2019 Water Quality Report

Prepared for the City of Plymouth

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 2019 calendar year. Ten stormwater sites, two lake sites, 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:** has an overview description of the watershed, map of stormwater monitoring sites with watershed boundary, and a list of any water quality impairments
- **Stormwater Monitoring:** has monitoring location descriptions and a summary of the monitored watershed acres and impervious acres
    - **Measured Flow:** has a graph showing daily average flow during the monitoring season at the monitoring site along with precipitation
    - **Concentrations:** has the average and range of concentrations of all samples collected and includes a discussion
    - **Loading:** a summary of annual load estimates, flow-weighted concentrations and unit area loads for each parameter since monitoring began
- **Lake monitoring:** has a map showing the watershed and key watershed features
    - **Phosphorus, secchi and Chlorophyll-a:** reports values and how values relate to MPCA standards
    - **Sonde results:** readings of dissolved oxygen, temperature, specific conductivity and pH with depth
    - **Concentrations**: Summarizes average concentrations
    - **Discussion:** provides a discussion of lake results

2.0 PRECIPITATION

Precipitation data was collected using a tipping bucket rain gauge located at the City of Plymouth Water facility on 23rd Ave N between Niagara Ln N and Fernbrook Ln N.

- Data from City of Plymouth was used from 4/21/2019 to 11/1/2019
    - During snow conditions, this gauge does not perform well
- Rest of year, precipitation data was from Minneapolis airport rain gauge (USW00014922) as reported by NOAA (National Oceanic and Atmospheric Administration)

Summary of precipitation data:

- Record setting: had 43.31 inches of precipitation for the 2019 calendar year
    - Almost 13 inches over 20-year average
- During the monitoring period (April 10th to Nov 5th), had 33.19 inches of rain
    - Monitoring period accounted for 77% of total calendar year precipitation
- The precipitation events that caused large stream responses:
    - Single day precipitation event:
        - 7/15/2019 with 2.85 inches
    - Multiday event over 10 days
        - 5/18 - 5/27/2019 totaled 3.7 inches

3.0 MONITORING METHODS

Stormwater

Each site was equipped to measure water flow using ISCO flow meters and to collect water samples during storm events using ISCO automated composite samplers. In addition, water samples were collected on a bi-weekly basis to characterize base flow conditions.

Water samples were analyzed at Three Rivers Park District's certified laboratory for total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), total suspended solids (TSS) and, at select sites, chlorides (Cl^-). The Standard Methods for the examination of Water and Wastewater 22nd edition (2011) were followed.

To estimate nutrient loads, the U.S. Army Corps of Engineer's FLUX model version 3.35 was used (Soballe, 2007). The concentrations and flow during the sample period were input to FLUX to determine the sample period load. The sample period load was extrapolated to the yearly load based on precipitation. The unit area loads (UAL) were determined by converting the yearly load to a per acre ratio. The UAL was compared to the MPCA Stormwater Manual (MPCA, 2017) typical unit area loads for TP and TSS based on land use (Table 3.1 and Table 3.2).

Table 3.1 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 (mg/L)	Minimum Concentration (mg/L)	Maximum Concentration (mg/L)
Residential	1.35	0.26	< 0.01	19.90
Commercial	2.25	0.20	< 0.01	4.27
Industrial	--	0.23	< 0.02	7.90
Freeway	3.50	--	--	--
Open Space	--	0.13	< 0.01	0.76

Table 3.2 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

The sampling protocols of the U.S. Environmental Protection Agency's Field Operations Manual (2007) were followed. Lakes were monitored bi-weekly from May through September. Pre- and post- thermal stratification monitoring occurred in April and October. Deepest location of the lake was sampled.

Sampling included:

- YSI EXO Sonde measurements of temperature, dissolved oxygen, specific conductivity and pH at one-meter intervals
- Secchi disk water clarity measurements

- Water samples collected at surface of shallow lakes and at three points in the water column on deeper lakes (surface, top of hypolimnion and within 1 meter of lake bottom)
    - Surface composite collected with two-meter PVC tube with 3.2 cm inside diameter
    - Deeper samples collected with Kemmerer sampler

Water samples were analyzed at Three Rivers Park Districts' certified laboratory for: total phosphorus (TP), soluble reactive phosphorus (SRP), total nitrogen (TN), chlorophyll-a (Chl-a) and, at select sites, chlorides (Cl-). The Standard Methods for the examination of Water and Wastewater 22nd edition (2011) were followed.

To assess the lake data, concentrations were compared to the Minnesota Pollution Control Agency (MPCA) standards (MN 7050.0222) and the Metropolitan Council (MC) grading system. The MPCA has state nutrient standards for deep and shallow lakes based on ecoregion (Figure 3.1). Hennepin County lies within the North Central Hardwood Forest Ecoregion. The MC has determined a grading system of lake water quality by assessing average concentrations of TP, Chl-a and secchi readings (Figure 3.2).

Ecoregion	TP (µg/L)	chl-*a* (µg/L)	Secchi (m)
Northern Lakes and Forest – Lake trout (Class 2A)	< 12	< 3	> 4.8
Northern Lakes and Forest – Stream trout (Class 2A)	< 20	< 6	> 2.5
Northern Lakes and Forest – Aquatic Rec. Use (Class 2B)	< 30	< 9	> 2.0
North Central Hardwood Forest – Stream trout (Class 2A)	< 20	< 6	> 2.5
North Central Hardwood Forest – Aq. Rec. Use (Class 2B)	< 40	< 14	> 1.4
North Central Hardwood Forest – Aq. Rec. Use (Class 2B) Shallow lakes	< 60	< 20	> 1.0
Western Corn Belt Plains & Northern Glaciated Plains – Aq. Rec. Use (Class 2B)	< 65	< 22	> 0.9
Western Corn Belt Plains & Northern Glaciated Plains – Aq. Rec. Use (Class 2B) Shallow lakes	< 90	< 30	> 0.7

Guidance Manual for Assessing the Quality of Minnesota Surface Waters — Minnesota Pollution Control Agency, December 2016

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Figure 3.1 MPCA lake eutrophication water quality standards for aquatic recreational use – all of the city of Plymouth and Hennepin County lie within the North Central Hardwood Forest ecoregion

WATER QUALITY GRADING SYSTEM				
Grade	Total Phosphorus (ug/l)	Chlorophyll -a (ug/l)	Secchi Depth (m)	(ft)
A	<23	<10	>3	>9.8
B	23-32	10-20	2.2-3.0	7.2-9.8
C	32-68	20-48	1.2-2.2	3.9-7.2
D	68-152	48-77	0.7-1.2	2.3-3.9
F	>152	>77	<0.7	<2.3

Figure 3.2 Met Council water quality grading system (Metropolitan Council 2016 Lake Water Quality Summary)

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).

- Two stormwater tributaries were monitored at sites PL1 and PL2
    - The sites capture almost 40% of the Parkers Lake contributing watershed area
- Parkers Lake has been listed as impaired for chlorides since 2014

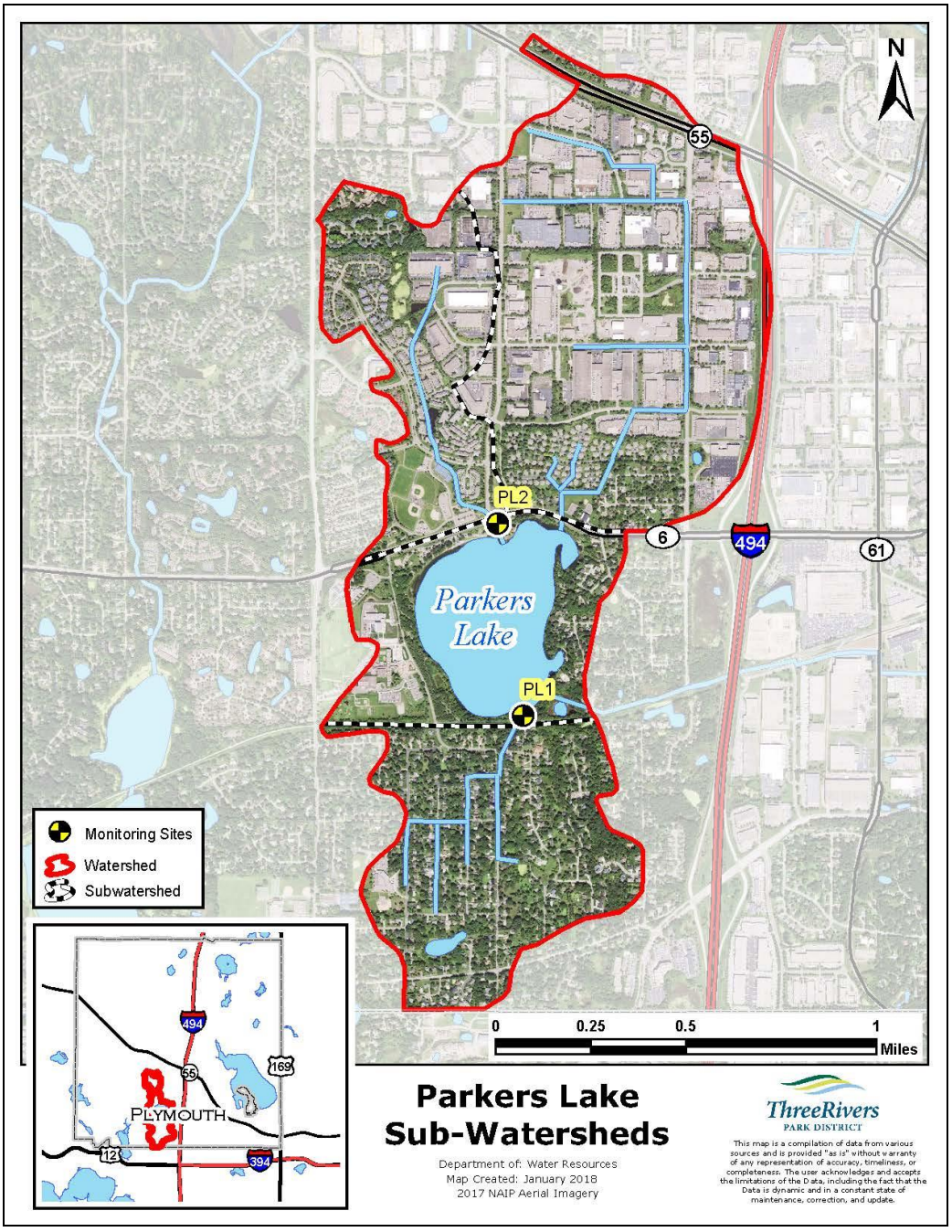


Figure 3.1.1 Parkers Lake sub-watershed map

3.1.1. Stormwater Monitoring Sites

PL1 (Parkers Lake Site 1) is located on the south side of the lake, north of the Luce Line State Trail. PL2 (Parkers Lake Site 2) is located on the northwest side of the lake at the public boat access. Details of the watershed are listed in Table 3.1.1.

