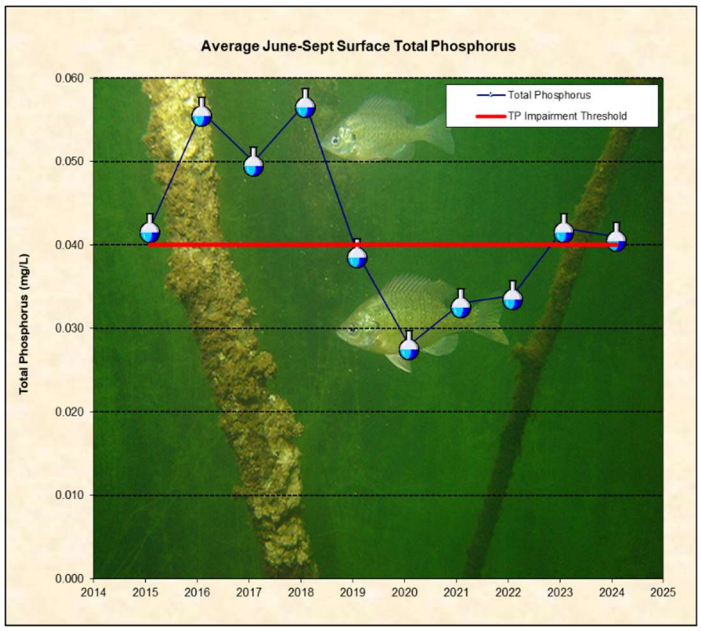
2024 Lake Grade: C

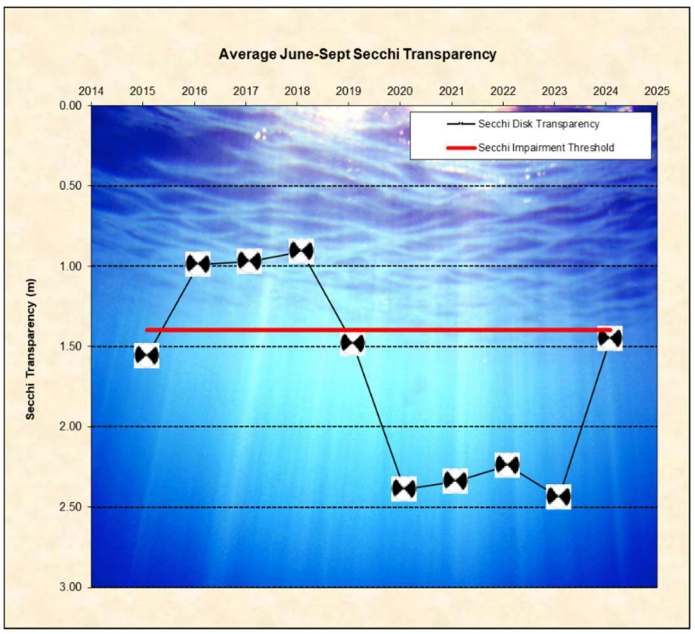
- DNR ID #: 820151
- Municipality: City of Hugo
- Location: S ½ Section 25, T31N-R21W
- Lake Size: 115 Acres
- Maximum Depth (2024): 21 ft.
- Ordinary High Water Mark: 965.30 ft.
- 100-Year High Water Level: 972.20 ft.
- 41% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as eutrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average total phosphorus, and no trend for average Secchi transparency and average chlorophyll-α at this time.
- The major land use is rural/agricultural.
- The lake did not stratify in 2024.
- The North and South School Section basins were connected in 2024.
- This lake is categorized as a deep lake according to the Minnesota Pollution Control Agency's standards.
- South School Section Lake is listed as impaired for nutrients on the Minnesota Pollution Control Agency's Impaired Waters List.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





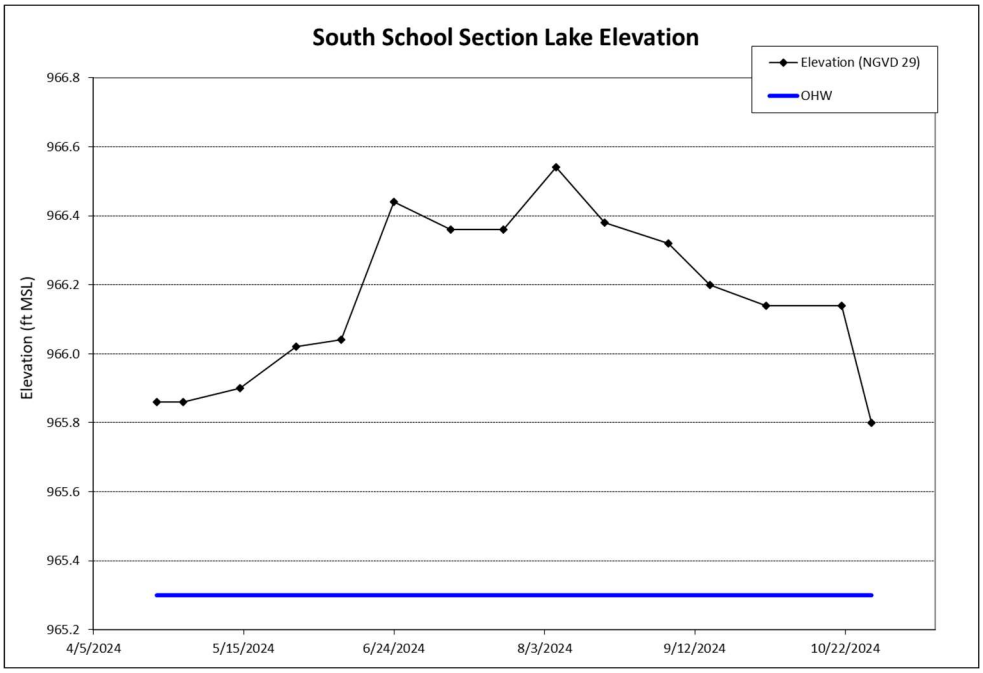
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/17/2024 9:40	0.022	12.0	10.0	0.73	2.44	10.5	15.72
4/29/2024 13:34	0.033	7.4	6.1	0.75	2.29	10.6	10.20
5/14/2024 10:45	0.037	2.0	1.6	0.68	3.96	17.6	9.98
5/29/2024 14:22	0.023	3.6	3.5	0.65	4.42	21.0	9.52
6/10/2024 13:25	0.027	5.7	5.3	0.78	3.05	22.3	8.51
6/24/2024 14:40	0.028	13.0	13.0	1.32	2.13	23.1	11.44
7/9/2024 13:40	0.023	15.0	15.0	0.82	1.83	26.4	16.08
7/23/2024 12:58	0.040	45.0	44.0	1.10	1.22	25.5	13.24
8/6/2024 14:15	0.045	41.0	41.0	1.10	1.22	25.5	9.90
8/19/2024 13:11	0.057	50.0	50.0	1.60	0.76	26.1	16.96
9/5/2024 9:00	0.050	48.0	46.0	1.41	0.76	22.2	9.81
9/16/2024 13:15	0.056	79.0	79.0	1.79	0.61	24.7	17.46
10/1/2024 9:05	0.056	37.0	34.0	1.41	0.91	20.1	6.52
10/21/2024 13:50	0.040	26.0	25.0	1.29	1.37	14.1	12.50
2024 Average	0.038	27.5	26.7	1.10	1.93	20.7	11.99
2024 Summer Average	0.041	37.1	36.7	1.24	1.45	24.5	12.93

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	966.54	8/6/2024	965.80	10/29/2024	966.16

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."

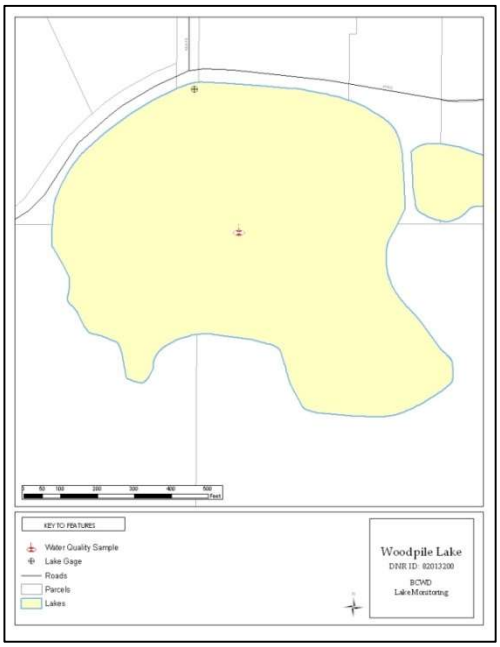


Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	C	C	B	B	B	C	C	C	C	C
Chlorophyll-*a* (ug/l)	C	B	B	B	B	C	D	C	C	C
Secchi depth (ft)	C	B	B	B	B	C	D	D	C	C
Overall	**C**	**B-**	**B**	**B**	**B**	**C**	**D+**	**C-**	**C**	**C**

Woodpile Lake

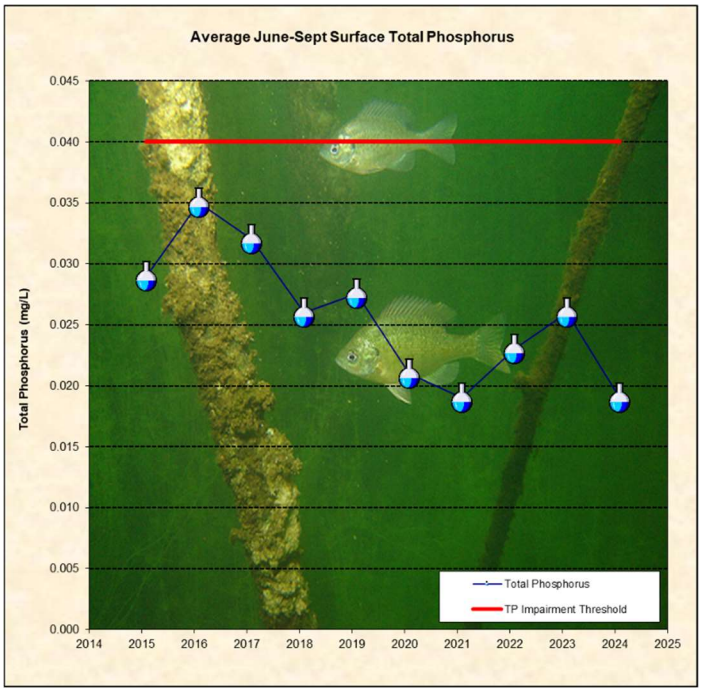
2024 Lake Grade: A

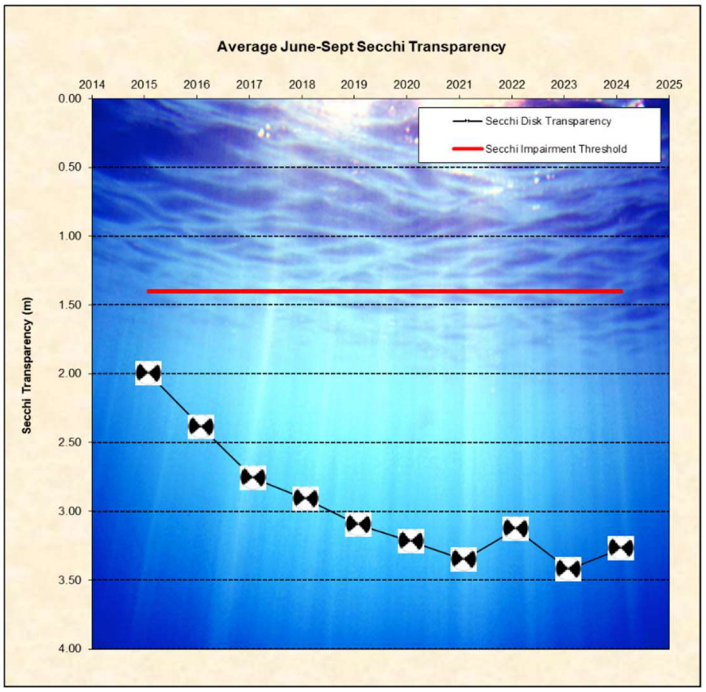
- DNR ID #: 820132
- Municipality: City of Grant
- Location: Section 23, T30N-R21W
- Lake Size: 15 Acres
- Maximum Depth (2024): 27 ft.
- Ordinary High Water Mark: 968.50 ft.
- 100-Year High Water Level: 971.00 ft.
- 8% Littoral
  Note: Littoral area is the portion of the lake <15 ft. and dominated by aquatic vegetation.



