2021 Water Quality Report

Prepared for the City of Plymouth

Prepared by: Three Rivers Park District

DEPARTMENT OF WATER RESOURCES

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1.0 INTRODUCTION

This report summarizes the water quality monitoring conducted by the Three Rivers Park District Water Resources Department for the City of Plymouth during the 2021 calendar year. Nine stormwater sites, one lake site, a rain garden and five sites for a sub-watershed assessment around Mooney Lake were monitored.

In this report, each watershed has several sections including:

- **Watershed:** an overview description of the watershed, map of stormwater monitoring sites with watershed boundary, and a list of any water quality impairments
- **Stormwater Monitoring:** monitoring location descriptions and a summary of the monitored watershed acres and impervious acres
    - **Hydrograph:** daily average flow during monitoring season with precipitation
    - **Concentrations:** average and range of concentrations of samples collected
    - **Yearly Summary:** yearly FLUX model annual load estimates, flow-weighted concentrations, and calculations of unit area loads
- **Lake monitoring:** a map showing the watershed and key watershed features
    - **Phosphorus, secchi and Chlorophyll-a:** reports values relative to MPCA standards
    - **Sonde results:** readings of dissolved oxygen, temperature, specific conductivity and pH with depth
    - **Concentrations**: Summary of average concentrations
    - **Discussion:** Summary of measurements

2.0 PRECIPITATION

Precipitation data was from two sources:

- Tipping bucket rain gauge at City of Plymouth: from 4/21/2021 to 11/1/2021
    - Does not represent precipitation from snowfall during freezing conditions
    - Located at City of Plymouth Water facility (14800 23rd Ave N, Plymouth, MN)
- Minneapolis airport rain gauge (USW00014922) as reported by National Oceanic and Atmospheric Administration (NOAA) was used to supplement precipitation data not captured by the City of Plymouth rain gauge including snowfall

Summary of annual precipitation data:

- Second year of below average precipitation:

    - 23.4 inches in 2021 calendar year
    - 25.9 inches in 2020 calendar year
    - 4.3 inches below 2000-2020 average precipitation for Plymouth (30.2 inches)
- Monitoring period precipitation (March 26th to November 9th): 16.8 inches
    - Monitoring period accounted for 72% of total calendar year precipitation
    - March 23rd and 24th, just before monitoring began, there was a 1.5-inch rain event that led to increased flows
- Precipitation events that caused large stream responses:
    - Two several-day events: accounted for 35% of monitoring period precipitation
        - 5/19 - 5/21/2021: 1.24 inches
        - 8/24 – 8/29/2021: 4.59 inches
            - 8/26/2021 had the highest daily precipitation of 2.41 inches

3.0 MONITORING METHODS

Stormwater

Monitored stormwater sites are summarized in Table 3.1.

- Bi-weekly water grab samples were collected to characterize base flow conditions
- Sites equipped with ISCO auto-samplers measured water flow using ISCO flow meters and collected water samples during storm events
- Grab samples during storm events were taken at sites without ISCO equipment that do not have continuous flow
- Rating curve required for open stream sites to better estimate amount of water flow

Table 3.1 List of stormwater monitoring sites, types of samples taken, parameters analyzed and whether a rating curve was established. Sites were monitored from March 26th to November 9th, 2021

Location	Site Name	Grabs – Bi-weekly					ISCO auto sampler – storm events					Grabs – Storm events					Rating Curve?
		TP	SRP	TN	TSS	Cl^-	TP	SRP	TN	TSS	Cl^-	TP	SRP	TN	TSS	Cl^-	
Inlet to Bass Lake	BL3	x	x	x	x		x	x	x	x							
Elm Creek at Elm Road	ECER	x	x	x	x	x	x	x	x	x	x						Yes
Gleason Creek	GC-1	x	x	x	x	x	x	x	x	x	x						Yes
Elm Creek at Hamel	Hamel	x	x	x	x	x	x	x	x	x	x						Yes
Plymouth Creek at Industrial Park	IP2	x	x	x	x	x	x	x	x	x	x						
Northwood Lake sub-watershed	NLS	x	x	x	x		x	x	x	x							Yes
Plymouth Creek at Medicine Lake	PC2	x	x	x	x	x	x	x	x	x	x						Yes
South Inlet to Parker Lake	PL1						x	x	x	x	x						
North inlet to Parker Lake	PL2	x	x	x	x	x	x	x	x	x	x						
Ponderosa Rain Garden	PRG-IN and OUT											x	x	x	x		
Mooney sub-watershed assessment	MOO: SW1-SW5	x	x	x	x							x	x	x	x		

To estimate annual loads:

- Used U.S. Army Corps of Engineer's FLUX model version 5.0 (Soballe, 2020)
- Concentrations and flow during sample period were input to FLUX to determine the sample period nutrient load
- Sample period nutrient load was extrapolated to yearly load based on precipitation
- Unit area loads (UAL) were calculated by converting the yearly load to a per acre ratio
- UAL's were compared to the MPCA Stormwater Manual (MPCA, 2017) typical unit area loads for TP and TSS based on land use (Table 3.2 and Table 3.3)

Chloride concentrations were assessed based on standards in the MPCA Stormwater Manual's Chloride Management Plan (MPCA, 2017):

- Considered impaired if samples (averaged over 4-day period):
    - Exceed chronic standard: 230 mg/L in two or more samples over a 3-year period
    - Exceed maximum standard: 860 mg/L in one sample over a 3-year period

Table 3.2 MPCA Stormwater manual TP unit area load values by land use and a common range of runoff concentrations by land use (MPCA, 2017)

Typical Total Phosphorus values as stated in the MN Stormwater Manual				
Land Use	Unit Area Loads (lbs/ac)	Median Concentration (µg/L)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)
Residential	1.35	260	< 10	19,900
Commercial	2.25	200	< 10	4,270
Industrial	--	230	< 20	7,900
Freeway	3.50	--	--	--
Open Space	--	130	< 10	760

Table 3.3 MPCA Stormwater manual TSS unit area loads by land use and common range of runoff concentrations by land use (MPCA, 2017)

Typical Total Suspended Solids values as stated in the MN Stormwater Manual				
Land Use	Unit Area Loads (lbs/ac)	Median Concentration (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)
Residential	76	58	< 0.5	4,168
Mixed Residential	111	--	--	--
Commercial	221	52	< 0.5	2,385
Industrial	193	75	< 1	2,490
Freeway	560	--	--	--
Open Space	35	58	< 1	4,168

Lake

Lake monitoring followed U.S. EPA's Field Operations Manual (2007) sampling protocols. Table 3.4 summarizes the monitored water bodies and parameters analyzed. Table 3.5 summarizes the equipment used and how the equipment was used.

- Monitoring occurred bi-weekly from May through September
    - Pre- and post- thermal stratification monitoring occurred in April and October

Table 3.4 List of lake monitoring sites and parameters analyzed

Location	Site type	Sampling location	Surface parameters					Middle parameters		Bottom parameters		
			TP	SRP	TN	Chl-a	Cl	TP	SRP	TP	SRP	Cl
Camelot	Wetland	From boardwalk on south end	x	x	x	x						

Table 3.5 Summary of lake sampling equipment and types of measurements taken with each

Equipment	Measurements	Position in water column
Secchi disk	Water clarity	Surface
YSI EXO sonde	Temperature Dissolved oxygen Specific Conductivity pH	1-meter intervals from surface to bottom
2-meter composite tube (3.2 cm inside diameter)	Take water sample	Surface
Kemmerer	>2m deep water sample	Middle: Top of hypolimnion Bottom: 1 meter from lake bottom

To assess lake data, June to September average concentrations were compared to:

- Minnesota Pollution Control Agency (MPCA) June to September standards (MN 7050.0222) (Table 3.6) for the North Central Hardwood Forest Ecoregion
- Metropolitan Council (MC) lake water quality grading system (Table 3.7)

Chloride concentrations in lakes are assessed in a similar way to stormwater, except that each depth is compared against the standard (i.e., the surface may meet standards, while the bottom samples may not, this will count as 1 exceedance).

Table 3.6 MPCA lake water quality (MPCA, 2018) standards for averaged June to September data

North Central Hardwood Forest Ecoregion	TP (µg/L)	Chl-a (µg/L)	Secchi (m)
Aquatic Recreational Use (Class 2B) - Shallow Lake	<60	<20	>1.0
Aquatic Recreational Use (Class 2B) - Deep Lake	<40	<14	>1.4

Table 3.7 Met Council water quality grading system (MC, 2018)

Water Quality Grading System	TP (µg/L)	Chl-a (µg/L)	Secchi (m)
A	<23	<10	>3
B	23-32	10-20	2.2-3.0
C	32-68	20-48	1.2-2.2
D	68-152	48-77	0.7-1.2
F	>152	>77	<0.7

Lab

Water analyses followed Standard Methods for the examination of Water and Wastewater 22nd edition (2011).

- Water samples were analyzed at Three Rivers Park Districts' MPCA certified lab
- Stormwater analyses included: total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), total suspended solids (TSS), and, at select sites, chlorides (Cl^-)
- Lake analyses included: total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), chlorophyll-a (Chl-a), and, at select sites, chlorides (Cl^-)

3.1. Parkers Lake Watershed

The Parkers Lake Watershed is 1,150 acres and is located entirely within the City of Plymouth (Figure 3.1.1). Parkers Lake is part of the Bassett Creek Watershed.

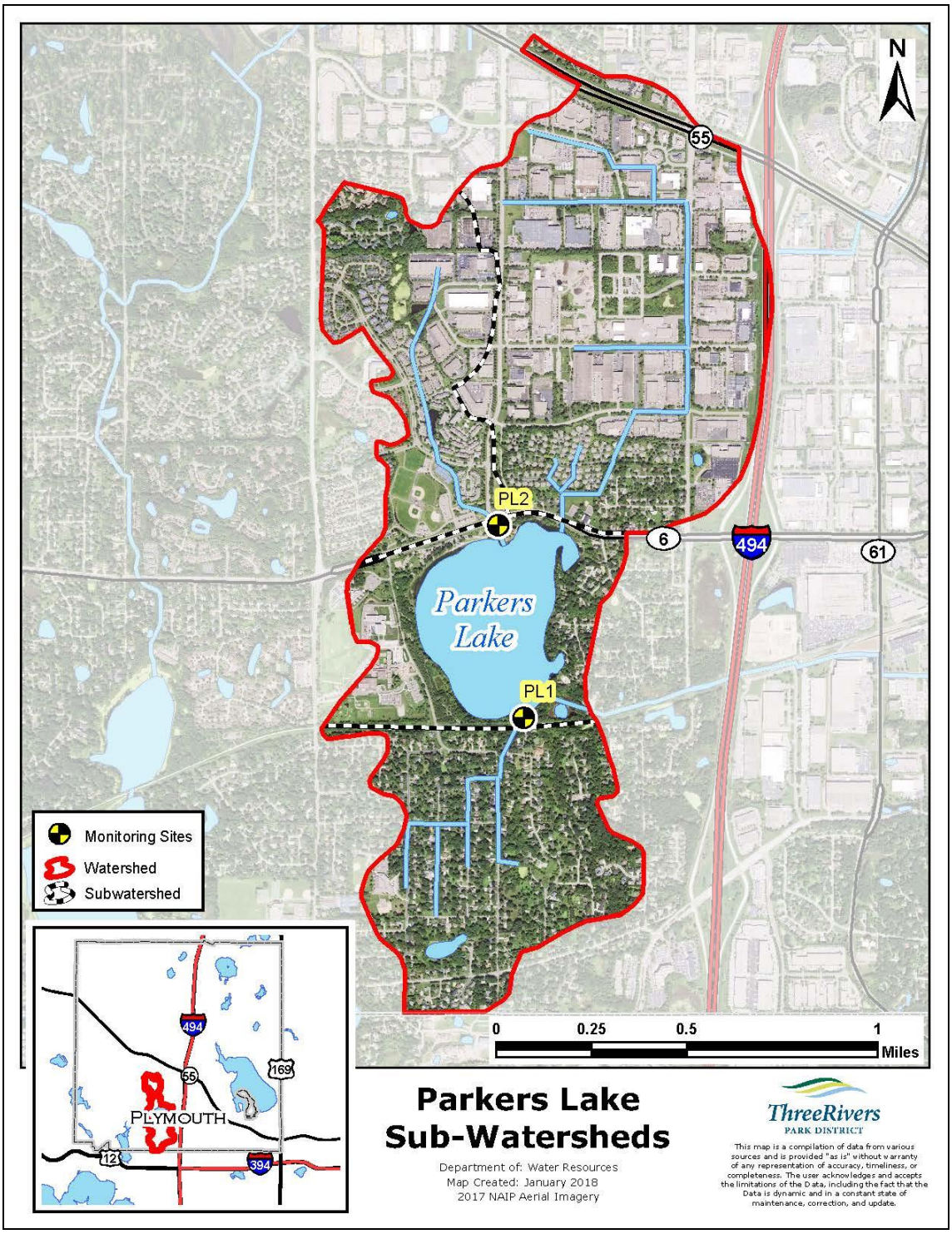


Figure 3.1.1 Parkers Lake sub-watershed map

- Parkers Lake has been listed as impaired for chlorides since 2014
- TMDL approved by EPA in 2016 as part of the Twin Cities Metro Area Chloride TMDL
- BMP's and infrastructure changes:
    - 2005: Curb and pond installation in PL1 watershed

3.1.1. Stormwater Monitoring Sites

To assess the nutrients and chlorides flowing into Parkers Lake, two tributaries were monitored that accounted for 38% of the watershed area (Table 3.1.1)

- PL1 (Parkers Lake Site 1)
    - Located on south side of the lake off the Luce Line State Trail
    - Round culvert: 48-inch diameter
    - Sub-watershed has sandier soils, flatter topography and less impervious area allowing more rainfall infiltration and therefore less stream flow
- PL2 (Parkers Lake Site 2)
    - Located on the northwest side of the lake at the public boat access
    - Round culvert: 48-inch diameter
    - Sub-watershed is more developed with steeper elevation changes and more impervious area creating more stream flow

Table 3.1.1 Summary of watershed characteristics for sites PL1 and PL2

Site	*Sub watershed Area (acres)*	*% impervious (acres)[1]*	*% of Parkers Lake Watershed*	*Dominant land uses[2]*
PL1	**258**	**19% (48 ac.)**	**22%**	**Residential**
PL2	**189**	**49% (92 ac.)**	**16%**	**Multi-family Residential, Industrial**

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer
[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.1.2. Hydrograph

The hydrographs for PL1 and PL2 corresponds with precipitation amount and intensity since the watersheds are small and developed (Figure 3.1.2)

- PL1
    - Largest average daily flow: 1.5 cfs on 8/26/21 after largest 1-day precipitation event
    - Average daily flow during monitoring period: 0.05 cfs
    - Sample site is dry between rain events and does not have continuous base flow between rain events

- PL2:
    - Largest average daily flow: 5.3 cfs on 8/26/21 after largest 1-day precipitation event
    - Average daily flow during monitoring period: 0.29 cfs
    - Sample site occasionally has continuous base flow between rain events

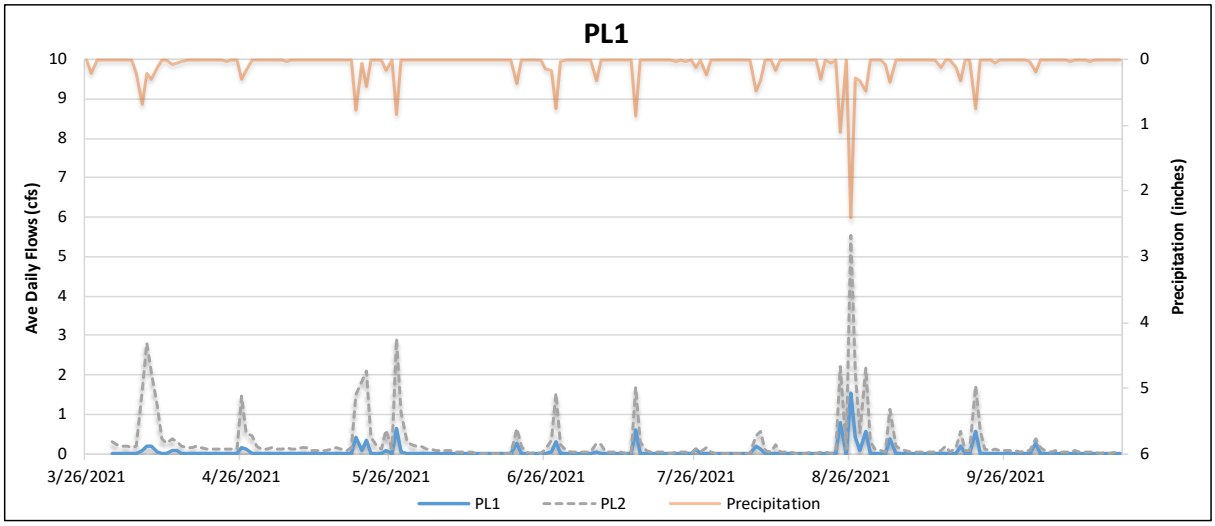


Figure 3.1.2 Average daily flow for Parkers Lake Site 1 (PL1) and Parkers Lake Site 2 (PL2)

3.1.3. Concentrations

Summary of Table 3.1.2, Figure 3.1.3, and Figure 3.1.4.

PL1:

- Number of water samples collected:
    - 11: all automated composites
- Chlorides:
    - Meets standards; has not exceeded standard in past three years
- SRP to TP ratio
    - On average, SRP accounts for 50% of TP

PL2:

- Number of water samples collected:
    - 27: 9 automated composites and 18 grab samples
- Higher SRP and TN values occurred in spring and fall of the year
- Chlorides – 11 exceedances in 2021

- Not meeting standards since more than two exceedances in past 3 years
- Collected samples during March
  - One sample had a concentration of 852 mg/L which is close to the 860 mg/L state maximum standard
- Highest concentrations of chlorides occurred from March into June
- Chloride concentrations, from April through October, were 27 times higher at PL2 compared to PL1
  - Commercial/Industrial land use with higher percentage of impervious area contributes to more salt use

- SRP to TP ratio
  - On average, SRP accounts for 52% of TP

Table 3.1.2 Summary of average, minimum, and maximum concentrations for TP, SRP, TN, TSS, and Cl^- at PL1 and PL2

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	Avg Cl- (min-max) mg/L
PL1	**326 (168 - 639)**	**163 (60 - 551)**	**2.4 (1.4 - 3.8)**	**73.0 (15.3 - 184)**	**6 (0 - 18)**
PL2	**250 (69 - 601)**	**129 (27 - 298)**	**1.4 (0.6 - 3.3)**	**50.2 (0.7 - 331)**	**160 (52 - 852)**

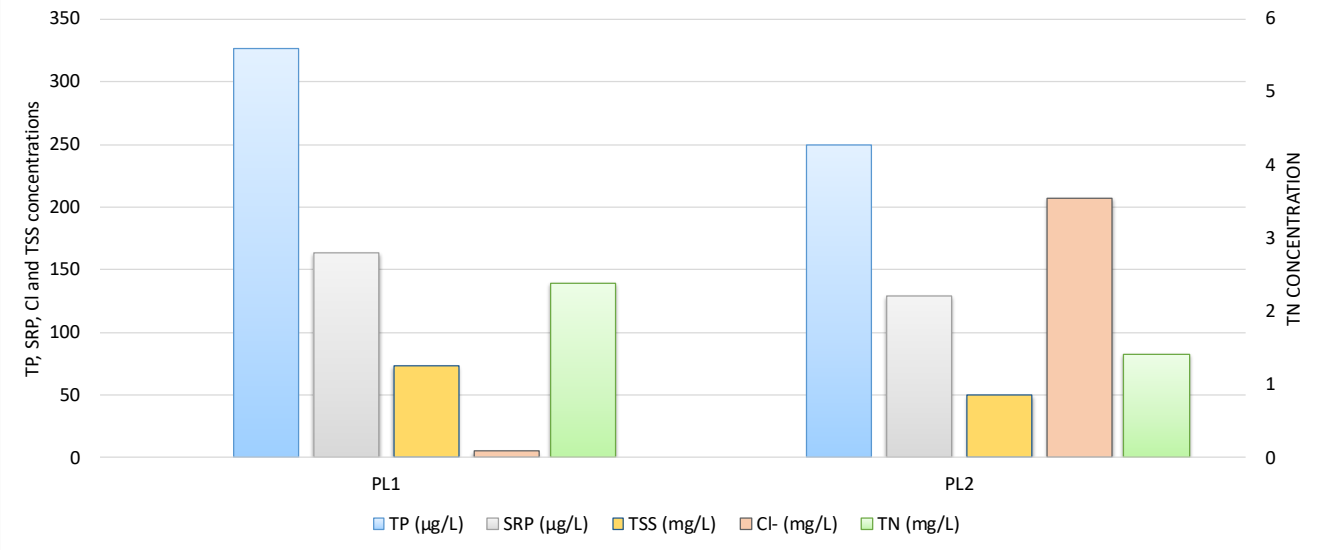
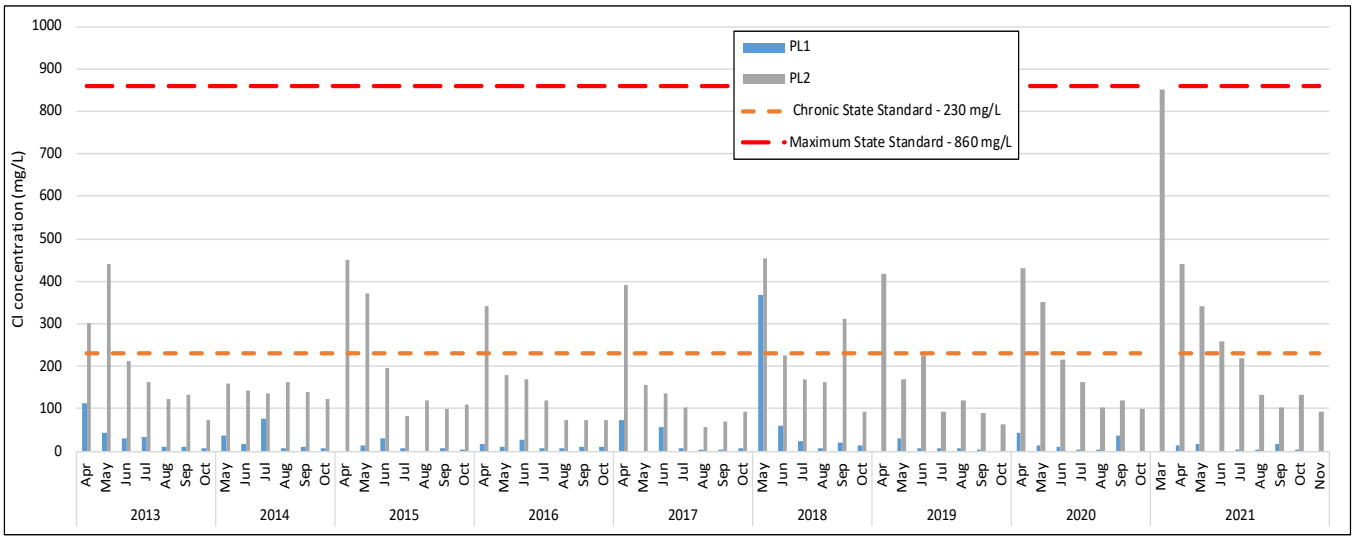


Figure 3.1.3 Average TP, SRP, TN, TSS, and Cl^- concentrations for PL1 and PL2

Figure 3.1.4 Maximum monthly chloride concentration at PL1 and PL2 versus the MPCA chloride standard. When standard is exceeded, there may be more than 1 exceedance in that month



3.1.4. Yearly Summary

PL1

At PL1, data has been collected since 2000. The data in Table 3.1.3 is segmented to 'pre-2006' and '2006-present' to compare changes in water quality and flow relative to installation of ponds and curb/storm sewer in 2005. The curbs increased runoff by not allowing water to infiltrate in ditches while the ponds allow suspended sediment to settle out. In general, there have been similar concentrations in the '2006-present' dataset compared to the 'pre-2006' dataset, but the increased flow volumes have led to higher loadings.

- Precipitation and flow volume:
    - 2021 compared to '2006-present' average
        - Precipitation lower in 2021 by 21%
        - Flow volume lower in 2021 by 46%
    - Poor correlation (r^2 = 0.36) between flow and precipitation (2006 to 2021)
        - Relationship improved (r^2 = 0.69) if 2014 outlier (higher flows with below average precipitation) is removed
- Flow weighted concentration:
    - 2021 compared to '2006-present' average: Close to average concentrations
        - TP and TN: about 10% higher in 2021
        - SRP and TSS: within 4% of average

        - Chloride: 52% less than average; past three years have had lower concentrations

- Loading
    - 46% lower flow volumes in 2021, led to 40-75% lower annual loadings compared with '2006-present' average for all parameters
- Average UAL versus MPCA Stormwater manual UAL: Table 3.1.4
    - TP: 0.14 lbs/acre average versus 1.35 lbs/acre for residential land use
    - TSS: 36 lbs/acre average versus 77 lbs/acre for residential land use
        - Only 2 of 18 monitored years have TSS UAL's higher than the MPCA UAL

Table 3.1.3 Loading and flow weighted concentrations for TP, SRP, TN, TSS, and Cl^- at PL1. The data is segmented by pre and post installation of ponds and curbs in 2005. The % change compares the average loadings and concentrations before and after 2005

PL1 - Parkers Lake - Site 1												
Year	Nutrient Loading					Nutrient Concentration					Flow Volume ($x\ 10^6\ m^3$)	Annual Precipitation (inches)
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)		
Pre-2006												
2000	6	2	42	1,304		243	89	1.50	48		0.01	32.3
2001	11	6	58	1,392		293	157	1.60	39		0.01	34.6
2002	40	16	225	11,365		318	124	1.80	91		0.05	38.1
2003	39	21	215	12,139		308	165	1.70	95		0.06	25.8
2004	23	14	140	5,531		272	138	1.40	62		0.04	32.1
2005	35	10	230	23,196		377	108	2.60	252		0.04	32.6
Average	26	12	152	9,155		302	130	1.77	98		0.04	32.6
2006 - present												
2006	27	12	119	10,003		343	169	1.50	126		0.04	29.1
2007	22	8	136	4,419		232	82	1.40	47		0.04	31.1
2009	22	15	75	1,246		291	191	1.00	17		0.03	19.6
2013	49	23	392	10,663	3,239	248	119	1.98	54	16.4	0.09	31.6
2014	63	37	763	18,517	1,158	264	132	2.71	66	9.1	0.13	27.5
2015	34	12	241	6,536	1,052	302	107	2.15	58	9.4	0.04	29.1
2016	59	21	389	10,125	1,797	296	103	1.96	51	8.3	0.08	38.6
2017	41	17	286	8,269	4,904	269	110	1.87	54	32.0	0.07	27.8
2018	46	18	290	3,243	4,701	321	125	2.02	23	33.1	0.06	30.8
2019	88	31	786	29,968	926	307	109	2.75	105	3.2	0.13	43.3
2020	30	19	292	5,905	679	303	192	2.99	60	6.9	0.04	25.9
2021	25	11	180	4,883	532	319	137	2.26	61	6.7	0.04	23.4
Average	42	19	329	9,481	2,110	291	131	2.05	60	14	0.07	29.8
% Change	64	62	117	4		-3	1	16	-38		83	-8

Table 3.1.4 Unit area loads for TP, SRP, TN, TSS, and Cl^- at PL1

PL1 - Parkers Lake - Site 1					
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)
2000	0.02	0.01	0.16	5	
2001	0.04	0.02	0.22	5	
2002	0.16	0.06	0.87	44	
2003	0.15	0.08	0.83	47	
2004	0.09	0.05	0.54	21	
2005	0.14	0.04	0.89	90	
2006	0.10	0.05	0.46	39	
2007	0.09	0.03	0.53	17	
2009	0.09	0.06	0.29	5	
2013	0.19	0.09	1.52	41	12.6
2014	0.24	0.14	2.96	72	4.5
2015	0.13	0.05	0.93	25	4.1
2016	0.23	0.08	1.51	39	7.0
2017	0.16	0.07	1.11	32	19.0
2018	0.18	0.07	1.12	13	18.2
2019	0.34	0.12	3.05	116	3.6
2020	0.11	0.07	1.13	23	2.6
2021	0.10	0.04	0.70	19	2.1
Average	0.14	0.06	1.05	36	8.2

PL2

The PL2 site was monitored from 2000-2008 and from 2013 to present. In Table 3.1.5, the data is segmented to '2000-2008' and '2013-present.' Between the two periods, both the flow weighted concentrations and loadings have increased with about a 1% increase in precipitation.