- Each site has a 48-inch round culvert
- PL1 has a larger watershed than PL2
- PL2 is more developed with more impervious area than PL1

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. Measured Flow

Both Parkers Lake sites, PL1 and PL2, respond quickly to precipitation since the watersheds are small and developed (Figure 3.1.2) (Figure 3.1.3).

- PL2 has a smaller watershed than PL1, but has higher flows
    - The watershed soils, slopes and impervious areas cause there to be more runoff
        - PL1 has sandier soils, flatter topography and less impervious area allowing more rainfall infiltration and therefore less stream flow
        - PL2 has steep elevation changes and more impervious areas
- PL1 goes dry while PL2 has a baseflow
    - PL1 monitoring site has intermittent flow in response to rain events
    - PL2 monitoring site typically has a base flow but during longer periods without rain, can have very little to no flow
- Largest average daily flow events
    - PL1: 3.47 cfs on 5/27 after multi-day precipitation events
    - PL2: 7.13 cfs on 7/2 after multi-day precipitation events

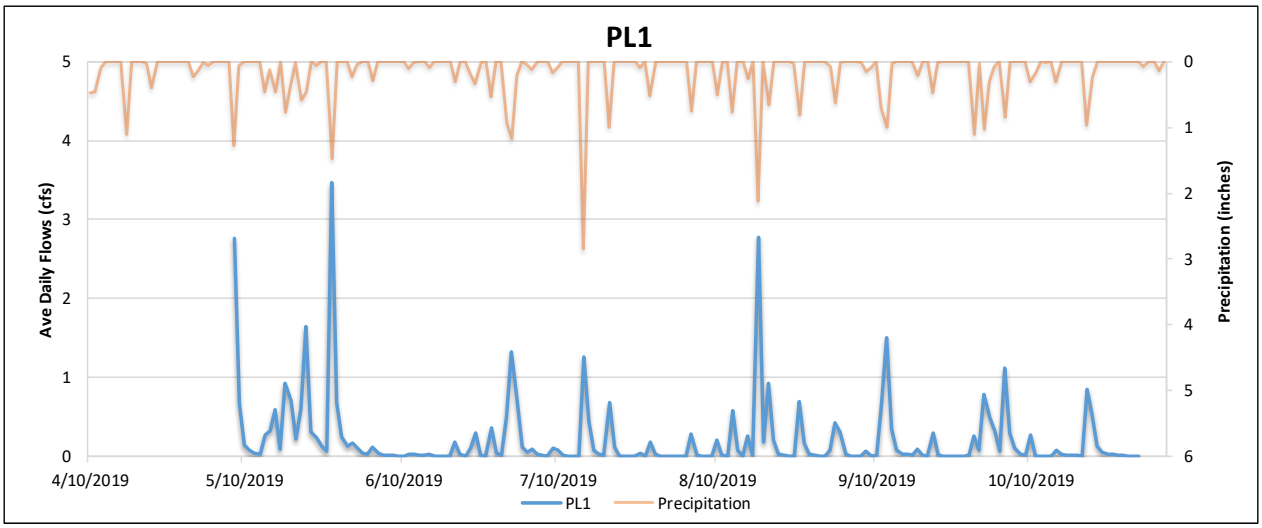


Figure 3.1.2 Average daily flow for Parkers Lake Site 1 (PL1)

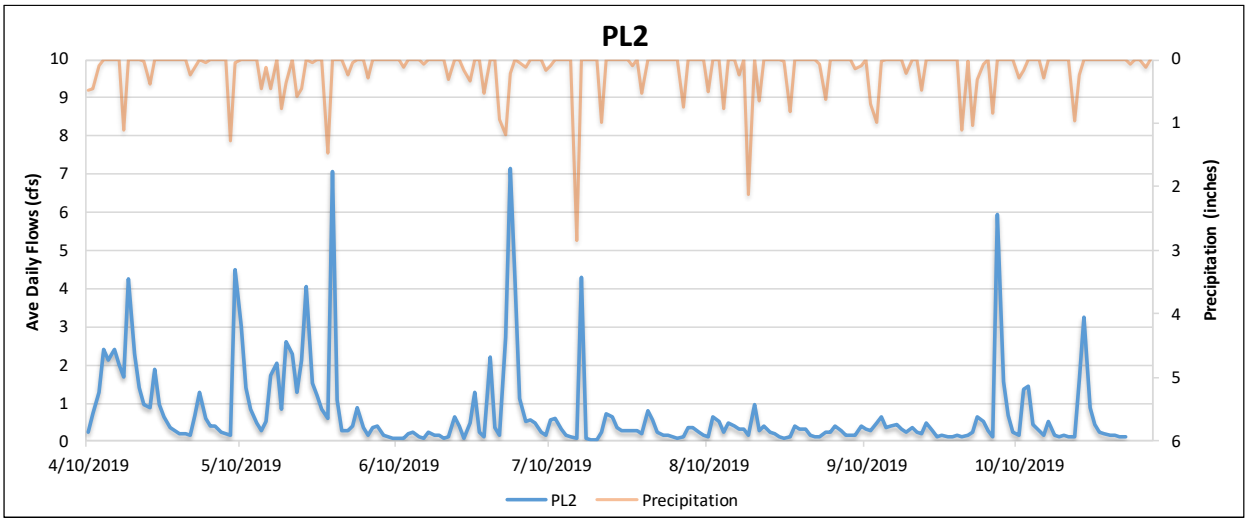


Figure 3.1.3 Average daily flow for Parkers Lake Site 2 (PL2)

3.1.3. Concentrations

Summary of Table 3.1.2, Figure 3.1.4 and Figure 3.1.5

- Number of water samples collected:
  - PL1: 16 samples including 15 automated composites and 1 grab sample
    - The grab sample from 5/9 had the lowest TSS (4.8 mg/L) and the highest chloride (30 mg/L) concentrations of all the samples
  - PL2: 31 samples including 14 automated composites and 17 grab samples
- Average concentrations of TP, SRP, TN and TSS were almost double at PL1 compared to PL2
  - PL2 has both composite and grab samples while PL1 is mainly composite samples
    - Concentrations are typically higher in composite samples compared to grab samples since collection is during storm events
  - Could be due to concentration dilution during collection of storm events at PL2 since the stream returns to baseflow while PL1 stops flowing
- Chloride concentrations were 18 times higher at PL2 compared to PL1
  - Due to and land use and higher percentage of impervious area in PL2 watershed that receives salt during winter
  - The highest concentrations of chlorides at PL2 occurred from April into June
- Chloride concentration versus standard
  - PL1 - considered not impaired; only exceeded standard 1 time in past three years
  - PL2 - considered impaired; exceeded standard 9 times in past three years
- SRP to TP ratio
  - PL1: On average, SRP made up 41% of TP
  - PL2: On average, SRP made up 46% 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	276 (138 - 406)	113 (71 - 162)	2.6 (1.2 - 3.7)	81.5 (4.8 - 192.8)	6 (2 - 30)
PL2	168 (64 - 431)	77 (7 - 158)	1.4 (0.7 - 3.5)	44.8 (1.2 - 346.7)	107 (16 - 418)