Summary Points

- Based on chlorophyll-α data, the lake is classified as mesotrophic according to the Carlson Trophic State Index.
- Using the Kendall's Tau correlation test ($p<0.05$) there is a statistically significant **improving** trend for the average Secchi transparency, average chlorophyll-α, and average total phosphorus.
- The major land use is rural/agricultural.
- The lake stratified in 2024 with a thermocline between 2 and 3 meters.
- This lake is categorized as a deep lake according to the Minnesota Pollution Control Agency's standards.
- Lab methodology was changed for 2023 total phosphorus sample analysis, as such no results were reported <0.022 mg/L (April-mid September).





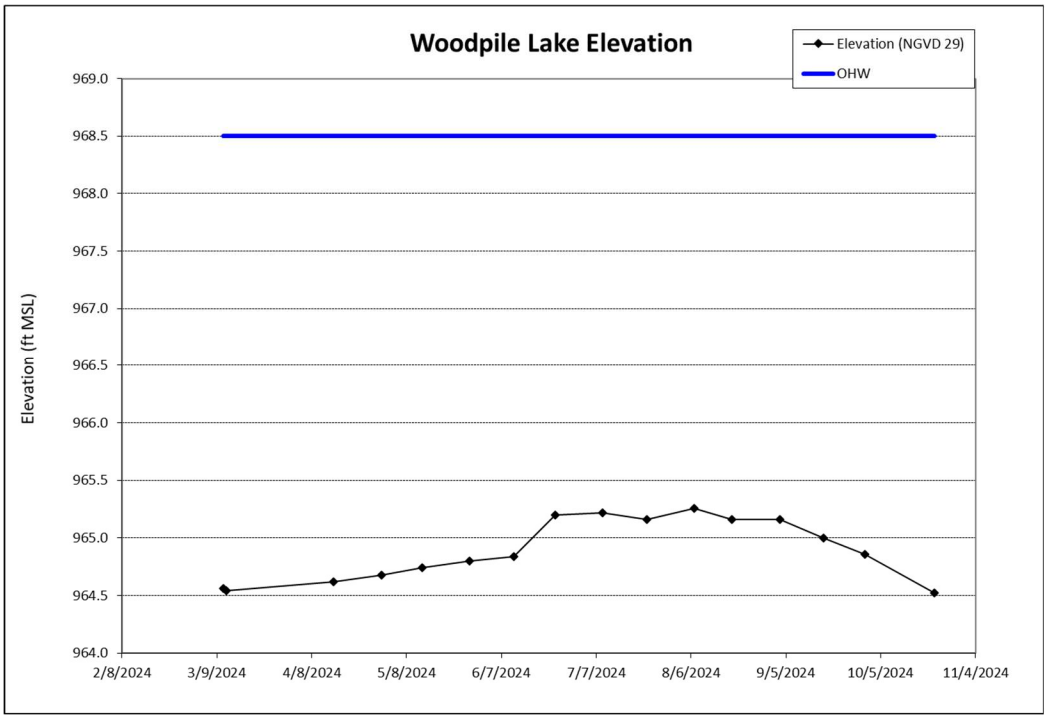
Date/Time	Total Phosphorus (mg/L)	Uncorrected Trichromatic Chlorophyll-*a* (ug/L)	Pheophytin-Corrected Chlorophyll-*a* (ug/L)	Total Kjeldahl Nitrogen (mg/L)	Secchi Disk Depth (m)	Surface Temperature (Celsius)	Surface Dissolved Oxygen (mg/L)
4/15/2024 11:22	0.020	1.7	1.3	0.50	4.88	13.5	15.85
4/30/2024 8:12	0.016	2.3	1.9	0.56	4.72	11.3	10.33
5/13/2024 9:21	0.020	1.6	1.3	0.59	4.88	18.6	10.49
5/28/2024 9:36	0.020	2.0	1.9	0.52	3.66	19.1	8.46
6/11/2024 9:02	0.020	2.6	2.4	0.59	3.96	22.1	9.45
6/24/2024 10:22	0.021	3.8	3.5	2.38	2.74	23.4	9.82
7/9/2024 8:45	0.020	8.3	8.0	0.66	3.05	24.5	12.05
7/23/2024 11:02	0.022	8.5	8.3	0.67	2.74	25.6	13.04
8/7/2024 9:09	0.021	5.8	5.3	0.64	2.74	24.2	8.71
8/19/2024 9:00	0.021	3.5	3.5	0.73	3.66	24.1	12.83
9/3/2024 9:13	0.020	5.2	4.3	0.62	2.90	22.8	11.35
9/17/2024 8:22	0.018	4.4	4.0	0.73	3.81	23.6	15.46
9/30/2024 9:35	0.007	2.8	1.9	0.52	3.81	20.9	11.23
10/22/2024 8:36	0.016	2.9	2.7	0.62	3.66	14.3	12.50
2024 Average	0.019	4.0	3.6	0.74	3.66	20.6	11.54
2024 Summer Average	0.019	5.0	4.6	0.84	3.27	23.5	11.55

Water quality thresholds are 0.04 mg/L TP, 14 µg/L CL-a, 1.4 m Secchi depth*

Shallow lake water quality thresholds are 0.06 mg/L TP, 20 µg/L CL-a, 1.0 m Secchi depth*

	High	High Date	Low	Low Date	Average
2024 Elevation (ft)	965.26	8/7/2024	964.54	3/12/2024	964.92

*Data requirements and determinations of use assessment according to the MPCA's Guidance Manual for Assessing the Quality of Minnesota Surface Waters: "Samples must be collected over a minimum of 2 years and data used for assessments must be collected from June to September. Typically, a minimum of 8 individual data points for TP, corrected chlorophyll-a (chl-a corrected for pheophytin), and Secchi are required. Data used for phosphorus and chlorophyll-a calculations are limited to those collected from the upper most 3 meters of the water column (surface). If more than one sample is collected in a lake per day, these values are averaged to yield a daily average value. Following this step, all June to September data for the 10-year assessment window are averaged to determine summer-mean values for TP, corrected chl-a, and Secchi depth. These values are then compared to the standards and the assessment is made."



Lake Water Quality Summary										
	Lake Grades (May-Sept)									
	2024	2023	2022	2021	2020	2019	2018	2017	2016	2015
Total Phosphorus (mg/l)	A	B	A	A	A	B	B	B	C	B
Chlorophyll-*a* (ug/l)	A	A	A	A	A	A	A	A	A	B
Secchi depth (ft)	A	A	A	A	A	A	B	B	B	C
Overall	**A**	**A-**	**A**	**A**	**A**	**A-**	**B+**	**B+**	**B**	**B-**

APPENDIX B –STREAM DATA

Total Phosphorus and Total Suspended Solids Loading Tables

Field Water Quality Data Tables

Table 1. Brown's Creek at Highway 15 2024 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	**Start**	**End**	**TSS (mg/L)**	**TP (mg/L)**	**Start**	**End**	**Interval Volume (cf)**	**Interval Volume (ac-ft)**	**Interval TSS (lb)**	**Interval TP (lb)**
*Base**			*6*	*0.109*	*1/1/2024 0:00*	*3/29/2024 12:00*	*15,292,800*	*351.26*	*5,728*	*104.06*
*Snowmelt**			*42*	*0.201*	*3/29/2024 12:00*	*3/31/2024 18:00*	*777,600*	*17.86*	*2,039*	*9.76*
*Base**			*6*	*0.109*	*3/31/2024 18:00*	*4/7/2024 11:00*	*1,333,080*	*30.62*	*499*	*9.07*
*Storm**			*70*	*0.270*	*4/7/2024 11:00*	*4/8/2024 7:00*	*432,000*	*9.92*	*1,888*	*7.28*
*Base**			*6*	*0.109*	*4/8/2024 7:00*	*4/11/2024 10:00*	*675,000*	*15.50*	*253*	*4.59*
Base			*6*	*0.109*	*4/11/2024 10:00*	*4/16/2024 13:00*	*961,179*	*22.08*	*360*	*6.54*
Storm			*70*	*0.270*	*4/16/2024 13:00*	*4/16/2024 22:00*	*118,672*	*2.73*	*519*	*2.00*
Storm Composite	4/16/2024 22:53	4/17/2024 13:11	39	0.236	4/16/2024 22:00	4/17/2024 14:00	425,026	9.76	1,035	6.26
Base			*6*	*0.109*	*4/17/2024 14:00*	*4/28/2024 18:00*	*2,245,260*	*51.57*	*841*	*15.28*
Storm Composite	4/29/2024 4:55	4/30/2024 2:06	12	0.068	4/28/2024 18:00	4/30/2024 3:00	490,768	11.27	368	2.08
Base			*6*	*0.109*	*4/30/2024 3:00*	*5/2/2024 8:00*	*684,332*	*15.72*	*256*	*4.66*
Storm			*70*	*0.270*	*5/2/2024 8:00*	*5/3/2024 1:00*	*329,443*	*7.57*	*1,440*	*5.55*
Base			*6*	*0.109*	*5/3/2024 1:00*	*5/19/2024 14:00*	*3,469,020*	*79.68*	*1,299*	*23.60*
Base Grab	5/20/2024 14:10	5/20/2024 14:10	10	0.109	5/19/2024 14:00	5/21/2024 17:00	417,267	9.58	260	2.84
Storm Composite	5/21/2024 19:32	5/22/2024 19:17	83	0.279	5/21/2024 17:00	5/22/2024 20:00	1,003,020	23.04	5,197	17.47
Base			*6*	*0.109*	*5/22/2024 20:00*	*6/4/2024 19:00*	*3,020,630*	*69.38*	*1,131*	*20.55*
Storm Composite	6/4/2024 20:15	6/5/2024 13:06	113	0.339	6/4/2024 19:00	6/5/2024 18:00	945,509	21.72	6,670	20.01
Base			*6*	*0.109*	*6/5/2024 18:00*	*6/12/2024 23:00*	*1,725,780*	*39.64*	*646*	*11.74*
Storm			*70*	*0.270*	*6/12/2024 23:00*	*6/14/2024 2:00*	*595,476*	*13.68*	*2,602*	*10.04*
Base			*6*	*0.109*	*6/14/2024 2:00*	*6/16/2024 1:00*	*534,305*	*12.27*	*200*	*3.64*
Storm			*70*	*0.270*	*6/16/2024 1:00*	*6/17/2024 1:00*	*874,736*	*20.09*	*3,822*	*14.74*
Base			*6*	*0.109*	*6/17/2024 1:00*	*6/18/2024 21:00*	*1,513,600*	*34.77*	*567*	*10.30*
Storm Composite	6/18/2024 21:43	6/20/2024 6:02	78	0.279	6/18/2024 21:00	6/20/2024 6:00	1,860,760	42.74	9,060	32.41
Base Grab	6/26/2024 14:01	6/26/2024 14:01	8	0.218	6/20/2024 6:00	6/28/2024 6:00	3,938,240	90.46	1,967	53.60
Storm Composite	6/28/2024 11:43	6/28/2024 20:09	66	0.310	6/28/2024 6:00	6/29/2024 4:00	672,606	15.45	2,771	13.02
Base			*6*	*0.109*	*6/29/2024 4:00*	*7/13/2024 8:00*	*5,331,620*	*122.46*	*1,997*	*36.28*
Storm			*70*	*0.270*	*7/13/2024 8:00*	*7/13/2024 11:00*	*53,880*	*1.24*	*235*	*0.91*
Base			*6*	*0.109*	*7/13/2024 11:00*	*7/22/2024 18:00*	*3,220,060*	*73.96*	*1,206*	*21.91*
Storm Composite	7/22/2024 18:01	7/23/2024 9:03	137	0.449	7/22/2024 18:00	7/23/2024 9:00	472,873	10.86	4,044	13.25
Storm			*70*	*0.270*	*7/23/2024 9:00*	*7/24/2024 2:00*	*659,807*	*15.16*	*2,883*	*11.12*
Base Grab	7/25/2024 13:20	7/25/2024 13:20	5	0.120	7/24/2024 2:00	7/26/2024 14:00	1,068,710	24.55	334	8.01
Base			*6*	*0.109*	*7/26/2024 14:00*	*8/5/2024 17:00*	*3,203,220*	*73.57*	*1,200*	*21.80*
Storm			*70*	*0.270*	*8/5/2024 17:00*	*8/6/2024 8:00*	*867,355*	*19.92*	*3,790*	*14.62*
Storm Grab	8/6/2024 13:14	8/6/2024 13:14	29	0.196	8/6/2024 8:00	8/6/2024 19:00	688,023	15.80	1,246	8.42
Base			*6*	*0.109*	*8/6/2024 19:00*	*8/15/2024 4:00*	*3,118,990*	*71.64*	*1,168*	*21.22*
Storm			*70*	*0.270*	*8/15/2024 4:00*	*8/15/2024 9:00*	*67,578*	*1.55*	*295*	*1.14*
Base			*6*	*0.109*	*8/15/2024 9:00*	*8/27/2024 6:00*	*3,088,510*	*70.94*	*1,157*	*21.02*
Storm			*70*	*0.270*	*8/27/2024 6:00*	*8/27/2024 19:00*	*232,170*	*5.33*	*1,015*	*3.91*
Base			*6*	*0.109*	*8/27/2024 19:00*	*8/29/2024 17:00*	*770,667*	*17.70*	*289*	*5.24*
Storm			*70*	*0.270*	*8/29/2024 17:00*	*8/30/2024 4:00*	*242,790*	*5.58*	*1,061*	*4.09*
Base Grab	9/3/2024 9:37	9/3/2024 9:37	4	0.080	8/30/2024 4:00	9/4/2024 10:00	1,685,950	38.72	421	8.42
Base			*6*	*0.109*	*9/4/2024 10:00*	*9/23/2024 9:00*	*3,810,810*	*87.53*	*1,427*	*25.93*
Base Grab	9/24/2024 9:07	9/24/2024 9:07	5	0.067	9/23/2024 9:00	9/25/2024 9:00	451,286	10.37	141	1.89
Base			*6*	*0.109*	*9/25/2024 9:00*	*10/20/2024 14:00*	*5,785,020*	*132.88*	*2,167*	*39.36*
Base Grab	10/21/2024 14:14	10/21/2024 14:14	5	0.057	10/20/2024 14:00	10/22/2024 14:00	638,535	14.67	199	2.27
Base			*6*	*0.109*	*10/22/2024 14:00*	*10/29/2024 15:00*	*2,533,000*	*58.18*	*949*	*17.24*
*Base**			*6*	*0.109*	*10/29/2024 15:00*	*10/31/2024 6:00*	*575,640*	*13.22*	*216*	*3.92*
*Storm**			*70*	*0.270*	*10/31/2024 6:00*	*10/31/2024 20:00*	*315,000*	*7.24*	*1,376*	*5.31*
*Base**			*6*	*0.109*	*10/31/2024 20:00*	*11/18/2024 16:00*	*5,392,800*	*123.87*	*2,020*	*36.70*
*Storm**			*70*	*0.270*	*11/18/2024 16:00*	*11/19/2024 16:00*	*907,200*	*20.84*	*3,964*	*15.29*
*Base**			*6*	*0.109*	*11/19/2024 16:00*	*12/27/2024 18:00*	*9,871,200*	*226.73*	*3,697*	*67.17*
*Storm**			*70*	*0.270*	*12/27/2024 18:00*	*12/28/2024 8:00*	*252,000*	*5.79*	*1,101*	*4.25*
*Base**			*6*	*0.109*	*12/28/2024 8:00*	*1/1/2025 0:00*	*950,400*	*21.83*	*356*	*6.47*
Storm Average			70	0.270						
Base Average			6	0.109						
All Average			42	0.201						
Total							**100,591,203**	**2,310**	**91,374**	**838**
Brown's Creek Major Subwatershed Total Acres							3,532			
Total TSS/TP(lb/ac/yr)									25.87	0.237
Total TSS/TP (kg/ha/yr)									29.00	0.266