- Precipitation and total flow volume:
  - 2021 compared to '2013 to present' average:
    - Precipitation was lower in 2021 by 24%
    - Flow volume was lower in 2021 by 46%
  - Weak correlation ($r^2 = 0.24$) between flow and precipitation (2013 to 2020)
- Flow weighted concentrations:
  - 2021 nutrients and TSS were all higher than '2013-present' average
    - Between 15% and 68% higher depending on parameter
    - TP and TSS had highest concentrations of all monitored years
  - Chloride concentration:
    - Lower precipitation in 2021 led to higher chloride concentrations
      - Years with higher precipitation tend to have lower chloride concentrations - higher precipitation dilutes the concentration

- Loading
    - The high nutrient concentrations paired with low flows led to 2021 loadings that were below '2013-present' average
        - Nutrients and TSS loading were between 10% and 39% lower in 2021 than the '2013-present' average
    - Even with the higher chloride concentration in 2021, the load was lower than the '2013-present' average due to low flows
- Average UAL versus MPCA Stormwater manual UAL: Table 3.1.6.
    - TP: 0.78 average versus 1.35 lbs/acre for residential land use
        - No UAL listed for mixed residential
    - TSS: 251 lbs/acre average versus 111 lbs/acre for mixed residential or 193 lbs/acre for industrial land use

PL1 vs PL2

Comparing PL1 to PL2 in 2021, the TP concentrations at PL2 and PL1 are about the same. However, SRP and TN are 20% less at PL2 while TSS is 83% higher. The chlorides concentration is 23 times higher at PL2 than at PL1, which is likely due to the difference in land use.

Table 3.1.5 Loading and flow weighted concentrations of TP, SRP, TN, TSS, and Cl^- at PL2. Data is segmented by a break in data collection from 2009-2012.

PL2 - Parkers Lake - Site 2												
Year	Nutrient Loading					Nutrient Concentration						
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)	Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
2000-2008												
2000	18	5	219	2,459		125	39	1.50	17		0.06	32.3
2001	125	43	1,132	24,170		160	56	1.50	31		0.33	34.6
2002	124	36	1,217	45,038		148	143	1.40	54		0.36	38.1
2003	80	42	882	31,784		121	63	1.30	48		0.30	25.8
2004	117	45	1,131	33,485		136	53	1.30	39		0.39	32.1
2005	126	50	1,243	40,351		125	50	1.20	40		0.45	32.6
2006	176	54	1,632	33,941		153	47	1.40	30		0.52	29.1
2007	255	118	1,780	107,627		239	110	1.70	101		0.48	31.1
2008	48	7	392	2,901		277	39	2.28	17		0.08	20.8
Average	119	44	1,070	35,751		165	67	1.51	42		0.33	30.7
2013-present												
2013	145	73	1,299	50,840	105,991	169	85	1.51	59	123	0.39	31.6
2014	182	100	1,980	73,498	55,650	152	84	1.66	62	103	0.54	27.5
2015	221	85	1,776	68,765	161,814	234	90	1.88	73	120	0.42	29.1
2016	262	95	1,648	65,665	66,855	272	99	1.71	67	68.1	0.44	38.6
2017	219	72	1,716	61,684	122,460	188	62	1.48	53	105	0.49	27.8
2018	169	59	1,363	37,574	138,692	187	65	1.51	42	153	0.41	30.8
2019	195	80	1,659	110,549	84,831	184	76	1.56	104	80	0.48	43.3
2020	52	27	448	10,961	71,449	131	68	1.13	28	179	0.18	25.9
2021	150	52	861	53,130	73,146	316	110	1.82	112	154	0.21	23.4
Average	177	71	1,417	59,185	97,876	204	82	1.58	67	121	0.40	30.9
% Change	52	66	39	68		15	18	3	45		27	3.63

Table 3.1.6 Unit area loads for TP, SRP, TN, TSS, and Cl^- at PL2

PL2 - Parkers Lake - Site 2					
Year	Load/Acre				
	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)
2000	0.10	0.03	1.16	13	
2001	0.66	0.23	5.99	128	
2002	0.66	0.19	6.44	238	
2003	0.42	0.22	4.67	168	
2004	0.62	0.24	5.98	177	
2005	0.67	0.26	6.58	213	
2006	0.93	0.29	8.63	180	
2007	1.35	0.62	9.42	569	
2008	0.25	0.04	2.07	15	
2013	0.77	0.39	6.87	269	561
2014	0.96	0.53	10.48	389	294
2015	1.17	0.45	9.40	364	856
2016	1.39	0.50	8.72	347	354
2017	1.16	0.38	9.08	326	648
2018	0.89	0.31	7.21	199	734
2019	1.03	0.43	8.78	585	449
2020	0.28	0.14	2.37	58	378
2021	0.79	0.28	4.55	281	387
Average	0.78	0.31	6.58	251	517

3.2. Medicine Lake Watershed

The Medicine Lake watershed is 11,666 acres that lies within several municipalities (Figure 3.2.1). Most of the watershed is in the City of Plymouth (10,268 acres). Medicine Lake is part of the Bassett Creek Watershed.

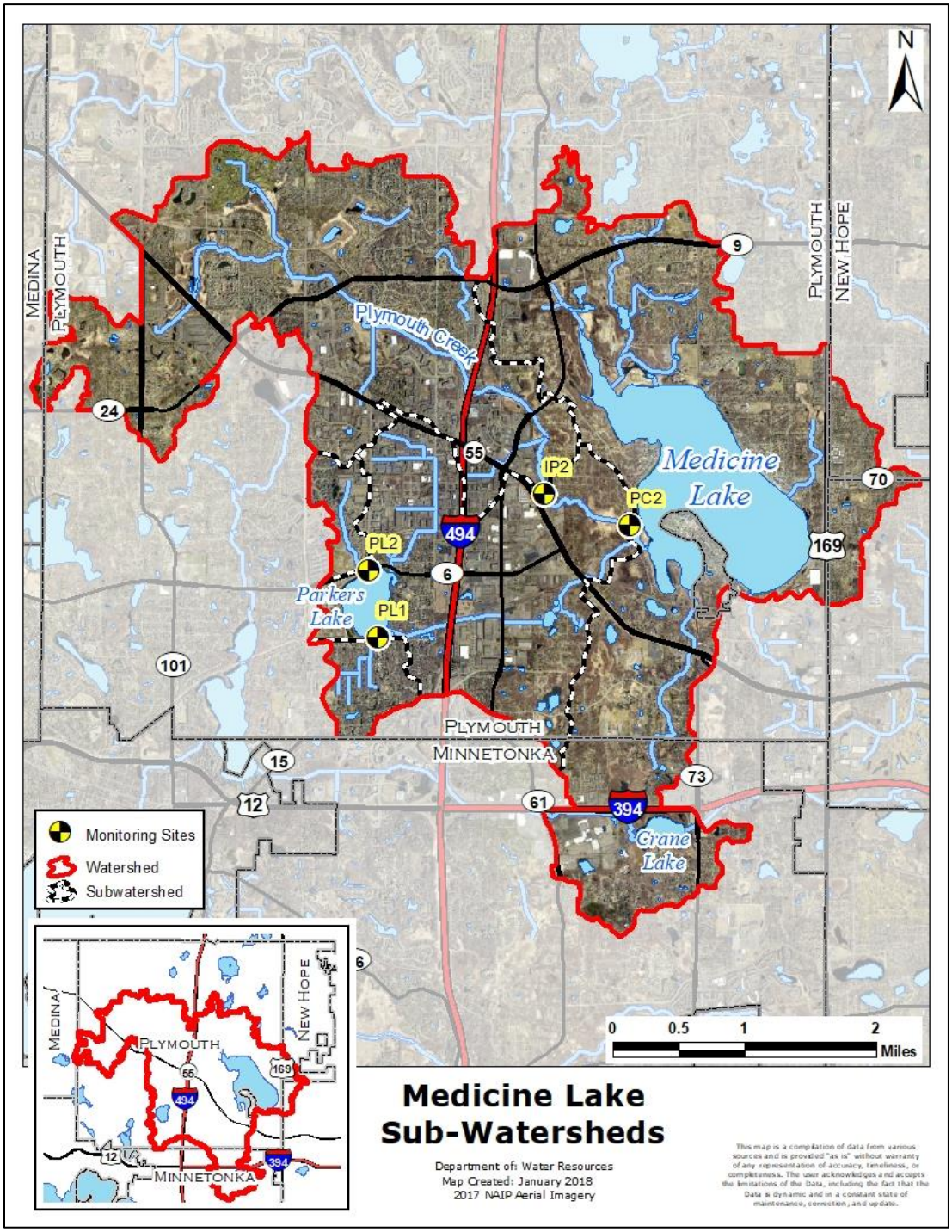


Figure 3.2.1 Medicine Lake sub-watershed map

- Impairments:
    - Medicine Lake has been impaired for excess nutrients since 2004
    - Since 2014:
        - Plymouth Creek impaired for chlorides and E. Coli
        - Medicine Lake considered high risk for chloride impairments
- TMDL's:
    - Twin Cities Metro Area Chloride TMDL approved by EPA in 2016
    - Medicine Lake TMDL for nutrients approved by EPA in 2011
    - Upper Mississippi River Bacteria TMDL approved by EPA in 2014
- BMP's and infrastructure changes:
    - 2009-2010: Detention ponds installed upstream of PC2 to reduce nutrient loading and flooding impact
    - 2010-2011: Stream restoration upstream of PC2 to improve water conveyance
    - 2017-2018: Streambank stabilization upstream of IP2

3.2.1. Stormwater Monitoring Sites

To assess the nutrients and chlorides flowing into Medicine Lake, two sites along Plymouth Creek were monitored that accounted for 55% of the watershed area (Table 3.2.1).

- IP2 (Industrial Park site 2)
    - Located behind an industrial building at 12940 Teakwood Ln N
    - 14-foot-wide rectangular weir structure
    - Monitors nutrient loadings from the upstream portions of Plymouth Creek prior to discharging into a wetland complex
- PC2 (Plymouth Creek site 2)
    - Downstream of IP2 and includes drainage from Parkers Lake
    - Located on Medicine Lake Drive West near West Medicine Lake Beach
    - An open channel
        - Downstream of a pond with a corrugated weir outlet
        - Close to Medicine Lake: potential lake effect causes site to become stagnant

Table 3.2.1 Summary of watershed characteristics for sites IP2 and PC2

Site	*Sub watershed Area (acres)*	*% impervious (acres)[1]*	*% of Medicine Lake Watershed*	*Dominant land uses[2]*
IP2	**3,725**	**34% (1,279 ac.)**	**32%**	**Residential**
PC2	**6,390**	**37% (2,363 ac.)**	**55%**	**Residential, commercial**

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.2.2. Hydrograph

The IP2 monitoring site is upstream of PC2 and therefore has a smaller watershed. The especially dry year in 2021 and holding ponds between IP2 and PC2 resulted in lower flows at PC2 (Figure 3.2.2).

- IP2
    - Highest average daily flow: 29 cfs on 8/27/21 after largest precipitation event
    - Average daily flow during monitoring period: 5.36 cfs
- PC2:
    - Highest average daily flow: 44 cfs on 5/20/21 after several day precipitation event
    - Average daily flow during monitoring period: 3.4 cfs

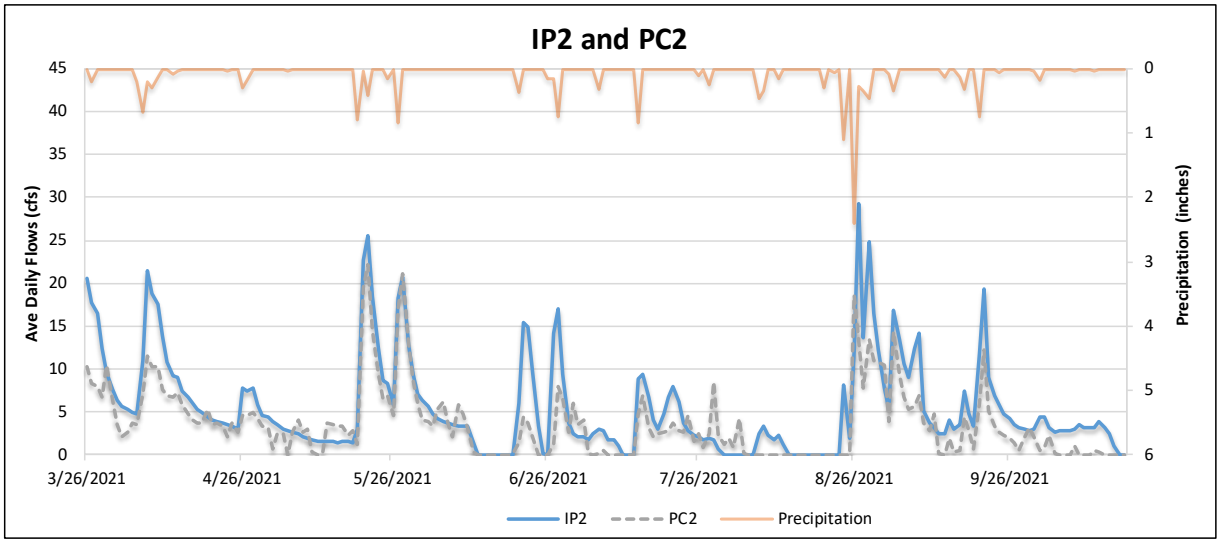


Figure 3.2.2 Average daily flow for Industrial Park site 2 (IP2) and downstream Plymouth Creek Site 2 (PC2)

3.2.3. Concentrations

Table 3.2.2, Figure 3.2.3 and Figure 3.2.4.

IP2:

- Number of water samples collected:
    - 21: 9 automated composite and 12 grab samples
- Composite sample taken on 8/24
    - Highest concentrations of season for TP and TSS
    - Sample occurred during largest precipitation event

- Chlorides:
    - Not meeting standard since more than two exceedances in past three years
    - Highest concentrations occurred from April into May
        - 80% of samples exceeded the standard in April and May
    - Chloride samples below standard the rest of the sampling season
- SRP to TP ratio
    - On average, SRP accounts for 35% of TP

PC2:

- Number of water samples collected:
    - 15: 2 automated composites and 13 grab samples
- Highest concentrations
    - TP highest on 9/7/21 grab
    - TSS highest on 8/26/21 composite
- Chlorides:
    - Not meeting standards since more than two exceedances in past three years
        - Three exceedances in 2021
    - Highest concentrations occurred from April into May
- SRP to TP ratio
    - On average, SRP accounted for 50% of TP

Table 3.2.2 Summary of sample average, minimum and maximum concentrations for TP, SRP, TN, TSS, and Cl^- at IP2 and PC2

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	Avg Cl^- (min-max) mg/L
IP2	191 (59 - 389)	66 (6 - 226)	1.8 (0.9 - 3.8)	24.7 (1.7 - 113.8)	147 (49 - 364)
PC2	119 (46 - 196)	56 (8 - 156)	1.2 (0.6 - 1.8)	7.4 (0.1 - 38.0)	149 (52 - 268)

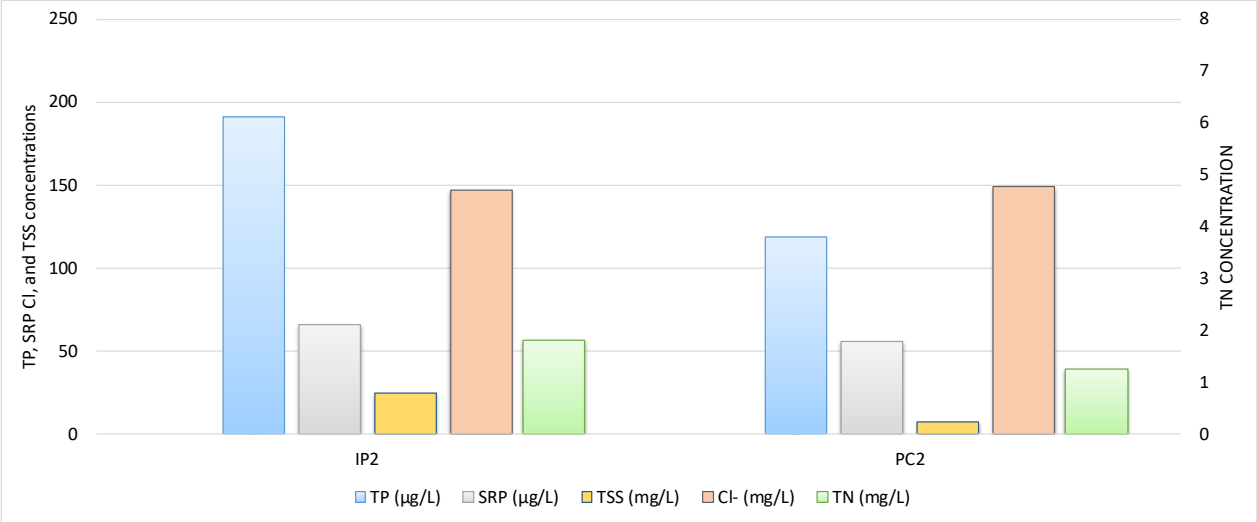


Figure 3.2.3 Average concentrations of TP, SRP, TSS, Cl^-, and TN for the Medicine Lake Watershed sites including IP2 and PC2

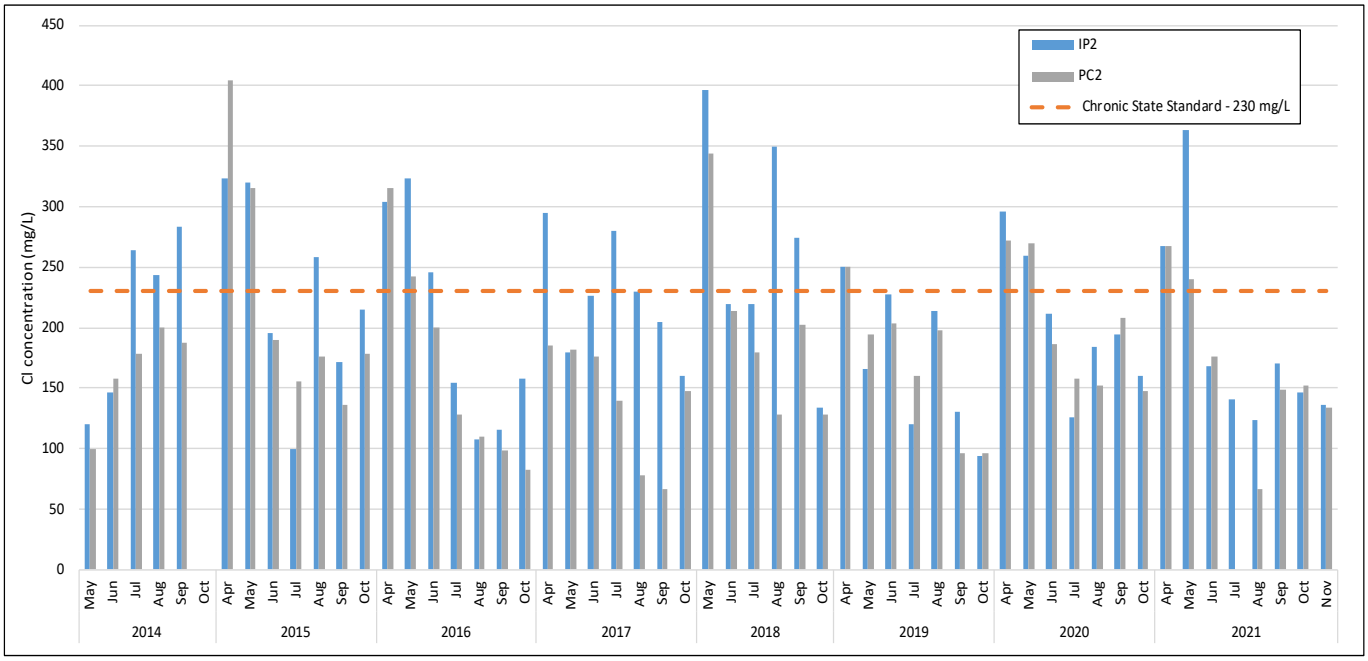


Figure 3.2.4 Maximum monthly chloride concentration at IP2 and PC2 versus the MPCA chloride standard. When standard is exceeded, there may be more than 1 exceedance in that month

3.2.4. Yearly Summary

IP2

At IP2, data has been collected since 2004 except for 2007, 2010, and 2011. In Table 3.2.3, the yearly flow-weighted concentrations and loadings are segmented to 'pre-2012' and '2012-present' due to a gap in the data. In general, there have been similar concentrations in the

'2012-present' dataset compared to the 'pre-2012' dataset, but the 44% increased flow volumes due to increased precipitation have led to higher loadings overall.

- Precipitation and flow volume:
    - The '2012-present' dataset has higher precipitation by 3.5 inches, on average, than the 'pre-2012' dataset
        - Led to 6% increased flow volume and increased loading
    - Good correlation (r^2 = 0.80) between flow and precipitation (2004 to 2021)
- Flow-weighted average concentrations
    - 2021 compared to '2012-present' average
        - TP, TN, TSS and Cl^-: 27% to 30% higher than average
        - SRP: 4% higher than average
- Loading
    - Decreased 2021 flow volume led to 13% to 34% lower loadings than '2012-present' average for all parameters

The unit area loads (UAL) by year are listed in Table 3.2.4.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.55 lbs/acre average versus 1.35 lbs/acre for residential land use
- TSS: 77 lbs/acre average versus 77 lbs/acre for residential land use

Table 3.2.3 Loading and flow weighted concentrations for TP, SRP, TN, TSS, and Cl^- at IP2. The % change compares the average loadings and concentrations before and after 2012

IP2 - Industrial Park site 2												
	Nutrient Loading					Nutrient Concentration						
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)	Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
Pre-2012												
2004	1,716	1,081	13,441	189,407		128	81	1.00	14		6.04	32.1
2005	1,785	816	13,080	348,060		144	66	1.06	24		4.69	32.6
2006	1,768	558	15,039	497,672		147	46	1.25	41		5.47	29.1
2008	1,228	265	9,131	183,900		147	36	1.20	25		3.35	20.8
2009	713	338	5,520	52,461		127	61	0.99	9		2.54	19.6
Average	1,442	612	11,242	254,300		139	58	1.10	23		4.42	26.9
2012-present												
2012	2,168	920	20,615	392,171		171	73	1.62	31		5.75	26.7
2013	2,812	1,438	25,699	338,965		161	82	1.47	19		7.93	31.6
2014	2,153	882	24,143	405,612	1,651,825	161	66	1.81	30	124	6.06	27.5
2015	2,237	693	17,870	164,959	2,038,841	191	59	1.53	14	174	3.89	29.1
2016	3,704	1,403	33,662	412,583	2,492,823	183	70	1.67	20	123	9.16	38.6
2017	1,864	569	19,240	273,001	1,515,227	142	43	1.47	21	115	5.94	27.8
2018	2,309	746	19,523	306,631	1,865,496	173	56	1.47	23	140	6.04	30.8
2019	3,092	1,473	29,896	328,862	1,828,800	136	65	1.31	14	80	10.34	43.3
2020	1,382	404	11,772	167,236	1,298,661	150	44	1.28	18	141	4.18	25.9
2021	1,998	602	18,272	265,181	1,158,983	216	65	1.97	29	125	4.20	23.4
Average	2,372	913	22,069	305,520	1,731,332	168	62	1.56	22	128	6.35	30.5
% Change	64	49	96	20		22	7	42	-3		44	13

Table 3.2.4 Unit area loads for TP, SRP, TN, TSS, and Cl^- at IP2

Industrial Park - Site 2					
	Load/Acre				
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)
2004	0.46	0.29	3.61	51	
2005	0.48	0.22	3.51	93	
2006	0.47	0.15	4.04	134	
2008	0.33	0.07	2.45	49	
2009	0.19	0.09	1.48	14	
2012	0.58	0.25	5.53	105	
2013	0.75	0.39	6.90	91	
2014	0.58	0.24	6.48	109	443
2015	0.60	0.19	4.80	44	547
2016	0.99	0.38	9.04	111	669
2017	0.50	0.15	5.17	73	407
2018	0.62	0.20	5.24	82	501
2019	0.83	0.40	8.03	88	491
2020	0.37	0.11	3.16	45	349
2021	0.54	0.16	4.91	71	311
Average	0.55	0.22	4.96	77	465

PC2

At PC2, data was collected since 2001. In Table 3.2.5, the data is segmented to 'pre-2012' and '2012-present' due to the implementation of BMP's upstream of site. Just prior to 2012, there were ponds installed along with a stream restoration upstream of the site. In general, there have been lower concentrations and higher precipitation in the '2012-present' dataset compared to the 'pre-2012' dataset, this has led to higher flows and higher nutrient loading.