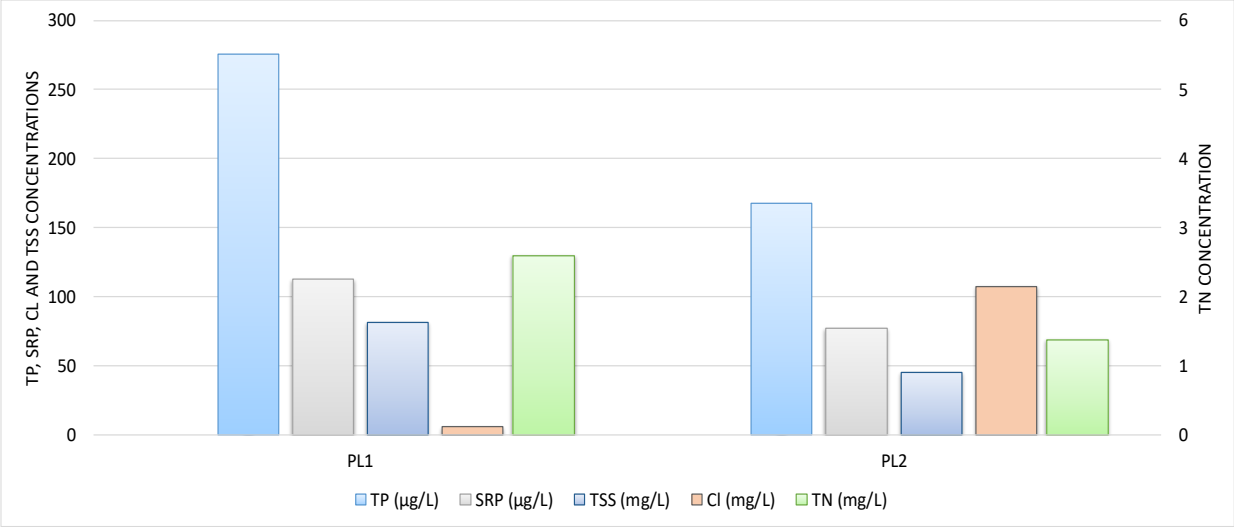


Figure 3.1.4 Average TP, SRP, TN, TSS and Cl concentrations for PL1 and PL2

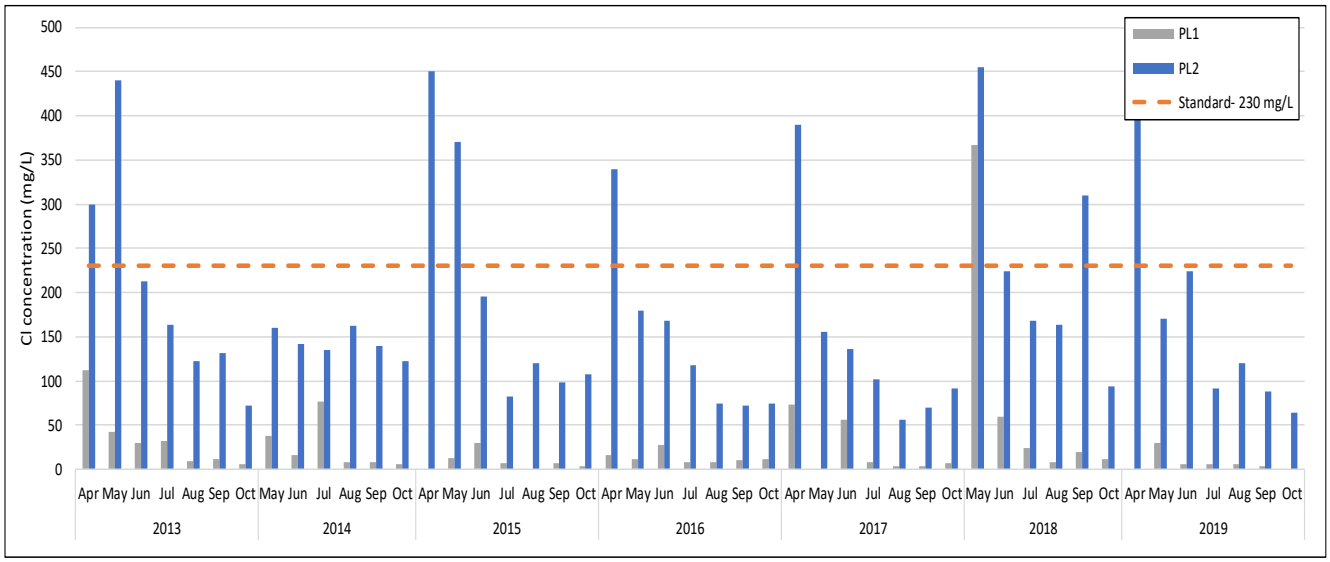


Figure 3.1.5 Maximum monthly chloride concentration at PL1 and PL2 versus the MPCA chloride standard. When standard is exceeded, there may be more than 1 exceedance in that month; An impaired stream is defined as 2 or more standard exceedances in any 3 year window over the previous 10 years

3.1.4. Loading

Comparing PL1 to PL2, the loading for TP, SRP and TN are 2-4x higher at PL2 compared to PL1. The increased loading is due to the amount of flow since there is 4x more flow at PL2, but 50% lower concentrations at PL2 compared to PL1.

PL1

At PL1, data has been collected since 2000. In 2005, there was an installation of ponds and curbs in the watershed. Table 3.1.3 is segmented to reflect the concentrations and loading before and after the installation of the ponds and curbs. The curbs increased runoff by not allowing water to infiltrate in ditches.

- From 2018 to 2019:
    - Flow doubled
    - TN and TSS flow weighted concentrations increased 36% and 361%, respectively
        - TP and SRP flow weighted concentrations were within 20%
    - Loading of TP, SRP and TN were about 2x higher in 2019
        - TSS loading increased 824%
- 2019 had highest TP, TN and TSS load of all monitored years
- Comparing pre- and post- curb installation, average flow increased 98% after installation
    - Average TP, SRP and TN concentrations were within 10% between monitoring periods, so increased flows led to:
        - Increased TP load of 76% and increased SRP load of 69%
        - Increased nitrogen load of 129%
- Comparing pre- and post- pond installation, the ponds allow sediment settling
    - Average TSS concentration decreased by 39% after ponds installed
    - Average TSS loading increased by 13%, but increase was mainly due to higher loading that occurred in 2019
        - Prior to 2019 monitoring, post-installation average TSS loading had decreased by 11%

In 2019, the flow weighted chloride concentration of 3.2 mg/L was the lowest it has been since monitoring began in 2013 (Table 3.1.4).

- Increased precipitation may have diluted the chloride concentration in runoff

The unit area loads (UAL) by year for PL1 are listed in Table 3.1.5.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.15 lbs/acre versus 1.35 lbs/acre for residential land use
    - TSS: 38 lbs/acre versus 77 lbs/ for residential land use
        - 2019: TSS UAL of 116 lbs/acre was 150% higher than MPCA UAL
        - 2 of 16 monitored years have TSS UAL's higher than the MPCA UAL

Table 3.1.3 Loading and flow weighted concentrations for TP, SRP, TN and TSS at PL1. The data is segmented based on before and after of the installation of ponds and curbs. The % change compares the average loadings and concentrations before and after installation

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)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)		
Data Collected before Installation of Water Quality Pond and Curb/Gutter										
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
Data Collected after Installation of Water Quality Pond and Curb/Gutter										
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	248	119	1.98	54	0.09	31.6
2014	63	37	763	18,517	264	132	2.71	66	0.13	27.5
2015	34	12	241	6,536	302	107	2.15	58	0.04	29.1
2016	59	21	389	10,125	296	103	1.96	51	0.08	38.6
2017	41	17	286	8,269	269	110	1.87	54	0.07	27.8
2018	46	18	290	3,243	321	125	2.02	23	0.06	30.8
2019	88	31	786	29,968	307	109	2.75	105	0.13	43.3
Average	45	19	348	10,299	287	125	1.93	60	0.07	30.9
% Change	76	69	129	13	-5	-4	9	-39	98	-5

Table 3.1.4 Loading and flow weighted concentration of chlorides at PL1 and PL2

Year	PL1		PL2	
	Chloride		Chloride	
	Loading (lbs/Yr)	Concentration (mg/L)	Loading (lbs/Yr)	Concentration (mg/L)
2013	3,239	16.4	105,991	123
2014	1,158	9.1	55,650	103
2015	1,052	9.4	161,814	120
2016	1,797	8.3	66,855	68.1
2017	4,904	32.0	122,460	105
2018	4,701	33.1	138,692	153
2019	926	3.2	84,831	80
Average	2,540	16	105,185	107

Table 3.1.5 Unit area loads for TP, SRP, TN, TSS and chlorides at PL1

PL1 - Parkers Lake - Site 1					
Year	Load/Acre				
	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
Average	0.15	0.06	1.06	38.3	9.8

PL2

The PL2 site was monitored from 2000-2008 and from 2013 to present. The data is compared between the two monitoring periods in Table 3.1.6.

- Average precipitation increased about 6%
    - Led to 37% increase in average flow
- All average flow weighted concentrations increased between the monitoring periods
    - TP and SRP increased by 20%
    - TSS increased by 57%
- The combination of increased flow and concentration led to increased average loading
    - 53-87% increase depending on parameter
- In 2019, the TSS flow weighted concentration was the highest it has been during monitoring due to the increased precipitation
    - Led to the highest TSS loading of all monitored years
    - All other parameters had similar concentrations and loadings in 2019 compared to the 2013-2019 data period

In Table 3.1.4, the flow weighted chloride concentration and loadings are summarized since monitoring began in 2013.

- Years with higher precipitation amounts, 2016 and 2019, have the lowest chloride concentrations and loadings
    - The higher precipitation may have diluted the chloride concentrations

The unit area loads (UAL) by year are listed in Table 3.1.7.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.81 versus 1.35 lbs/acre for residential land use
        - No UAL listed for mixed residential
    - TSS: 261 versus 111 lbs/ for mixed residential or 193 lbs/acre for industrial land use
    - The watershed is about 49% mixed residential and 30% industrial

Table 3.1.6 Loading and flow weighted concentrations of TP, SRP, TN and TSS at PL2. Data is segmented by a break in data collection from 2009-2012

PL2 - Parkers Lake - 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)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)		
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
2013-2019										
2013	145	73	1,299	50,840	169	85	1.51	59	0.39	31.6
2014	182	100	1,980	73,498	152	84	1.66	62	0.54	27.5
2015	221	85	1,776	68,765	234	90	1.88	73	0.42	29.1
2016	262	95	1,648	65,665	272	99	1.71	67	0.44	38.6
2017	219	72	1,716	61,684	188	62	1.48	53	0.49	27.8
2018	169	59	1,363	37,574	187	65	1.51	42	0.41	30.8
2019	195	80	1,659	110,549	184	76	1.56	104	0.48	43.3
Average	199	81	1,634	66,939	198	80	1.62	66	0.45	32.7
% Change	67	81	53	87	20	20	7	57	37	6.4

Table 3.1.7 Unit area loads for TP, SRP, TN, TSS and chlorides 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
Average	0.81	0.32	6.97	261	557