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

Table 2. Brown's Creek at McKusick Road 2024 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base**			*8*	*0.120*	*1/1/2024 0:00*	*3/25/2024 12:00*	*23,727,600*	*545.00*	*11,850*	*177.75*
*Snowmelt**			*107*	*0.315*	*3/25/2024 12:00*	*3/31/2024 15:00*	*3,439,800*	*79.01*	*22,976*	*67.64*
*Base**			*8*	*0.120*	*3/31/2024 15:00*	*4/7/2024 11:00*	*2,066,400*	*47.46*	*1,032*	*15.48*
*Storm**			*225*	*0.511*	*4/7/2024 11:00*	*4/8/2024 14:00*	*1,749,600*	*40.19*	*24,575*	*55.81*
*Base**			*8*	*0.120*	*4/8/2024 14:00*	*4/16/2024 11:00*	*3,742,200*	*85.95*	*1,869*	*28.03*
*Storm**			*225*	*0.511*	*4/16/2024 11:00*	*4/17/2024 10:00*	*1,573,200*	*36.13*	*22,097*	*50.18*
*Base**			*8*	*0.120*	*4/17/2024 10:00*	*4/24/2024 15:15*	*3,430,350*	*78.79*	*1,713*	*25.70*
Base			*8*	*0.120*	*4/24/2024 15:15*	*4/28/2024 15:15*	*1,776,660*	*40.81*	*887*	*13.31*
Storm Composite	4/29/2024 4:09	4/29/2024 19:20	26	0.107	4/28/2024 15:15	4/29/2024 20:15	1,248,460	28.68	2,026	8.34
Base			*8*	*0.120*	*4/29/2024 20:15*	*4/30/2024 8:30*	*597,078*	*13.71*	*298*	*4.47*
*Base**			*8*	*0.120*	*4/30/2024 8:30*	*5/2/2024 7:00*	*1,975,320*	*45.37*	*986*	*14.80*
*Storm**			*225*	*0.511*	*5/2/2024 7:00*	*5/3/2024 0:00*	*1,224,000*	*28.11*	*17,192*	*39.05*
*Base**			*8*	*0.120*	*5/3/2024 0:00*	*5/6/2024 15:15*	*1,884,600*	*43.29*	*941*	*14.12*
Base			*8*	*0.120*	*5/6/2024 15:15*	*5/19/2024 14:15*	*5,031,240*	*115.56*	*2,513*	*37.69*
Base Grab	5/20/2024 14:39	5/20/2024 14:39	8	0.087	5/19/2024 14:15	5/21/2024 17:15	849,253	19.51	424	4.61
Storm Composite	5/21/2024 17:25	5/22/2024 17:06	188	0.427	5/21/2024 17:15	5/22/2024 17:15	2,407,100	55.29	28,250	64.16
Base			*8*	*0.120*	*5/22/2024 17:15*	*5/27/2024 17:15*	*4,357,550*	*100.09*	*2,176*	*32.64*
Turbidity Spike			225	0.511	5/27/2024 17:15	5/27/2024 21:15	64,936	1.49	912	2.07
Base			*8*	*0.120*	*5/27/2024 21:15*	*5/31/2024 17:15*	*1,341,220*	*30.81*	*670*	*10.05*
Storm			*225*	*0.511*	*5/31/2024 17:15*	*6/1/2024 5:15*	*298,635*	*6.86*	*4,195*	*9.53*
Base			*8*	*0.120*	*6/1/2024 5:15*	*6/3/2024 3:15*	*1,131,310*	*25.98*	*565*	*8.47*
Storm			*225*	*0.511*	*6/3/2024 3:15*	*6/3/2024 9:15*	*182,174*	*4.18*	*2,559*	*5.81*
Base			*8*	*0.120*	*6/3/2024 9:15*	*6/4/2024 18:15*	*871,354*	*20.01*	*435*	*6.53*
Storm Composite	6/4/2024 19:25	6/4/2024 23:25	456	0.726	6/4/2024 18:15	6/5/2024 3:15	780,663	17.93	22,223	35.38
Storm			*225*	*0.511*	*6/5/2024 3:15*	*6/5/2024 12:15*	*818,067*	*18.79*	*11,490*	*26.10*
Base			*8*	*0.120*	*6/5/2024 12:15*	*6/12/2024 23:15*	*4,265,190*	*97.97*	*2,130*	*31.95*
Storm			*225*	*0.511*	*6/12/2024 23:15*	*6/13/2024 5:15*	*208,628*	*4.79*	*2,930*	*6.66*
Base			*8*	*0.120*	*6/13/2024 5:15*	*6/15/2024 23:15*	*1,733,980*	*39.83*	*866*	*12.99*
Storm			*225*	*0.511*	*6/15/2024 23:15*	*6/16/2024 7:15*	*422,908*	*9.71*	*5,940*	*13.49*
Base			*8*	*0.120*	*6/16/2024 7:15*	*6/17/2024 5:15*	*1,203,260*	*27.64*	*601*	*9.01*
Storm			*225*	*0.511*	*6/17/2024 5:15*	*6/17/2024 13:15*	*478,595*	*10.99*	*6,722*	*15.27*
Base			*8*	*0.120*	*6/17/2024 13:15*	*6/18/2024 21:15*	*1,598,080*	*36.71*	*798*	*11.97*
Storm Composite	6/18/2024 21:52	6/19/2024 22:37	69	0.299	6/18/2024 21:15	6/19/2024 23:15	2,457,140	56.44	10,584	45.86
Base Grab	6/26/2024 14:33	6/26/2024 14:33	15	0.222	6/19/2024 23:15	6/28/2024 5:15	7,119,280	163.52	6,666	98.66
Storm			*225*	*0.511*	*6/28/2024 5:15*	*6/28/2024 12:15*	*310,965*	*7.14*	*4,368*	*9.92*
Base			*8*	*0.120*	*6/28/2024 12:15*	*7/11/2024 13:15*	*5,656,000*	*129.91*	*2,825*	*42.37*
In Water Work			*225*	*0.511*	*7/11/2024 13:15*	*7/11/2024 19:15*	*63,687*	*1.46*	*895*	*2.03*
Base			*8*	*0.120*	*7/11/2024 19:15*	*7/13/2024 8:15*	*375,179*	*8.62*	*187*	*2.81*
Storm			*225*	*0.511*	*7/13/2024 8:15*	*7/13/2024 13:15*	*132,384*	*3.04*	*1,859*	*4.22*
Base			*8*	*0.120*	*7/13/2024 13:15*	*7/14/2024 1:15*	*267,443*	*6.14*	*134*	*2.00*
Storm			*225*	*0.511*	*7/14/2024 1:15*	*7/14/2024 4:15*	*88,735*	*2.04*	*1,246*	*2.83*
Base			*8*	*0.120*	*7/14/2024 4:15*	*7/17/2024 12:15*	*1,355,290*	*31.13*	*677*	*10.15*
In Water Work			*225*	*0.511*	*7/17/2024 12:15*	*7/17/2024 19:15*	*81,211*	*1.87*	*1,141*	*2.59*
Base			*8*	*0.120*	*7/17/2024 19:15*	*7/18/2024 10:15*	*158,200*	*3.63*	*79*	*1.19*
In Water Work			*225*	*0.511*	*7/18/2024 10:15*	*7/18/2024 19:15*	*94,930*	*2.18*	*1,333*	*3.03*
Base			*8*	*0.120*	*7/18/2024 19:15*	*7/22/2024 17:15*	*873,383*	*20.06*	*436*	*6.54*
Storm Composite	7/22/2024 18:20	7/23/2024 1:17	387	0.762	7/22/2024 17:15	7/23/2024 2:15	331,402	7.61	8,006	15.76
Base Grab	7/25/2024 13:33	7/25/2024 13:33	9	0.124	7/23/2024 2:15	7/26/2024 14:15	1,917,040	44.03	1,077	14.84
Base			*8*	*0.120*	*7/26/2024 14:15*	*7/27/2024 11:15*	*208,810*	*4.80*	*104*	*1.56*
In Water Work			*225*	*0.511*	*7/27/2024 11:15*	*7/27/2024 15:15*	*40,051*	*0.92*	*563*	*1.28*
Base			*8*	*0.120*	*7/27/2024 15:15*	*7/28/2024 11:15*	*189,922*	*4.36*	*95*	*1.42*
In Water Work			*225*	*0.511*	*7/28/2024 11:15*	*7/28/2024 16:15*	*46,438*	*1.07*	*652*	*1.48*
Base			*8*	*0.120*	*7/28/2024 16:15*	*7/30/2024 11:15*	*467,867*	*10.75*	*234*	*3.50*
In Water Work			*225*	*0.511*	*7/30/2024 11:15*	*7/30/2024 19:15*	*94,756*	*2.18*	*1,331*	*3.02*
Base			*8*	*0.120*	*7/30/2024 19:15*	*7/31/2024 11:15*	*174,348*	*4.00*	*87*	*1.31*
In Water Work			*225*	*0.511*	*7/31/2024 11:15*	*7/31/2024 17:15*	*64,956*	*1.49*	*912*	*2.07*
Base			*8*	*0.120*	*7/31/2024 17:15*	*8/1/2024 12:15*	*261,361*	*6.00*	*131*	*1.96*
In Water Work			*225*	*0.511*	*8/1/2024 12:15*	*8/1/2024 21:15*	*167,163*	*3.84*	*2,348*	*5.33*
Base			*8*	*0.120*	*8/1/2024 21:15*	*8/2/2024 10:15*	*251,277*	*5.77*	*125*	*1.88*