- Precipitation and flow volume:
    - 2021 compared to '2012-present' average:
        - Precipitation lower in 2021 by 23%
        - Flow volume lower in 2021 by 67%
    - Moderate correlation ($r^2 = 0.50$) between flow and precipitation (2012-2021)
        - Site experiences lake effect from Medicine Lake
        - Upstream wetlands and ponds infiltrate water and provide storage capacity
- Flow-weighted average concentrations:
    - 2021 nutrients and TSS compared to '2012-present' average
        - TP, SRP, TN, and TSS were lower by 8%, 30%, 4%, and 48%, respectively
    - 2021 Chlorides compared to '2012-present'
        - Chlorides increased by 40%
        - Low flows concentrated the chlorides
- Loading
    - Lower concentrations and flow volumes led to lower loadings in 2021 compared to the '2012-present' average
        - Nutrient and TSS loadings were 66% to 83% lower
    - The lower flow volume and increased chloride concentrations resulted in a 47% lower chloride loading in 2021 compared to the average '2012-present' loadings

The unit area loads (UAL) by year are listed in Table 3.2.6.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.33 lbs/acre average versus 1.35 lbs/acre for residential land use
        - TP UAL has been lower than MPCA UAL since monitoring began
    - TSS: 69 lbs/acre average versus 77 lbs/acre for residential land use

Table 3.2.5 Loading and flow weighted concentrations for TP, SRP, TN, TSS, and Cl^- at PC2. The data is segmented based on the before and after of pond installation and stream stabilization. The % change compares the average loadings and concentrations before and after 2012

PC2 - Plymouth Creek Site 2												
Year	Nutrient Loading					Nutrient Concentration					Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)		
Pre-2012												
2001	1,484	534	7,416	95,455		236	85	1.20	15		2.92	34.6
2002	3,931	1,761	21,261	316,003		212	110	1.30	20		8.41	38.1
2003	2,274	1,125	11,040	208,858		216	107	1.05	20		4.76	25.8
2004	2,306	1,052	12,630	490,844		182	83	1.00	42		5.73	32.1
2005	1,327	783	10,761	421,668		161	95	1.30	51		3.14	32.6
2006	2,619	983	22,491	1,623,423		272	102	2.34	169		4.42	29.1
2007	3,157	1,244	23,625	1,319,995		275	108	2.06	115		5.22	31.1
2008	969	191	9,925	827,829		206	105	2.10	175		2.14	20.8
2009	496	222	4,834	121,726		131	59	1.28	32		1.71	19.6
2010	1,588	790	12,118	80,263		134	67	1.02	7		5.40	31.2
2011	2,737	851	30,284	468,328		148	46	1.64	25		8.37	26.3
Average	2,081	867	15,126	543,127		198	88	1.48	61		4.75	29.2
2012-present												
2012	2,049	740	19,555	273,588		149	54	1.42	20		6.25	26.7
2013	2,487	1,198	22,839	395,732		157	76	1.44	25		13.75	31.6
2014	2,920	1,602	35,271	686,184	3,482,178	125	59	1.29	25	127	12.42	27.5
2015	1,289	599	12,577	104,856	1,512,773	131	61	1.28	11	154	4.46	29.1
2016	3,846	1,899	35,957	494,863	2,472,477	147	73	1.37	19	95	11.88	38.6
2017	1,323	622	15,689	255,076	1,153,509	110	52	1.30	21	96	5.13	27.8
2018	2,296	827	23,727	331,692	1,901,731	145	52	1.50	21	120	7.18	30.8
2019	3,489	1,278	35,260	569,318	1,332,400	120	44	1.21	20	46	13.22	43.3
2020	1,165	465	11,860	137,478	1,466,676	111	44	1.13	13	139	4.77	25.9
2021	717	228	7,475	56,526	975,438	121	39	1.27	10	165	2.68	23.4
Average	2,157	946	22,014	330,469	1,857,015	132	55	1.32	18	118	8.17	30.5
% Change	4	9	46	-39		-33	-37	-11	-70		72	4

Table 3.2.6 Unit area loads for TP, SRP, TN, TSS, and Cl^- at PC2

Plymouth Creek Site 2 - PC2					
Year	Load/Acre				
	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)
2001	0.23	0.08	1.16	15	
2002	0.62	0.28	3.33	49	
2003	0.36	0.18	1.73	33	
2004	0.36	0.16	1.98	77	
2005	0.21	0.12	1.68	66	
2006	0.41	0.15	3.52	254	
2007	0.49	0.19	3.70	207	
2008	0.15	0.03	1.55	130	
2009	0.08	0.03	0.76	19	
2010	0.25	0.12	1.90	13	
2011	0.43	0.13	4.74	73	
2012	0.32	0.12	3.06	43	
2013	0.39	0.19	3.57	62	
2014	0.46	0.25	5.52	107	545
2015	0.20	0.09	1.96	16	324
2016	0.60	0.30	5.63	77	387
2017	0.21	0.10	2.46	40	181
2018	0.36	0.13	3.71	52	298
2019	0.55	0.20	5.52	89	209
2020	0.18	0.07	1.86	22	310
2021	0.11	0.04	1.17	9	153
Average	0.33	0.14	2.88	69	291

IP2 versus PC2

While PC2 is downstream of IP2, there was 36% less flow at PC2 compared to IP2. The ponds and wetlands allow infiltration, and a second year of below average precipitation led to the reduced flows at PC2. Allowing the water to infiltrate at the ponds allowed for the nutrients to be used or adsorbed onto sediments upstream of PC2, thereby making the concentrations of TP, SRP and TN each lower by about 40%. The ponds allow sediments to settle out, so there was a larger decrease in TSS of 67%. The reduced concentrations along with less flow resulted in a 59% to 79% reduction in overall loading of nutrients and TSS at PC2. Chloride loading was 16% lower at PC2 than IP2 even though the concentration was 32% higher at PC2.

Comparing the UAL's between sites, gives a sense of where the loading is occurring. The UALs at IP2 are higher than at PC2, so more nutrients, TSS and chloride are coming from upstream of

IP2 than below. The reduction in unit area load is likely a result of the stormwater ponds between IP2 and PC2 functioning as intended.

3.3. Northwood Lake Sub-watershed

The Northwood Lake Sub-watershed (NLS) creates the headwaters of the North Branch of Bassett Creek. The monitored site's watershed is located entirely within the City of Plymouth and is upstream of Northwood Lake, located in the City of New Hope (Figure 3.3.1).

- Northwood Lake water level is controlled by a 10' weir at the outlet along Boone Ave
    - Causes water to back up into NLS monitoring station
    - In 2016-2017, City of New Hope installed several improvements around the lake to reduce phosphorus loading
        - More information can be found at the Bassett creek WMO website: https://www.bassettcreekwmo.org/lakes-streams/northwood-lake
- Northwood Lake has been classified as impaired for excess nutrients since 2004
    - There is no TMDL

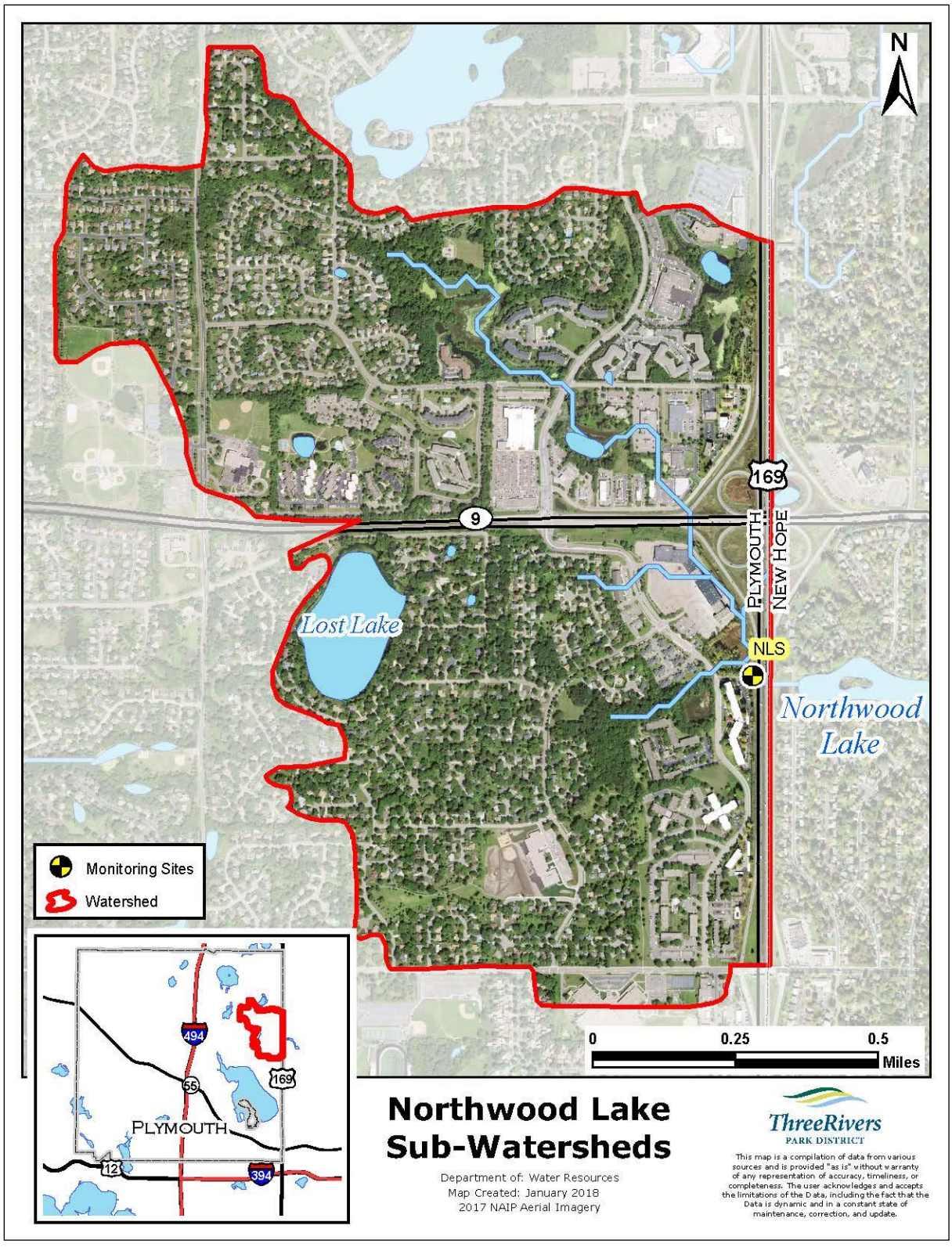


Figure 3.3.1 Northwood Lake Sub-watershed map

3.3.1. Stormwater Monitoring Site

The NLS monitoring site is located at the edge of the City of Plymouth. Details of the site are listed in Table 3.3.1.

- Located behind the apartment complex at 3940 Lancaster Ln N
- At the mouth of a six-foot culvert just before the stream flows under Highway 169
- At the confluence of a northern and western tributary (Figure 3.3.1)

Table 3.3.1 Summary of watershed characteristics for NLS

Site	*Sub watershed Area (acres)*	*% impervious (acres)1*	*% of Watershed in Plymouth*	*Dominant land uses2*
NLS	**835**	**34% (285 ac.)**	**100%**	**Residential**

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer
[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.3.2. Hydrograph

Being at the headwaters of the North Branch of Bassett Creek, this site is quite flashy and responds quickly to precipitation (Figure 3.3.2).

- Due to the outlet of Northwood Lake being a weir, the NLS site typically goes stagnant at a staff gage level of about 1.45 feet
- Largest average daily flow event: 18 cfs on 8/27/21 after largest precipitation event
- Average daily flow during monitoring period: 1.2 cfs

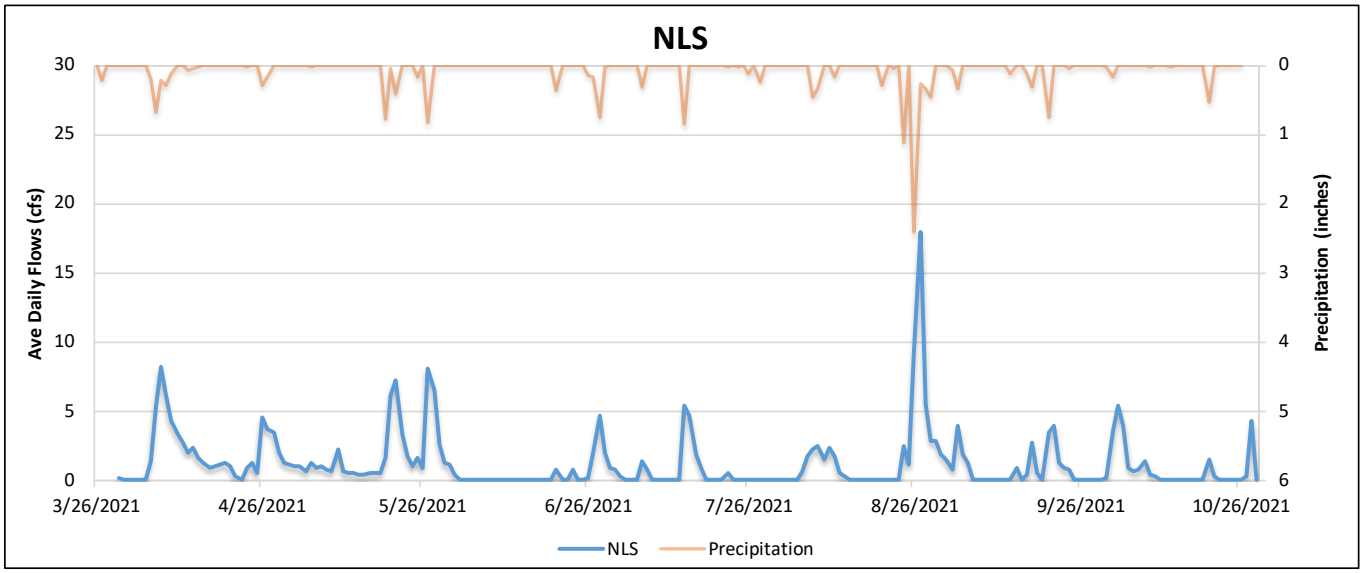


Figure 3.3.2 Average daily flow for Northwood Lake Sub-watershed (NLS)

3.3.3. Concentrations

Summary for Table 3.3.2.

- Number of water samples collected:
    - 17 samples: 8 automated composites and 12 grab samples
- Composite sample from 10/20/21 following 0.53-inch rain event had the highest TP concentration (604 µg/L) and SRP concentration (333 µg/L) for the season
- SRP to TP ratio: on average, SRP accounted for 34% of TP

Table 3.3.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS at NLS

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
NLS	**250 (72 - 604)**	**85 (9 - 333)**	**2.2 (0.9 - 5.1)**	**68.3 (2.2 - 290)**

3.3.4. Yearly Summary

Since 2012, water quality has been monitored every year with the exception of 2020. In Table 3.3.3, the yearly flow-weighted concentrations and loadings are segmented to 'pre-2017' and '2017-present' since there has been a shift in the flow regime. In 2016, several stormwater infrastructure projects occurred adjacent to Northwood Lake that affected the flows at the monitoring station; the downstream improvements seem to back the flow up into the monitoring site, which allows more infiltration thereby reducing flow.

- Precipitation and flow volume:
    - Average flows decreased by 21% in '2017-present' compared to 'pre-2017' despite very little difference in average precipitation
    - Between 2017 to 2021 there is a positive correlation (r^2 = 0.89) between flow and precipitation
        - There was a positive correlation from 2012-2015 (r^2 = 0.76) – the relationship was shifted to have higher flows at the same precipitation
- Flow-weighted average concentrations:
    - 2021 concentrations were within 20% of the '2017-present' average concentrations
- Loading
    - With the reduced flows, the loadings were 23% to 48% lower in 2021 compared to '2017-present' averages

The unit area loads (UAL) by year are listed in Table 3.3.4.

- Average UAL versus MPCA Stormwater manual UAL
  - TP: 1.02 versus 1.35 lbs/acre for residential land use
    - 7 of the 9 monitored years are lower than MPCA TP UAL
  - TSS: 337 versus 77 lbs/acre for residential land use
    - Has exceeded MPCA UAL every year since monitoring began in 2012

Table 3.3.3 Loading and flow weighted concentrations of TP, SRP, TN and TSS at NLS

NLS - Northwood Lake Sub watershed										
	Nutrient Loading				Nutrient Concentration					
Year	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Flow Volume (x 10^6 M^3)	Annual Precipitation (inches)
2012-2016										
2012	641	254	6,198	98,605	153	61	1.48	24	1.90	26.7
2013	821	361	7,492	225,785	185	83	1.71	52	1.99	31.6
2014	1,279	589	12,748	377,933	265	122	2.64	78	1.87	27.5
2015	933	296	8,142	266,447	214	68	1.87	61	1.97	29.1
2016	585	195	5,211	240,786	278	93	2.47	114	0.95	38.6
Average	852	339	7,958	241,911	219	85	2.03	66	1.74	30.7
2017-current										
2017	803	210	7,401	439,568	254	66	2.34	139	1.35	27.8
2018	1,215	372	8,202	427,514	388	119	2.62	137	1.42	30.8
2019	739	261	7,226	284,697	184	65	1.80	71	1.82	43.3
2021	640	154	5,421	173,546	332	80	2.82	90	0.87	23.4
Average	849	249	7,063	331,331	290	83	2.39	109	1.37	31.3
% change	0	-26	-11	37	32	-3	18	66	-21	2

Table 3.3.4 Unit area loading for TP, SRP, TN and TSS at NLS

NLS - Northwood Lake Sub watershed				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2012	0.77	0.30	7.42	118
2013	0.98	0.43	8.97	270
2014	1.53	0.71	15.26	453
2015	1.12	0.35	9.75	319
2016	0.70	0.23	6.24	288
2017	0.96	0.25	8.86	526
2018	1.46	0.45	9.82	512
2019	0.89	0.31	8.65	341
2021	0.77	0.18	6.49	208
Average	1.02	0.36	9.05	337

3.4. Bass Lake Watershed

The Bass Lake watershed is 3,105 acres and is located entirely within the City of Plymouth.

- Bass Lake was classified as impaired for excess nutrients in 2002
- A TMDL was completed in 2009 to address nutrient impairments in Bass, Schmidt and Pomerleau Lakes (Wenck, 2009)
- In 2017, a follow up document reviewed the progress toward meeting reductions in the TMDL report (Wenck, 2017)
- 2019: Alum treatments were applied in both Pomerleau Lake and Bass Lake

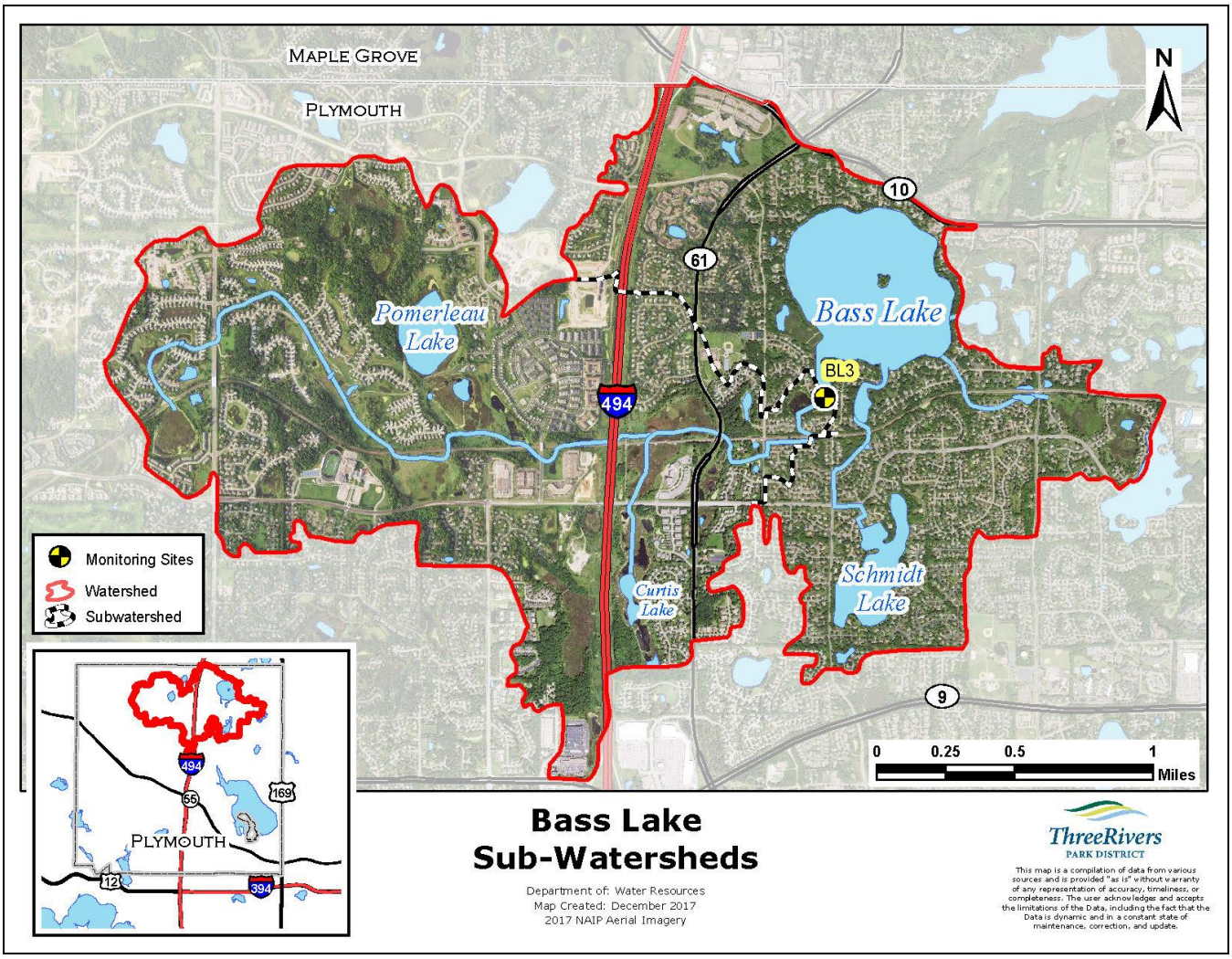


Figure 3.4.1 Bass Lake sub-watershed map

3.4.1. Stormwater Monitoring Site

To assess the nutrients flowing into Bass Lake, one site was monitored that accounts for 59% of the Bass Lake watershed area (Figure 3.4.1).

- BL3 (Bass Lake Site 3)
    - Located east of 54th Ave North on Norwood Lane North
    - Two side-by-side 24-inch round culverts referred to as "east" and "west"
        - Flow measurements taken in both culverts
        - Water samples taken from west culvert only
        - Nutrient concentrations applied to total flow to estimate nutrient loading
    - Located at the outfall of a 6.5-acre pond that attenuates flow and allows settling of particulates

Table 3.4.1 Summary of watershed characteristics for site BL3

Site	*Subwatershed Area (acres)*	*% impervious (acres)1*	*% of Bass Lake Watershed*	*Dominant land uses2*
BL3	**1,846**	**28% (511 ac.)**	**59%**	**Residential**

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer
[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.4.2. Hydrograph

With a pond on the upstream side of the BL3 culvert, the site has a delayed hydrologic response to rainfall events; there is a delayed peak after a storm event followed by a prolonged duration in flow (Figure 3.4.2).

- BL3
    - Measured flow of side-by-side culverts: within 23% of each other
    - Largest average daily flow: 14 cfs on 7/15/21 after 0.85-inch rain event
    - Average daily flow during monitoring period: 1.5 cfs

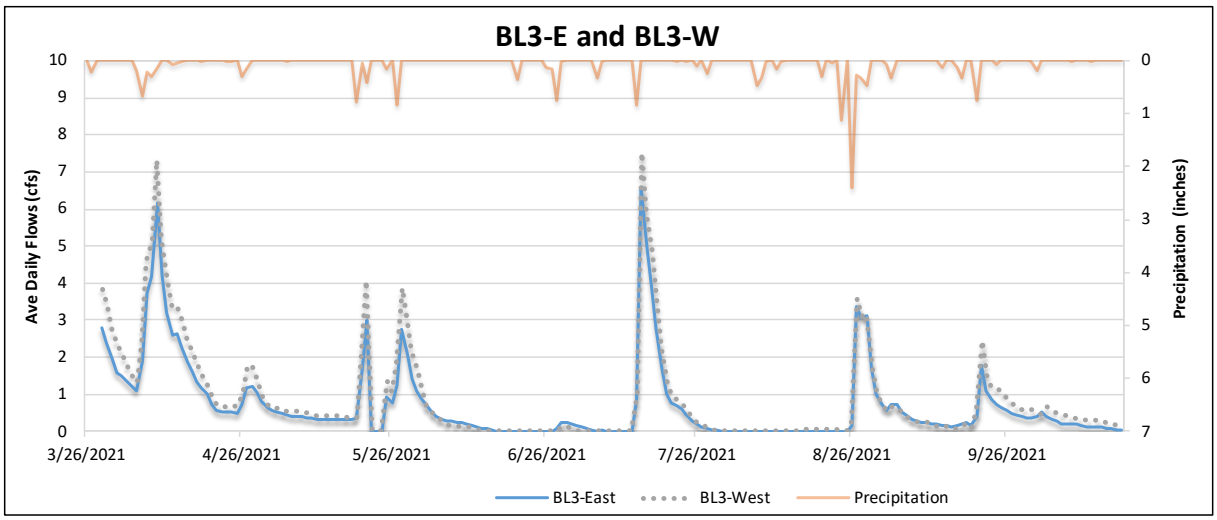


Figure 3.4.2 Average daily flow for Bass Lake site 3 East and West (BL3-E and BL3-W)

3.4.3. Concentrations

Summary of Table 3.4.2.

- Number of water samples collected:
  - 17 samples: 2 automated composites and 15 grab samples
- SRP to TP ratio:
  - On average, SRP accounted for 24% of TP

Table 3.4.2 Summary of average, minimum, and maximum concentrations for TP, SRP, TN, and TSS at BL3-W

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
BL3-W	**134 (19 - 593)**	**32 (2 - 85)**	**1.6 (0.7 - 4.5)**	**4.3 (0.2 - 15.6)**

3.4.4. Yearly Summary

At BL3, data has been collected since 2015 (Table 3.4.3).