3.1.5. Parkers Lake

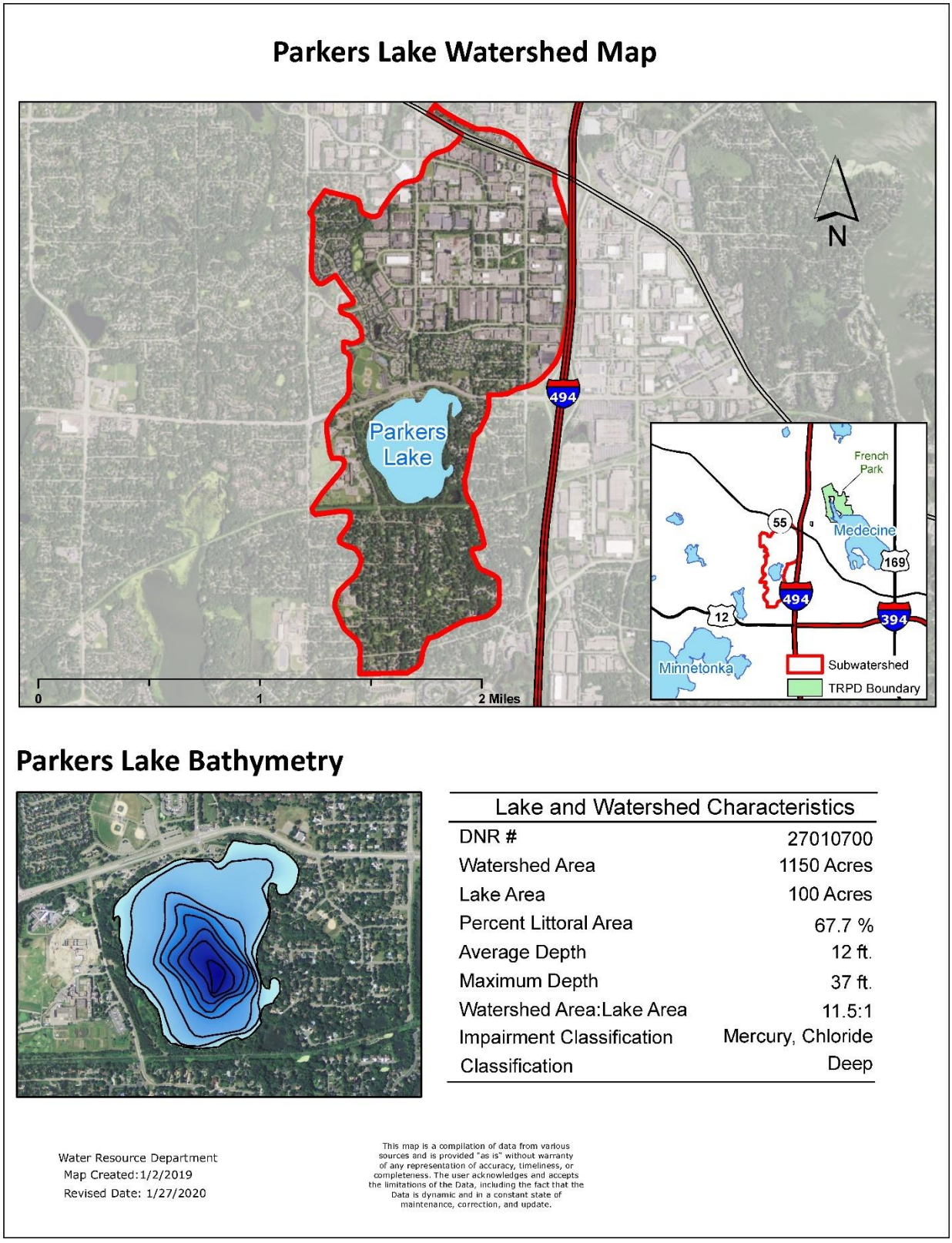
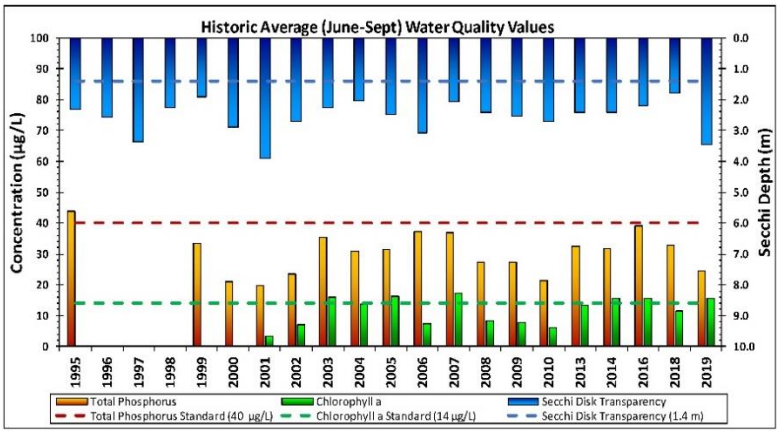
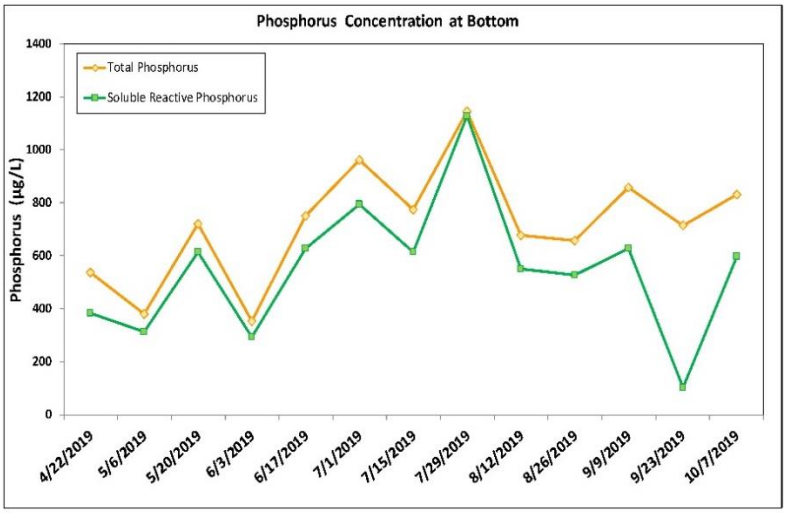


Figure 3.1.6 A summary of the watershed characteristics for Parkers Lake within the Medicine Lake watershed





Parkers Lake Water Quality Report Card				
Year	TP	Chl-a	Secchi	Avg Grade
1995	C		B	B-
1996			B	B
1997			A	A
1998			B	B
1999	C		C	C
2000	A		B	A-
2001	A	A	A	A
2002	B	A	B	B+
2003	C	B	B	B-
2004	B	B	C	B-
2005	B	B	B	B
2006	C	A	A	B+
2007	C	B	C	C+
2008	B	A	B	B+
2009	B	A	B	B+
2010	A	A	B	A-
2013	C	B	B	B-
2014	B	B	B	B
2016	C	B	B	B-
2018	C	B	C	C+
2019	B	B	A	B+
MPCA Standard	C	B	C	C+

Met Council Grading System for Lake Water Quality

ThreeRivers PARK DISTRICT

Division of Water Resources

January 2020

Figure 3.1.7 Summary of the total phosphorus, secchi and chlorophyll-a June-September averages as they relate to the MPCA standards, the results of each 2019 sample, the phosphorus concentrations at the bottom of the lake and a "report card" grade as defined by the Met Council and as the water quality relates to the MPCA guidelines

Sonde results

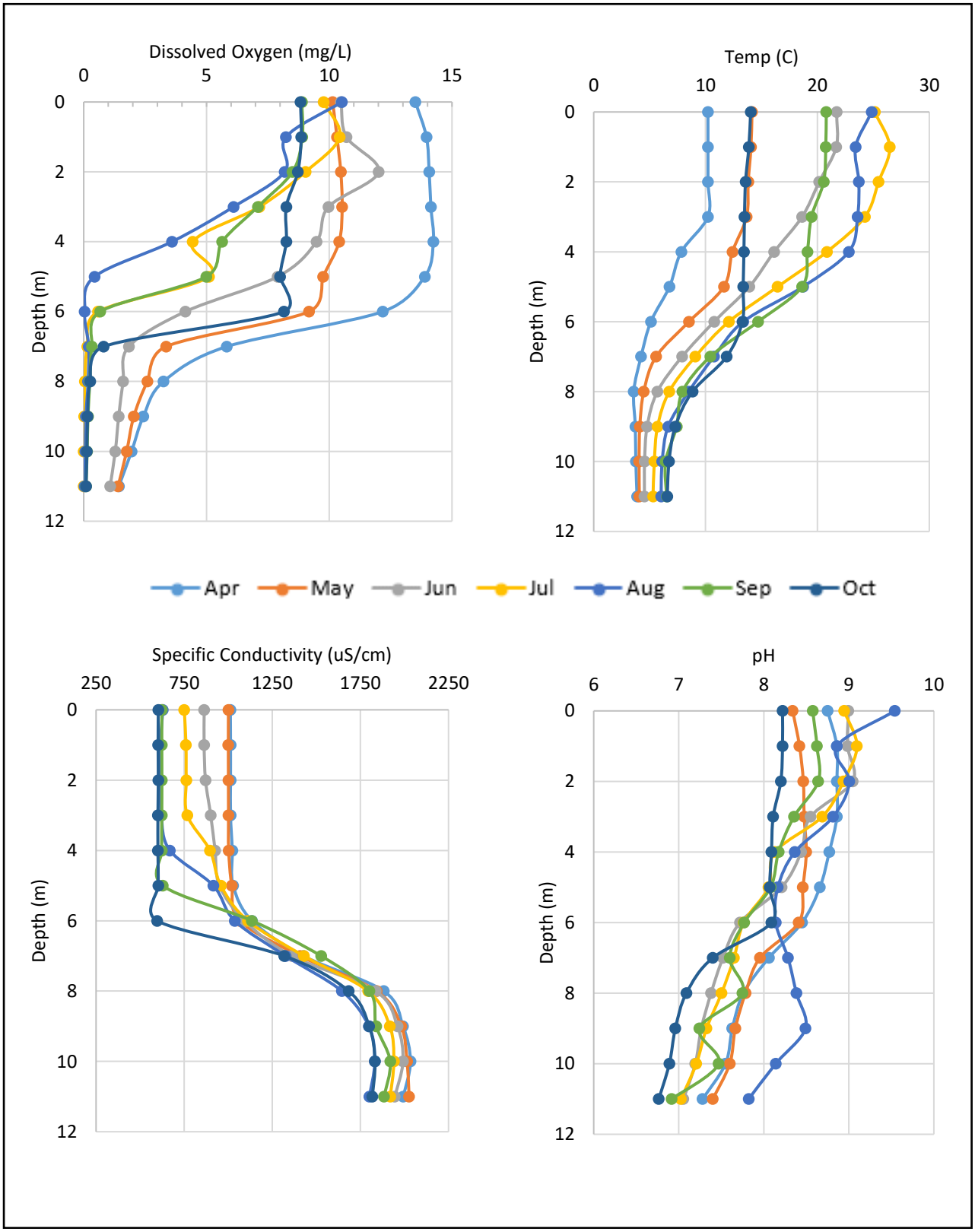


Figure 3.1.8 Sonde readings for dissolved oxygen, temperature, specific conductivity and pH with depth (from the surface of the lake to near the bottom) averaged by month at Parkers Lake