In Water Work			*225*	*0.511*	*8/2/2024 10:15*	*8/2/2024 15:15*	*88,564*	*2.03*	*1,244*	*2.83*
Base			*8*	*0.120*	*8/2/2024 15:15*	*8/5/2024 9:15*	*780,012*	*17.92*	*390*	*5.84*
Storm Composite[X]	8/5/2024 12:10	8/6/2024 0:23	1,670	0.742	8/5/2024 9:15	8/6/2024 1:15	1,242,300	28.53	129,512	57.54
Storm			*225*	*0.511*	*8/6/2024 1:15*	*8/6/2024 11:15*	*1,279,740*	*29.39*	*17,975*	*40.82*
Base			*8*	*0.120*	*8/6/2024 11:15*	*8/7/2024 10:15*	*2,460,540*	*56.52*	*1,229*	*18.43*
In Water Work			*225*	*0.511*	*8/7/2024 10:15*	*8/7/2024 15:15*	*321,315*	*7.38*	*4,513*	*10.25*
Base			*8*	*0.120*	*8/7/2024 15:15*	*8/8/2024 13:15*	*922,922*	*21.20*	*461*	*6.91*
In Water Work			*225*	*0.511*	*8/8/2024 13:15*	*8/8/2024 18:15*	*162,299*	*3.73*	*2,280*	*5.18*
Base			*8*	*0.120*	*8/8/2024 18:15*	*8/9/2024 10:15*	*447,370*	*10.28*	*223*	*3.35*
In Water Work			*225*	*0.511*	*8/9/2024 10:15*	*8/9/2024 14:15*	*100,247*	*2.30*	*1,408*	*3.20*
Base			*8*	*0.120*	*8/9/2024 14:15*	*8/12/2024 13:15*	*1,087,940*	*24.99*	*543*	*8.15*
In Water Work			*225*	*0.511*	*8/12/2024 13:15*	*8/12/2024 16:15*	*35,329*	*0.81*	*496*	*1.13*
Base			*8*	*0.120*	*8/12/2024 16:15*	*8/13/2024 12:15*	*225,964*	*5.19*	*113*	*1.69*
In Water Work			*225*	*0.511*	*8/13/2024 12:15*	*8/13/2024 20:15*	*89,411*	*2.05*	*1,256*	*2.85*
Base			*8*	*0.120*	*8/13/2024 20:15*	*8/14/2024 13:15*	*180,726*	*4.15*	*90*	*1.35*
In Water Work			*225*	*0.511*	*8/14/2024 13:15*	*8/14/2024 20:15*	*74,197*	*1.70*	*1,042*	*2.37*
Base			*8*	*0.120*	*8/14/2024 20:15*	*8/15/2024 4:15*	*81,418*	*1.87*	*41*	*0.61*
Storm			*225*	*0.511*	*8/15/2024 4:15*	*8/15/2024 15:15*	*293,556*	*6.74*	*4,123*	*9.36*
Base			*8*	*0.120*	*8/15/2024 15:15*	*8/19/2024 11:15*	*1,653,890*	*37.99*	*826*	*12.39*
In Water Work			*225*	*0.511*	*8/19/2024 11:15*	*8/19/2024 19:15*	*102,175*	*2.35*	*1,435*	*3.26*
Base			*8*	*0.120*	*8/19/2024 19:15*	*8/20/2024 9:15*	*171,504*	*3.94*	*86*	*1.28*
In Water Work			*225*	*0.511*	*8/20/2024 9:15*	*8/20/2024 19:15*	*115,925*	*2.66*	*1,628*	*3.70*
Base			*8*	*0.120*	*8/20/2024 19:15*	*8/21/2024 11:15*	*180,658*	*4.15*	*90*	*1.35*
In Water Work			*225*	*0.511*	*8/21/2024 11:15*	*8/21/2024 14:15*	*33,780*	*0.78*	*474*	*1.08*
Base			*8*	*0.120*	*8/21/2024 14:15*	*8/22/2024 11:15*	*225,143*	*5.17*	*112*	*1.69*
In Water Work			*225*	*0.511*	*8/22/2024 11:15*	*8/22/2024 18:15*	*76,736*	*1.76*	*1,078*	*2.45*
Base			*8*	*0.120*	*8/22/2024 18:15*	*8/23/2024 10:15*	*183,154*	*4.21*	*91*	*1.37*
In Water Work			*225*	*0.511*	*8/23/2024 10:15*	*8/23/2024 18:15*	*91,128*	*2.09*	*1,280*	*2.91*
Base			*8*	*0.120*	*8/23/2024 18:15*	*8/26/2024 19:15*	*792,747*	*18.21*	*396*	*5.94*
Storm			*225*	*0.511*	*8/26/2024 19:15*	*8/26/2024 23:15*	*97,857*	*2.25*	*1,374*	*3.12*
Base			*8*	*0.120*	*8/26/2024 23:15*	*8/27/2024 5:15*	*116,955*	*2.69*	*58*	*0.88*
Storm			*225*	*0.511*	*8/27/2024 5:15*	*8/27/2024 21:15*	*813,497*	*18.69*	*11,426*	*25.95*
Base			*8*	*0.120*	*8/27/2024 21:15*	*8/28/2024 8:15*	*466,386*	*10.71*	*233*	*3.49*
In Water Work			*225*	*0.511*	*8/28/2024 8:15*	*8/28/2024 19:15*	*394,482*	*9.06*	*5,541*	*12.58*
Base			*8*	*0.120*	*8/28/2024 19:15*	*8/29/2024 8:15*	*356,527*	*8.19*	*178*	*2.67*
Storm			*225*	*0.511*	*8/29/2024 8:15*	*8/30/2024 0:15*	*621,134*	*14.27*	*8,724*	*19.81*
Base			*8*	*0.120*	*8/30/2024 0:15*	*8/30/2024 9:15*	*499,923*	*11.48*	*250*	*3.74*
In Water Work			*225*	*0.511*	*8/30/2024 9:15*	*8/30/2024 17:15*	*423,888*	*9.74*	*5,954*	*13.52*
Base			*8*	*0.120*	*8/30/2024 17:15*	*9/2/2024 11:15*	*1,892,860*	*43.48*	*945*	*14.18*
In Water Work			*225*	*0.511*	*9/2/2024 11:15*	*9/2/2024 17:15*	*93,200*	*2.14*	*1,309*	*2.97*
Base Grab	9/3/2024 10:11	9/3/2024 10:11	7	0.135	9/2/2024 17:15	9/4/2024 10:15	574,933	13.21	251	4.85
Base			*8*	*0.120*	*9/4/2024 10:15*	*9/21/2024 9:15*	*6,690,070*	*153.66*	*3,341*	*50.12*
Storm			*225*	*0.511*	*9/21/2024 9:15*	*9/21/2024 15:15*	*148,131*	*3.40*	*2,081*	*4.73*
Base Grab	9/24/2024 9:28	9/24/2024 9:28	5	0.088	9/21/2024 15:15	9/25/2024 10:15	1,890,510	43.42	590	10.39
Base			*8*	*0.120*	*9/25/2024 10:15*	*10/20/2024 14:15*	*7,252,100*	*166.57*	*3,622*	*54.33*
Base Grab	10/21/2024 14:45	10/21/2024 14:45	3	0.063	10/20/2024 14:15	10/29/2024 10:30	2,303,950	52.92	431	9.06
*Base**			*8*	*0.120*	*10/29/2024 10:30*	*10/31/2024 7:00*	*480,600*	*11.04*	*240*	*3.60*
*Storm**			*225*	*0.511*	*10/31/2024 7:00*	*10/31/2024 16:00*	*324,000*	*7.44*	*4,551*	*10.34*
*Base**			*8*	*0.120*	*10/31/2024 16:00*	*11/18/2024 16:00*	*4,665,600*	*107.16*	*2,330*	*34.95*
*Storm**			*225*	*0.511*	*11/18/2024 16:00*	*11/19/2024 8:00*	*864,000*	*19.85*	*12,136*	*27.56*
*Base**			*8*	*0.120*	*11/19/2024 8:00*	*12/27/2024 18:00*	*11,617,200*	*266.83*	*5,802*	*87.03*
*Storm**			*225*	*0.511*	*12/27/2024 18:00*	*12/28/2024 8:00*	*604,800*	*13.89*	*8,495*	*19.29*
*Base**			*8*	*0.120*	*12/28/2024 8:00*	*1/1/2025 0:00*	*2,059,200*	*47.30*	*1,028*	*15.43*
Storm Average			225	0.511						
Base Average			8	0.120						
All Average			107	0.315						
Total							**158,481,122**	**3,640**	**508,266**	**1,803**
Brown's Creek Major Subwatershed Total Acres							3,999			
Total TSS/TP (lb/ac/yr)									127.10	0.451
Total TSS/TP (kg/ha/yr)									142.46	0.505

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

[X]TSS result excluded from averages.