- Precipitation and flow volume:
  - 2021 compared to '2015-present' average
    - Precipitation was lower in 2021 by 25%
    - Flow volume was lower in 2021 by 49%
  - Good correlation (r^2 = 0.84) between flow and precipitation (2015-2021)
- Flow weighted concentration:
  - 2021 compared to '2015-present' average:

    - All parameters lower by between 9% and 50%
- Loading
    - Decreased 2021 flow volume led to between 57% to 78% lower loadings than '2015-present' average
    - Lower flows in 2020 and 2021 led to the lowest loadings since monitoring began
- Average UAL versus MPCA Stormwater manual UAL: Table 3.4.4.
    - TP: 0.30 lbs/acre average versus 1.35 lbs/acre for residential land use
    - TSS: 12 lbs/acre average versus 77 lbs/acre for residential land use

Table 3.4.3 Loading and flow weighted concentrations of TP, SRP, TN, and TSS at BL3

BL3 - Bass Lake Site 3										
Year	Nutrient Loading				Nutrient Concentration				Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)		
2015	1,079	396	9,546	40,986	172	63	1.52	6.5	2.84	29.1
2016	800	368	8,774	24,015	111	51	1.22	3.3	3.27	38.6
2017	316	121	4,739	17,210	69	26	1.04	3.8	1.04	27.8
2018	612	248	6,983	36,118	114	46	1.30	6.7	2.44	30.8
2019	668	317	9,824	29,408	73	34	1.07	3.2	4.18	43.3
2020	193	79	3,153	5,812	65	27	1.06	2.0	1.35	25.9
2021	200	49	2,819	6,528	77	19	1.08	2.5	1.18	23.4
Average	553	225	6,548	22,868	97	38	1.19	4.0	2.33	31.3

Table 3.4.4 Unit area loading for TP, SRP, TN, and TSS at BL3

Bass Lake - Site 3				
Year	Load/Acre			
	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2015	0.58	0.21	5.17	22
2016	0.43	0.20	4.75	13
2017	0.17	0.07	2.57	9
2018	0.33	0.13	3.78	20
2019	0.36	0.17	5.32	16
2020	0.10	0.04	1.71	3
2021	0.11	0.03	1.53	4
Average	0.30	0.12	3.55	12

3.5. Gleason Lake Watershed

The Gleason Lake Watershed is 2,643 acres with 93% of the watershed in the City of Plymouth (Figure 3.5.1). Gleason Lake is part of the Minnehaha Watershed.

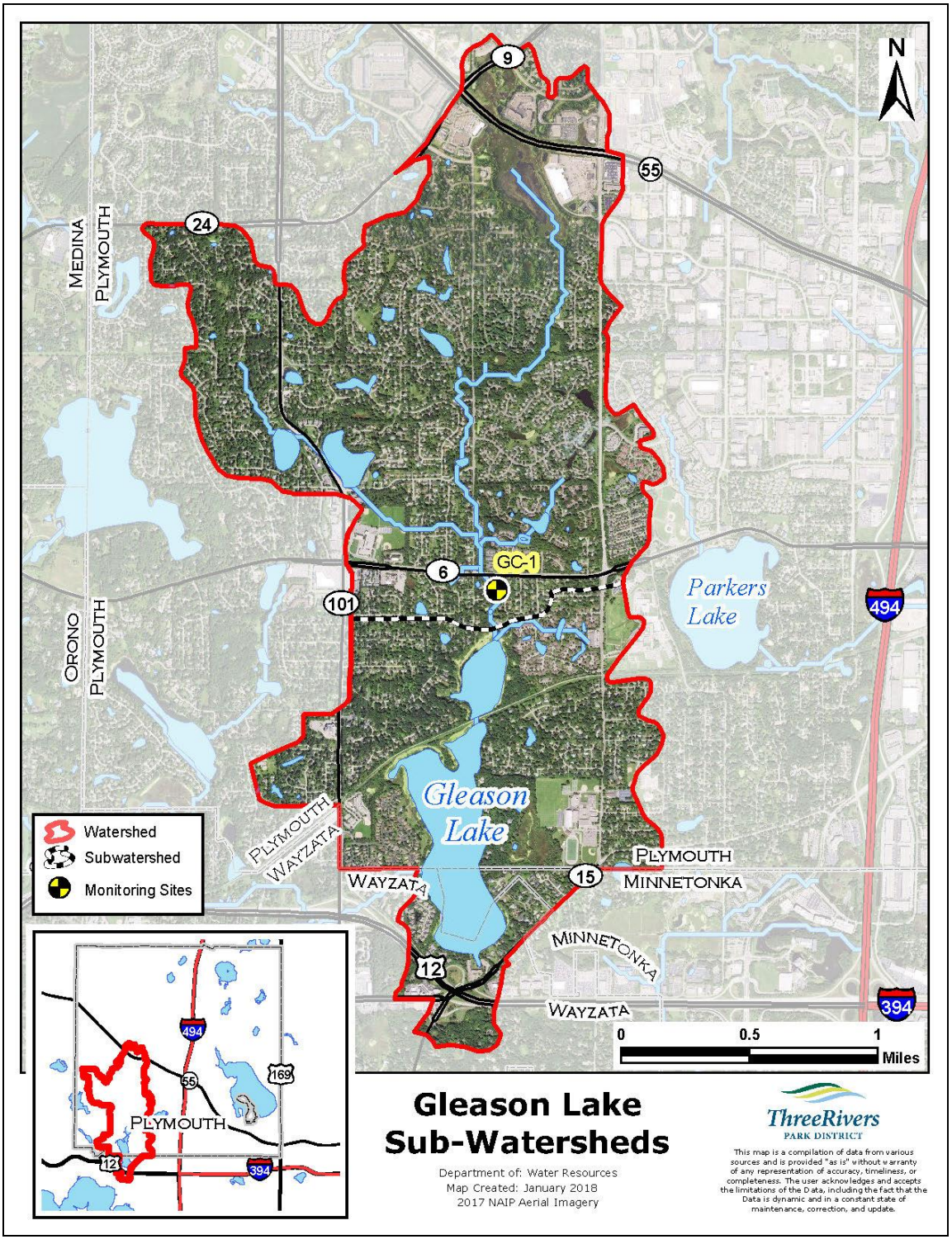


Figure 3.5.1 Gleason Creek sub-watershed map

- Impairments:
    - Gleason Lake: Impaired for excess nutrients since 2010
    - Unnamed creek to Gleason Lake: Impaired for Dissolved oxygen since 2020
- TMDL:
    - Upper Minnehaha Creek Watershed Nutrient and Bacteria TMDL approved by EPA in 2014
- BMP's or infrastructure changes:
    - 2022: Removed most trees along creek - primarily Ash and Buckthorn; Street project in the area where new curbs and gutters were installed

3.5.1. Stormwater Monitoring

To assess the nutrients flowing into Gleason Lake, one location was monitored that captures 67% of the watershed area. (Table 3.5.1)

- GC-1 (Gleason Creek Site 1)
    - Open Channel
    - Located off a bike path that connects Highway 6 and Black Oaks Lane North

Table 3.5.1 Summary of watershed characteristics for site GC-1

Site	*Subwatershed Area (acres)*	*% impervious (acres)[1]*	*% of Gleason Lake Watershed*	*Dominant land uses[2]*
GC-1	**1,650**	**28% (454 ac.)**	**67%**	**Residential**

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer
[2] Dominant Land Uses determined using GIS layer obtained from the City of Plymouth

3.5.2. Hydrograph

The hydrograph for GC-1 corresponds with precipitation but has a delayed hydrologic response following storm events that persists for several days (Figure 3.5.2).

- GC-1
    - There were three times flow reached more than 5 cfs but the largest average daily flow event was 5.9 cfs on 8/29/21 after largest precipitation event
    - Average daily flow during monitoring period: 0.69 cfs

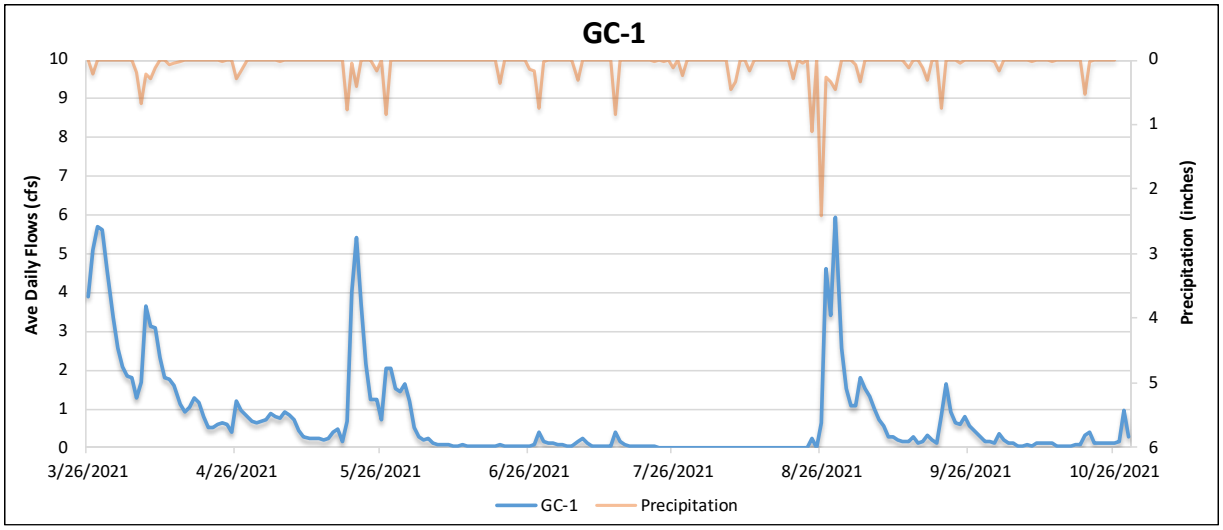


Figure 3.5.2 Average daily flow for Gleason Creek site 1 (GC-1)

3.5.3. Concentrations

Summary of Table 3.5.2.

- Number of water samples collected:
  - 21 samples: 12 automated composites and 9 grab samples
- Chlorides:
  - Meeting standard: Only exceeded standard one time in past three years on 4/5/2021 at a concentration of 256 mg/L
  - Highest concentrations occurred from April and May
- SRP to TP ratio: on average, SRP accounts for 25% of TP

Table 3.5.2 Summary of average, minimum, and maximum concentrations for TP, SRP, TN, TSS, and Cl^- at GC-1

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	Avg Cl^- (min-max) mg/L
GC-1	238 (51 - 626)	60 (2 - 157)	2.4 (0.8 - 8.2)	63.1 (2.0 - 272.0)	94 (3 - 256)

3.5.4. Yearly Summary

Data has been collected at GC-1 by the Minnehaha Creek Watershed District (MCWD) from 2005-2016 with the exception of 2006; and collected by Three Rivers Park District from 2017-2021 (Table 3.5.3).

- The agencies use different techniques for estimating loading; therefore, datasets should be assessed independently of each other

    - TRPD collects bi-weekly grabs and samples during storm events
        - MCWD only collects routine grabs
    - TRPD extrapolates to annual load based on yearly precipitation
        - MCWD reports loading during sampling period only
    - The differences result in TRPD having higher concentrations and higher total loads
- Precipitation and flow volume:
    - 2021 compared to '2017-present' average
        - Precipitation is lower in 2021 by 23%
        - Flow volume is lower in 2021 by 57%
    - Good correlation (r^2 = 0.97) between flow and precipitation (2017 to 2021)
- Flow weighted concentration:
    - Concentrations in 2021 were 7% to 50% higher than '2017-present' average depending on parameter
- Loading
    - Lower flow volumes in 2021 resulted in 27% to 55% lower loadings than the '2017-present' average
- Average UAL versus MPCA Stormwater manual UAL: Table 3.5.4
    - TP: 0.31 lbs/acre average versus 1.35 lbs/acre for residential land use
    - TSS: 90 lbs/acre average versus 77 lbs/acre for residential land use

Table 3.5.3 Loading and flow weighted concentrations of TP, SRP, TN, TSS, and Cl^- at GC-1. Data is a compilation from Three Rivers Park District and Minnehaha Creek Watershed District and caution should be used when assessing the data for trends since different methodologies were used by the agencies to determine loading (sampling period vs extrapolated to yearly) and concentrations (grab only vs storm event and grab samples)

GC-1 - Gleason Lake Sub watershed												
Year	Nutrient Loading					Nutrient Concentration						
	TP (lbs)	SRP (lbs)	TN (lbs)	TSS (lbs)	Cl^- (lbs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)	Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
2005-2016												
2005*	156	34	1,031	15,376		197	42	1.30	19		0.77	32.6
2007*	456	72	2,621	39,107		228	36	1.31	17		1.64	31.1
2008*	75	15	854	10,337		123	24	1.39	17		0.58	20.8
2009*	35	7	283	2,487		129	26	1.03	9		0.23	19.6
2010*	232	100	2,095	7,377		123	53	1.12	4		1.46	31.2
2011*	387	133	3,537	43,103		143	49	1.31	16		2.10	26.3
2012*	214	75	1,004	14,450		149	52	0.70	10		1.58	26.7
2013*	583	297	1,691	28,555		194	99	0.56	10		2.84	31.6
2014*	576	308	4,978	15,477		147	79	1.27	4		3.59	27.5
2015*	331	137	1,648	25,900		161	67	0.80	13		1.51	29.1
2016*	266	104	1,914	11,035		143	56	1.03	6		1.24	38.6
Average	301	117	1,969	19,382		158	53	1.08	11		1.59	28.6
2017-present												
2017	479	85	4,194	120,809		211	37	1.85	53		0.97	27.8
2018	498	150	3,812	194,593		216	65	1.66	85		1.04	30.8
2019	1,008	364	8,578	233,617	191,710	160	58	1.36	37	30	2.85	43.3
2020	247	68	2,821	83,197	189,118	134	37	1.53	45	102	0.84	25.9
2021	366	66	2,858	107,268	86,870	309	56	2.42	91	73	0.54	23.4
Average	520	147	4,453	128,588	155,899	206	51	1.76	62	69	1.25	30.2

*** Data collected by Minnehaha Creek Watershed District (MCWD) 1**

[1] MCWD Disclaimer: The data to which this notice is attached are made available pursuant to the Minnesota Government Data Practices Act (Minnesota Statutes Chapter 13). THE DATA ARE PROVIDED TO YOU AS IS AND WITHOUT ANY WARRANTY AS TO THEIR PERFORMANCE, MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE. These data were developed by the Minnehaha Creek Watershed District for its own business purposes. The Minnehaha Creek Watershed District (MCWD) makes every effort to assure that the data and the associated documentation are error-free, complete, current, and accurate; however, the Minnehaha Creek Watershed District does not guarantee this. The Minnehaha Creek Watershed District is NOT responsible for any consequences resulting from your use of the data. You should consult the available online documentation or contact the staff contact listed in the MCWD's website to determine the limitations of the data. If you transmit or provide the data (or any portion of it) to another user, the data must include a copy of this disclaimer.

Table 3.5.4 Loading per acre for TP, SRP, TN, TSS, and Cl^- for GC-1

GC-1					
Year	Load/Acre				
	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre
2017	0.29	0.05	2.54	73	
2018	0.30	0.09	2.31	118	
2019	0.61	0.22	5.20	142	116
2020	0.15	0.04	1.71	50	115
2021	0.22	0.04	1.73	65	53
Average	0.31	0.09	2.70	89	94

3.6. Elm Creek Watershed

A portion of Elm Creek runs through the northwest corner of the City of Plymouth (Figure 3.6.1). There has been a significant amount of development in Medina and the City of Plymouth.

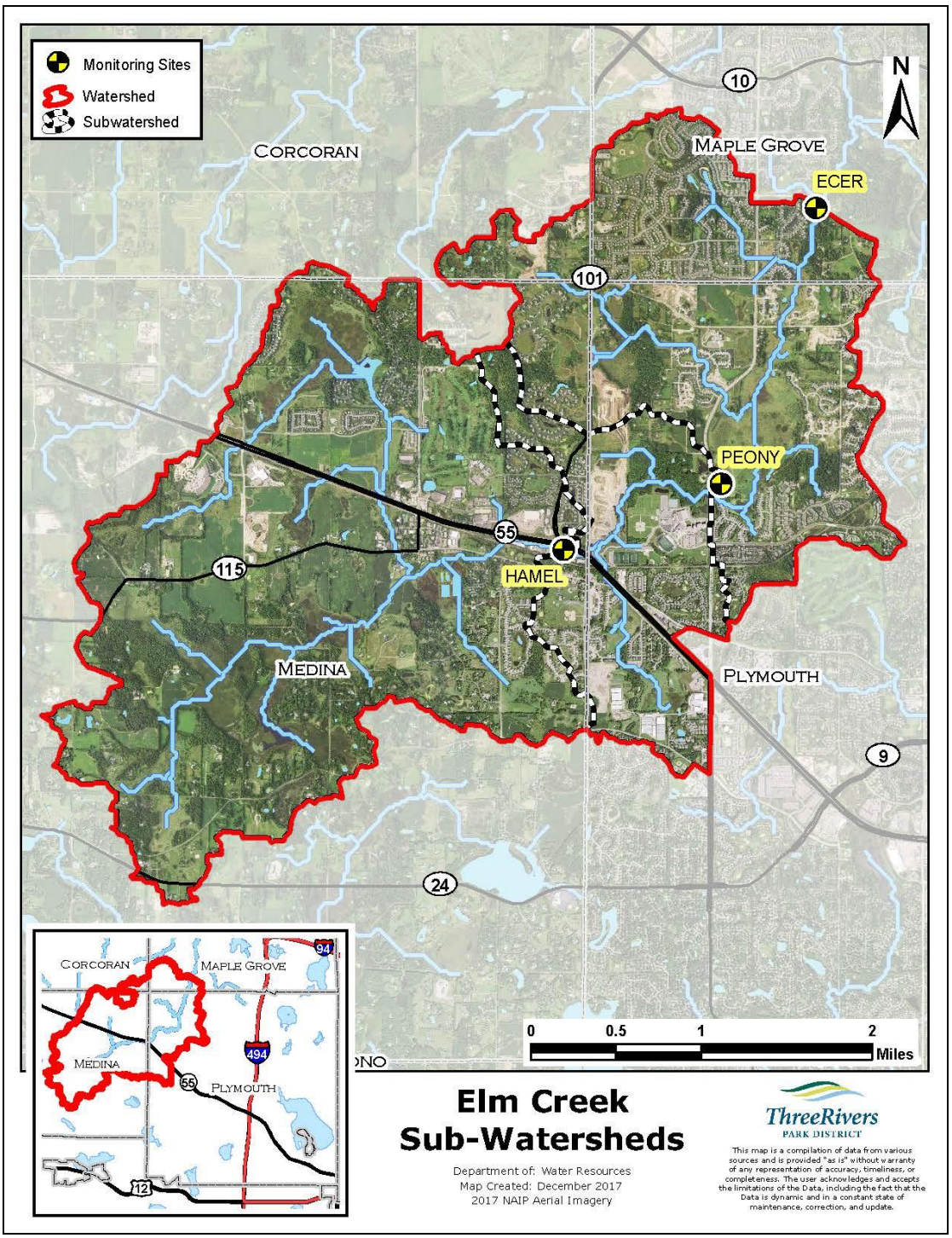


Figure 3.6.1 Elm Creek sub-watershed map

- Impairments:
    - Elm Creek was listed as impaired for E. Coli in 2010
    - Elm Creek was listed as impaired for Chlorides and Dissolved Oxygen in 2014
    - Several lakes in the watershed are listed as impaired for excess nutrients
- TMDL approved by EPA in 2017 for the Elm Creek watershed (TRPD, 2016)
- BMP's and infrastructure changes:
    - Completed 2015: Small retention pond and stream restoration
        - Immediately downstream of Hamel monitoring site and before Hwy 55
    - Completed 2016: Stream restoration, retention ponds and iron enhanced benches within a retention pond to reduce nutrient loading
        - Between Wayzata High School and Peony Lane
    - Competed 2019: Stream restoration and a passive iron enhanced filter
        - Between Hwy 55 and Wayzata High school
    - Completed 2022: Installed two bridges and adjusted main channel flow
        - Peony site and at ECER site

3.6.1. Stormwater Monitoring Sites

To assess Elm Creek nutrients and chlorides that flow through the City of Plymouth, three sites were monitored. Watershed characteristics of those sites can be found in Table 3.6.1.

- Hamel: Before Elm Creek reaches the City of Plymouth
    - Located at intersection of Hamel Road and Hwy 55
    - Box culvert: 8 feet wide by 4 feet high
- Peony: Mid-way through the City of Plymouth
    - Near the Wayzata High School off Peony Lane North
    - Downstream of BMP's completed in 2016 and 2019
    - Due to 2020 construction changes to stream channel, site was moved upstream to culvert directly under Peony Lane North – flows between two locations are similar
- ECER: After Elm Creek leaves the City of Plymouth
    - Located in Maple Grove on the south side of Elm Road along a walking path
    - Downstream of Peony monitoring site
    - Open channel
    - Downstream of a 210-acre wetland complex
        - Captures nutrients and allows for sediment settling

Table 3.6.1 Summary of Elm Creek watershed characteristics for sites Hamel and ECER

Site	Subwatershed Area (acres)	% impervious (acres)[1]	% of Total Watershed in Plymouth
Hamel	**4,272**	**12% (506 ac.)**	**0%**
Peony	**5,429**	**15% (811 ac.)**	**17%**
ECER	**7,921**	**18% (1,414 ac.)**	**29%**

[1] % impervious area determined using the 2016 University of Minnesota TCMA 1-meter land cover classification GIS layer

3.6.2. Hydrograph

The cumulative flow volume increases downstream for each sampling site. There is a delayed hydraulic response at downstream ECER after a precipitation event due to watershed size (Figure 3.6.2).

- Hamel
    - Largest average daily flow: 24 cfs on 5/20/21 during several day precipitation event
    - Average daily flow during monitoring period was 3.2 cfs
- Peony
    - Largest average daily flow: 44 cfs on 5/20/21 during several day precipitation event
    - Average daily flow during monitoring period was 3.6 cfs
    - Equipment wasn't put out until 5/3/21; since there is a good relationship between flow at Hamel and Peony, 3/29-5/3/21 is estimated based on Hamel's flow
- ECER
    - Largest average daily flow: 82 cfs on 7/15/21 after a 0.85-inch rain event
    - Average daily flow during monitoring period: 5.8 cfs

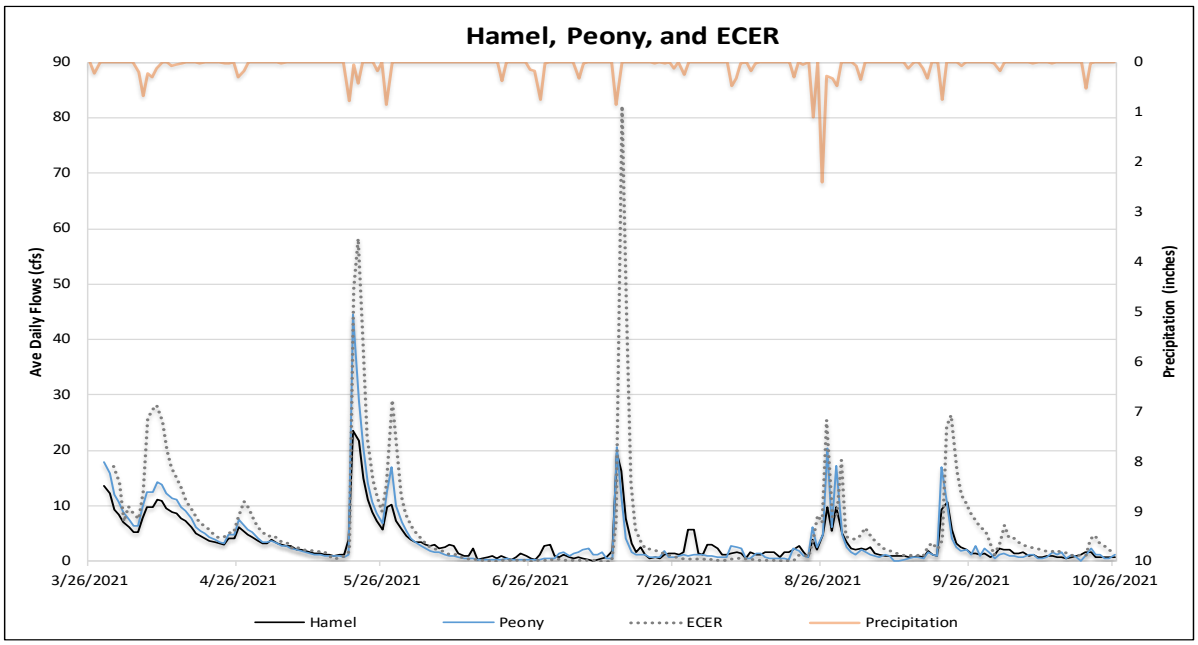


Figure 3.6.2 Average daily flow for Elm Creek watershed sites: Hamel, Peony, and ECER

3.6.3. Concentrations

Summary of Table 3.6.2, Figure 3.6.3, Figure 3.6.4.