Concentrations

Table 3.1.8 Number of samples collected at the Surface (S), top of the hypolimnion (M) and bottom (B) of Parkers Lake with average, minimum and maximum concentrations for Total Phosphorus, Soluble Reactive Phosphorus, Total Nitrogen, Chlorophyll-A and Chloride for the entire sampling season

	TP (ug/L)				SRP (ug/L)				TN (mg/L)				Cl (mg/L)				CHL-a (ug/L)			
Site	#	Ave	Min	Max	#	Ave	Min	Max	#	Ave	Min	Max	#	Ave	Min	Max	#	Ave	Min	Max
PAR																				
S	13	28	13	62	13	6.0	2.0	11	13	0.63	0.01	0.91	6	183	126	232	13	14	0.3	46
M	13	42	15	85	13	14.5	1.7	40												
B	13	720	354	1,144	13	552	103	1,127					6	385	92	502				

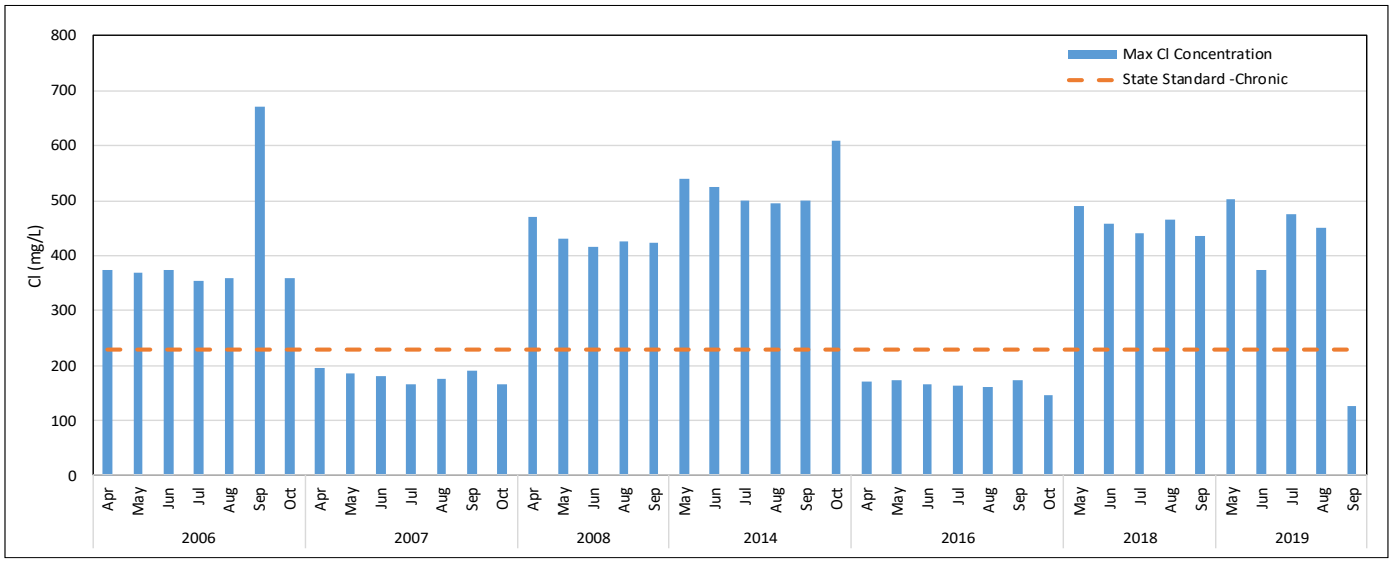


Figure 3.1.9 Maximum monthly chloride concentration versus MPCA standard at Parkers Lake. When standard is exceeded, there may be more than 1 exceedance in that month; an impaired lake is defined as 2 or more standard exceedances in any 3 year window over the past 10 years

Discussion

Figure 3.1.6 shows the Parkers Lake watershed and some characteristics of the watershed. Figure 3.1.7 shows the concentrations of total phosphorus, chlorophyll-a and secchi depths. Table 3.1.8 lists the concentrations for the sampling season. Figure 3.1.9 shows the monthly maximum chloride concentration and standard exceedances.

Water Quality

- Parkers Lake is meeting, and has been meeting, water quality standards for TP, Chl-A and secchi readings
    - 6 of the 15 monitoring years have Chl-A concentrations at or just over the standard
- In 2019, with record precipitation, water quality standards for nutrients were still met
    - Highest surface TP concentartions (62 ug/L) occurred in April
    - August had an algae bloom that reduced water clarity
    - Bottom TP concentrations ranged from 354 up to 1,144 ug/L
    - SRP to TP ratio:
        - Surface: on average, SRP makes up 23% of TP
        - Bottom: on average, SRP makes up 76% of TP
- The lake is impaired for chlorides
    - 11 exceedances of state standard over the past 2 years
    - Concentrations are higher at bottom of the lake than surface
    - High concentrations persist throughout sampling year

Sonde profiles

Figure 3.1.8 shows the sonde profiles for dissolved oxygen, temperature, specific conductivity and pH averaged by month.

- Stratification
    - April: Already stratified when sampling began
    - October: Still stratified at about 7 meters when sampling ended
- Oxygen levels
    - Starting in July, bottom dissolved oxygen levels were less than 1 mg/L
    - July and August: Shallowest oxygenated profiles at about 5 meters
        - Occurred during sampling events with higher surface temperatures
- Specific conductivity is higher in Parkers Lake than other lakes partially due to the high chloride levels
    - The highest surface values are in April and May
    - High levels near the lake bottom persist throughout sampling

3.2. Medicine Lake Watershed

The Medicine lake watershed is 11,666 acres that consists of several municipalities. Most of the watershed is in the City of Plymouth (10,268 acres). Two sites that drain directly to Medicine Lake were monitored, as well as, two sites that drain to Parkers Lake (Figure 3.2.1).

- Monitoring sites account for 55% of the watershed drainage acreage to Medicine Lake
- Medicine Lake has been classified as impaired for excess nutrients since 2004
- Plymouth Creek was classified as impaired for Chlorides and E. Coli in 2014

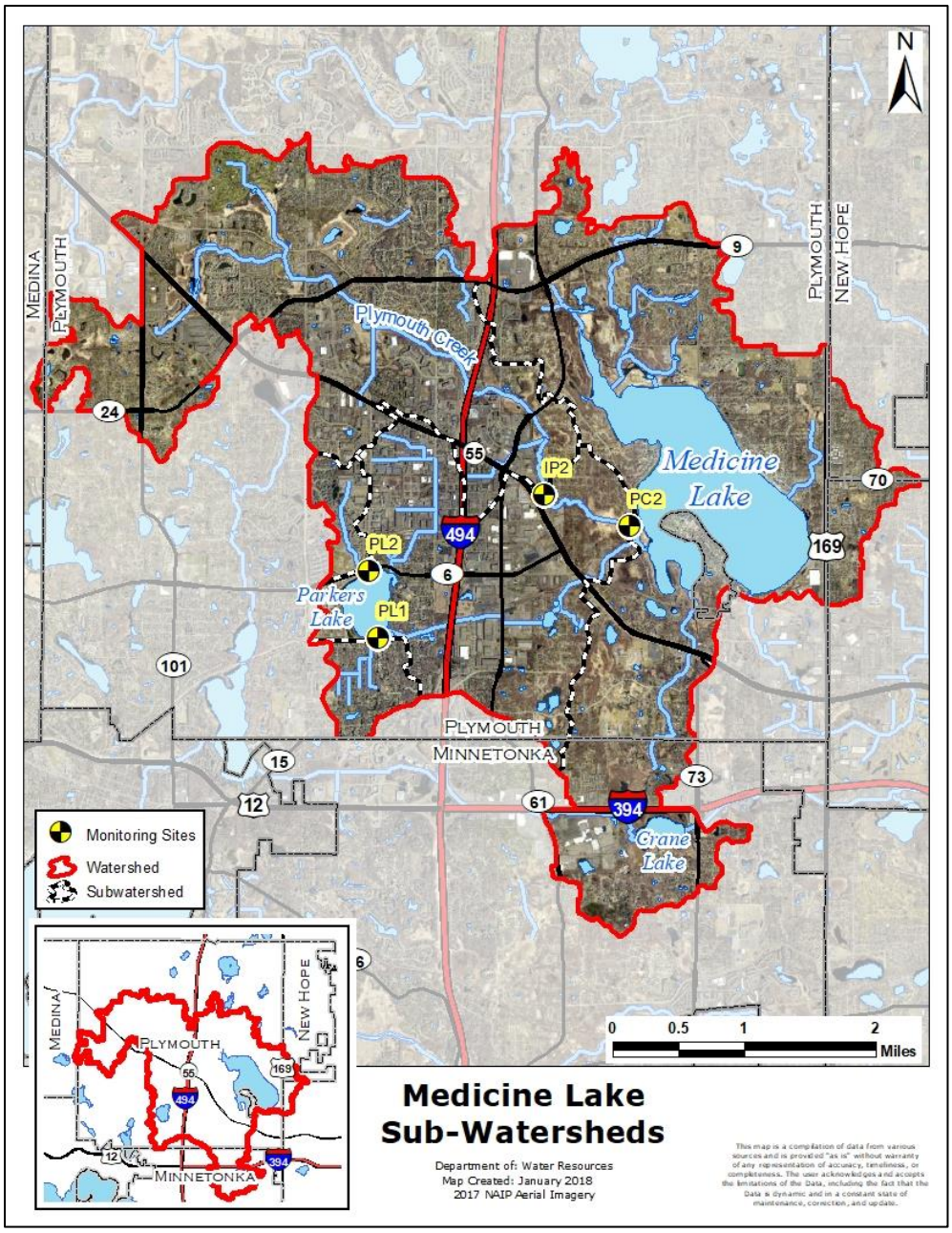


Figure 3.2.1 Medicine Lake sub-watershed map

3.2.1. Stormwater Monitoring Sites

Two stormwater sites were monitored in 2019. IP2 (Industrial Park site 2) and PC2 (Plymouth Creek Site 2) are on the west side of Medicine Lake along Plymouth Creek. Table 3.2.1 lists some aspects of the monitored watersheds.