Table 3. Brown's Creek at Stonebridge Trail 2024 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base**			*6*	*0.098*	*1/1/2024 0:00*	*3/25/2024 12:00*	*25,552,800*	*586.92*	*9,571*	*156.33*
*Snowmelt**			*169*	*0.371*	*3/25/2024 12:00*	*3/31/2024 15:00*	*3,969,000*	*91.16*	*41,873*	*91.92*
*Base**			*6*	*0.098*	*3/31/2024 15:00*	*4/7/2024 11:00*	*2,361,600*	*54.24*	*885*	*14.45*
*Storm**			*271*	*0.542*	*4/7/2024 11:00*	*4/8/2024 14:00*	*1,749,600*	*40.19*	*29,599*	*59.20*
*Base**			*6*	*0.098*	*4/8/2024 14:00*	*4/15/2024 15:15*	*3,503,475*	*80.47*	*1,312*	*21.43*
Base			*6*	*0.098*	*4/15/2024 15:15*	*4/16/2024 11:15*	*327,083*	*7.51*	*123*	*2.00*
Storm Composite	4/16/2024 18:26	4/17/2024 13:01	125	0.428	4/16/2024 11:15	4/17/2024 13:15	1,936,160	44.47	15,108	51.73
Base			*6*	*0.098*	*4/17/2024 13:15*	*4/28/2024 15:15*	*5,288,630*	*121.47*	*1,981*	*32.35*
Storm Composite	4/29/2024 7:18	4/30/2024 5:08	108	0.307	4/28/2024 15:15	4/30/2024 9:15	1,790,090	41.12	12,069	34.31
Base			*6*	*0.098*	*4/30/2024 9:15*	*5/2/2024 7:15*	*1,977,000*	*45.41*	*740*	*12.09*
Storm			*271*	*0.542*	*5/2/2024 7:15*	*5/3/2024 0:15*	*1,289,810*	*29.63*	*21,820*	*43.64*
Base			*6*	*0.098*	*5/3/2024 0:15*	*5/19/2024 15:15*	*9,370,910*	*215.24*	*3,510*	*57.33*
Base Grab	5/20/2024 15:03	5/20/2024 15:03	7	0.079	5/19/2024 15:15	5/21/2024 17:15	813,557	18.69	356	4.01
Storm Composite	5/21/2024 17:56	5/22/2024 5:29	315	0.582	5/21/2024 17:15	5/22/2024 14:15	2,230,330	51.23	43,858	81.03
Base			*6*	*0.098*	*5/22/2024 14:15*	*5/27/2024 18:15*	*4,649,070*	*106.78*	*1,741*	*28.44*
Storm			*271*	*0.542*	*5/27/2024 18:15*	*5/27/2024 21:15*	*84,261*	*1.94*	*1,425*	*2.85*
Base			*6*	*0.098*	*5/27/2024 21:15*	*6/4/2024 19:15*	*3,427,790*	*78.73*	*1,284*	*20.97*
Storm Composite	6/4/2024 19:36	6/4/2024 22:04	299	0.732	6/4/2024 19:15	6/5/2024 4:15	905,778	20.80	16,907	41.39
Base			*6*	*0.098*	*6/5/2024 4:15*	*6/12/2024 23:15*	*4,937,520*	*113.41*	*1,849*	*30.21*
Storm			*271*	*0.542*	*6/12/2024 23:15*	*6/13/2024 6:15*	*264,725*	*6.08*	*4,478*	*8.96*
Base			*6*	*0.098*	*6/13/2024 6:15*	*6/15/2024 23:15*	*1,741,040*	*39.99*	*652*	*10.65*
Storm			*271*	*0.542*	*6/15/2024 23:15*	*6/16/2024 7:15*	*483,729*	*11.11*	*8,183*	*16.37*
Base			*6*	*0.098*	*6/16/2024 7:15*	*6/18/2024 21:15*	*3,573,740*	*82.08*	*1,339*	*21.86*
Storm Composite	6/18/2024 22:04	6/19/2024 4:11	125	0.347	6/18/2024 21:15	6/19/2024 4:15	734,842	16.88	5,734	15.92
Base			*6*	*0.098*	*6/19/2024 4:15*	*6/26/2024 13:15*	*9,030,170*	*207.41*	*3,382*	*55.24*
Storm Grab	6/26/2024 14:20	6/26/2024 14:20	107	0.302	6/26/2024 13:15	6/26/2024 15:15	48,342	1.11	323	0.91
Base			*6*	*0.098*	*6/26/2024 15:15*	*6/28/2024 5:15*	*796,153*	*18.29*	*298*	*4.87*
Storm			*271*	*0.542*	*6/28/2024 5:15*	*6/28/2024 11:15*	*341,377*	*7.84*	*5,775*	*11.55*
Base			*6*	*0.098*	*6/28/2024 11:15*	*7/11/2024 16:15*	*6,418,350*	*147.42*	*2,404*	*39.27*
In Water Work			*271*	*0.542*	*7/11/2024 16:15*	*7/11/2024 22:15*	*52,071*	*1.20*	*881*	*1.76*
Base			*6*	*0.098*	*7/11/2024 22:15*	*7/13/2024 8:15*	*267,877*	*6.15*	*100*	*1.64*
Storm			*271*	*0.542*	*7/13/2024 8:15*	*7/13/2024 14:15*	*158,333*	*3.64*	*2,679*	*5.36*
Base			*6*	*0.098*	*7/13/2024 14:15*	*7/17/2024 14:15*	*1,666,850*	*38.29*	*624*	*10.20*
In Water Work			*271*	*0.542*	*7/17/2024 14:15*	*7/17/2024 21:15*	*66,996*	*1.54*	*1,133*	*2.27*
Base			*6*	*0.098*	*7/17/2024 21:15*	*7/18/2024 12:15*	*122,779*	*2.82*	*46*	*0.75*
In Water Work			*271*	*0.542*	*7/18/2024 12:15*	*7/19/2024 0:15*	*94,987*	*2.18*	*1,607*	*3.21*
Base			*6*	*0.098*	*7/19/2024 0:15*	*7/22/2024 17:15*	*571,006*	*13.12*	*214*	*3.49*
Storm Composite	7/22/2024 19:26	7/22/2024 21:21	424	0.785	7/22/2024 17:15	7/23/2024 0:15	320,873	7.37	8,493	15.72
Base Grab	7/25/2024 13:00	7/25/2024 13:00	9	0.128	7/23/2024 0:15	7/27/2024 14:15	2,413,470	55.43	1,356	19.28
In Water Work			*271*	*0.542*	*7/27/2024 14:15*	*7/27/2024 17:15*	*25,337*	*0.58*	*429*	*0.86*
Base			*6*	*0.098*	*7/27/2024 17:15*	*7/28/2024 14:15*	*155,064*	*3.56*	*58*	*0.95*
In Water Work			*271*	*0.542*	*7/28/2024 14:15*	*7/28/2024 18:15*	*27,366*	*0.63*	*463*	*0.93*
Base			*6*	*0.098*	*7/28/2024 18:15*	*7/30/2024 13:15*	*411,736*	*9.46*	*154*	*2.52*
In Water Work			*271*	*0.542*	*7/30/2024 13:15*	*7/30/2024 20:15*	*67,062*	*1.54*	*1,135*	*2.27*
Base			*6*	*0.098*	*7/30/2024 20:15*	*7/31/2024 13:15*	*146,061*	*3.35*	*55*	*0.89*
In Water Work			*271*	*0.542*	*7/31/2024 13:15*	*7/31/2024 19:15*	*48,226*	*1.11*	*816*	*1.63*
Base			*6*	*0.098*	*7/31/2024 19:15*	*8/1/2024 14:15*	*241,974*	*5.56*	*91*	*1.48*
In Water Work			*271*	*0.542*	*8/1/2024 14:15*	*8/1/2024 22:15*	*136,633*	*3.14*	*2,311*	*4.62*
Base			*6*	*0.098*	*8/1/2024 22:15*	*8/2/2024 12:15*	*249,319*	*5.73*	*93*	*1.53*
In Water Work			*271*	*0.542*	*8/2/2024 12:15*	*8/2/2024 18:15*	*93,225*	*2.14*	*1,577*	*3.15*
Base			*6*	*0.098*	*8/2/2024 18:15*	*8/5/2024 9:15*	*676,611*	*15.54*	*253*	*4.14*
Storm			*271*	*0.542*	*8/5/2024 9:15*	*8/5/2024 17:15*	*298,456*	*6.86*	*5,049*	*10.10*
Storm Composite	8/5/2024 18:20	8/5/2024 21:38	663	0.854	8/5/2024 17:15	8/5/2024 23:15	765,349	17.58	31,677	40.80
Storm			*271*	*0.542*	*8/5/2024 23:15*	*8/6/2024 20:15*	*2,798,640*	*64.28*	*47,346*	*94.69*
Base			*6*	*0.098*	*8/6/2024 20:15*	*8/7/2024 11:15*	*1,720,040*	*39.51*	*644*	*10.52*
In Water Work			*271*	*0.542*	*8/7/2024 11:15*	*8/7/2024 17:15*	*513,119*	*11.79*	*8,681*	*17.36*
Base			*6*	*0.098*	*8/7/2024 17:15*	*8/8/2024 14:15*	*1,182,980*	*27.17*	*443*	*7.24*
In Water Work			*271*	*0.542*	*8/8/2024 14:15*	*8/8/2024 20:15*	*246,793*	*5.67*	*4,175*	*8.35*
Base			*6*	*0.098*	*8/8/2024 20:15*	*8/9/2024 13:15*	*604,103*	*13.88*	*226*	*3.70*
In Water Work			*271*	*0.542*	*8/9/2024 13:15*	*8/9/2024 15:15*	*65,488*	*1.50*	*1,108*	*2.22*
Base			*6*	*0.098*	*8/9/2024 15:15*	*8/12/2024 16:15*	*1,562,980*	*35.90*	*585*	*9.56*
In Water Work			*271*	*0.542*	*8/12/2024 16:15*	*8/12/2024 19:15*	*45,289*	*1.04*	*766*	*1.53*
Base			*6*	*0.098*	*8/12/2024 19:15*	*8/13/2024 14:15*	*269,585*	*6.19*	*101*	*1.65*
In Water Work			*271*	*0.542*	*8/13/2024 14:15*	*8/13/2024 22:15*	*104,186*	*2.39*	*1,763*	*3.53*
Base			*6*	*0.098*	*8/13/2024 22:15*	*8/14/2024 15:15*	*208,420*	*4.79*	*78*	*1.28*
In Water Work			*271*	*0.542*	*8/14/2024 15:15*	*8/14/2024 23:15*	*90,430*	*2.08*	*1,530*	*3.06*
Base			*6*	*0.098*	*8/14/2024 23:15*	*8/15/2024 4:15*	*53,896*	*1.24*	*20*	*0.33*

Storm			*271*	*0.542*	*8/15/2024 4:15*	*8/15/2024 10:15*	*208,665*	*4.79*	*3,530*	*7.06*
Base			*6*	*0.098*	*8/15/2024 10:15*	*8/19/2024 13:15*	*2,538,870*	*58.31*	*951*	*15.53*
In Water Work			*271*	*0.542*	*8/19/2024 13:15*	*8/19/2024 22:15*	*157,440*	*3.62*	*2,663*	*5.33*
Base			*6*	*0.098*	*8/19/2024 22:15*	*8/20/2024 13:15*	*244,139*	*5.61*	*91*	*1.49*
In Water Work			*271*	*0.542*	*8/20/2024 13:15*	*8/20/2024 21:15*	*121,972*	*2.80*	*2,063*	*4.13*
Base			*6*	*0.098*	*8/20/2024 21:15*	*8/22/2024 13:15*	*555,999*	*12.77*	*208*	*3.40*
In Water Work			*271*	*0.542*	*8/22/2024 13:15*	*8/22/2024 21:15*	*108,071*	*2.48*	*1,828*	*3.66*
Base			*6*	*0.098*	*8/22/2024 21:15*	*8/23/2024 12:15*	*211,275*	*4.85*	*79*	*1.29*
In Water Work			*271*	*0.542*	*8/23/2024 12:15*	*8/23/2024 21:15*	*120,626*	*2.77*	*2,041*	*4.08*
Base			*6*	*0.098*	*8/23/2024 21:15*	*8/26/2024 20:15*	*868,495*	*19.95*	*325*	*5.31*
Storm			*271*	*0.542*	*8/26/2024 20:15*	*8/27/2024 22:15*	*1,375,990*	*31.60*	*23,278*	*46.56*
Base			*6*	*0.098*	*8/27/2024 22:15*	*8/28/2024 9:15*	*594,580*	*13.66*	*223*	*3.64*
In Water Work			*271*	*0.542*	*8/28/2024 9:15*	*8/28/2024 21:15*	*544,203*	*12.50*	*9,207*	*18.41*
Base			*6*	*0.098*	*8/28/2024 21:15*	*8/29/2024 10:15*	*435,504*	*10.00*	*163*	*2.66*
Storm			*271*	*0.542*	*8/29/2024 10:15*	*8/30/2024 0:15*	*746,001*	*17.13*	*12,620*	*25.24*
Base			*6*	*0.098*	*8/30/2024 0:15*	*8/30/2024 10:15*	*711,979*	*16.35*	*267*	*4.36*
In Water Work			*271*	*0.542*	*8/30/2024 10:15*	*8/30/2024 18:15*	*531,404*	*12.21*	*8,990*	*17.98*
Base			*6*	*0.098*	*8/30/2024 18:15*	*9/2/2024 13:15*	*2,422,990*	*55.65*	*908*	*14.82*
In Water Work			*271*	*0.542*	*9/2/2024 13:15*	*9/2/2024 19:15*	*122,801*	*2.82*	*2,077*	*4.15*
Base Grab	9/3/2024 9:22	9/3/2024 9:22	9	0.128	9/2/2024 19:15	9/4/2024 9:15	674,029	15.48	379	5.39
Base			*6*	*0.098*	*9/4/2024 9:15*	*9/21/2024 9:15*	*4,995,650*	*114.74*	*1,871*	*30.56*
Storm			*271*	*0.542*	*9/21/2024 9:15*	*9/21/2024 15:15*	*150,386*	*3.45*	*2,544*	*5.09*
Base Grab	9/24/2024 9:37	9/24/2024 9:37	3	0.090	9/21/2024 15:15	9/25/2024 10:15	1,821,850	41.85	341	10.24
Base			*6*	*0.098*	*9/25/2024 10:15*	*10/20/2024 13:15*	*8,204,230*	*188.44*	*3,073*	*50.19*
Base Grab	10/21/2024 13:36	10/21/2024 13:36	3	0.067	10/20/2024 13:15	10/25/2024 15:00	2,708,900	62.22	507	11.33
*Base**			*6*	*0.098*	*10/25/2024 15:00*	*10/31/2024 7:00*	*1,713,600*	*39.36*	*642*	*10.48*
*Storm**			*271*	*0.542*	*10/31/2024 7:00*	*10/31/2024 16:00*	*332,100*	*7.63*	*5,618*	*11.24*
*Base**			*6*	*0.098*	*10/31/2024 16:00*	*11/18/2024 16:00*	*5,443,200*	*125.02*	*2,039*	*33.30*
*Storm**			*271*	*0.542*	*11/18/2024 16:00*	*11/19/2024 8:00*	*950,400*	*21.83*	*16,078*	*32.16*
*Base**			*6*	*0.098*	*11/19/2024 8:00*	*12/27/2024 18:00*	*13,276,800*	*304.95*	*4,973*	*81.22*
*Storm**			*271*	*0.542*	*12/27/2024 18:00*	*12/28/2024 8:00*	*655,200*	*15.05*	*11,084*	*22.17*
*Base**			*6*	*0.098*	*12/28/2024 8:00*	*1/1/2025 0:00*	*2,138,400*	*49.12*	*801*	*13.08*
Storm Average			271	0.542						
Base Average			6	0.098						
All Average			169	0.371						
Total							**173,826,291**	**3,993**	**488,806**	**1,781**
Brown's Creek Major Subwatershed Total Acres							4,189			
Total TSS/TP(lb/ac/yr)									116.69	0.425
Total TSS/TP (kg/ha/yr)									130.79	0.477