Hamel:

- Number of water samples collected:
  - 27: 12 automated composites and 15 grab sample
- Chlorides:
  - Exceeded standard two times in June 2021
    - Did not exceed standard in 2020
    - From 2007-2012 - both chronic and maximum standards were exceeded
- SRP to TP ratio
  - On average, SRP accounted for 36% of TP

Peony:

- Number of water samples collected:
  - 24: 5 automated composites and 19 grab sample
- Highest concentration of TSS and TP occurred on 9/20/21 composite sample
- Chlorides:
  - Did not exceed standard in 2021

        - First year of collecting chloride data
    - Highest concentrations occurred in May and June
- SRP to TP ratio
    - On average, SRP accounted for 64% of TP

ECER:

- Number of water samples collected:
    - 24: 9 automated composites and 15 grab sample
- Highest concentration of TSS and TP occurred on 7/14/21 composite sample – sample was an anomaly for the year, but notes confirmed that the stream was very turbid
- Chlorides:
    - Did not exceed standard in 2021
        - Did not exceed standards from 2007-2012
    - Highest concentrations occurred in June
- SRP to TP ratio
    - On average, SRP accounted for 44% of TP

Table 3.6.2 Summary of average, minimum, and maximum concentrations for TP, SRP, TN, TSS, and Cl^- at Hamel, Peony, and ECER

Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	Avg Cl^- (min-max) mg/L
HAMEL	192 (45 - 587)	68 (13 - 160)	1.8 (1.1 - 4.7)	46.2 (1.7 - 270.0)	122 (30 - 310)
PEONY	315 (92 - 746)	203 (43 - 324)	1.4 (0.8 - 3.3)	34.9 (1.9 - 244.8)	74 (40 - 156)
ECER	276 (67 - 1406)	121 (30 - 225)	1.7 (0.8 - 4.8)	69.8 (2.3 - 1005.0)	79 (45 - 134)

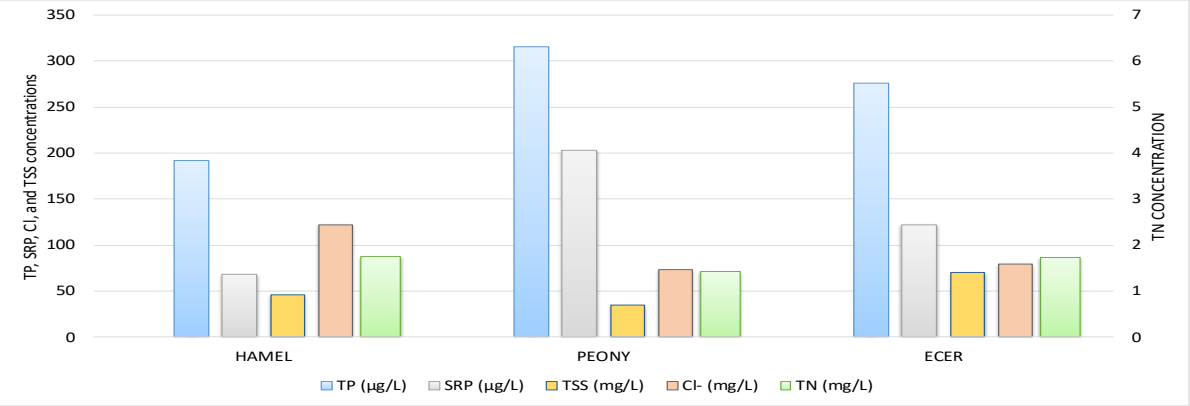


Figure 3.6.3 Average concentrations of TP, SRP, TSS, Cl^-, and TN for the Elm Creek Watershed sites including: Hamel, Peony, and ECER

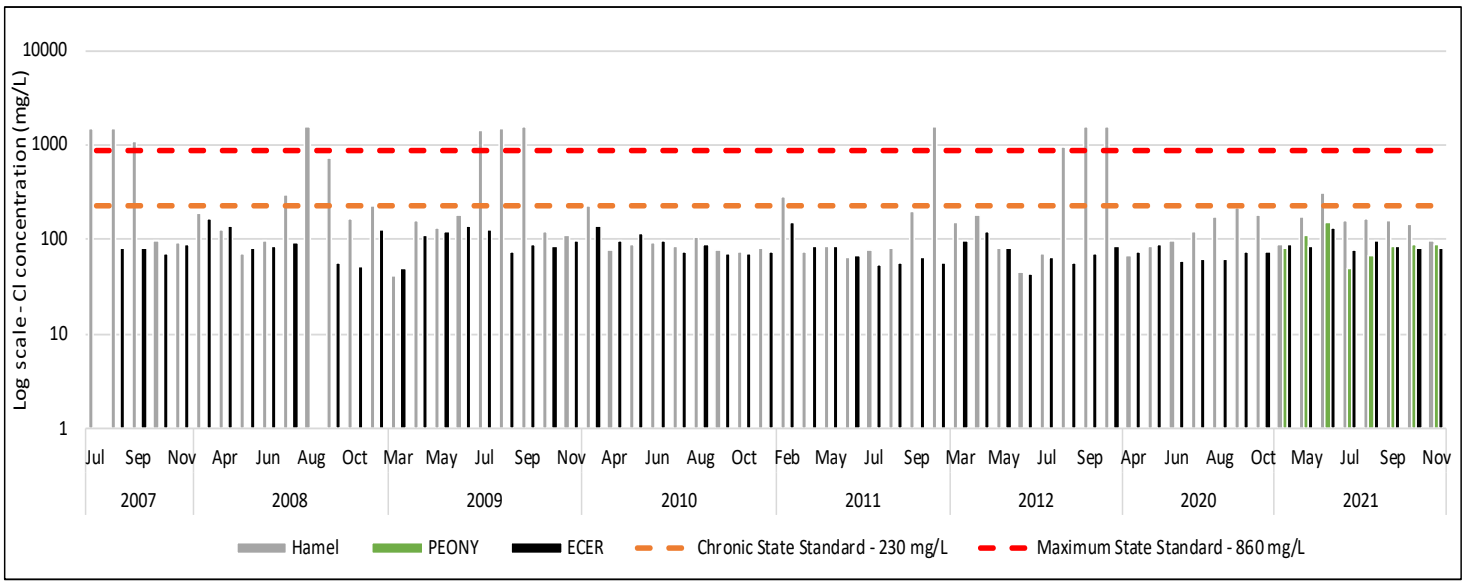


Figure 3.6.4 Log scale of maximum monthly chloride concentration at Hamel, Peony, and ECER versus the MPCA chloride standard and maximum standard. When standard is exceeded, there may be more than 1 exceedance in that month

3.6.4. Yearly Summary

In general, flow weighted nutrient concentrations and sediment loading increase between Hamel and ECER since there is two times as much flow at ECER. The Hamel site provides baseline flow and nutrient loading conditions as Elm Creek leaves Medina and enters Plymouth. The ECER site represents flow and nutrient loading as Elm Creek leaves Plymouth and enters Maple Grove.

Hamel

At Hamel, data has been collected since 2000 except for 2004-2006 and 2013-2015 (Table 3.6.3). The data is segmented to '2000-2012' and '2016-present'.

- Precipitation and flow volume:
    - 2021 compared to '2016-present' average
        - Precipitation is lower in 2021 by 26%
        - Flow volume is lower in 2021 by 50%
    - Very good correlation (r^2 = 0.97) between flow and precipitation (2016 to 2021)
- Flow weighted concentration:
    - 2021 compared to '2016-present' average:
        - TP, TN, and TSS concentrations higher in 2021 by between 5% to 37%
        - SRP concentrations lower in 2021 by 17%

    - Chloride concentration two times higher in 2021 compared to 2020
- Loading
    - Lower 2021 flow volume and concentrations resulted in 34% to 62% lower loadings than '2016-present' average
    - Chloride loading was 2.4 times higher in 2021 compared to 2020
- Average UAL versus MPCA Stormwater manual UAL: Table 3.6.4
    - TP: 0.55 lbs/acre average versus 1.35 lbs/acre for residential land use
    - TSS: 104 lbs/acre average versus 77 lbs/acre for residential land use

Table 3.6.3 Loading and flow weighted concentrations of TP, SRP, TN, TSS, and Cl^- at Hamel

Hamel												
Year	Nutrient Loading					Nutrient Concentration					Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)		
	2000-2012											
2000	195	73	1,288	32,551		304	113	2.00	54		0.31	32.3
2001	1,164	533	5,922	39,637		354	162	1.80	12		1.97	34.6
2002	5,967	2,769	30,496	771,083		378	175	1.90	49		7.14	38.1
2003	1,233	703	9,442	141,995		234	133	1.80	27		2.39	25.8
2007	308	171	4,268	155,002		158	88	2.19	98		0.88	31.1
2008	798	261	7,111	246,323		208	68	1.85	76		3.22	20.8
2009	280	122	3,425	40,295		187	82	2.29	30		0.68	19.6
2010	2,157	721	9,810	166,074	538,727	331	111	1.51	25	73	2.95	31.2
2011	4,021	1,004	36,604	365,365	698,750	301	75	2.74	27	100	6.07	26.3
2012	2,459	853	20,583	645,515		349	121	2.92	92		3.20	26.7
Average	1,858	721	12,895	260,384	618,739	280	113	2.10	49	87	2.88	28.6
	2016 - present											
2016	7,803	1,877	50,003	1,377,750		435	103	2.74	76		8.13	38.6
2017	1,601	475	16,871	670,208		214	64	2.25	90		3.19	27.8
2018	2,497	935	19,250	543,975		247	93	1.91	54		4.58	30.8
2019	4,981	1,395	40,569	1,324,682		242	68	1.97	64		9.35	43.3
2020	358	166	6,257	85,089	299,959	81	38	1.42	19	68	2.01	25.9
2021	1,596	324	11,993	493,267	704,687	289	59	2.17	89	128	2.50	23.4
Average	3,139	862	24,157	749,162	502,323	251	71	2	65	98	4.96	31.6
% Change	69	20	87	188	-19	-10	-37	-1	33	13	72	11

Table 3.6.4 Hamel unit area loading for TP, SRP, TN, TSS, and Cl^-

Hamel					
Year	Load/Acre				
	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)
2000	0.05	0.02	0.30	8	
2001	0.27	0.12	1.39	9	
2002	1.40	0.65	7.14	180	
2003	0.29	0.16	2.21	33	
2007	0.07	0.04	1.00	36	
2008	0.19	0.06	1.66	58	
2009	0.07	0.03	0.80	9	
2010	0.50	0.17	2.30	39	126
2011	0.94	0.24	8.57	86	
2012	0.58	0.20	4.82	151	164
2016	1.83	0.44	11.7	323	
2017	0.37	0.11	3.95	157	
2018	0.58	0.22	4.51	127	
2019	1.17	0.33	9.50	310	
2020	0.08	0.04	1.46	20	70
2021	0.37	0.08	2.81	115	165
Average	0.55	0.18	4.01	104	131

Peony

At Peony, data has been collected since 2016 (Table 3.6.5). Data was not collected in 2020 due to construction in and around the stream.

- Precipitation and flow volume:
  - 2021 compared to '2016-present' average
    - Precipitation is lower in 2021 by 25%
    - Flow volume is lower in 2021 by 59%
  - Good correlation (r^2 = 0.93) between flow and precipitation (2016-2021)
- Flow weighted average concentrations:
  - 2021 versus '2016-present' average
    - TP, SRP, and TN within 19%
    - TSS was lower by 73%
- Loading
  - 2021 compared to '2016-present' average
    - Due to the decreased concentrations and flow, TP, SRP, and TN were all about 60% lower in 2021
    - TSS loading was 89% lower in 2021

The UAL was assessed as the whole watershed and as a subsection of the contributing area minus the upstream site using the formula:

$$\frac{(Peony\ load - Hamel\ load)}{(Peony\ acres - Hamel\ acres)}$$

Average UAL versus MPCA Stormwater manual UAL at Peony adjusted for Hamel (Table 3.6.6).

- TP: 2.4 lbs/acre versus 1.35 lbs/acre for residential land use
- TSS: 2,879 lbs/acre versus 77 lbs/ for residential land use
- In 2021, the ponds between Hamel and Peony seem to be working very well since all of the TSS loading is coming from upstream of Hamel; There is a reduction of TSS between Hamel and Peony of 30 lbs/acre

Table 3.6.5 Loading and flow weighted concentrations of TP, SRP, TN, and TSS at Peony

Peony												
Year	Nutrient Loading					Nutrient Concentration					Flow Volume (x 10^6 m^3)	Annual Precipitation (inches)
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)		
2016-present												
2016	11,470	2,575	54,362	4,284,931		643	144	3.05	240		8.08	31.2
2017	3,734	1,549	22,516	5,139,148		317	127	1.85	422		5.19	27.8
2018	5,161	1,659	28,147	5,167,027		453	146	2.47	453		5.17	30.8
2019	9,627	3,463	67,505	6,016,665		355	128	2.49	222		12.29	43.3
2021	2,381	746	11,661	458,109	358,986	391	123	1.92	75	59	2.76	23.4
Average	6,475	1,998	36,838	4,213,176	358,986	432	133	2	283	59	7	31.3

Table 3.6.6 Unit area loads for TP, SRP, TN, and TSS at Peony along with unit area loads at Peony adjusted for Hamel loading

	Peony					Peony adjusted for Hamel loading				
	Load/Acre					Load/Acre				
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl (lbs/acre)	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl (lbs/acre)
2016	2.11	0.47	10.01	789		3.17	0.60	3.77	2,513	
2017	0.69	0.29	4.15	947		1.84	0.93	4.88	3,863	
2018	0.95	0.31	5.18	952		2.30	0.63	7.69	3,996	
2019	1.77	0.64	12.43	1,108		4.02	1.79	23.3	4,055	
2021	0.44	0.14	2.15	84	66	0.68	0.36	-0.29	-30	-299
Average	1.19	0.37	6.79	776		2.40	0.86	7.87	2,879	

ECER

At ECER, data has been collected since 2000 except for 2004-2006 and 2013-2015 (Table 3.6.7). The data is segmented to '2000-2012' and '2016-present'.

- Precipitation and flow volume:
  - 2021 compared to '2016-present' average
    - Precipitation is lower in 2021 by 26%
    - Flow volume is lower in 2021 by 53%
  - Very good correlation (r^2 = 0.91) between flow and precipitation (2016 to 2021)
- Flow weighted concentration:
  - 2021 compared to '2016-present' average:
    - TP, SRP, TN, and Chloride concentrations were within 9%
    - TSS was 171% higher in 2021 – due to construction upstream and in the vicinity of site

- Loading
    - Decreased 2021 flow volume led to 47% to 54% lower TP, SRP, and TN loadings than '2016-present' average
    - Higher TSS concentrations led to 69% higher TSS loading over '2016-present' average

Average UAL versus MPCA Stormwater manual UAL adjusted for ECER loading: Table 3.6.8. The UAL was assessed as the whole watershed and as a subsection of the contributing area minus the upstream site using the formula:

$$\frac{(ECER\ load - Peony\ load)}{(ECER\ acres - Peony\ acres)}$$

- TP: -0.42 lbs/acre average versus 1.35 lbs/acre for residential land use
    - The loading at ECER is lower than at Peony, so the wetland is reducing nutrients between Peony and ECER
- TSS: -1,171 lbs/acre average versus 77 lbs/acre for residential land use
- Typically, the wetland between Peony and ECER allows for quite a bit of sediment to settle out and so there is a decrease in TSS; In 2021, with the construction, there was additions to TSS between Peony and ECER

Table 3.6.7 Loading and flow weighted concentrations of TP, SRP, TN, TSS, and Cl^- at ECER.

ECER - Elm Creek @ Elm Road												
Year	Nutrient Loading					Nutrient Concentration					Flow Volume (x 106 M3)	Annual Precipitation (inches)
	TP (lbs/yr)	SRP (lbs/yr)	TN (lbs/yr)	TSS (lbs/yr	Cl^- (lbs/yr)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)	Cl^- (mg/L)		
	2000-2012											
2000	869	261	6,415	104,191		232	70	1.70	28		1.62	32.3
2001	4,408	1,946	26,544	342,708		289	131	1.80	23		5.37	34.6
2002	7,994	2,911	30,541	838,460		416	151	1.60	44		8.72	38.1
2003	2,218	968	12,840	215,520		263	115	1.50	26		3.82	25.8
2007	659	583	8,238	390,206		227	201	2.84	134		2.29	31.1
2008	941	576	8,744	473,456		261	160	2.43	131		2.25	20.8
2009	654	372	4,539	65,183		232	132	1.61	23		1.42	19.6
2010	3,601	2,063	19,074	728,546	814,569	381	218	2.02	77	65	5.19	31.2
2011	5,615	2,753	18,313	147,238	1,410,158	287	141	1.98	16	64	9.81	26.3
2012	2,784	1,890	22,641	284,335		209	142	1.70	21		7.08	26.7
Average	2,974	1,432	15,789	358,984	1,112,364	280	146	1.92	52	65	4.76	28.6
	2016 - present											
2016	8,214	2,731	54,385	1,198,469		333	111	2.20	49		11.47	38.6
2017	3,281	1,889	26,705	460,503		184	106	1.50	26		7.60	27.8
2018	6,388	2,907	43,845	2,341,010		276	126	1.90	101		10.48	30.8
2019	6,734	3,715	46,806	493,109		171	94	1.19	13		17.86	43.3
2020	1,852	734	11,746	528,096	612,321	205	81	1.30	58	68	4.10	25.9
2021	2,540	996	17,212	1,976,906	752,711	261	102	1.77	203	77	4.42	23.4
Average	4,835	2,162	33,450	1,166,349	683,016	238	103	2	75	73	9.32	31.6
% Change	63	51	112	225	-39	-15	-29	-14	43	12	96	11

Table 3.6.8 Unit area loads for TP, SRP, TN, TSS, and Cl^- at ECER and UALs for ECER adjusted for Peony loading

ECER						ECER adjusted for Peony loading				
Year	Load/Acre					Load/Acre				
	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	Cl^- (lbs/acre)
2000	0.11	0.03	0.81	13						
2001	0.56	0.25	3.35	43						
2002	1.01	0.37	3.86	106						
2003	0.28	0.12	1.62	27						
2007	0.08	0.07	1.04	49						
2008	0.12	0.07	1.10	60						
2009	0.08	0.05	0.57	8						
2010	0.45	0.26	2.41	92	103					
2011	0.71	0.35	2.31	19	178					
2012	0.35	0.24	2.86	36						
2016	1.04	0.34	6.87	151		-1.31	0.06	0.01	-1,239	
2017	0.41	0.24	3.37	58		-0.18	0.14	1.68	-1,877	
2018	0.81	0.37	5.54	296		0.49	0.50	6.30	-1,134	
2019	0.85	0.47	5.91	62		-1.16	0.10	-8.31	-2,217	
2020	0.23	0.09	1.48	67	77					
2021	0.32	0.13	2.17	250	95	0.06	0.10	2.23	609	158
Average	0.46	0.22	2.83	84	113	-0.42	0.18	0.38	-1,171	-0.42

3.7. Ponderosa Rain Garden (PRG)

An iron enhanced rain garden was installed near 2625 Garland Lane North in the summer of 2016. The rain garden is monitored during rain events by taking samples of the water going in and out of the rain garden. Despite lower-than-average precipitation in 2021, five samples were collected. Flow is not monitored – these samples are only a comparison of concentrations – not loading.

- PRG-IN: Water samples collected from street runoff flowing into rain garden
- PRG-OUT: Water samples collected at outlet of a perforated pipe from rain garden to a nearby storm drain

3.7.1. Concentration

Summary of Figure 3.7.1, Table 3.7.1, and Figure 3.7.2

- Samples collected during rain events
    - Five at each PRG-IN and PRG-OUT
        - One sample: June, July, September
        - Two samples in August
    - September sample was the only one where there was a decrease in TP and TN between the 'In' and 'Out' of the rain garden
    - TSS decreased in every single sample
- Changes in average concentrations between 'In' and 'Out' sample
    - TP and SRP concentration increased by 126% and 300%, respectively
    - TN increased by 131%
    - TSS decreased by 78%
- SRP to TP Ratio
    - Rain garden does not affectively reduce SRP
        - On average, SRP accounts for 44% of TP at PRG-IN
        - On average, SRP accounts for 78% of TP at PRG-OUT
- Yearly trends show the rain garden TP and SRP removal rates have improved since monitoring began, but still have not removed phosphorus from runoff
    - TSS reductions have remained about the same each year

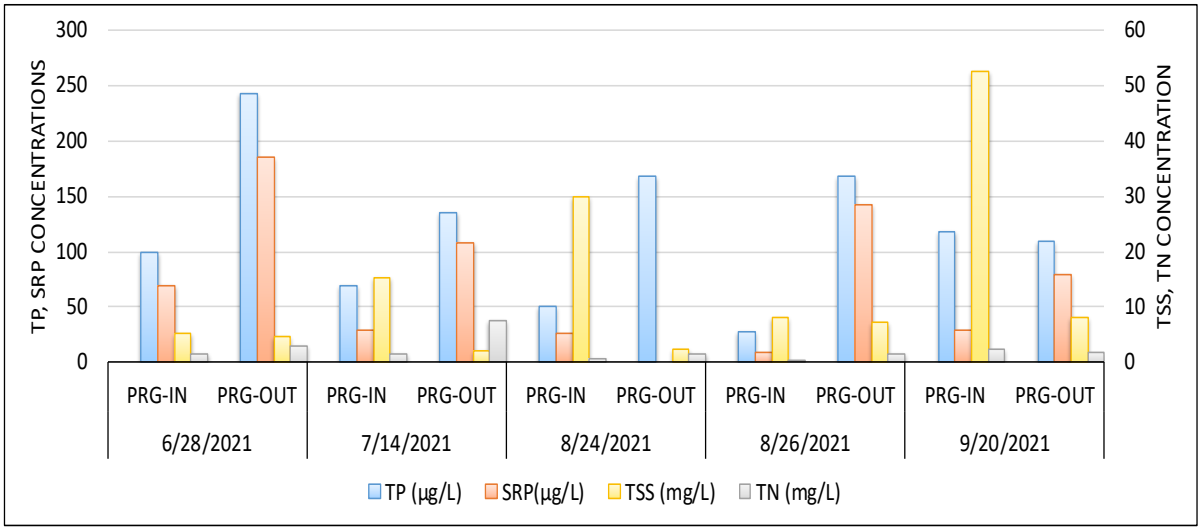


Figure 3.7.1 Concentrations of TP, SRP, TSS, and TN for the Ponderosa Rain Garden inlet versus outlet for each sampling occurrence

Table 3.7.1 Summary of average, minimum, and maximum concentrations for TP, SRP, TN, and TSS at the Ponderosa rain garden for ingoing water and outgoing water

Year	Site	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L	SRP: TP ratio
2017	PRG-IN	103 (18 - 156)	39 (8 - 101)	1.3 (0.3 - 2.0)	22 (3.2 - 55)	38
	PRG-OUT	383 (244 - 586)	309 (164 - 497)	2.0 (1.4 - 3.2)	7.1 (1.7 - 21)	81
2018	PRG-IN	63 (33 - 77)	25 (9 - 52)	1.6 (0.3 - 4.2)	7.2 (5.2 - 11.2)	40
	PRG-OUT	251 (107 - 388)	140 (3 - 308)	2.4 (1.1 - 4.6)	1.9 (0.2 - 3.2)	56
2019	PRG-IN	175 (20 - 558)	79 (7 - 205)	0.8 (0.2 - 1.2)	19.1 (3.8 - 34.2)	45
	PRG-OUT	177 (139 - 211)	127 (36 - 192)	2.0 (1.1 - 3.3)	3.2 (0.8 - 9.8)	72
2020	PRG-IN	94	52	1.7	17.6	56
	PRG-OUT	139 (114 - 165)	118 (95 - 141)	2.1 (1.7 - 2.5)	3.1 (2.0 - 4.1)	85
2021	PRG-IN	73 (28 - 118)	32 (9 - 69)	1.3 (0.4 - 2.4)	22.2 (5.2 - 52.6)	44
	PRG-OUT	165 (110 - 243)	129 (79 - 186)	3.0 (1.4 - 7.6)	4.8 (2.0 - 8.0)	78

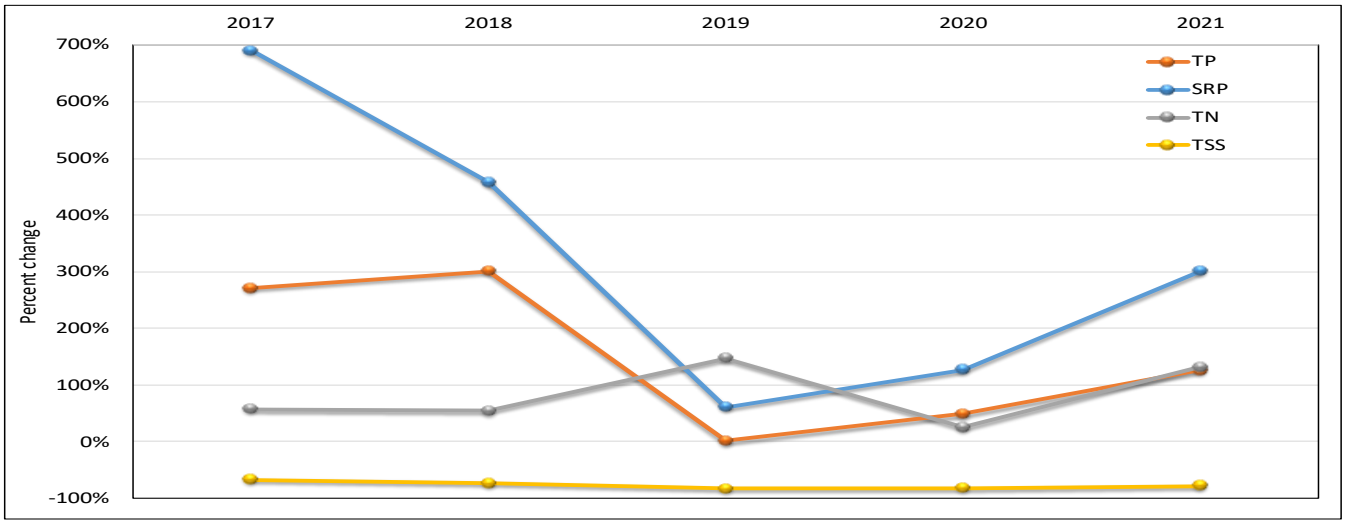


Figure 3.7.2 Percent change from PRG-In to PRG-Out by year

3.8. Mooney Lake Watershed

Five locations around Mooney Lake watershed were monitored (Figure 3.8.1). Grab samples were taken to compare concentrations only; no flow estimations were included.

- MOO SW1
    - Collected at culvert to lake
- MOO SW2
    - TRPD monitored this culvert from 2012-2015
    - Only culvert that has baseflow but becomes stagnant after periods of no rain
- MOO SW3
    - Only has flow during storm events
    - Samples taken from culvert at lake
- MOO SW4 and MOO SW5
    - Only have flow during storm events
    - Samples taken from storm sewer in street

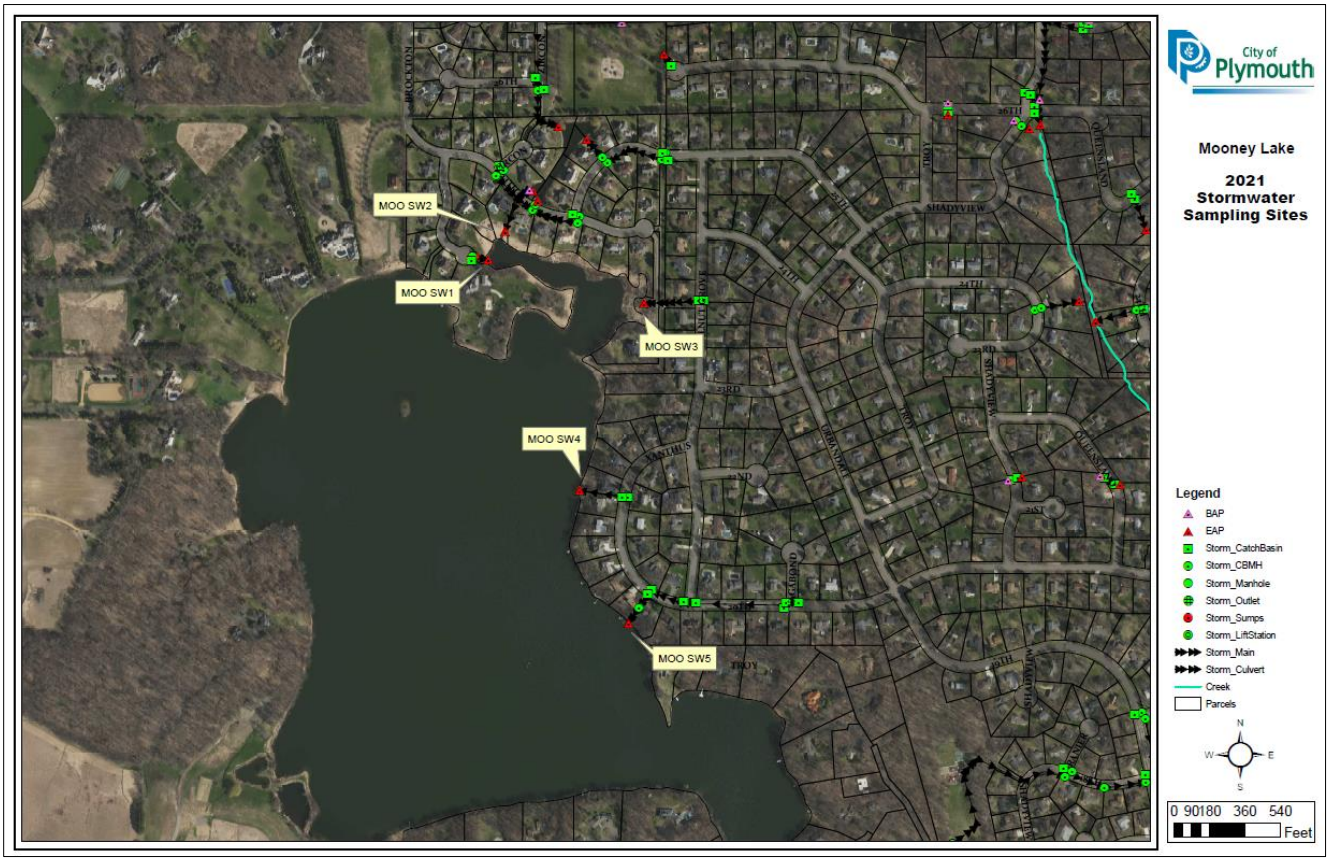


Figure 3.8.1 Mooney Lake sampling locations

3.8.1. Concentration

Summary of Figure 3.8.2 and Table 3.8.1.