- IP2
    - Located behind an industrial building at 12940 Teakwood Ln N
    - 14-foot-wide rectangular weir structure
    - Monitors nutrient loading from the upstream portions of Plymouth Creek prior to discharging into a wetland complex
    - 2017-2018: streambank stabilization occurred upstream of IP2
- PC2
    - 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 held by a corrugated weir
        - Upstream of Medicine Lake and becomes stagnant due to lake effect
    - 2009-2010: two detention ponds installed upstream of monitoring location to reduce nutrient loading and reduce flooding impact
    - 2010-2011: stream restoration project upstream of monitoring location to improve conveyance of water

Table 3.2.1 Summary of watershed characteristics for sites IP2, PC2 and ML3

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. Measured Flow

The IP2 monitoring site is upstream of PC2 and therefore has lower flows. Due to the large size of the watersheds, several large wetlands and constructed retention ponds in the watershed, there is a lag time before the stream flow pulse after a precipitation event (Figure 3.2.2).

- For the most part, PC2 had higher flows than IP2
    - Flows higher at IP2 than PC2: 2 instances (7/18 and 8/18)

        - Storage ponds between sites may have reduced storm surge at PC2
- Different storm events resulted in the largest average daily flows for PC2 and IP2
    - IP2: 92 cfs on 7/17 after highest precipitation event of 2.85 on July 15th
    - PC2: 75 cfs on 5/23 after multi-day precipitation events

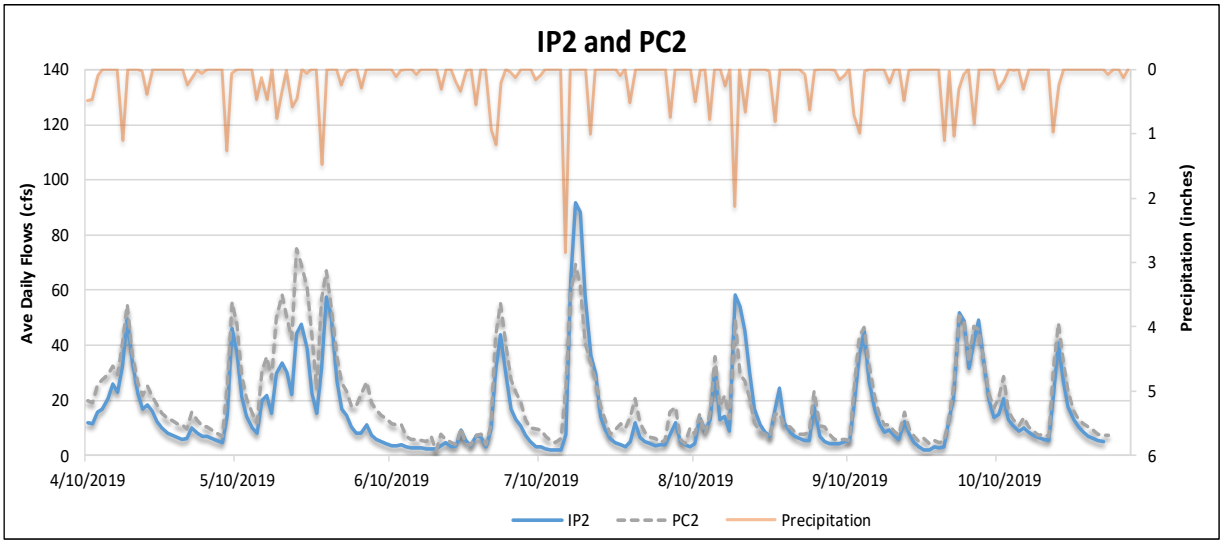


Figure 3.2.2 Average daily flow for Industrial Park site 2 (IP2) and downstream Plymouth Creek Site 2 (PC2)

3.2.3. Concentrations

Summary of Table 3.2.2, Figure 3.2.3 and Figure 3.2.4.

- Number of water samples collected:
    - IP2: 29 samples including 12 automated composites and 17 grab samples
    - PC2: 25 samples including 8 automated composites and 17 grab samples
- Concentrations of TP, SRP, TN and Cl were within 20% for the 2 sites
- Concentration of TSS was 60% higher at downstream PC2 site
- Both IP2 and PC2 are impaired for chlorides
    - More than 2 exceedances in the past 3 years
        - IP2 – 11 exceedances
        - PC2 – 4 exceedances
- SRP to TP ratio: on average, SRP made up 42% of TP at both IP2 and PC2

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	129 (65 - 237)	55 (8 - 122)	1.3 (0.9 - 2.5)	12.7 (1.6 - 60.4)	118 (40 - 250)
PC2	117 (42 - 350)	49 (6 - 109)	1.2 (0.8 - 4.3)	19.8 (1.3 - 158.0)	121 (44 - 250)

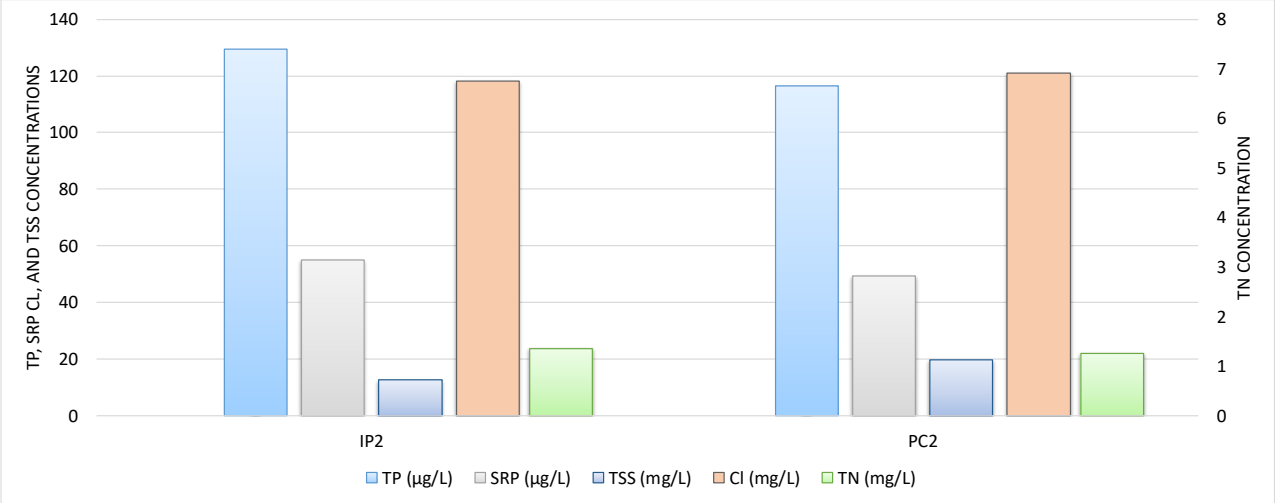


Figure 3.2.3 Average concentrations of TP, SRP, TSS chlorides and TN for the Medicine Lake Watershed sites including IP2 and PC2

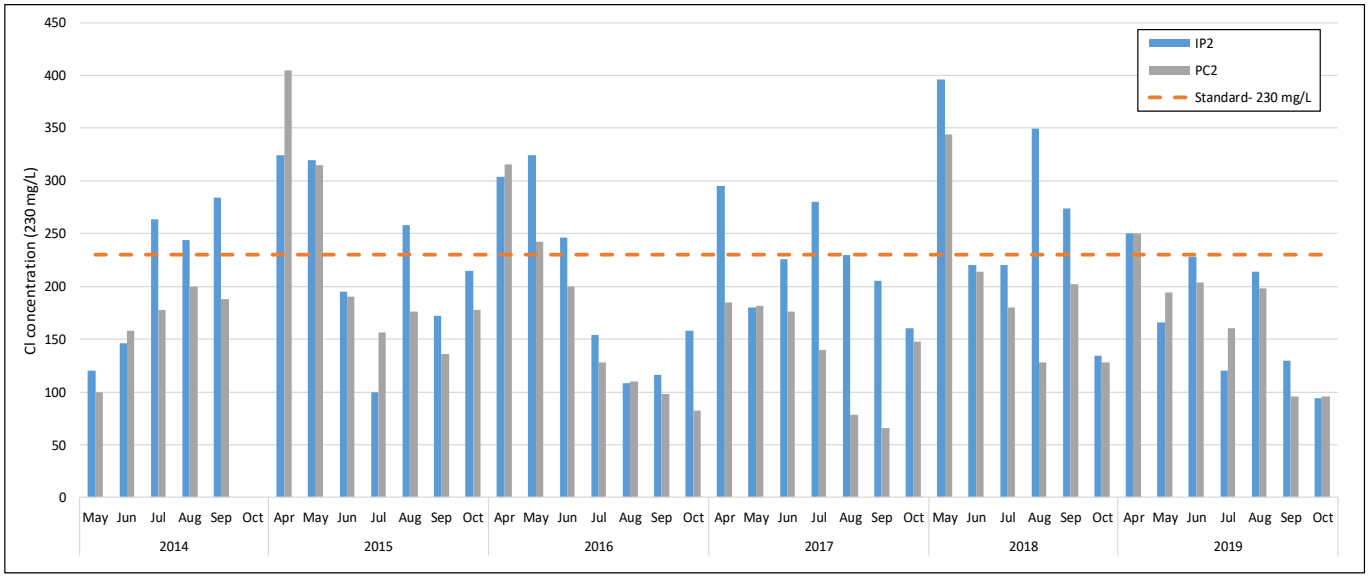


Figure 3.2.4 Maximum monthly chloride concentration at IP2 and PC2 versus the MPCA chloride standard. When standard is exceeded, there may be more than 1 exceedance in that month; An impaired stream is defined as 2 or more standard exceedances in any 3 year window over the previous 10 years

3.2.4. Loading

The yearly loading at IP2 and PC2 are segmented as before 2012 and 2012 and later.