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

Table 4. Tributary to Long Lake at Marketplace Pond 2024 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Intermittent Flow**			*5*	*0.095*	*1/1/2024 0:00*	*3/25/2024 12:00*	*7,301*	*0.17*	*2*	*0.04*
*Snowmelt**			*16*	*0.111*	*3/25/2024 12:00*	*3/31/2024 15:00*	*1,058,400*	*24.31*	*1,057*	*7.33*
*Base**			*5*	*0.095*	*3/31/2024 15:00*	*4/7/2024 11:00*	*295,200*	*6.78*	*92*	*1.75*
*Storm**			*23*	*0.119*	*4/7/2024 11:00*	*4/8/2024 1:00*	*756,000*	*17.36*	*1,085*	*5.62*
*Base**			*5*	*0.095*	*4/8/2024 1:00*	*4/16/2024 11:00*	*218,160*	*5.01*	*68*	*1.29*
*Storm**			*23*	*0.119*	*4/16/2024 11:00*	*4/17/2024 1:00*	*756,000*	*17.36*	*1,085*	*5.62*
*Base**			*5*	*0.095*	*4/17/2024 1:00*	*4/25/2024 14:15*	*369,450*	*8.49*	*115*	*2.19*
Base			*5*	*0.095*	*4/25/2024 14:15*	*4/28/2024 13:15*	*12,445*	*0.29*	*4*	*0.07*
Storm Composite	4/28/2024 21:06	4/29/2024 2:34	14	0.103	4/28/2024 13:15	4/29/2024 3:15	146,909	3.37	128	0.94
Base			*5*	*0.095*	*4/29/2024 3:15*	*4/30/2024 19:15*	*283,710*	*6.52*	*89*	*1.68*
Storm			*23*	*0.119*	*4/30/2024 19:15*	*5/1/2024 1:15*	*91,314*	*2.10*	*131*	*0.68*
Base			*5*	*0.095*	*5/1/2024 1:15*	*5/2/2024 7:15*	*221,978*	*5.10*	*69*	*1.32*
Storm			*23*	*0.119*	*5/2/2024 7:15*	*5/2/2024 15:15*	*239,417*	*5.50*	*344*	*1.78*
Base			*5*	*0.095*	*5/2/2024 15:15*	*5/4/2024 7:15*	*349,565*	*8.03*	*109*	*2.07*
Storm			*23*	*0.119*	*5/4/2024 7:15*	*5/4/2024 14:15*	*114,409*	*2.63*	*164*	*0.85*
Base			*5*	*0.095*	*5/4/2024 14:15*	*5/7/2024 4:15*	*310,145*	*7.12*	*97*	*1.84*
Storm			*23*	*0.119*	*5/7/2024 4:15*	*5/7/2024 11:15*	*72,159*	*1.66*	*104*	*0.54*
Base			*5*	*0.095*	*5/7/2024 11:15*	*5/15/2024 8:15*	*279,542*	*6.42*	*87*	*1.66*
Base Grab	5/16/2024 8:46	5/16/2024 8:46	7	0.109	5/15/2024 8:15	5/17/2024 20:15	66,641	1.53	29	0.45
Storm			*23*	*0.119*	*5/17/2024 20:15*	*5/18/2024 2:15*	*31,501*	*0.72*	*45*	*0.23*
Base			*5*	*0.095*	*5/18/2024 2:15*	*5/20/2024 3:15*	*115,522*	*2.65*	*36*	*0.69*
Storm			*23*	*0.119*	*5/20/2024 3:15*	*5/20/2024 9:15*	*66,004*	*1.52*	*95*	*0.49*
Base			*5*	*0.095*	*5/20/2024 9:15*	*5/21/2024 1:15*	*121,578*	*2.79*	*38*	*0.72*
Storm			*23*	*0.119*	*5/21/2024 1:15*	*5/21/2024 16:15*	*238,836*	*5.49*	*343*	*1.77*
Storm Composite	5/21/2024 17:31	5/21/2024 20:37	17	0.089	5/21/2024 16:15	5/22/2024 2:15	682,202	15.67	724	3.79
Base			*5*	*0.095*	*5/22/2024 2:15*	*5/27/2024 17:15*	*1,092,500*	*25.09*	*341*	*6.48*
Storm			*23*	*0.119*	*5/27/2024 17:15*	*5/27/2024 21:15*	*27,714*	*0.64*	*40*	*0.21*
Base			*5*	*0.095*	*5/27/2024 21:15*	*5/31/2024 16:15*	*154,950*	*3.56*	*48*	*0.92*
Storm Composite	5/31/2024 19:35	6/1/2024 4:12	13	0.094	5/31/2024 16:15	6/1/2024 5:15	195,928	4.50	159	1.15
Base			*5*	*0.095*	*6/1/2024 5:15*	*6/3/2024 4:15*	*304,472*	*6.99*	*95*	*1.81*
Storm			*23*	*0.119*	*6/3/2024 4:15*	*6/3/2024 9:15*	*126,783*	*2.91*	*182*	*0.94*
Base			*5*	*0.095*	*6/3/2024 9:15*	*6/4/2024 18:15*	*289,160*	*6.64*	*90*	*1.71*
Storm Composite	6/4/2024 19:14	6/5/2024 0:18	7	0.076	6/4/2024 18:15	6/5/2024 1:15	336,641	7.73	147	1.60
Base			*5*	*0.095*	*6/5/2024 1:15*	*6/12/2024 22:15*	*710,255*	*16.31*	*222*	*4.21*
Storm Composite	6/12/2024 23:59	6/13/2024 0:43	63	0.203	6/12/2024 22:15	6/13/2024 3:15	155,145	3.56	610	1.97
Base			*5*	*0.095*	*6/13/2024 3:15*	*6/15/2024 14:15*	*390,347*	*8.97*	*122*	*2.31*
Storm			*23*	*0.119*	*6/15/2024 14:15*	*6/16/2024 6:15*	*481,013*	*11.05*	*691*	*3.57*
Base			*5*	*0.095*	*6/16/2024 6:15*	*6/17/2024 5:15*	*418,596*	*9.61*	*131*	*2.48*
Storm			*23*	*0.119*	*6/17/2024 5:15*	*6/17/2024 11:15*	*170,042*	*3.91*	*244*	*1.26*
Base			*5*	*0.095*	*6/17/2024 11:15*	*6/18/2024 21:15*	*381,376*	*8.76*	*119*	*2.26*
Storm			*23*	*0.119*	*6/18/2024 21:15*	*6/19/2024 2:15*	*125,269*	*2.88*	*180*	*0.93*
Base			*5*	*0.095*	*6/19/2024 2:15*	*6/21/2024 5:15*	*311,447*	*7.15*	*97*	*1.85*
Storm			*23*	*0.119*	*6/21/2024 5:15*	*6/22/2024 20:15*	*436,696*	*10.03*	*627*	*3.24*
Base Grab	6/27/2024 13:25	6/27/2024 13:25	3	0.090	6/22/2024 20:15	6/28/2024 2:15	321,247	7.38	60	1.80
Storm Composite	6/28/2024 5:22	6/28/2024 7:00	17	0.116	6/28/2024 2:15	6/28/2024 7:15	115,737	2.66	123	0.84
Base			*5*	*0.095*	*6/28/2024 7:15*	*7/2/2024 0:15*	*606,267*	*13.93*	*189*	*3.60*
Storm			*23*	*0.119*	*7/2/2024 0:15*	*7/2/2024 7:15*	*74,951*	*1.72*	*108*	*0.56*
Base			*5*	*0.095*	*7/2/2024 7:15*	*7/4/2024 14:15*	*252,511*	*5.80*	*79*	*1.50*
Storm			*23*	*0.119*	*7/4/2024 14:15*	*7/4/2024 21:15*	*56,017*	*1.29*	*80*	*0.42*
Base			*5*	*0.095*	*7/4/2024 21:15*	*7/8/2024 13:15*	*156,850*	*3.60*	*49*	*0.93*
Storm			*23*	*0.119*	*7/8/2024 13:15*	*7/8/2024 16:15*	*24,778*	*0.57*	*36*	*0.18*
Base			*5*	*0.095*	*7/8/2024 16:15*	*7/13/2024 8:15*	*190,725*	*4.38*	*60*	*1.13*
Storm			*23*	*0.119*	*7/13/2024 8:15*	*7/13/2024 11:15*	*50,157*	*1.15*	*72*	*0.37*
Base			*5*	*0.095*	*7/13/2024 11:15*	*7/13/2024 23:15*	*126,229*	*2.90*	*39*	*0.75*
Storm Composite	7/13/2024 23:41	7/14/2024 1:18	20	0.121	7/13/2024 23:15	7/14/2024 3:15	138,248	3.18	173	1.04
Base			*5*	*0.095*	*7/14/2024 3:15*	*7/22/2024 17:15*	*538,461*	*12.37*	*168*	*3.19*
Storm Composite	7/22/2024 17:53	7/22/2024 19:02	43	0.154	7/22/2024 17:15	7/22/2024 21:15	175,345	4.03	471	1.69
Base Grab	7/25/2024 14:07	7/25/2024 14:07	5	0.078	7/22/2024 21:15	8/1/2024 0:15	522,301	12.00	163	2.54
Storm			*23*	*0.119*	*8/1/2024 0:15*	*8/1/2024 7:15*	*66,672*	*1.53*	*96*	*0.50*
Base			*5*	*0.095*	*8/1/2024 7:15*	*8/5/2024 7:15*	*276,571*	*6.35*	*86*	*1.64*
Storm Composite	8/5/2024 10:43	8/5/2024 14:22	10	0.119	8/5/2024 7:15	8/5/2024 15:15	245,412	5.64	153	1.82
Storm			*23*	*0.119*	*8/5/2024 15:15*	*8/5/2024 23:15*	*567,474*	*13.03*	*815*	*4.22*
Base			*5*	*0.095*	*8/5/2024 23:15*	*8/15/2024 3:15*	*1,051,980*	*24.16*	*328*	*6.24*
Storm			*23*	*0.119*	*8/15/2024 3:15*	*8/15/2024 9:15*	*145,395*	*3.34*	*209*	*1.08*
Base			*5*	*0.095*	*8/15/2024 9:15*	*8/26/2024 19:15*	*503,363*	*11.56*	*157*	*2.99*
Storm			*23*	*0.119*	*8/26/2024 19:15*	*8/26/2024 22:15*	*90,044*	*2.07*	*129*	*0.67*
Base			*5*	*0.095*	*8/26/2024 22:15*	*8/27/2024 5:15*	*132,636*	*3.05*	*41*	*0.79*
Storm			*23*	*0.119*	*8/27/2024 5:15*	*8/27/2024 10:15*	*299,777*	*6.89*	*430*	*2.23*
Base			*5*	*0.095*	*8/27/2024 10:15*	*8/29/2024 17:15*	*620,141*	*14.24*	*194*	*3.68*
Storm			*23*	*0.119*	*8/29/2024 17:15*	*8/29/2024 22:15*	*181,852*	*4.18*	*261*	*1.35*
Base Grab	9/3/2024 10:39	9/3/2024 10:39	7	0.083	8/29/2024 22:15	9/4/2024 11:15	506,623	11.64	221	2.63
Base			*5*	*0.095*	*9/4/2024 11:15*	*9/14/2024 9:15*	*59,656*	*1.37*	*19*	*0.35*
Storm			*23*	*0.119*	*9/14/2024 9:15*	*9/14/2024 12:15*	*10,195*	*0.23*	*15*	*0.08*
Base Grab	9/16/2024 11:23	9/16/2024 11:23	3	0.117	9/14/2024 12:15	9/19/2024 5:15	39,914	0.92	7	0.29
Storm			*23*	*0.119*	*9/19/2024 5:15*	*9/19/2024 21:15*	*31,666*	*0.73*	*45*	*0.24*
Base			*5*	*0.095*	*9/19/2024 21:15*	*9/21/2024 9:15*	*97,568*	*2.24*	*30*	*0.58*
Storm			*23*	*0.119*	*9/21/2024 9:15*	*9/21/2024 14:15*	*124,962*	*2.87*	*179*	*0.93*
Base			*5*	*0.095*	*9/21/2024 14:15*	*10/24/2024 18:15*	*418,283*	*9.61*	*131*	*2.48*
Storm			*23*	*0.119*	*10/24/2024 18:15*	*10/24/2024 22:15*	*46,416*	*1.07*	*67*	*0.34*
Base			*5*	*0.095*	*10/24/2024 22:15*	*10/29/2024 13:45*	*254,219*	*5.84*	*79*	*1.51*
*Base**			*5*	*0.095*	*10/29/2024 13:45*	*10/31/2024 7:00*	*74,250*	*1.71*	*23*	*0.44*
*Storm**			*23*	*0.119*	*10/31/2024 7:00*	*10/31/2024 14:00*	*496,440*	*11.40*	*713*	*3.69*
*Base**			*5*	*0.095*	*10/31/2024 14:00*	*11/18/2024 16:00*	*156,240*	*3.59*	*49*	*0.93*
*Storm**			*23*	*0.119*	*11/18/2024 16:00*	*11/19/2024 5:00*	*842,400*	*19.35*	*1,210*	*6.26*
*Base**			*5*	*0.095*	*11/19/2024 5:00*	*12/27/2024 18:00*	*166,500*	*3.82*	*52*	*0.99*
*Storm**			*23*	*0.119*	*12/27/2024 18:00*	*12/28/2024 4:00*	*252,000*	*5.79*	*362*	*1.87*
*Base**			*5*	*0.095*	*12/28/2024 4:00*	*1/1/2025 0:00*	*198,720*	*4.56*	*62*	*1.18*
Storm Average			23	0.119						
Base Average			5	0.095						
All Average			16	0.111						
Total							**24,319,915**	**559**	**18,320**	**157**
Brown's Creek Major Subwatershed Total Acres							410			
Total TSS/TP(lb/ac/yr)									44.68	0.383
Total TSS/TP (kg/ha/yr)									50.08	0.429

Italics indicate estimated concentrations based on average base and storm flow concentrations.