- Of the five locations, MOO SW2 had the most samples since it had flow during some bi-weekly grabs
    - MOO SW2 had 12 samples while the other sites had four or five
- Sample dates when four or five of the sites were sampled:
        - 6/28, 7/14, 8/24, 8/26, 9/20
    - Dates with highest concentrations among all sites
        - TP: 7/14 and 9/20
        - SRP: 6/28 and 9/20
        - TSS: 7/14

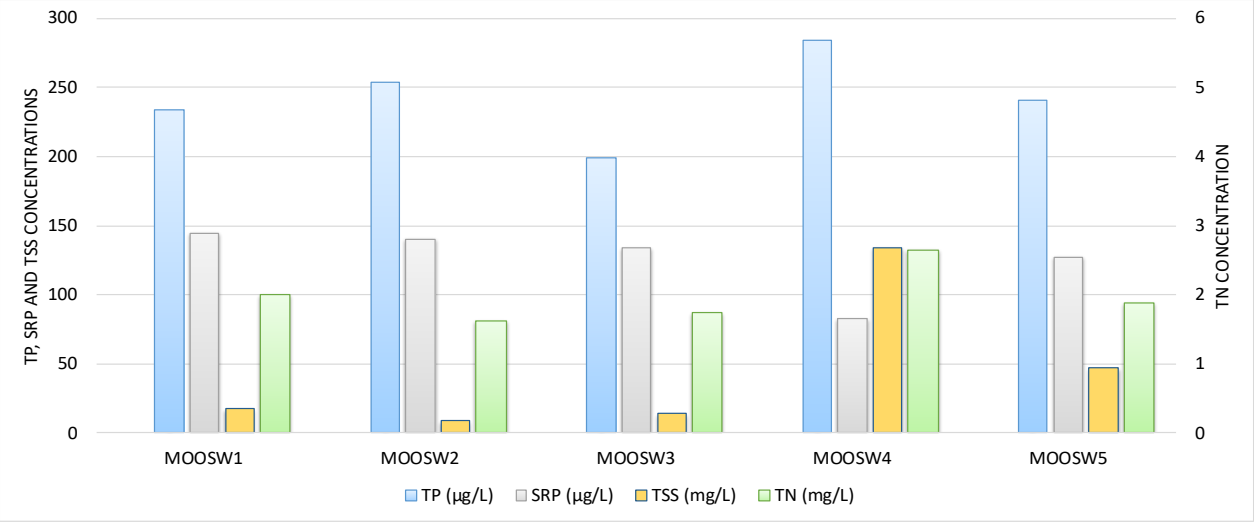
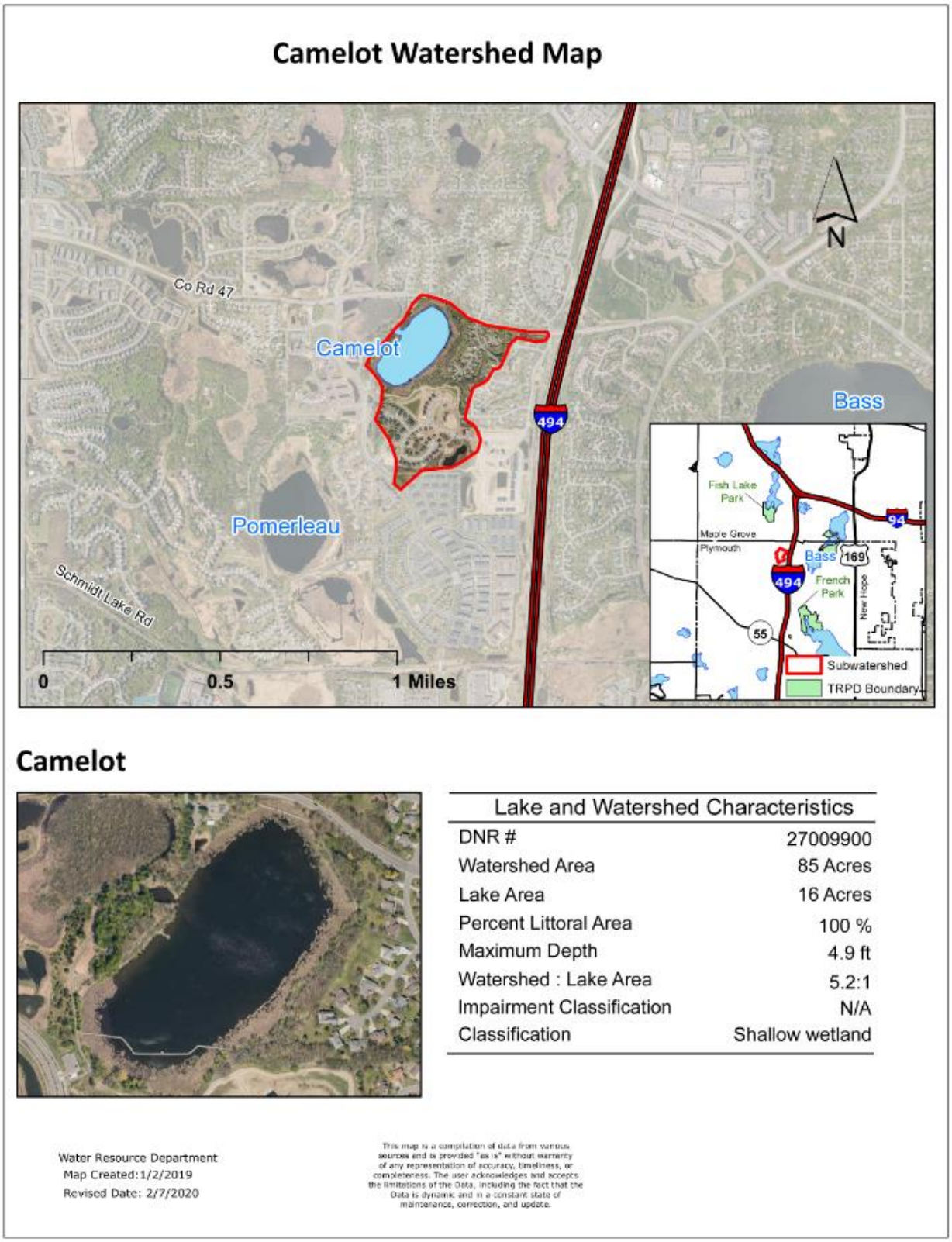


Figure 3.8.2 Average concentrations of TP, SRP, TSS, and TN for the Mooney watershed sites

Table 3.8.1 Summary of average, minimum, and maximum concentrations for TP, SRP, TN, and TSS at the Mooney watershed sites

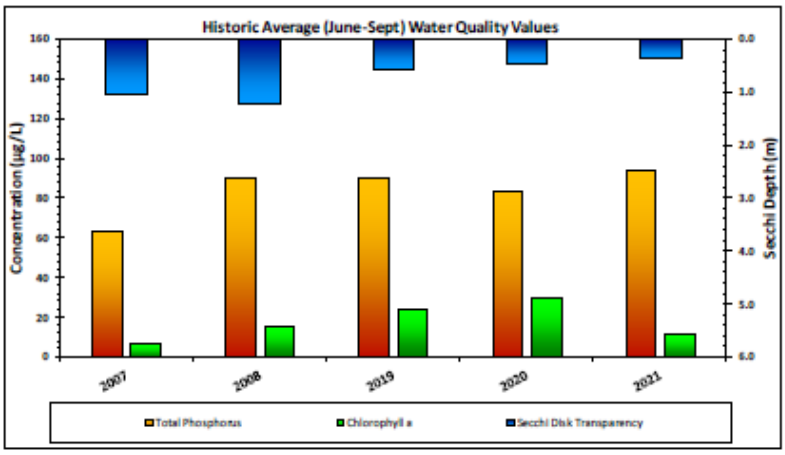
Site	# of samples	Avg TP (min-max) µg/L	Avg SRP (min-max) µg/L	Avg TN (min-max) mg/L	Avg TSS (min-max) mg/L
MOO SW1	**5**	**234 (171 - 294)**	**144 (103 - 199)**	**2.0 (1.4 - 2.6)**	**18 (3.5 - 38)**
MOO SW2	**12**	**254 (71 - 504)**	**140 (12 - 239)**	**1.6 (0.9 - 2.8)**	**9 (2.1 - 46)**
MOO SW3	**5**	**199 (118 - 330)**	**134 (67 - 285)**	**1.7 (0.9 - 2.4)**	**14 (3.3 - 29)**
MOO SW4	**4**	**284 (145 - 428)**	**83 (45 - 105)**	**2.6 (1.5 - 4.5)**	**134 (16 - 447)**
MOO SW5	**5**	**241 (160 - 284)**	**127 (84 - 227)**	**1.9 (1.1 - 2.4)**	**48 (8 - 143)**

3.9. Camelot Lake



Lake and Watershed Characteristics	
DNR #	27009900
Watershed Area	85 Acres
Lake Area	16 Acres
Percent Littoral Area	100 %
Maximum Depth	4.9 ft
Watershed : Lake Area	5.2:1
Impairment Classification	N/A
Classification	Shallow wetland

Figure 3.9.1 A summary of the watershed characteristics for Camelot Lake within the Elm Creek Watershed

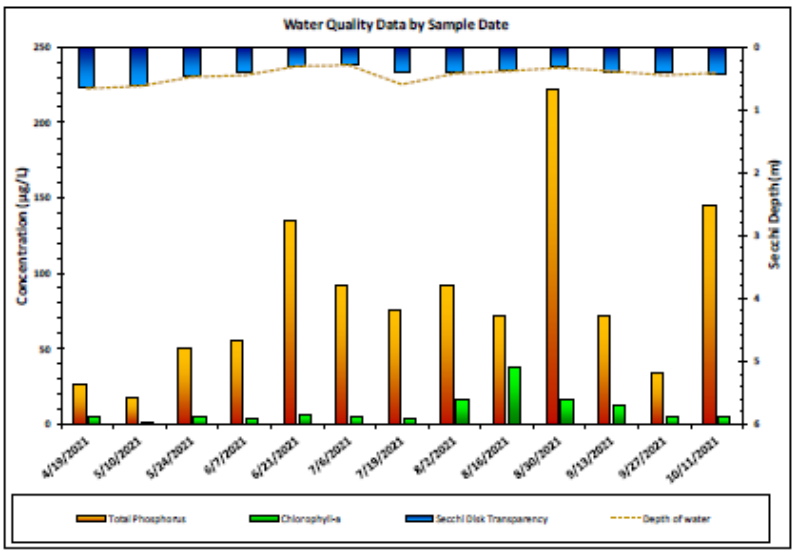


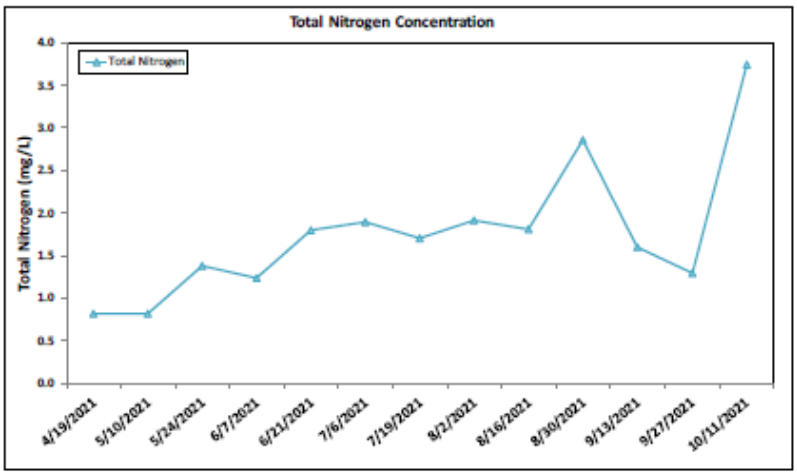
Camelot Water Quality Report Card				
Year	TP	Chl-a	Secchi	Avg Grade
2007	C	A	D	C+
2008	D	B	C	C
2019	D	C	F*	D
2020	D	C	F*	D
2021	D	B	F*	D+

Met Council Grading System for Lake Water Quality

Data collected by:
City of Plymouth (2007-2008);
TRPD (2019-2020)

** Secchi measurements taken at location where maximum depth was 0.5-0.8 meters therefore standards cannot be met; all readings were to bottom or close to bottom*





ThreeRivers PARK DISTRICT
Division of Water Resources
January 2022

Figure 3.9.2 Summary of June-September averages and individual sampling events for total phosphorus, secchi, chlorophyll-a, and TN values. Since Camelot Lake is classified as a wetland, the values are not comparable to the MPCA standards. A yearly "report card" grade as defined by the Met Council is listed.

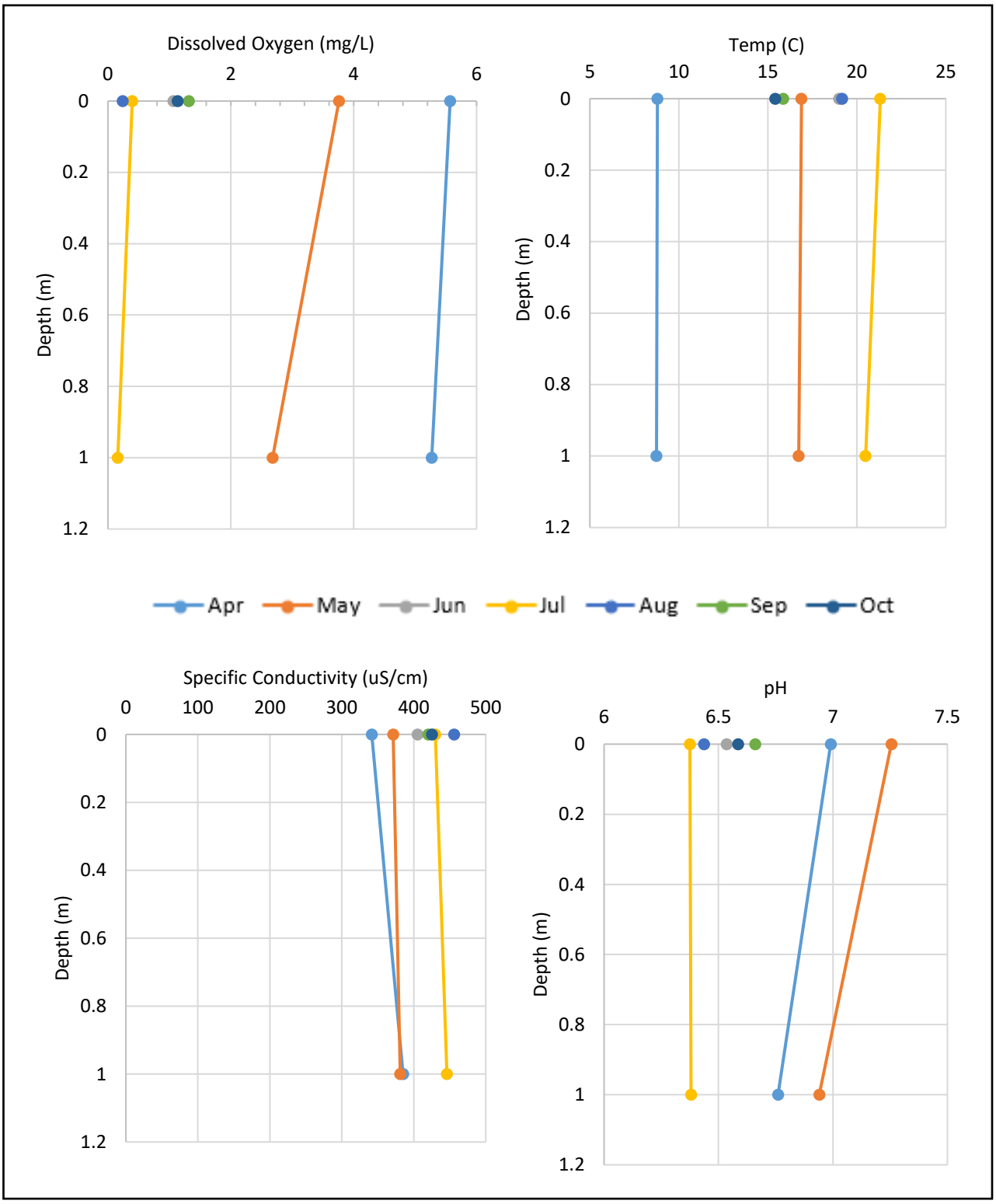


Figure 3.9.3 Sonde readings with depth (from the surface of the wetland to near the bottom) averaged by month at Camelot Lake for dissolved oxygen, temperature, specific conductivity, and pH

Concentrations

Table 3.9.1 Number of samples collected at Camelot Lake with average, minimum, and maximum concentrations for TP, SRP, TN, and Chl-a for the entire sampling season

	TP (ug/L)				SRP (ug/L)				TN (mg/L)				Chl-a (ug/L)				
Site	#	Avg	Min	Max	#	Avg	Min	Max	#	Avg	Min	Max	#	Avg	Min	Max	Avg TP:SRP ratio
S	13	83	17	222	13	15	3	33	13	1.76	0.82	3.75	13	9	1	38	21%

Discussion

Summary of Figure 3.9.1, Figure 3.9.2, and Table 3.9.1.

Water Quality

- Camelot Lake, while called a lake, is classified as an open water wetland in the Circular 39 (Shaw and Fredine, 1956)
    - No standards for wetlands
- Camelot Lake has very low grades for TP and Chl-a average concentrations using the Met Council lake grading system
    - Secchi readings are skewed lower due to the location of the measurement
        - Depth of water is only 0.3-0.7 meters
    - SRP accounts for about 21% of TP

Sonde profiles

Summary of Figure 3.9.3.

- With this being a wetland, the profile is less than a meter at the sampling location
    - This wetland was not stratified on any of the visits
- April had highest dissolved oxygen levels
    - Correlates with colder water temperatures
- Low specific conductivity
- pH in the neutral zone

4.0 CITATIONS

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5.0 STORMWATER AVERAGE DAILY FLOWS

Average daily flow in cfs for all sites along with precipitation in Plymouth, MN.

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
3/26/2021				3.88		20.65		10.32				0.00
3/27/2021				5.09		17.81		8.34				0.21
3/28/2021				5.69		16.56		7.91				0.00
3/29/2021	2.78	3.83		5.64	13.64	12.34		6.67	17.81			0.00
3/30/2021	2.41	3.41		4.61	12.21	9.56	0.10	10.52	15.86			0.00
3/31/2021	1.93	2.76	17.08	3.36	9.36	7.66	0.04	6.36	11.96	0.00	0.31	0.00
4/1/2021	1.58	2.33	14.18	2.57	8.38	6.34	0.02	3.49	10.62	0.00	0.22	0.00
4/2/2021	1.51	2.08	7.08	2.09	7.01	5.69	0.01	2.08	8.75	0.00	0.18	0.00
4/3/2021	1.35	1.81	9.89	1.83	6.05	5.26	0.01	2.64	7.44	0.00	0.19	0.00
4/4/2021	1.22	1.48	8.67	1.79	5.32	4.85	0.01	3.73	6.43	0.00	0.16	0.00
4/5/2021	1.08	1.32	7.59	1.29	5.19	4.73	1.33	3.54	6.26	0.00	0.19	0.20
4/6/2021	1.92	2.40	12.66	1.67	7.71	11.00	5.31	7.06	9.71	0.09	1.63	0.68
4/7/2021	3.74	4.59	25.69	3.64	9.70	21.41	8.16	11.53	12.42	0.20	2.80	0.21
4/8/2021	4.19	5.12	27.35	3.14	9.73	18.81	6.18	10.35	12.47	0.19	2.05	0.30
4/9/2021	6.17	7.32	28.07	3.08	11.06	17.53	4.24	10.18	14.28	0.05	1.20	0.12
4/10/2021	4.23	5.17	25.30	2.33	10.80	13.80	3.27	7.56	13.93	0.00	0.38	0.00
4/11/2021	3.19	4.09	20.13	1.81	9.60	10.80	2.75	6.92	12.29	0.00	0.28	0.00
4/12/2021	2.60	3.38	16.76	1.78	8.82	9.25	2.01	6.70	11.22	0.08	0.38	0.07
4/13/2021	2.62	3.42	15.37	1.59	8.65	8.94	2.30	7.19	10.99	0.08	0.32	0.04
4/14/2021	2.26	2.99	13.00	1.14	7.79	7.41	1.60	5.74	9.82	0.00	0.20	0.02
4/15/2021	1.88	2.49	10.79	0.91	7.26	6.65	1.26	4.70	9.09	0.00	0.15	0.00
4/16/2021	1.61	2.21	9.56	1.06	6.18	6.06	0.94	4.02	7.61	0.00	0.17	0.00
4/17/2021	1.35	1.81	8.36	1.30	5.08	5.37	0.94	3.76	6.11	0.00	0.18	0.00
4/18/2021	1.16	1.51	7.03	1.18	4.54	4.91	1.13	3.77	5.37	0.00	0.15	0.01
4/19/2021	1.01	1.33	6.31	0.81	4.21	4.37	1.20	5.34	4.92	0.00	0.12	0.00
4/20/2021	0.73	0.91	5.54	0.54	3.72	4.11	0.95	3.52	4.24	0.00	0.11	0.00
4/21/2021	0.56	0.73	4.64	0.53	3.42	3.87	0.27	3.66	3.83	0.00	0.10	0.00
4/22/2021	0.52	0.66	4.17	0.61	3.12	3.65	0.02	3.29	3.43	0.00	0.11	0.00
4/23/2021	0.51	0.65	4.37	0.64	2.97	3.47	0.83	2.11	3.23	0.00	0.13	0.03
4/24/2021	0.53	0.70	5.12	0.62	4.07	3.41	1.26	3.76	4.73	0.00	0.12	0.01
4/25/2021	0.48	0.65	5.02	0.41	4.17	3.03	0.54	2.60	4.86	0.00	0.11	0.00
4/26/2021	0.72	0.97	7.81	1.21	6.07	7.70	4.49	4.56	7.46	0.16	1.47	0.30
4/27/2021	1.15	1.71	10.79	0.96	5.35	7.39	3.64	4.56	6.48	0.11	0.55	0.17
4/28/2021	1.22	1.78	9.61	0.78	4.80	7.81	3.46	4.98	5.72	0.01	0.45	0.00
4/29/2021	1.04	1.47	7.83	0.70	4.37	5.86	2.02	4.27	5.14	0.00	0.20	0.00
4/30/2021	0.79	0.97	6.27	0.65	3.63	4.58	1.19	3.34	4.13	0.00	0.13	0.00
5/1/2021	0.66	0.75	5.32	0.69	3.19	4.34	1.10	3.22	3.53	0.00	0.14	0.00
5/2/2021	0.56	0.62	4.45	0.70	3.12	3.81	1.03	0.73	3.43	0.00	0.14	0.00
5/3/2021	0.52	0.61	4.61	0.87	3.80	3.45	0.99	2.50	3.65	0.00	0.13	0.00
5/4/2021	0.48	0.55	4.17	0.81	3.25	2.92	0.63	2.50	3.24	0.00	0.12	0.00
5/5/2021	0.44	0.53	3.52	0.75	2.87	2.72	1.27	0.00	2.73	0.00	0.14	0.03
5/6/2021	0.41	0.54	3.41	0.94	2.85	2.62	0.92	2.67	2.64	0.00	0.12	0.00
5/7/2021	0.41	0.53	2.49	0.82	2.71	2.37	0.95	4.11	2.35	0.00	0.14	0.00
5/8/2021	0.38	0.51	2.70	0.73	1.98	2.14	0.72	2.62	2.01	0.00	0.16	0.00
5/9/2021	0.36	0.49	2.21	0.43	2.08	1.88	0.65	3.05	1.86	0.00	0.15	0.00
5/10/2021	0.35	0.46	1.88	0.29	1.81	1.74	2.17	0.38	1.55	0.00	0.08	0.00
5/11/2021	0.33	0.44	1.85	0.24	1.60	1.60	0.66	0.00	1.40	0.00	0.09	0.00
5/12/2021	0.32	0.41	1.71	0.23	1.48	1.51	0.49	0.21	1.24	0.00	0.08	0.00
5/13/2021	0.32	0.43	1.63	0.23	1.35	1.49	0.49	3.68	1.11	0.00	0.07	0.00
5/14/2021	0.32	0.42	1.81	0.20	1.18	1.47	0.39	3.54	1.04	0.00	0.10	0.00