Comparing the data since 2012 between the two sites:

- Downstream PC2 flows are 35% higher than at IP2
- Average concentrations and loads are within 20% between the sites
    - In 2019, there was a 35% increase in TSS concentration between IP2 and PC2
        - Led to a 73% increase in loading between the sites

IP2

At IP2, data has been collected since 2004 with breaks in 2007, 2010 and 2011. In Table 3.2.3, are the yearly flow-weighted concentrations and loadings averaged by pre-2012 and 2012 and after.

- Precipitation increased, on average, 5 inches between the monitoring periods
    - Led to an increased flow volume and loading
    - Between 2012 to 2019 there is a positive correlation ($r^2 = 0.78$) between flow and precipitation
- Flow-weighted average concentrations comparing pre-2012 to 2012 and after
    - TP and SRP increased 19% and 11%, respectively
    - TN increased by 40%
    - TSS decreased by 4%
- Loading
    - With the increase in concentration and flow, there was a 29% to 112% increase in loading for the different parameters
- 2016, which had the next highest flow volume, has comparable loadings to 2019
    - Concentrations were lower and flows were higher in 2019 compared to 2016
        - In 2017-2018, a streambank stabilization occurred upstream of IP2, which may be a reason for the lower 2019 concentrations and loadings

In 2019, the flow-weighted chloride concentration of 80 mg/L was the lowest it has been since monitoring began in 2014 (Table 3.2.4).

- Increased precipitation may have diluted the chloride concentration in runoff

The unit area loads (UAL) by year are listed in Table 3.2.5.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.57 lbs/acre versus 1.35 lbs/acre for residential land use
    - TSS: 82 lbs/acre versus 77 lbs/ for residential land use

Table 3.2.3 Loading and flow weighted concentrations for IP2.

IP2 - Industrial Park site 2										
	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 M3)	Annual Precipitation (inches)
2004-2009										
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
2012-2018										
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	161	66	1.81	30	6.06	27.5
2015	2,237	693	17,870	164,959	191	59	1.53	14	3.89	29.1
2016	3,704	1,403	33,662	412,583	183	70	1.67	20	9.16	38.6
2017	1,864	569	19,240	273,001	142	43	1.47	21	5.94	27.8
2018	2,309	746	19,523	306,631	173	56	1.47	23	6.04	30.8
2019	3,092	1,473	29,896	328,862	136	65	1.31	14	10.34	43.3
Average	2,542	1,015	23,831	327,848	165	64	1.54	22	6.89	31.9
% Change	76	66	112	29	19	11	40	-4	56	19

Table 3.2.4 Loading and flow weighted chlorides at IP2 and PC2.

	IP2		PC2	
	Chloride		Chloride	
	Loading	Concentration	Loading	Concentration
Year	(lbs/Yr)	(mg/L)	(lbs/Yr)	(mg/L)
2014	1,651,825	124	3,482,178	127
2015	2,038,841	174	1,512,773	154
2016	2,492,823	123	2,472,477	95
2017	1,515,227	115	1,153,509	96
2018	1,865,496	140	1,901,731	120
2019	1,828,800	80	1,332,400	46
Average	1,898,835	126	2,069,002	106

Table 3.2.5 Unit area loads for TP, SRP, TN, TSS and Chlorides 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
Average	0.57	0.24	5.14	82	510

PC2

At PC2, data was collected since 2001. In Table 3.2.6, are the yearly flow-weighted concentrations and loadings averaged by pre-2012 and 2012 and after.

- The precipitation increased by an average of 3 inches between the monitoring periods
    - 96% increase in flow
- Between 2012 to 2019 there is a weak correlation ($r^2 = 0.35$) between flow and precipitation
    - Site experiences backflow from Medicine Lake
    - Upstream ponds infiltrate water and provide storage capacity
- Flow-weighted average concentrations comparing pre-2012 to 2012 and after
    - All parameters decreased
    - TSS had the largest decrease at 67%
        - 2006-2008 skewed the pre-2012 data higher
- 2006-2008 concentrations are higher than other pre-2012 concentrations
    - Construction occurred in watershed that may have caused higher concentrations and therefore higher loadings
        - Re-alignment of 18th avenue channel to Plymouth Creek (2007)
        - Construction of ponds (2008)

    - With 2006-2008 data removed, average concentrations would not change as much between the pre-2012 and 2012 and later datasets:
        - Decrease TP and TSS each by 24% instead of 31% and 67% respectively
        - Decrease SRP by 28% instead of by 33%
        - Increase TN by 10% instead of decreasing by 9%
- Comparing 2019 data to 2018 data
    - The concentrations were all lower in 2019 despite the flows being almost double
        - The increase in flows resulted in an increase in loadings

In 2019, the flow-weighted chloride concentration of 46 mg/L was the lowest concentration since monitoring began in 2014 (Table 3.2.4).

- The increased precipitation may have diluted chloride concentration in runoff

The unit area loads (UAL) by year are listed in Table 3.2.7.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.35 lbs/acre versus 1.35 lbs/acre for residential land use
        - TP UAL has been lower than MPCA UAL since monitoring began
    - TSS: 75 lbs/acre versus 77 lbs/acre for residential land use
        - 2019 (89 lbs/acre) was slightly over the MPCA UAL

Table 3.2.6 Loading and flow weighted concentrations for TP, SRP, TN and TSS at PC2. The data is segmented based on the before and after pond installation and stream stabilization. The % change compares the average loadings and concentrations before and after the restoration work

PC2 - Plymouth Creek Site 2										
	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)
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
After ponds and stream restoration										
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	125	59	1.29	25	12.42	27.5
2015	1,289	599	12,577	104,856	131	61	1.28	11	4.46	29.1
2016	3,846	1,899	35,957	494,863	147	73	1.37	19	11.88	38.6
2017	1,323	622	15,689	255,076	110	52	1.30	21	5.13	27.8
2018	2,296	827	23,727	331,692	145	52	1.50	21	7.18	30.8
2019	3,489	1,278	35,260	569,318	120	44	1.21	20	13.22	43.3
Average	2,462	1,095	25,100	388,835	135	59	1.35	20	9.28	31.9
% Change	18	26	66	-28	-31	-33	-9	-67	96	9

Table 3.2.7 Unit area loads for TP, SRP, TN, TSS and Chlorides at PC2

Plymouth Creek Site 2 - PC2					
	Load/Acre				
Year	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
Average	0.35	0.15	3.02	75	324

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, which is 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 City of New Hope's website
- Northwood Lake has been classified as impaired for excess nutrients since 2004

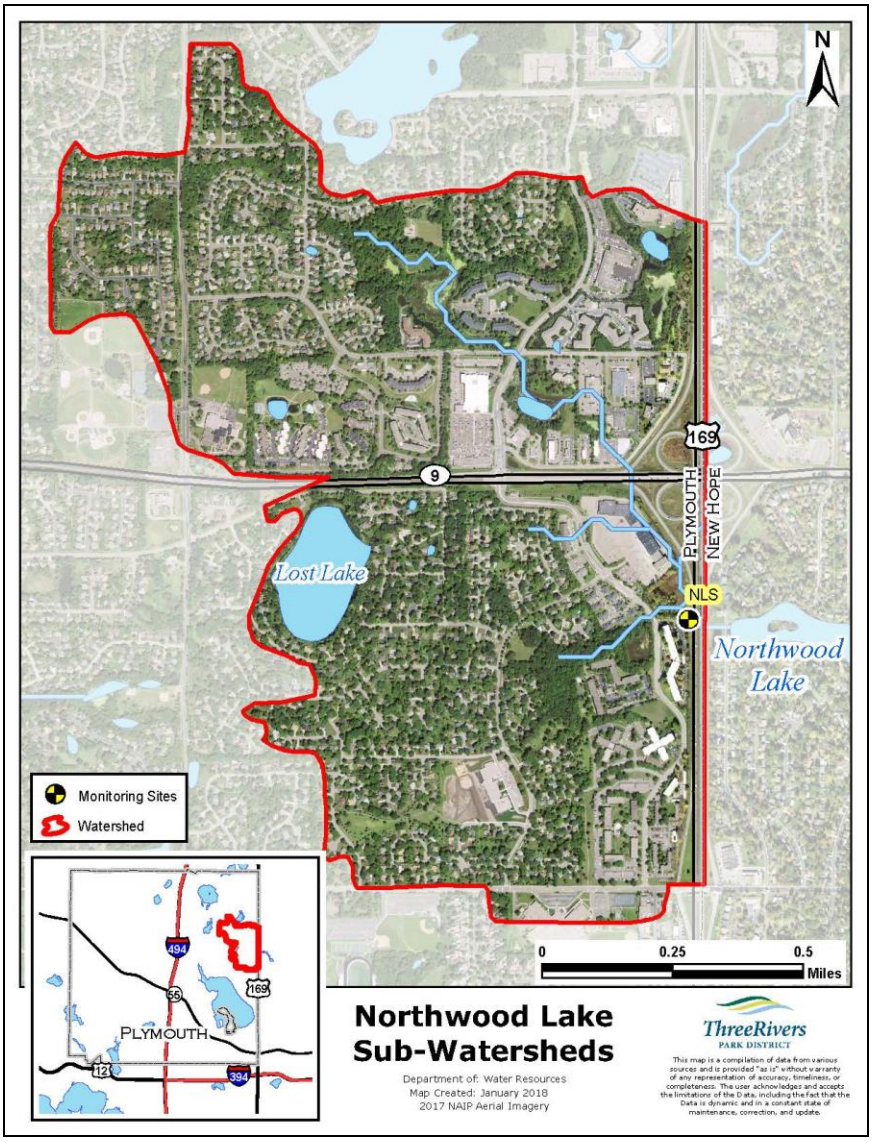


Figure 3.3.1 Northwood Lake Sub-watershed map

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 apartment complex at 3940 Lancaster Ln N
- In a six-foot culvert just before the stream flows under Highway 169
- Site receives runoff from two tributaries (Figure 3.3.1)
    - One branch from the north and the other from the west
    - In 2018, the west branch was more turbid and carrying more sediment