*Interval volumes were estimated using similar flow conditions.

Table 5. Brown's Creek Diversion Structure Drainage 2024 Total Suspended Solids (TSS) and Total Phosphorus (TP) Loading

	Sample Collection Time				Loading Interval					
Sample Type	Start	End	TSS (mg/L)	TP (mg/L)	Start	End	Interval Volume (cf)	Interval Volume (ac-ft)	Interval TSS (lb)	Interval TP (lb)
*Base**			*4*	*0.066*	*1/1/2024 0:00*	*3/29/2024 12:00*	*3,823,200*	*87.81*	*955*	*15.75*
*Snowmelt**			*215*	*0.321*	*3/29/2024 12:00*	*3/31/2024 18:00*	*583,200*	*13.40*	*7,827*	*11.69*
*Base**			*4*	*0.066*	*3/31/2024 18:00*	*4/7/2024 11:00*	*434,700*	*9.98*	*109*	*1.79*
*Storm**			*374*	*0.513*	*4/7/2024 11:00*	*4/8/2024 1:00*	*252,000*	*5.79*	*5,884*	*8.07*
*Base**			*4*	*0.066*	*4/8/2024 1:00*	*4/11/2024 11:30*	*445,500*	*10.23*	*111*	*1.84*
Base			*4*	*0.066*	*4/11/2024 11:30*	*4/16/2024 11:30*	*557,234*	*12.80*	*139*	*2.30*
Storm Composite	4/16/2024 16:47	4/17/2024 0:42	90	0.373	4/16/2024 11:30	4/17/2024 1:30	236,564	5.43	1,329	5.51
Base			*4*	*0.066*	*4/17/2024 1:30*	*4/28/2024 14:30*	*1,977,190*	*45.41*	*494*	*8.15*
Storm			*374*	*0.513*	*4/28/2024 14:30*	*4/29/2024 3:30*	*120,365*	*2.76*	*2,810*	*3.85*
Base			*4*	*0.066*	*4/29/2024 3:30*	*4/30/2024 19:30*	*354,784*	*8.15*	*89*	*1.46*
Storm			*374*	*0.513*	*4/30/2024 19:30*	*5/1/2024 2:30*	*84,996*	*1.95*	*1,984*	*2.72*
Base			*4*	*0.066*	*5/1/2024 2:30*	*5/2/2024 7:30*	*306,228*	*7.03*	*76*	*1.26*
Storm			*374*	*0.513*	*5/2/2024 7:30*	*5/2/2024 16:30*	*232,037*	*5.33*	*5,417*	*7.43*
Base			*4*	*0.066*	*5/2/2024 16:30*	*5/4/2024 7:30*	*971,731*	*22.32*	*243*	*4.00*
Storm			*374*	*0.513*	*5/4/2024 7:30*	*5/4/2024 16:30*	*252,387*	*5.80*	*5,893*	*8.08*
Base			*4*	*0.066*	*5/4/2024 16:30*	*5/7/2024 6:30*	*1,393,500*	*32.01*	*348*	*5.74*
Storm			*374*	*0.513*	*5/7/2024 6:30*	*5/7/2024 16:30*	*217,845*	*5.00*	*5,086*	*6.98*
Base			*4*	*0.066*	*5/7/2024 16:30*	*5/19/2024 14:30*	*2,104,770*	*48.34*	*526*	*8.67*
Base Grab	5/20/2024 14:27	5/20/2024 14:27	6	0.080	5/19/2024 14:30	5/21/2024 17:30	298,935	6.87	112	1.49
Storm Composite	5/21/2024 18:11	5/22/2024 6:11	186	0.432	5/21/2024 17:30	5/22/2024 7:30	926,589	21.28	10,759	24.99
Base			*4*	*0.066*	*5/22/2024 7:30*	*5/31/2024 17:30*	*5,501,990*	*126.37*	*1,374*	*22.67*
Storm			*374*	*0.513*	*5/31/2024 17:30*	*6/1/2024 9:30*	*162,909*	*3.74*	*3,803*	*5.22*
Base			*4*	*0.066*	*6/1/2024 9:30*	*6/3/2024 4:30*	*434,084*	*9.97*	*108*	*1.79*
Storm Composite	6/3/2024 5:43	6/3/2024 12:23	96	0.193	6/3/2024 4:30	6/3/2024 12:30	163,301	3.75	979	1.97
Base			*4*	*0.066*	*6/3/2024 12:30*	*6/4/2024 18:30*	*518,057*	*11.90*	*129*	*2.13*
Storm Composite	6/4/2024 19:53	6/4/2024 23:34	1,080	0.905	6/4/2024 18:30	6/5/2024 0:30	253,322	5.82	17,079	14.31
Storm			*374*	*0.513*	*6/5/2024 0:30*	*6/5/2024 7:30*	*341,701*	*7.85*	*7,978*	*10.94*
Base			*4*	*0.066*	*6/5/2024 7:30*	*6/12/2024 23:30*	*2,942,960*	*67.60*	*735*	*12.13*
Storm			*374*	*0.513*	*6/12/2024 23:30*	*6/13/2024 5:30*	*109,009*	*2.50*	*2,545*	*3.49*
Base			*4*	*0.066*	*6/13/2024 5:30*	*6/15/2024 14:30*	*759,648*	*17.45*	*190*	*3.13*
Storm			*374*	*0.513*	*6/15/2024 14:30*	*6/16/2024 1:30*	*179,389*	*4.12*	*4,188*	*5.74*
Storm Composite	6/16/2024 2:29	6/16/2024 5:52	148	0.344	6/16/2024 1:30	6/16/2024 6:30	230,727	5.30	2,132	4.95
Base			*4*	*0.066*	*6/16/2024 6:30*	*6/17/2024 5:30*	*930,115*	*21.36*	*232*	*3.83*
Storm			*374*	*0.513*	*6/17/2024 5:30*	*6/17/2024 13:30*	*419,452*	*9.63*	*9,793*	*13.43*
Base			*4*	*0.066*	*6/17/2024 13:30*	*6/18/2024 21:30*	*1,519,090*	*34.89*	*379*	*6.26*
Storm			*374*	*0.513*	*6/18/2024 21:30*	*6/19/2024 7:30*	*650,960*	*14.95*	*15,198*	*20.85*
Base			*4*	*0.066*	*6/19/2024 7:30*	*6/26/2024 13:30*	*5,013,340*	*115.15*	*1,252*	*20.66*
Base Grab	6/27/2024 13:56	6/27/2024 13:56	5	0.073	6/26/2024 13:30	6/28/2024 5:30	392,040	9.00	122	1.79
Storm Composite	6/28/2024 6:34	6/28/2024 8:33	758	0.675	6/28/2024 5:30	6/28/2024 9:30	123,385	2.83	5,838	5.20
Base			*4*	*0.066*	*6/28/2024 9:30*	*7/13/2024 8:30*	*5,140,780*	*118.08*	*1,284*	*21.18*
Storm			*374*	*0.513*	*7/13/2024 8:30*	*7/13/2024 13:30*	*90,192*	*2.07*	*2,106*	*2.89*
Base			*4*	*0.066*	*7/13/2024 13:30*	*7/13/2024 22:30*	*140,293*	*3.22*	*35*	*0.58*
*Storm**			*374*	*0.513*	*7/13/2024 22:30*	*7/14/2024 10:00*	*496,800*	*11.41*	*11,599*	*15.91*
Base			*4*	*0.066*	*7/14/2024 10:00*	*7/22/2024 18:00*	*2,823,750*	*64.86*	*705*	*11.63*
Storm Composite	7/22/2024 18:31	7/22/2024 21:26	396	0.697	7/22/2024 18:00	7/23/2024 0:00	178,879	4.11	4,422	7.78
Base Grab	7/25/2024 13:47	7/25/2024 13:47	3	0.051	7/23/2024 0:00	7/26/2024 14:00	1,186,900	27.26	222	3.78
Base			*4*	*0.066*	*7/26/2024 14:00*	*8/2/2024 13:00*	*1,346,420*	*30.93*	*336*	*5.55*
Beaver Dam Break			*215*	*0.321*	*8/2/2024 13:00*	*8/2/2024 16:00*	*44,053*	*1.01*	*591*	*0.88*
Base			*4*	*0.066*	*8/2/2024 16:00*	*8/5/2024 9:00*	*422,882*	*9.71*	*106*	*1.74*
Storm Composite	8/5/2024 12:11	8/5/2024 23:28	234	0.483	8/5/2024 9:00	8/6/2024 11:00	1,468,680	33.73	21,454	44.28
Base			*4*	*0.066*	*8/6/2024 11:00*	*8/12/2024 8:00*	*5,114,630*	*117.48*	*1,277*	*21.07*
Beaver Dam Break			*215*	*0.321*	*8/12/2024 8:00*	*8/12/2024 12:00*	*79,404*	*1.82*	*1,066*	*1.59*
Base			*4*	*0.066*	*8/12/2024 12:00*	*8/15/2024 4:00*	*587,468*	*13.49*	*147*	*2.42*
Storm			*374*	*0.513*	*8/15/2024 4:00*	*8/15/2024 10:00*	*121,145*	*2.78*	*2,828*	*3.88*
Base			*4*	*0.066*	*8/15/2024 10:00*	*8/26/2024 20:00*	*2,500,620*	*57.44*	*624*	*10.30*
Storm			*374*	*0.513*	*8/26/2024 20:00*	*8/27/2024 17:00*	*589,827*	*13.55*	*13,771*	*18.89*
Base			*4*	*0.066*	*8/27/2024 17:00*	*8/29/2024 17:00*	*1,291,320*	*29.66*	*322*	*5.32*
Storm			*374*	*0.513*	*8/29/2024 17:00*	*8/30/2024 7:00*	*681,385*	*15.65*	*15,909*	*21.82*
Base Grab	9/3/2024 9:51	9/3/2024 9:51	3	0.054	8/30/2024 7:00	9/4/2024 10:00	2,916,310	66.98	546	9.83
Base			*4*	*0.066*	*9/4/2024 10:00*	*9/21/2024 9:00*	*2,290,400*	*52.61*	*572*	*9.44*
Storm			*374*	*0.513*	*9/21/2024 9:00*	*9/21/2024 15:00*	*63,088*	*1.45*	*1,473*	*2.02*
Base Grab	9/24/2024 9:18	9/24/2024 9:18	3	0.073	9/21/2024 15:00	9/25/2024 10:00	561,952	12.91	105	2.56
Base			*4*	*0.066*	*9/25/2024 10:00*	*10/20/2024 14:00*	*1,737,670*	*39.91*	*434*	*7.16*
Base Grab	10/21/2024 14:30	10/21/2024 14:30	3	0.065	10/20/2024 14:00	10/24/2024 19:00	181,740	4.17	34	0.74
Storm			*374*	*0.513*	*10/24/2024 19:00*	*10/24/2024 23:00*	*20,323*	*0.47*	*474*	*0.65*
Base			*4*	*0.066*	*10/24/2024 23:00*	*10/25/2024 15:00*	*48,178*	*1.11*	*12*	*0.20*
*Base**			*4*	*0.066*	*10/25/2024 15:00*	*10/31/2024 6:00*	*291,600*	*6.70*	*73*	*1.20*
*Storm**			*374*	*0.513*	*10/31/2024 6:00*	*10/31/2024 20:00*	*252,000*	*5.79*	*5,884*	*8.07*
*Base**			*4*	*0.066*	*10/31/2024 20:00*	*11/18/2024 16:00*	*1,078,560*	*24.77*	*269*	*4.44*
*Storm**			*374*	*0.513*	*11/18/2024 16:00*	*11/19/2024 16:00*	*518,400*	*11.91*	*12,103*	*16.60*
*Base**			*4*	*0.066*	*11/19/2024 16:00*	*12/27/2024 18:00*	*1,645,200*	*37.79*	*411*	*6.78*
*Storm**			*374*	*0.513*	*12/27/2024 18:00*	*12/28/2024 8:00*	*226,800*	*5.21*	*5,295*	*7.26*
*Base**			*4*	*0.066*	*12/28/2024 8:00*	*1/1/2025 0:00*	*475,200*	*10.91*	*119*	*1.96*
Storm Average			374	0.513						
Base Average			4	0.066						
All Average			215	0.321						
Total							**72,832,083**	**1,673**	**230,855**	**573**
Brown's Creek Major Subwatershed Total Acres							3,855			
Total TSS/TP(lb/ac/yr)									59.88	0.149
Total TSS/TP (kg/ha/yr)									67.12	0.167

Italics indicate estimated concentrations based on average base and storm flow concentrations.
*Interval volumes were estimated using similar flow conditions.