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
5/15/2021	0.32	0.41	0.81	0.25	1.17	1.39	0.42	3.28	1.03	0.00	0.14	0.00
5/16/2021	0.33	0.39	0.40	0.38	0.97	1.50	0.55	3.39	0.93	0.00	0.12	0.00
5/17/2021	0.32	0.37	0.71	0.46	1.18	1.47	0.48	2.27	0.88	0.00	0.08	0.00
5/18/2021	0.31	0.35	0.75	0.16	1.15	1.43	0.48	2.83	0.79	0.00	0.14	0.00
5/19/2021	0.38	0.37	1.78	0.69	3.80	3.01	1.56	1.19	1.13	0.44	1.51	0.78
5/20/2021	1.69	2.20	49.28	4.02	23.57	22.78	6.15	19.52	44.46	0.10	1.84	0.04
5/21/2021	2.99	4.08	58.23	5.43	21.76	25.48	7.24	22.16	29.06	0.35	2.11	0.42
5/22/2021	0.00	0.00	41.09	3.70	15.04	18.37	3.27	14.48	20.35	0.01	0.41	0.00
5/23/2021	0.00	0.00	22.50	2.18	11.00	12.33	1.69	9.41	13.97	0.00	0.18	0.00
5/24/2021	0.00	0.00	14.66	1.24	8.74	8.60	1.05	6.62	10.64	0.00	0.13	0.00
5/25/2021	0.93	1.37	11.37	1.23	7.24	8.26	1.57	6.96	8.66	0.08	0.60	0.16
5/26/2021	0.76	1.05	8.90	0.71	5.72	5.85	0.88	4.64	6.81	0.00	0.12	0.00
5/27/2021	1.24	1.80	13.65	2.04	9.66	18.32	8.12	17.02	12.70	0.64	2.93	0.84
5/28/2021	2.77	3.89	28.98	2.07	10.21	20.70	6.46	21.11	16.93	0.05	1.04	0.00
5/29/2021	2.07	3.06	20.56	1.52	7.33	12.76	2.61	13.02	9.91	0.00	0.32	0.00
5/30/2021	1.43	2.19	11.79	1.44	5.58	9.30	1.26	8.69	6.94	0.00	0.24	0.00
5/31/2021	1.10	1.68	8.47	1.63	4.59	7.09	1.08	6.00	5.51	0.00	0.21	0.00
6/1/2021	0.87	1.14	6.26	1.21	3.94	6.37	0.36	4.05	4.19	0.00	0.18	0.00
6/2/2021	0.70	0.65	5.20	0.51	3.47	5.67	0.00	3.81	3.39	0.00	0.13	0.00
6/3/2021	0.54	0.49	4.31	0.29	3.43	4.70	0.00	3.26	2.84	0.00	0.11	0.00
6/4/2021	0.42	0.37	3.41	0.19	3.03	4.17	0.00	5.29	2.25	0.00	0.09	0.00
6/5/2021	0.33	0.29	2.63	0.22	2.71	3.85	0.00	6.15	1.83	0.00	0.08	0.00
6/6/2021	0.28	0.19	2.22	0.12	2.88	3.75	0.00	3.71	1.71	0.00	0.07	0.00
6/7/2021	0.27	0.14	2.01	0.08	2.38	3.56	0.00	2.12	1.57	0.00	0.09	0.00
6/8/2021	0.25	0.12	1.78	0.06	2.53	3.29	0.00	5.88	1.27	0.00	0.05	0.00
6/9/2021	0.23	0.13	1.37	0.07	3.07	3.34	0.00	4.68	0.99	0.00	0.04	0.00
6/10/2021	0.20	0.12	1.17	0.05	2.78	3.29	0.00	3.09	0.89	0.00	0.03	0.00
6/11/2021	0.15	0.10	0.82	0.05	1.34	1.36	0.00	0.36	0.68	0.00	0.04	0.00
6/12/2021	0.12	0.06	0.60	0.07	1.00	0.01	0.00	0.00	0.51	0.00	0.03	0.00
6/13/2021	0.09	0.02	0.44	0.05	0.90	0.00	0.00	0.00	0.48	0.00	0.03	0.00
6/14/2021	0.06	0.02	0.34	0.04	2.22	0.01	0.00	0.00	0.44	0.00	0.03	0.00
6/15/2021	0.03	0.02	0.24	0.04	0.35	0.02	0.00	0.00	0.28	0.00	0.02	0.00
6/16/2021	0.01	0.02	0.09	0.04	0.59	0.02	0.00	0.00	0.22	0.00	0.02	0.00
6/17/2021	0.01	0.02	0.00	0.03	0.68	0.01	0.00	0.00	0.21	0.00	0.02	0.00
6/18/2021	0.01	0.02	0.04	0.03	1.03	0.02	0.00	0.00	0.20	0.00	0.02	0.00
6/19/2021	0.00	0.02	0.00	0.03	0.55	0.02	0.00	0.19	0.19	0.00	0.02	0.00
6/20/2021	0.01	0.03	0.08	0.07	0.91	5.96	0.73	1.38	0.25	0.25	0.65	0.36
6/21/2021	0.02	0.02	0.19	0.05	0.58	15.35	0.00	4.31	0.53	0.00	0.20	0.00
6/22/2021	0.02	0.01	0.06	0.04	0.24	14.95	0.00	3.61	0.32	0.00	0.06	0.00
6/23/2021	0.01	0.02	0.06	0.04	0.63	9.80	0.76	2.06	0.23	0.00	0.03	0.00
6/24/2021	0.01	0.02	0.07	0.03	1.31	3.39	0.00	0.00	0.21	0.00	0.03	0.00
6/25/2021	0.01	0.02	0.05	0.03	0.91	0.19	0.00	0.00	0.19	0.00	0.01	0.00
6/26/2021	0.01	0.02	0.00	0.04	0.56	0.00	0.20	0.00	0.18	0.03	0.12	0.14
6/27/2021	0.01	0.02	0.07	0.08	0.29	14.09	1.95	1.24	0.19	0.06	0.35	0.16
6/28/2021	0.06	0.03	0.16	0.40	1.07	17.07	4.62	7.94	0.33	0.30	1.54	0.75
6/29/2021	0.23	0.13	0.26	0.15	2.80	9.41	2.00	6.52	0.42	0.00	0.22	0.02
6/30/2021	0.23	0.13	0.39	0.11	2.91	3.70	0.91	2.55	0.41	0.00	0.08	0.00
7/1/2021	0.20	0.04	0.22	0.10	0.88	2.53	0.79	6.03	0.45	0.00	0.06	0.00
7/2/2021	0.15	0.03	0.29	0.08	0.74	2.08	0.29	3.50	1.44	0.00	0.04	0.00
7/3/2021	0.12	0.03	0.15	0.06	1.07	2.02	0.00	4.11	1.57	0.00	0.03	0.00
7/4/2021	0.08	0.02	0.15	0.05	0.68	1.76	0.01	0.06	0.91	0.00	0.04	0.00
7/5/2021	0.02	0.01	0.04	0.03	0.51	2.48	0.00	0.00	1.29	0.00	0.04	0.00
7/6/2021	0.01	0.02	0.10	0.17	0.71	2.99	1.39	0.09	1.60	0.06	0.27	0.32
7/7/2021	0.02	0.02	0.21	0.22	0.55	2.73	0.78	0.53	2.03	0.00	0.23	0.01
7/8/2021	0.02	0.03	0.12	0.12	0.33	1.65	0.05	0.00	2.23	0.00	0.06	0.00

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
7/9/2021	0.01	0.02	0.05	0.02	0.00	1.71	0.00	0.00	1.23	0.00	0.05	0.00
7/10/2021	0.01	0.02	0.04	0.02	0.32	1.06	0.00	0.04	1.10	0.00	0.05	0.00
7/11/2021	0.01	0.02	0.01	0.02	0.38	0.01	0.00	0.00	1.69	0.00	0.03	0.00
7/12/2021	0.00	0.01	0.00	0.02	0.82	0.00	0.00	0.00	0.47	0.00	0.02	0.00
7/13/2021	0.00	0.00	0.00	0.02	1.83	0.00	0.00	0.04	0.46	0.00	0.02	0.00
7/14/2021	0.83	1.00	7.20	0.39	19.46	8.85	5.40	4.69	20.60	0.59	1.68	0.85
7/15/2021	6.55	7.53	82.16	0.14	16.32	9.32	4.70	6.87	11.87	0.01	0.32	0.00
7/16/2021	4.93	5.90	45.40	0.08	7.66	6.63	1.83	3.20	4.17	0.00	0.07	0.00
7/17/2021	3.89	4.84	14.17	0.05	3.11	4.03	0.92	2.09	1.62	0.00	0.05	0.00
7/18/2021	2.74	3.50	5.78	0.02	1.58	2.91	0.00	2.41	1.10	0.00	0.04	0.00
7/19/2021	1.68	2.24	3.29	0.02	2.50	4.73	0.00	2.55	1.08	0.00	0.05	0.00
7/20/2021	1.00	1.33	2.26	0.02	1.15	6.74	0.00	2.81	1.24	0.00	0.04	0.00
7/21/2021	0.77	0.96	2.10	0.02	0.58	7.94	0.00	3.70	0.77	0.00	0.02	0.00
7/22/2021	0.68	0.86	1.97	0.05	0.66	6.19	0.51	2.79	0.70	0.01	0.04	0.02
7/23/2021	0.59	0.74	1.64	0.00	0.47	3.69	0.00	2.63	0.71	0.00	0.03	0.00
7/24/2021	0.46	0.54	1.32	0.00	1.07	2.85	0.00	4.56	1.92	0.01	0.05	0.02
7/25/2021	0.28	0.43	0.94	0.00	1.31	2.24	0.00	1.53	0.68	0.00	0.02	0.00
7/26/2021	0.21	0.28	0.73	0.00	1.31	2.16	0.00	2.45	0.63	0.12	0.13	0.11
7/27/2021	0.14	0.20	0.51	0.00	1.27	1.81	0.00	0.87	0.97	0.00	0.03	0.00
7/28/2021	0.09	0.11	0.38	0.00	1.58	1.98	0.03	2.37	1.21	0.01	0.17	0.24
7/29/2021	0.03	0.05	0.35	0.00	5.60	1.76	0.00	8.46	0.98	0.00	0.05	0.00
7/30/2021	0.02	0.03	0.36	0.00	5.62	0.73	0.00	2.22	1.13	0.00	0.02	0.00
7/31/2021	0.01	0.01	0.29	0.00	1.30	0.00	0.00	1.19	1.11	0.00	0.01	0.00
8/1/2021	0.00	0.01	0.29	0.00	1.19	0.00	0.00	1.84	1.09	0.00	0.03	0.00
8/2/2021	0.00	0.01	0.13	0.00	2.87	0.00	0.00	0.82	0.89	0.00	0.01	0.00
8/3/2021	0.00	0.01	0.27	0.00	2.88	0.00	0.00	4.31	0.86	0.00	0.01	0.00
8/4/2021	0.00	0.01	0.26	0.00	2.30	0.00	0.00	0.12	0.74	0.00	0.00	0.00
8/5/2021	0.00	0.01	0.12	0.00	1.14	0.00	0.63	0.00	0.62	0.00	0.00	0.00
8/6/2021	0.00	0.00	0.10	0.00	1.21	0.00	1.74	0.00	0.62	0.00	0.00	0.00
8/7/2021	0.00	0.00	0.29	0.00	1.50	2.44	2.26	0.00	2.83	0.19	0.46	0.47
8/8/2021	0.00	0.00	0.28	0.00	1.69	3.25	2.49	0.00	2.59	0.12	0.58	0.33
8/9/2021	0.00	0.00	0.60	0.00	1.34	2.22	1.50	0.00	2.31	0.01	0.10	0.01
8/10/2021	0.00	0.00	0.44	0.00	0.50	1.74	2.33	0.00	0.40	0.00	0.05	0.00
8/11/2021	0.00	0.00	0.38	0.00	1.56	2.28	1.70	0.00	0.53	0.01	0.25	0.16
8/12/2021	0.00	0.00	0.20	0.00	1.10	1.19	0.53	0.00	1.45	0.00	0.06	0.01
8/13/2021	0.00	0.00	0.17	0.00	1.27	0.00	0.23	0.00	1.39	0.00	0.04	0.00
8/14/2021	0.00	0.00	0.08	0.00	1.71	0.00	0.00	0.00	0.77	0.00	0.03	0.00
8/15/2021	0.00	0.03	0.07	0.00	1.69	0.00	0.00	0.00	0.51	0.00	0.03	0.00
8/16/2021	0.00	0.06	0.07	0.00	1.52	0.00	0.00	0.00	0.44	0.00	0.03	0.00
8/17/2021	0.00	0.07	0.05	0.00	0.66	0.00	0.00	0.00	0.41	0.00	0.02	0.00
8/18/2021	0.00	0.06	0.03	0.00	1.61	0.00	0.00	0.00	0.41	0.00	0.03	0.00
8/19/2021	0.00	0.05	0.05	0.00	1.71	0.00	0.00	0.00	0.24	0.00	0.02	0.00
8/20/2021	0.00	0.06	0.15	0.00	2.14	0.00	0.00	0.00	2.22	0.00	0.03	0.30
8/21/2021	0.00	0.06	1.06	0.00	2.74	0.00	0.00	0.00	1.92	0.01	0.05	0.00
8/22/2021	0.00	0.05	1.16	0.00	1.68	0.00	0.00	0.00	0.85	0.00	0.02	0.05
8/23/2021	0.00	0.06	0.72	0.00	0.78	0.00	0.00	0.00	0.83	0.00	0.05	0.00
8/24/2021	0.00	0.03	4.08	0.23	3.96	8.21	2.50	0.00	6.11	0.80	2.21	1.11
8/25/2021	0.00	0.03	8.20	0.00	2.10	1.91	1.12	0.00	2.42	0.01	0.12	0.00
8/26/2021	0.16	0.15	6.84	0.65	4.81	11.98	9.22	18.63	4.79	1.54	5.53	2.41
8/27/2021	3.36	3.61	25.38	4.61	9.73	29.35	17.97	13.30	20.32	0.42	2.07	0.27
8/28/2021	3.10	3.11	7.89	3.43	5.44	13.65	5.56	7.75	6.12	0.10	0.52	0.33
8/29/2021	3.13	3.19	8.45	5.93	9.70	24.90	2.78	13.51	17.31	0.55	2.17	0.47
8/30/2021	1.69	1.72	18.16	2.57	5.07	16.40	2.85	11.04	4.88	0.00	0.32	0.00
8/31/2021	1.01	1.06	4.41	1.50	3.42	12.21	1.81	10.83	2.42	0.00	0.13	0.00
9/1/2021	0.73	0.75	3.92	1.06	2.39	7.74	1.48	10.46	1.52	0.00	0.09	0.00

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
9/2/2021	0.57	0.55	3.91	1.07	2.11	5.28	0.71	3.84	1.11	0.01	0.05	0.07
9/3/2021	0.71	0.68	4.62	1.78	2.35	16.77	3.94	14.38	2.00	0.37	1.13	0.34
9/4/2021	0.71	0.67	6.03	1.51	2.03	13.48	1.82	9.40	1.65	0.00	0.21	0.00
9/5/2021	0.52	0.51	4.43	1.32	2.51	10.61	1.23	6.77	1.09	0.00	0.12	0.00
9/6/2021	0.43	0.40	3.52	1.02	1.30	9.06	0.00	5.37	0.84	0.00	0.08	0.00
9/7/2021	0.34	0.33	2.81	0.74	1.08	12.41	0.00	5.59	0.67	0.00	0.06	0.00
9/8/2021	0.28	0.28	2.14	0.54	0.90	14.19	0.00	6.83	1.16	0.00	0.06	0.00
9/9/2021	0.26	0.27	1.94	0.27	0.92	5.20	0.00	3.66	0.85	0.00	0.06	0.00
9/10/2021	0.23	0.25	1.50	0.28	0.90	3.64	0.00	2.72	0.00	0.00	0.06	0.00
9/11/2021	0.19	0.18	1.26	0.20	0.88	3.10	0.00	4.71	0.03	0.00	0.06	0.00
9/12/2021	0.18	0.14	1.04	0.15	0.85	2.52	0.00	0.09	0.36	0.01	0.05	0.00
9/13/2021	0.16	0.12	0.95	0.17	0.76	2.42	0.00	0.00	0.52	0.00	0.08	0.12
9/14/2021	0.18	0.12	1.15	0.27	0.80	3.97	0.93	2.00	0.63	0.03	0.20	0.00
9/15/2021	0.14	0.12	1.06	0.12	0.94	2.90	0.00	0.30	0.60	0.00	0.06	0.00
9/16/2021	0.14	0.08	0.93	0.15	0.66	3.55	0.43	0.44	0.50	0.01	0.14	0.12
9/17/2021	0.20	0.15	2.42	0.34	1.90	7.34	2.77	4.35	1.70	0.20	0.58	0.32
9/18/2021	0.22	0.23	3.41	0.21	1.05	4.75	0.51	2.72	1.12	0.00	0.08	0.00
9/19/2021	0.17	0.11	2.24	0.13	0.87	3.30	0.00	0.59	1.00	0.00	0.06	0.00
9/20/2021	0.41	0.53	3.79	0.84	9.28	11.87	3.48	6.04	16.88	0.56	1.73	0.75
9/21/2021	1.79	2.44	24.29	1.65	10.72	19.33	3.98	12.21	10.02	0.02	0.61	0.00
9/22/2021	1.10	1.52	26.25	0.90	5.59	8.97	1.25	5.12	4.16	0.00	0.12	0.00
9/23/2021	0.84	1.20	16.30	0.62	3.19	6.88	0.94	3.26	2.45	0.00	0.08	0.00
9/24/2021	0.74	1.14	11.85	0.59	2.52	5.80	0.77	2.58	1.76	0.01	0.12	0.06
9/25/2021	0.66	1.06	10.59	0.79	1.96	4.84	0.00	2.34	2.06	0.00	0.08	0.00
9/26/2021	0.57	0.90	8.65	0.57	1.40	4.15	0.02	1.99	1.26	0.00	0.10	0.00
9/27/2021	0.49	0.76	7.15	0.40	1.49	3.58	0.00	1.42	2.84	0.00	0.09	0.00
9/28/2021	0.43	0.67	6.09	0.27	1.28	3.20	0.00	0.57	0.85	0.00	0.08	0.00
9/29/2021	0.40	0.58	5.57	0.14	1.45	2.96	0.00	2.04	2.26	0.00	0.06	0.00
9/30/2021	0.37	0.62	3.60	0.16	0.77	2.81	0.00	3.14	1.46	0.00	0.07	0.00
10/1/2021	0.35	0.59	1.06	0.12	1.19	2.96	0.20	2.15	0.55	0.00	0.07	0.03
10/2/2021	0.41	0.48	3.32	0.34	2.21	4.37	3.53	0.48	1.21	0.26	0.37	0.18
10/3/2021	0.53	0.47	6.41	0.21	2.10	4.32	5.42	0.80	1.40	0.00	0.14	0.00
10/4/2021	0.40	0.67	4.17	0.13	2.03	3.07	3.96	2.31	1.04	0.00	0.08	0.00
10/5/2021	0.31	0.57	4.23	0.11	1.48	2.65	0.84	0.05	0.91	0.00	0.05	0.00
10/6/2021	0.26	0.51	3.35	0.04	1.31	2.75	0.67	0.00	0.80	0.00	0.07	0.00
10/7/2021	0.22	0.46	2.87	0.05	1.59	2.82	0.81	0.00	0.63	0.00	0.04	0.00
10/8/2021	0.19	0.42	2.56	0.06	1.05	2.87	1.35	0.00	1.22	0.00	0.06	0.00
10/9/2021	0.19	0.40	2.41	0.05	1.07	3.06	0.37	0.97	1.09	0.00	0.05	0.03
10/10/2021	0.19	0.35	2.26	0.10	0.76	3.44	0.23	0.00	0.46	0.00	0.07	0.00
10/11/2021	0.16	0.35	1.99	0.10	0.68	3.15	0.00	0.00	0.45	0.00	0.05	0.00
10/12/2021	0.12	0.31	1.71	0.10	0.90	3.20	0.00	0.00	0.66	0.00	0.05	0.00
10/13/2021	0.13	0.30	1.71	0.10	1.02	3.19	0.00	0.48	1.50	0.00	0.04	0.03
10/14/2021	0.13	0.29	1.85	0.05	0.80	3.84	0.00	0.23	1.25	0.00	0.04	0.00
10/15/2021	0.11	0.28	1.44	0.05	0.67	3.14	0.00	0.01	1.53	0.00	0.02	0.00
10/16/2021	0.08	0.24	1.56	0.05	0.55	2.38	0.00	0.00	0.58	0.00	0.05	0.00
10/17/2021	0.06	0.19	1.14	0.05	0.75	0.97	0.00	0.00	1.22	0.00	0.02	0.00
10/18/2021	0.05	0.19	1.01	0.07	0.99	0.04	0.00	0.00	0.68	0.00	0.05	0.00
10/19/2021	0.05	0.18	1.00	0.07	1.25	0.00	0.00	0.00	0.00	0.00	0.03	0.00
10/20/2021	0.05	0.23	1.00	0.32	1.72	1.95	1.52	0.47	0.97	0.37	0.53	0.53
10/21/2021	0.38	0.68	4.08	0.40	1.64	6.78	0.25	4.50	2.38	0.27	0.48	0.02
10/22/2021	0.41	0.72	4.78	0.13	0.64	3.71	0.05	1.07	1.15	0.00	0.08	0.00
10/23/2021	0.27	0.51	3.22	0.13	0.62	2.60	0.00	0.93	1.15	0.00	0.05	0.00
10/24/2021	0.17	0.41	2.53	0.13	0.61	2.60	0.00	0.52	0.50	0.00	0.07	0.00
10/25/2021	0.14	0.36	2.01	0.10	0.61	3.14	0.00	0.00	0.50	0.00	0.05	0.00
10/26/2021	0.12	0.33	1.54	0.10	0.68	2.74	0.00	0.16	1.09	0.00	0.05	0.00

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
10/27/2021	0.11	0.32	1.30	0.17	1.30	2.92	0.25	0.27	1.84	0.02	0.09	0.14
10/28/2021	0.42	0.80	6.41	0.96	3.55	9.40	4.24	4.79	3.00	0.37	1.03	0.47
10/29/2021	0.64	1.18	11.11	0.29	2.17	6.96	0.03	3.21	2.83	0.01	0.28	0.00
10/30/2021	0.56	1.04	7.79	0.16	2.54	4.49	0.00	1.70	1.66	0.00	0.10	0.00
10/31/2021	0.47	0.90	5.44	0.14	2.22	3.75	0.00	2.09	1.44	0.00	0.07	0.00
11/1/2021	0.34	0.71	3.80	0.12	1.41	3.26	0.00	2.51	0.90	0.00		0.00
11/2/2021	0.23	0.56	3.13	0.11	0.86	2.91	0.16	2.41	3.05	0.00		0.00
11/3/2021	0.16	0.45	2.65	0.13	0.74	2.68	0.00	1.55	3.83	0.00		0.00
11/4/2021	0.11	0.34	2.11	0.12	0.71	2.51		0.29	3.69	0.00		0.00
11/5/2021	0.09	0.29		0.12	0.86	2.70		0.62		0.00		0.00
11/6/2021	0.09	0.27		0.12	0.80	3.42		1.35		0.00		0.00
11/7/2021	0.09	0.27		0.12	0.82	3.58		1.36		0.00		0.00
11/8/2021	0.08	0.27		0.07	0.81	3.60		1.35		0.00		0.00
11/9/2021	0.08	0.27		0.05	0.80	3.56		1.33		0.00		0.00

6.0 STORMWATER SAMPLE DATA

Site	Date	Flow (cfs)	TP (ug/L) (Reporting limit 15 ug/L)	SRP (ug/L) (Reporting limit 6 ug/L)	TN (mg/L) (Reporting limit 0.5 mg/L)	TSS (mg/L)	TSS (mg/L) reporting limit	Cl (mg/L)	Type
BL3-W	4/5/2021	2.33	22.94	6.62	0.88	1.60	<5		GRAB
BL3-W	4/19/2021	2.35	18.80	4.90	0.78	0.20	<5	120	GRAB
BL3-W	5/3/2021	1.14	22.09	8.74	0.71	0.60	<5	154	GRAB
BL3-W	5/17/2021	0.68	48.71	15.95	0.79	3.38	<4		GRAB
BL3-W	5/21/2021	6.72	45.73	16.92	0.77	1.40	<5		GRAB
BL3-W	6/1/2021	2.06	66.69	29.35	0.88	2.12	<5		GRAB
BL3-W	6/14/2021	0.10	448.20	44.82	4.23	9.09	<10		GRAB
BL3-W	6/28/2021	0.15	592.60	64.54	4.51	15.60	15.60	128	GRAB
BL3-W	7/15/2021	14.66	118.56	58.00	1.07	4.00	<5	108	GRAB
BL3-W	7/26/2021	0.53	310.90	84.59	2.72	8.80	<10		GRAB
BL3-W	8/26/2021	0.54	170.44	18.14	2.15	10.63	10.63		COMP
BL3-W	9/7/2021	0.67	96.70	56.19	1.08	1.73	<8		GRAB
BL3-W	9/20/2021	0.18	114.46	61.38	1.52	4.87	<6		GRAB
BL3-W	9/20/2021	1.76	86.09	30.23	1.46	4.16	4.16		COMP
BL3-W	10/4/2021	1.04	48.83	23.49	1.07	2.13	<4		GRAB
BL3-W	10/18/2021	0.60	50.52	26.11	1.24	2.45	<4		GRAB
BL3-W	11/1/2021	1.04	23.36	2.09	0.68	0.85	<4		GRAB
ECER	4/5/2021	7.65	79.95	46.93	1.01	2.40	<5	90	GRAB
ECER	4/19/2021	7.27	67.42	30.39	0.84	3.60	<5	88	GRAB
ECER	5/3/2021	4.63	124.10	43.22	1.01	27.20	27.20	86	GRAB
ECER	5/17/2021	0.71	137.00	62.19	1.23	6.00	6.00	82	GRAB
ECER	5/19/2021	17.94	570.10	104.35	4.83	262.00	262.00		COMP
ECER	6/1/2021	6.33	124.16	62.99	1.00	2.69	<5	78	GRAB
ECER	6/14/2021	0.09	380.73	225.40	2.09	10.00	10.00	92	GRAB
ECER	6/28/2021	0.48	395.90	215.58	2.40	24.87	24.87	134	GRAB
ECER	7/14/2021	13.09	1,406.00	146.72	4.02	1,005.00	1,005.00	45	COMP
ECER	7/26/2021	0.79	227.00	135.61	1.45	5.00	5.00	78	GRAB
ECER	8/9/2021	0.66	263.69	176.61	1.50	4.60	<5	86	GRAB
ECER	8/8/2021	0.33	265.63	152.17	1.80	18.95	18.95	85	COMP
ECER	8/23/2021	0.74	218.10	157.71	1.15	3.31	<4	97	GRAB
ECER	8/21/2021	1.78	286.20	155.95	2.04	41.53	41.53	68	COMP
ECER	8/24/2021	4.53	323.90	147.08	2.19	52.02	52.02	58	COMP
ECER	8/26/2021	6.97	236.65	117.78	1.47	34.00	34.00	71	COMP
ECER	9/7/2021	2.73	176.23	135.65	1.10	2.30	<6	71	GRAB
ECER	9/17/2021	2.39	250.58	162.83	1.66	32.50	32.50	67	COMP
ECER	9/20/2021	1.69	161.01	122.19	1.09	3.69	<4	87	GRAB
ECER	9/20/2021	3.12	422.30	207.38	2.86	101.07	101.07	56	COMP
ECER	10/4/2021	5.01	138.20	89.90	1.05	2.60	<4	74	GRAB
ECER	10/18/2021	1.00	105.95	71.40	1.19	2.33	<6	82	GRAB
ECER	10/28/2021	6.18	168.55	89.12	1.55	25.25	25.25	70	COMP
ECER	11/1/2021	3.55	90.20	56.75	0.76	2.57	<4	80	GRAB
GC-1	4/5/2021	1.01	51.16	21.81	0.78	2.60	<5	256	GRAB
GC-1	4/19/2021	0.69	50.76	7.18	0.86	3.40	<5	194	GRAB
GC-1	5/3/2021	0.76	56.39	16.33	0.97	3.33	<4	202	GRAB
GC-1	5/17/2021	0.61	170.20	49.36	1.22	22.67	22.67	144	GRAB
GC-1	5/19/2021	2.64	562.20	2.83	5.66	248.00	248.00	42	COMP
GC-1	6/1/2021	1.20	135.61	43.49	1.14	5.14	5.14	156	GRAB
GC-1	6/14/2021	0.04	117.49	73.30	1.76	4.53	4.53	170	GRAB
GC-1	7/6/2021	0.32	328.14	2.05	4.44	88.00	88.00	98	COMP
GC-1	7/14/2021	2.15	625.93	4.93	2.86	272.00	272.00	22	COMP
GC-1	7/28/2021	0.04	543.40	128.67	8.16	255.00	255.00	18	COMP
GC-1	8/8/2021	0.06	185.31		2.72	26.47	26.47	7	COMP

Site	Date	Flow (cfs)	TP (ug/L) (Reporting limit 15 ug/L)	SRP (ug/L) (Reporting limit 6 ug/L)	TN (mg/L) (Reporting limit 0.5 mg/L)	TSS (mg/L)	TSS (mg/L) reporting limit	Cl (mg/L)	Type
GC-1	8/22/2021	0.01	112.60	42.26	3.67	5.43	<10	20	COMP
GC-1	8/24/2021	2.26	285.10	120.04	2.12	64.67	64.67	3	COMP
GC-1	8/26/2021	2.25	418.22	125.77	2.68	50.50	50.50	30	COMP
GC-1	9/3/2021	2.05	149.31	49.47	1.40	20.66	20.66	68	COMP
GC-1	9/7/2021	0.71	102.18	62.41	1.04	2.00	<5	126	GRAB
GC-1	9/15/2021	0.20	154.01	77.86	1.79	54.20	54.20	110	COMP
GC-1	9/20/2021	0.06	179.97	116.43	1.31	4.97	<6	106	GRAB
GC-1	9/20/2021	3.01	299.20	54.39	2.15	54.80	54.80	33	COMP
GC-1	10/4/2021	0.11	94.44	46.87	0.87	4.27	<6	145	GRAB
GC-1	10/28/2021	1.01	385.53	156.62	2.67	132.20	132.20	34	COMP
HAMEL	4/5/2021	4.55	68.21	20.24	1.24	13.40	13.40	88	GRAB
HAMEL	4/19/2021	3.87	44.50	12.59	1.14	3.20	<5	74	GRAB
HAMEL	5/3/2021	2.70	60.62	18.01	1.22	10.00	10.00	80	GRAB
HAMEL	5/17/2021	1.76	63.28	18.93	1.22	2.67	<6	114	GRAB
HAMEL	5/19/2021	7.34	431.20	33.65	4.71	253.00	253.00	176	COMP
HAMEL	6/1/2021	3.53	84.80	69.31	1.18	3.65	<5		GRAB
HAMEL	6/14/2021	3.81	154.32	71.99	1.81	6.80	6.80	90	GRAB
HAMEL	6/28/2021	0.55	144.70	41.23	1.71	5.20	<10	282	GRAB
HAMEL	6/28/2021	2.12	157.40	34.95	1.40	9.40	9.40	310	COMP
HAMEL	7/14/2021	12.40	587.30	65.28	2.63	270.00	270.00	160	COMP
HAMEL	7/26/2021	1.33	186.40	79.52	1.59	4.00	<10	85	GRAB
HAMEL	8/9/2021	0.60	156.27	86.00	1.31	3.23	<6	154	GRAB
HAMEL	8/9/2021	1.26	108.85		1.48	6.17	6.17	165	COMP
HAMEL	8/23/2021	0.60	156.20	86.95	1.13	4.37	<5	72	GRAB
HAMEL	8/20/2021	7.43	261.90	79.81	3.58	177.05	177.05	122	COMP
HAMEL	8/24/2021	9.42	269.30	83.88	2.32	67.58	67.58	30	COMP
HAMEL	8/26/2021	6.85	205.01	75.44	1.38	27.00	27.00	74	COMP
HAMEL	9/3/2021	2.58	174.02	135.21	1.47	57.05	57.05	72	COMP
HAMEL	9/7/2021	1.49	169.93	76.93	1.23	2.44	<6	74	GRAB
HAMEL	9/17/2021	3.73	229.90	83.85	1.60	55.36	55.36	107	COMP
HAMEL	9/20/2021	0.64	140.70	83.96	1.75	33.54	33.54	158	GRAB
HAMEL	9/20/2021	16.31	568.80	160.25	3.52	182.65	182.65		COMP
HAMEL	10/4/2021	2.21	185.60	101.63	1.31	2.00	<5	74	GRAB
HAMEL	10/18/2021	0.76	114.86	60.12	1.33	2.86	<4	145	GRAB
HAMEL	10/20/2021	2.20	228.93	69.67	1.80	30.95	30.95	136	COMP
HAMEL	10/28/2021	2.88	126.79	83.52	1.15	13.00	13.00	98	COMP
HAMEL	11/1/2021	1.75	111.57	44.78	1.25	1.74	<4	98	GRAB
IP2	4/5/2021	4.58	62.36	7.79	1.33	5.40	5.40	268	GRAB
IP2	4/19/2021	4.31	64.97	6.88	1.18	2.60	<5	226	GRAB
IP2	5/3/2021	3.37	92.99	9.50	1.42	6.13	6.13	234	GRAB
IP2	5/17/2021	1.47	59.35	11.66	1.26	2.40	<5	364	GRAB
IP2	5/19/2021	10.48	259.90	6.00	3.84	73.00	73.00	268	COMP
IP2	6/1/2021	6.20	127.25	34.41	1.28	2.69	<5	168	GRAB
IP2	6/28/2021	15.78	143.60	80.56	1.13	2.60	<5	126	GRAB
IP2	6/28/2021	23.30	267.10	57.25	3.12	86.80	86.80	59	COMP
IP2	7/14/2021	14.41	253.85	52.50	2.23	49.20	49.20	103	COMP
IP2	7/26/2021	2.25	227.80	102.50	2.08	3.60	<5	141	GRAB
IP2	8/9/2021	2.18	176.27	107.15	1.14	2.40	<5	59	GRAB
IP2	8/7/2021	5.98	205.07		2.29	7.96	7.96	123	COMP
IP2	8/24/2021	17.97	389.08	65.62	3.48	113.79	113.79	49	COMP
IP2	8/26/2021	19.28	337.87	51.01	2.13	78.04	78.04	71	COMP
IP2	9/3/2021	13.02	251.02	186.07	1.59	16.53	16.53	87	COMP
IP2	9/7/2021	7.79	304.91	226.30	1.76	1.75	<7	95	GRAB
IP2	9/20/2021	2.71	169.96	83.84	1.33	3.70	<11	170	GRAB

Site	Date	Flow (cfs)	TP (ug/L) (Reporting limit 15 ug/L)	SRP (ug/L) (Reporting limit 6 ug/L)	TN (mg/L) (Reporting limit 0.5 mg/L)	TSS (mg/L)	TSS (mg/L) reporting limit	Cl (mg/L)	Type
IP2	9/20/2021	24.93	275.50	72.26	2.00	47.97	47.97	68	COMP
IP2	10/4/2021	3.06	153.70	54.59	1.48	2.67	<6	146	GRAB
IP2	10/28/2021	9.91	114.55	57.03	0.93	6.60	6.60	134	COMP
IP2	11/1/2021	4.77	75.44	47.23	0.85	1.99	<4	136	GRAB
MOOSW1	6/28/2021		290.70	178.95	2.62	24.40	24.40		GRAB
MOOSW1	7/14/2021		293.55	199.24	2.42	17.40	17.40		GRAB
MOOSW1	8/24/2021		197.10	132.00	1.61	3.49	<4		GRAB
MOOSW1	8/26/2021		218.24	106.62	1.44	38.00	38.00		GRAB
MOOSW1	9/20/2021		171.38	103.36	1.94	6.14	6.14		GRAB
MOOSW2	4/19/2021		70.61	11.96	1.25	3.40	<5	98	GRAB
MOOSW2	5/3/2021		84.70	25.85	1.35	4.00	4.00		GRAB
MOOSW2	6/1/2021		264.35	164.02	1.19	2.10	<5		GRAB
MOOSW2	6/28/2021		418.10	238.65	2.45	10.60	10.60		GRAB
MOOSW2	7/14/2021		504.02	211.80	2.83	45.60	45.60		GRAB
MOOSW2	8/9/2021		447.83	215.96	2.47	8.00	<10		GRAB
MOOSW2	8/24/2021		207.91	106.23	1.36	4.44	<6		GRAB
MOOSW2	8/26/2021		277.45	156.31	1.72	10.84	<11		GRAB
MOOSW2	9/7/2021		191.62	105.09	1.46	2.06	<7		GRAB
MOOSW2	9/20/2021		202.81	140.33	1.29	6.92	6.92		GRAB
MOOSW2	10/4/2021		143.20	99.89	0.94	2.17	<5		GRAB
MOOSW2	10/28/2021		239.41	204.88	1.13	4.20	<5		GRAB
MOOSW3	6/28/2021		205.00	112.04	2.21	29.00	29.00		GRAB
MOOSW3	7/14/2021		221.29	128.77	2.43	18.00	18.00		GRAB
MOOSW3	8/24/2021		117.60	66.77	1.02	3.26	<4		GRAB
MOOSW3	8/26/2021		122.58	79.15	0.91	11.20	11.20		GRAB
MOOSW3	9/20/2021		329.58	284.55	2.13	9.27	9.27		GRAB
MOOSW4	6/28/2021		228.80	104.85	2.35	53.60	53.60		GRAB
MOOSW4	7/14/2021		428.27	96.64	4.48	447.20	447.20		GRAB
MOOSW4	8/24/2021		144.55	45.19	1.46	18.22	18.22		GRAB
MOOSW4	9/20/2021		335.31	84.90	2.26	16.29	16.29		GRAB
MOOSW5	6/28/2021		225.50	102.71	2.26	34.00	34.00		GRAB
MOOSW5	7/14/2021		281.31	98.03	2.35	142.80	142.80		GRAB
MOOSW5	8/24/2021		159.61	83.53	1.32	7.59	7.59		GRAB
MOOSW5	8/26/2021		252.98	122.42	1.07	37.60	37.60		GRAB
MOOSW5	9/20/2021		284.30	227.27	2.40	15.42	15.42		GRAB
NLS	4/5/2021	0.16	105.50	41.81	1.80	22.60	22.60		GRAB
NLS	4/19/2021	1.29	72.36	9.28	1.48	2.20	<5	212	GRAB
NLS	5/3/2021	1.06	120.50	41.48	1.66	5.07	5.07		GRAB
NLS	5/20/2021	6.04	460.60	25.75	3.79	212.00	212.00		COMP
NLS	6/1/2021	0.70	103.93	29.31	1.08	3.70	<10		GRAB
NLS	6/29/2021	1.71	147.30	53.07	1.08	4.20	<5		GRAB
NLS	7/14/2021	10.15	565.92	33.87	4.05	290.40	290.40		COMP
NLS	8/9/2021	0.87	178.66	68.86	1.48	3.20	<5		GRAB
NLS	8/5/2021	17.69	501.23		5.12	193.75	193.75		COMP
NLS	8/24/2021	6.22	294.50	97.93	2.59	167.43	167.43		COMP
NLS	8/27/2021	18.45	182.22	119.47	1.33	10.67	10.67		GRAB
NLS	9/3/2021	4.55	135.39	101.19	1.81	42.62	42.62		COMP
NLS	9/7/2021	0.53	195.37	88.13	1.71	3.46	<6		GRAB
NLS	9/14/2021	0.53	192.19	89.29	1.85	59.64	59.64	60	COMP
NLS	10/20/2021	4.56	604.10	333.25	4.50	123.60	123.60		COMP
NLS	10/28/2021	6.10	272.57	194.62	0.85	9.60	9.60		COMP
NLS	11/1/2021	0.00	117.62	36.65	1.46	6.56	6.56		GRAB
PC2	4/5/2021	4.95	46.45	15.75	1.15	5.60	5.60	268	GRAB
PC2	4/19/2021	8.16	51.82	14.34	1.08	3.60	<5	234	GRAB

Site	Date	Flow (cfs)	TP (ug/L) (Reporting limit 15 ug/L)	SRP (ug/L) (Reporting limit 6 ug/L)	TN (mg/L) (Reporting limit 0.5 mg/L)	TSS (mg/L)	TSS (mg/L) reporting limit	Cl (mg/L)	Type
PC2	5/3/2021	2.49	70.41	7.72	1.19	6.00	6.00	240	GRAB
PC2	5/20/2021	16.74	136.50	33.50	1.67	11.00	<50	166	GRAB
PC2	6/1/2021	3.56	96.89	32.15	1.23	1.92	<5	176	GRAB
PC2	6/28/2021	1.43	188.10	63.45	1.66	3.40	<5	150	GRAB
PC2	8/9/2021	1.88	128.74	61.99	1.12	2.00	<5	66	GRAB
PC2	8/24/2021	7.49	160.50	71.89	1.79	11.13	11.13		GRAB
PC2	8/26/2021	22.13	174.41	46.38	1.40	38.04	38.04	52	COMP
PC2	9/2/2021	8.65	189.83	155.68	1.49	18.95	18.95	91	COMP
PC2	9/7/2021	4.88	196.48	148.45	1.25	0.15	<4	112	GRAB
PC2	9/20/2021	18.51	86.93	33.97	0.97	2.52	<4	149	GRAB
PC2	10/4/2021	4.18	90.64	35.98	1.27	1.98	<5	152	GRAB
PC2	10/28/2021	7.38	107.23	66.18	0.84	4.00	<4	98	GRAB
PC2	11/1/2021	2.46	61.81	53.17	0.61	0.99	<4	134	GRAB
PEONY	4/5/2021	6.26	95.47	42.95	1.11	5.40	5.40	72	GRAB
PEONY	4/19/2021	4.92	91.96	45.52	1.02	3.20	<5	80	GRAB
PEONY	5/3/2021	3.73	131.30	78.79	1.09	1.87	<4	86	GRAB
PEONY	5/17/2021	0.85	160.50	92.84	1.14	3.20	<5	110	GRAB
PEONY	6/1/2021	4.34	158.89	103.97	1.20	3.46	<5	80	GRAB
PEONY	6/14/2021	0.41	246.87	148.12	1.59	16.80	16.80	70	GRAB
PEONY	6/28/2021	0.25	314.20	93.53	2.72	38.80	38.80	156	GRAB
PEONY	7/12/2021	0.53	208.60	139.97	0.88	11.73	11.73	42	GRAB
PEONY	7/15/2021	9.73	455.60	289.87	2.32	88.00	88.00	45	GRAB
PEONY	7/26/2021	0.65	349.30	237.25	1.09	20.80	20.80	49	GRAB
PEONY	8/9/2021	0.52	211.36	172.82	0.81	3.24	<4	61	GRAB
PEONY	8/23/2021	0.90	308.70	253.78	1.03	5.38	5.38	69	GRAB
PEONY	8/24/2021	14.13	445.71	174.29	2.38	102.06	102.06	40	GRAB
PEONY	8/27/2021	23.48	485.41	305.68	1.71	30.20	30.20	43	GRAB
PEONY	9/3/2021	3.85	369.97	295.86	1.35	49.84	49.84	62	COMP
PEONY	9/7/2021	0.75	401.87	314.36	1.09	5.18	5.18	74	GRAB
PEONY	9/17/2021	3.24	379.57	252.69	1.43	67.61	67.61	85	COMP
PEONY	9/20/2021	0.74	394.56	323.28	1.13	31.32	31.32	75	GRAB
PEONY	9/20/2021	38.69	746.20	323.58	3.32	244.85	244.85	49	COMP
PEONY	10/4/2021	0.90	340.20	251.84	1.12	2.80	<5	73	GRAB
PEONY	10/18/2021	1.26	360.44	251.56	1.26	43.19	43.19	82	GRAB
PEONY	10/20/2021	1.42	381.06	262.33	1.41	31.96	31.96	84	COMP
PEONY	10/28/2021	3.60	300.40	265.43	1.24	23.80	23.80	88	COMP
PEONY	11/1/2021	0.87	224.75	151.59	0.91	3.01	<5	90	GRAB
PL1	4/27/2021	0.18	226.50	139.65	2.31	28.80	28.80	12	COMP
PL1	5/19/2021	1.23	446.00	125.85	3.76	92.50	92.50	18	COMP
PL1	6/27/2021	0.09	389.30	60.31	3.39	184.00	184.00	0	COMP
PL1	7/14/2021	4.45	326.62	111.70	2.87	99.60	99.60	3	COMP
PL1	8/7/2021	0.23	200.58		2.16	20.93	20.93	4	COMP
PL1	8/24/2021	4.44	296.14	142.25	1.92	93.60	93.60	3	COMP
PL1	8/26/2021	13.50	254.50	89.61	1.76	102.45	102.45	1	COMP
PL1	9/3/2021	0.83	168.10	126.53	1.41	22.85	22.85	1	COMP
PL1	9/16/2021	0.19	307.58	159.98	2.12	58.89	58.89	15	COMP
PL1	9/20/2021	2.16	334.70	126.72	2.92	84.43	84.43	4	COMP
PL1	10/28/2021	0.89	638.86	551.38	1.55	15.33	15.33	2	COMP
PL2	4/5/2021	0.20	68.67	53.74	0.76	2.00	<10	322	GRAB
PL2	4/19/2021	0.11	90.38	26.83	0.78	3.80	<5	440	GRAB
PL2	5/3/2021	0.13	133.50	78.13	0.76	3.20	<4	320	GRAB
PL2	5/17/2021	0.08	200.60	141.81	1.12	5.60	5.60	342	GRAB
PL2	5/19/2021	5.00	318.20	60.95	2.89	114.67	114.67	260	COMP
PL2	6/1/2021	0.19	151.81	109.84	0.87	1.71	<5	180	GRAB

Site	Date	Flow (cfs)	TP (ug/L) (Reporting limit 15 ug/L)	SRP (ug/L) (Reporting limit 6 ug/L)	TN (mg/L) (Reporting limit 0.5 mg/L)	TSS (mg/L)	TSS (mg/L) reporting limit	Cl (mg/L)	Type
PL2	6/14/2021	0.02	309.58	249.51	1.13	1.60	<5	220	GRAB
PL2	6/28/2021	0.09	348.70	240.06	1.01	2.60	<5	260	GRAB
PL2	6/28/2021	8.00	428.50	102.44	3.11	195.20	195.20	159	COMP
PL2	7/7/2021	0.48	366.56	156.53	1.56	17.00	17.00	188	COMP
PL2	7/12/2021	0.02	382.00	298.10	1.32	3.40	<5	220	GRAB
PL2	7/14/2021	7.44	601.30	132.92	2.25	331.10	331.10	122	COMP
PL2	7/26/2021	0.14	307.70	174.61	1.27	7.00	7.00	151	GRAB
PL2	8/9/2021	0.12	263.51	178.82	1.46	3.40	<5	132	GRAB
PL2	8/7/2021	0.72	299.78	126.57	2.03	56.85	56.85	116	COMP
PL2	8/23/2021	0.06	242.60	202.23	0.86	1.96	<5	122	GRAB
PL2	8/24/2021	10.74	432.38	118.31	3.31	230.14	230.14	77	COMP
PL2	8/26/2021	17.61	357.66	65.05	1.50	172.00	172.00	52	COMP
PL2	9/3/2021	1.50	153.58	108.80	1.41	16.96	16.96	57	GRAB
PL2	9/7/2021	0.06	148.63	130.92	0.84	3.14	<5	79	GRAB
PL2	9/20/2021	0.04	160.13	159.34	0.81	1.34	<6	104	GRAB
PL2	9/20/2021	8.82	293.40	174.74	2.16	129.44	129.44	54	COMP
PL2	10/4/2021	0.10	110.10	89.52	0.80	2.17	<5	106	GRAB
PL2	10/18/2021	0.06	115.94	94.70	0.78	1.37	<4	132	GRAB
PL2	10/20/2021	1.10	258.85	103.33	1.81	41.86	41.86	100	COMP
PL2	10/28/2021	0.27	114.26	59.08	1.12	4.20	<5	86	GRAB
PL2	11/1/2021	0.27	86.24	59.15	0.60	0.70	<4	94	GRAB
PRG-IN	6/28/2021		98.97	68.55	1.61	5.20	5.20	0	GRAB
PRG-OUT	6/28/2021		242.60	186.06	2.92	4.67	4.67	0	GRAB
PRG-IN	7/14/2021		68.93	29.25	1.42	15.20	15.20		GRAB
PRG-OUT	7/14/2021		135.27	108.59	7.56	2.00	<5		GRAB
PRG-IN	8/24/2021		51.04	25.51	0.68	29.82	29.82		GRAB
PRG-OUT	8/24/2021		168.29		1.43	2.35	<6		GRAB
PRG-IN	8/26/2021		27.87	8.79	0.42	8.20	8.20		GRAB
PRG-OUT	8/26/2021		168.96	142.15	1.45	7.20	7.20		GRAB
PRG-IN	9/20/2021		117.72	28.78	2.38	52.56	52.56		GRAB
PRG-OUT	9/20/2021		109.83	78.65	1.66	7.97	7.97		GRAB

7.0 LAKE SONDE DATA

Date	Time	Site	Depth Measured (m)	Depth Rounded (m)	Temp (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Specific Conductivity (uS/cm)	pH	ORP mV
4/19/2021	10:20:13 AM	CAM	0.38	0.0	8.8	48.0	5.57	342	7.0	42
4/19/2021	10:21:34 AM	CAM	0.66	1.0	8.7	45.4	5.27	385	6.8	-11
5/10/2021	10:01:54 AM	CAM	0.29	0.0	13.2	63.5	6.66	362	7.9	45
5/10/2021	10:02:33 AM	CAM	0.62	1.0	13.1	46.5	4.88	364	7.5	51
5/24/2021	9:54:24 AM	CAM	0.35	0.0	20.6	9.6	0.86	381	6.6	29
5/24/2021	9:55:31 AM	CAM	0.47	1.0	20.3	5.3	0.48	399	6.4	17
6/7/2021	9:46:34 AM	CAM	0.32	0.0	21.1	15.2	1.35	413	6.5	-31
6/7/2021	9:47:02 AM	CAM	0.44	0.0	20.6	8.6	0.77	444	6.4	-58
6/21/2021	9:59:57 AM	CAM	0.02	0.0	17.0	16.2	1.56	355	6.9	175
6/21/2021	10:00:52 AM	CAM	0.29	0.0	17.3	6.2	0.59	409	6.3	132
7/6/2021	9:59:07 AM	CAM	0.29	0.0	21.8	4.2	0.37	417	6.4	-128
7/19/2021	9:24:20 AM	CAM	0.37	0.0	20.8	4.7	0.42	443	6.4	-65
7/19/2021	9:25:21 AM	CAM	0.58	1.0	20.5	1.8	0.16	446	6.4	-81
8/2/2021	9:47:35 AM	CAM	0.32	0.0	19.3	3.4	0.31	420	6.5	-78
8/2/2021	9:47:54 AM	CAM	0.42	0.0	19.3	1.6	0.15	493	6.4	-88
8/16/2021	9:15:43 AM	CAM	0.31	0.0	18.5	3.6	0.33	444	6.5	-91
8/16/2021	9:17:02 AM	CAM	0.38	0.0	18.8	2.0	0.19	435	6.4	-103
8/30/2021	9:29:25 AM	CAM	0.32	0.0	20.0	2.5	0.23	488	6.3	-100
9/13/2021	9:44:30 AM	CAM	0.31	0.0	16.6	9.1	0.88	414	6.8	35
9/13/2021	9:45:11 AM	CAM	0.38	0.0	16.7	6.2	0.60	417	6.7	16
9/27/2021	9:16:41 AM	CAM	0.24	0.0	15.1	21.7	2.18	423	6.7	60
9/27/2021	9:17:12 AM	CAM	0.44	0.0	15.1	16.0	1.61	426	6.5	32
10/11/2021	9:33:52 AM	CAM	0.31	0.0	15.6	14.6	1.46	427	6.6	68
10/11/2021	9:34:53 AM	CAM	0.41	0.0	15.2	8.0	0.81	424	6.6	34

8.0 LAKE SAMPLE DATA

Date	Site	Depth (m)	Sample Type	TP (ug/L) (Reporting limit 15 ug/L)	SRP (ug/L) (Reporting limit 6 ug/L)	TN (mg/L) (Reporting limit 0.5 mg/L)	Cl (mg/L)	Chl-a (ug/L) Measured	Chl-a Reported Value (ug/L)	Secchi (m)	Secchi notes	SRP:TP ratio
4/19/2021	CAM	0.0	S	26	8	0.82		5	<7	0.65	Bottom, Snow	29.8%
5/10/2021	CAM	0.0	S	17	6	0.82		1	<7	0.60	Bottom	34.2%
5/24/2021	CAM	0.0	S	50	10	1.38		4	<10	0.47	Bottom	19.8%
6/7/2021	CAM	0.0	S	56	22	1.24		4	<20	0.40		38.4%
6/21/2021	CAM	0.0	S	134	33	1.80		6	<33	0.30	Bottom	24.5%
7/6/2021	CAM	0.0	S	92	18	1.90		4	<20	0.28		19.3%
7/19/2021	CAM	0.0	S	75	15	1.71		4	<7	0.40	Bottom	19.7%
8/2/2021	CAM	0.0	S	92	8	1.92		16	<17	0.40	Bottom	8.2%
8/16/2021	CAM	0.0	S	72	5	1.81		38	38	0.37		6.6%
8/30/2021	CAM	0.0	S	222	19	2.86		17	17	0.30	Bottom	8.6%
9/13/2021	CAM	0.0	S	71	28	1.60		12	12	0.40		38.6%
9/27/2021	CAM	0.0	S	34	3	1.30		4	<5	0.40	Bottom	9.8%
10/11/2021	CAM	0.0	S	145	17	3.75		5	<6	0.41	Bottom	11.5%