Table 6. Brown's Creek at Highway 15 2023 Field Water Quality Results

Date/Time	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
5/20/2024 14:10	16.0	8.90	344	7.45
6/26/2024 14:01	20.6	4.29		7.47
7/25/2024 13:20	18.3	5.82	359	7.61
9/3/2024 9:37	13.8	6.76	388	7.63
9/24/2024 9:07	11.1	7.29		7.62
10/21/2024 14:14	12.9	7.62	415	7.66

Exceeds Water Quality Standard

Table 7. Brown's Creek at McKusick Road 2024 Field Water Quality Results

Date/Time	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
5/20/2024 14:39	15.2	9.20	402	8.24
6/26/2024 14:33	19.9	8.04		7.88
7/25/2024 13:33	17.5	8.23	389	
9/3/2024 10:11	14.6	7.60	420	7.70
9/24/2024 9:28	11.5	8.80		7.91
10/21/2024 14:45	13.3	8.36	417	7.97

Exceeds Water Quality Standard

Table 8. Brown's Creek at Stonebridge Trail 2024 Field Water Quality Results

Date/Time	Water Temperature (^{o}C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
5/20/2024 15:03	15.7	9.30	406	8.25
6/26/2024 14:20	20.0	8.23		7.99
7/25/2024 13:00	17.9	8.47	388	8.14
9/3/2024 9:22	14.5	8.81	419	7.98
9/24/2024 9:37	11.8	9.37		8.05
10/21/2024 13:36	12.4	9.49	463	8.12

Exceeds Water Quality Standard

Table 9. Brown's Creek Outlet 2024 Field Water Quality Results

Date/Time	Water Temperature (^{o}C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
1/4/2024 10:33	1.4	14.35	477	8.45
1/17/2024 11:01	0.0	14.65	470	8.79
1/31/2024 11:10	3.2	13.09	477	8.41
2/14/2024 10:46	2.9	13.17	491	8.32
2/27/2024 9:57	3.7	12.38	485	7.81
3/13/2024 9:40	4.7	11.93	455	8.34
3/27/2024 9:51	0.7	15.09	409	8.20
4/10/2024 9:37	5.9	13.63	352	8.32
4/25/2024 9:05	7.9	12.76	442	8.34
5/8/2024 8:40	11.4	10.77	370	8.05
5/22/2024 12:47	15.4	8.97	267	7.98
6/5/2024 9:24	16.6	8.89	270	7.98
6/20/2024 8:29	16.7	9.40	324	7.97
7/18/2024 8:40	14.2	10.11	462	7.91
8/12/2024 8:35	13.5	10.04	434	
8/28/2024 8:51	17.6	9.06	385	8.30
9/10/2024 9:01	13.8	10.10		8.33
9/25/2024 8:27	11.7	10.38		8.25
10/8/2024 14:51	10.7	10.69		8.37
10/22/2024 9:02	10.8	11.15	503	8.27
11/6/2024 13:54	7.9	11.13	376	8.31
11/21/2024 10:00	3.7	12.75	386	8.21
12/4/2024 10:30	1.9	13.50	493	8.40
12/18/2024 10:00	1.4	13.20	505	
12/31/2024 10:00	2.1	13.06	441	8.65

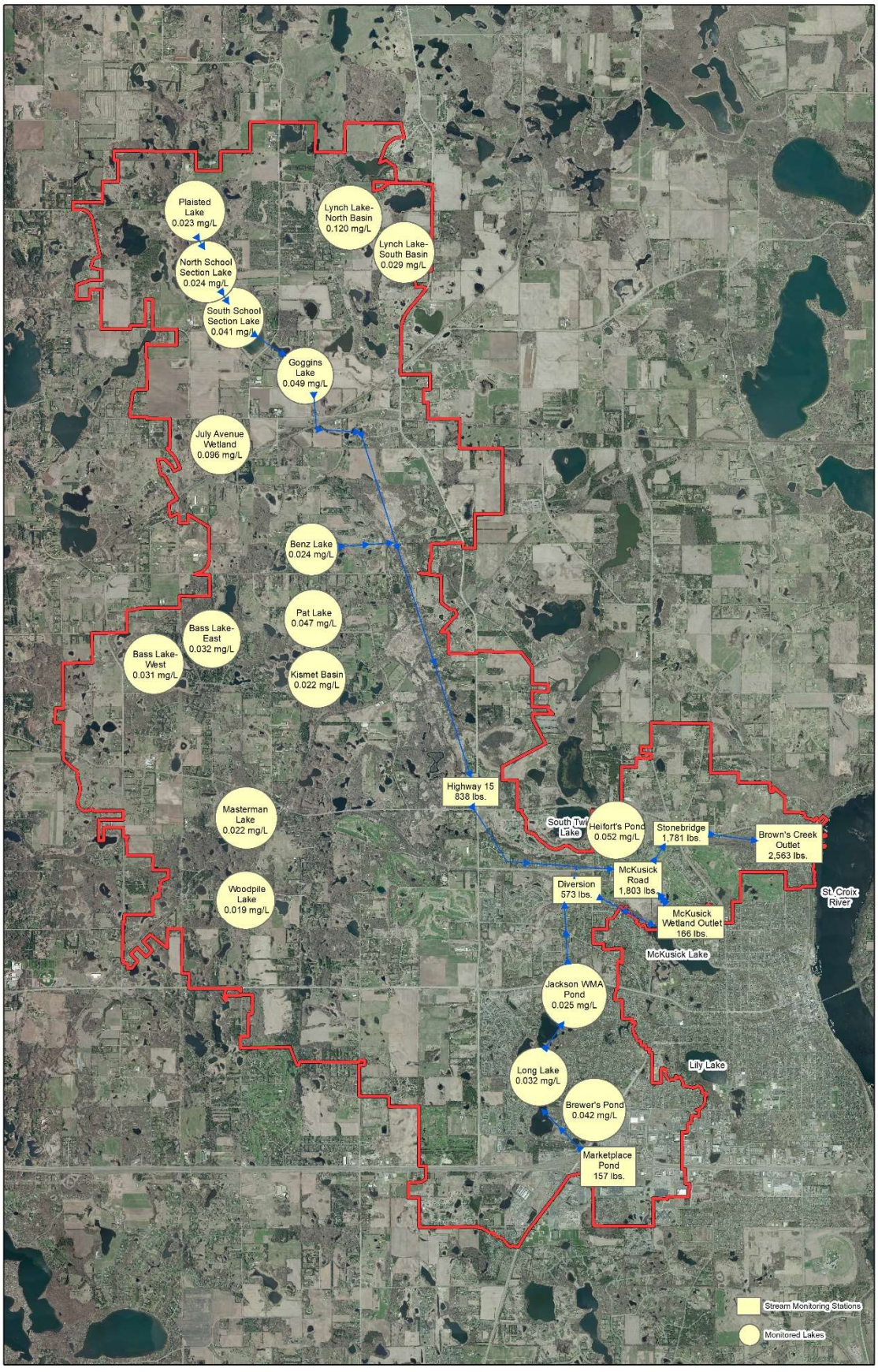
Exceeds Water Quality Standard

Table 10. Brown's Creek Diversion 2024 Field Water Quality Results

Date/Time	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (umhos/cm)	pH
5/20/2024 14:27	18.2	9.57	514	7.86
6/27/2024 13:56	22.0	7.16	336	7.81
7/25/2024 13:47	23.4	6.91	335	6.46
9/3/2024 9:51	19.3	6.68	264	7.46
9/24/2024 9:18	14.2	5.84	511	7.40
10/21/2024 14:30	12.4	6.71	596	7.54

Exceeds Water Quality Standard

APPENDIX C – 2024 BROWN'S CREEK TOTAL PHOSPHORUS FLOW CHART



GLOSSARY

Anoxic- Lacking oxygen.

Best Management Practice (BMP)- Any practice or constructed feature designed to reduce pollution, erosion, or other environmental degradation such as silt fence, rain gardens, storm water pollution prevention plans, buffer strips, etc.

Biota- Living organisms such as plants, animals, and bacteria.

Chronic Standard- The highest water concentration or fish tissue concentration of a toxicant or effluent to which aquatic life, humans, or wildlife can be exposed indefinitely without causing chronic toxicity.

Composite Sample- A collection of individual samples taken over the course of a storm and combined into a single sample to represent conditions throughout the entire storm event.

Discharge- The amount of water moving past a given point in a stream, usually measured in cubic feet per second, but may also be discussed as the total volume of water that flowed through a site in a year, measured in cubic feet.

Eutrophic- Bodies of water with high levels of biological productivity characterized by high amounts of aquatic vegetation with clear water, or minimal vegetation with green water due to algal growth shading out larger plants. These waters are often shallow, have excessive nutrients, and may experience severe algal blooms resulting in anoxic conditions and potential fish kills. Most district lakes fall within this classification.

External Load- Nutrients or pollution contributed from outside a water body such as atmospheric deposition or inlets from streams or pipes.

Final Acute Value (FAV)- An estimate of the concentration of a pollutant corresponding to the cumulative probability of 0.05 in the distribution of all the acute toxicity values for the genera or species from the acceptable acute toxicity tests conducted on a pollutant. This concentration is severe enough to rapidly induce a response, normally observed in 96 hours or less. Acute mortality can be expected above this concentration.

Gaining Stream- A stream which gains water through the stream bed from groundwater.

Hypereutrophic- Bodies of water with extremely high biological productivity and nutrients which often experience severe algal blooms, very low clarity, and limited aquatic life beyond algae and vegetation. Often have the appearance of “pea soup” in mid-summer.

Impaired Waters List/303(d) List- A section of the Clean Water Act which lists water bodies impaired by one or more pollutants for which a TMDL study should be completed.

Internal Load- Nutrients or pollution cycled within a lake from sediments, vegetation, or other sources within a water body.

Littoral- The area of a lake less than 15 feet deep dominated by aquatic vegetation.

Load/Loading- The amount of nutrients or pollutants from a source, usually expressed as pounds or pounds per acre.

Losing Stream- A stream which loses water through the stream bed to the groundwater.

Maximum Standard- The highest concentration of a toxicant in water to which aquatic organisms can be exposed for a brief time with zero or slight mortality. The max standard is half of the final acute value.

Mesotrophic- Bodies of water with an intermediate amount of biological productivity. These waters are typically clear water with healthy aquatic vegetation, some algal growth, and an intermediate amount of nutrients. When stratified, these waters may become anoxic near the bottom.

Non-point Source- A source of pollution from a undefined area such as runoff from a landscape.

Nutrients- Discussed in this report as total phosphorus (TP), total suspended solids (TSS) or sediment, and total Kjeldahl nitrogen (TKN).

Ordinary High Water Level (OHWL)- The boundary of public waters and wetlands determined by a level of water maintained with enough time to leave evidence upon the landscape, such as a change in natural vegetation from terrestrial to aquatic, or the top of the bank of a channel.

Oligotrophic- Bodies of water with low biological productivity characterized by clear water, low algal growth, low nutrient concentrations, minimal aquatic vegetation, and well-oxygenated water.

Point Source- A source of pollution from a single defined outlet such as a pipe.

Shallow Lake- A lake 50 acres or greater in size and less than 15 feet deep, or has greater than 80% littoral area.

Stratification- Separation of water within a lake based on density as a result of differences in water temperature from warm water near the surface and heavy, cold water near the bottom.

Thermocline/metalimnion- The boundary between warm and cold water within a stratified lake characterized by a sudden change in temperature and dissolved oxygen.

Total Maximum Daily Load (TMDL)- Defined by the Clean Water Act as the amount of a pollutant a water body can receive and still meet water quality standards. TMDL studies will often assign a point source load, non-point source load, internal load, and a margin of safety to each pollutant to guide management activities for load reductions from each source.