Table 3.3.1 Summary of watershed characteristics for NLS

Site	*Sub watershed Area (acres)*	*% impervious (acres)[1]*	*% of Watershed in Plymouth*	*Dominant land uses[2]*
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. Measured Flow

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
    - 18.5 cfs after 2nd largest precipitation event of 2.12-inches on August 18th

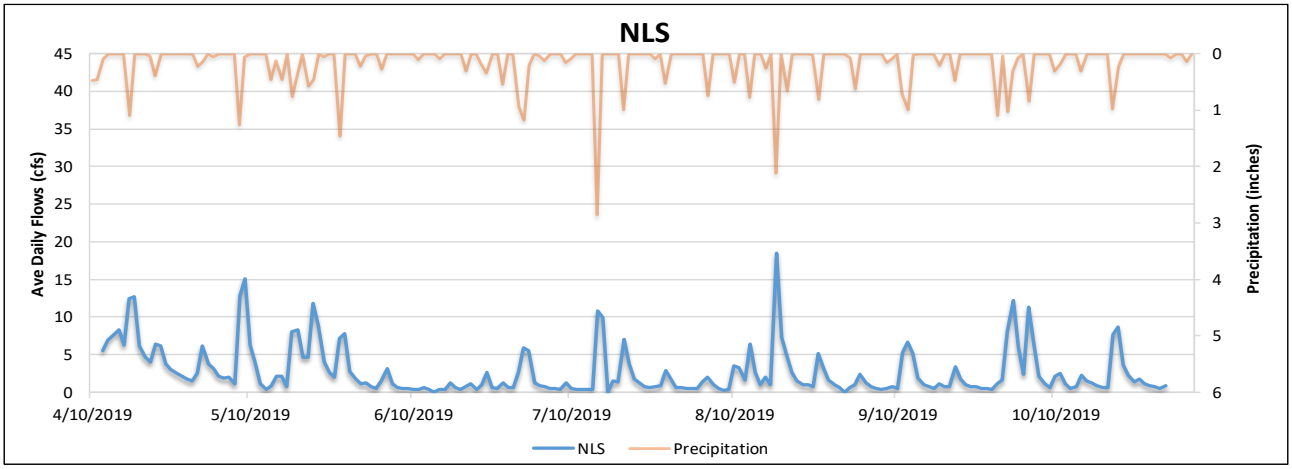


Figure 3.3.2 Average daily flow for Northwood Lake Sub-watershed (NLS)

3.3.3. Concentrations

Summary for Table 3.3.2.

- Number of water samples collected:
    - 25 samples including 13 automated composites and 12 grab samples
- Composite sample from 7/15, the largest precipitation event of the season, had the highest TP concentration (639 µg/L) and TSS concentration (410 mg/L) for the season
- SRP to TP ratio: on average, SRP made up 29% 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	**175 (72 - 639)**	**51 (8 - 107)**	**1.8 (0.8 - 4.9)**	**65.8 (1.0 - 410.0)**

3.3.4. Loading

At NLS, water quality has been monitored since 2012 (Table 3.3.3).

- In 2016, several stormwater infrastructure projects occurred adjacent to Northwood Lake that seemed to affect the flows at the monitoring station
    - The projects created less flow by ponding the water
        - Average flows decreased by 28% in 2016-2019 compared to 2012 to 2015 despite an average increase of 6 inches of precipitation
        - Between 2017 to 2019 there has been a positive correlation ($r^2 = 0.99$) between flow and precipitation
            - There was a positive correlation from 2012-2015 ($r^2 = 0.78$)
            - A shift in data between these two time periods supports that the flow regime changed
    - 2019 was the first-year nutrient concentrations decreased since 2016
        - With more stagnant flow, the sediment is settling out creating a berm of sediment upstream of the monitoring station
        - Apartment complexes, along western tributary, finished construction projects that may have contributed to higher 2018 TSS loading
- Flow, flow-weighted concentrations and loading:
    - Increased precipitation of about 12 inches between 2018 to 2019
        - Led to increase in flow of 28%
    - Flow weighted concentrations of TP, SRP and TSS:

        - All about 50% lower in 2019 compared to 2018
    - Loading
        - Loading of TP, SRP and TN were all lower in 2019 compared to the 2012-2016 average (prior to stormwater improvement projects)
        - TSS loading increased by 17% in 2019 compared to the 2012-2016 average, but decreased by 40% compared to 2018

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

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 1.05 versus 1.35 lbs/acre for residential land use
        - 6 of the 8 monitored years are lower than MPCA TP UAL
    - TSS: 353 versus 77 lbs/acre for residential land use
        - Has been almost 5 times higher than MPCA UAL 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	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
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

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
Average	1.05	0.38	9.37	353

3.4. Bass Lake Watershed

The Bass Lake watershed is 3,105 acres and is located entirely within the City of Plymouth. The largest sub watershed of Bass Lake is monitored at BL3 (Bass Lake Site 3), accounting for about 59% of the Bass Lake watershed area (Figure 3.4.1).

- 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

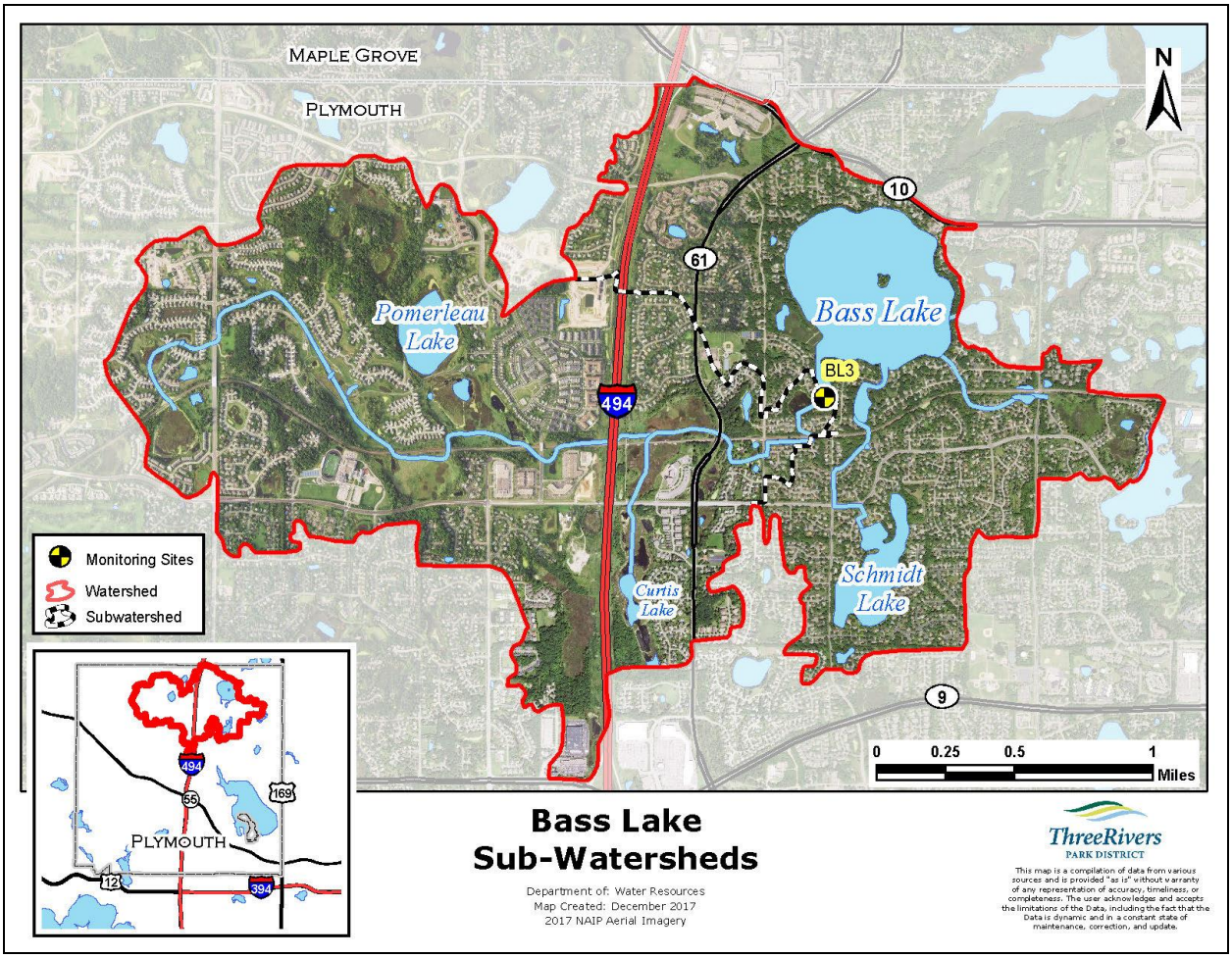


Figure 3.4.1 Bass Lake sub-watershed map

3.4.1. Stormwater Monitoring Site

The BL3 (Bass Lake Site 3) sampling site is located 0.1 miles southeast of the 54th Ave N and Norwood Lane North intersection along a private driveway. Details of the watershed are listed in Table 3.4.1.

- Located at the outfall of a 6.5-acre pond that attenuates flow and allows settling of particulates
- Has two adjacent 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 are applied to total flow from both culverts to estimate nutrient loading

Table 3.4.1 Summary of watershed characteristics for site BL3

Site	*Sub watershed Area (acres)*	*% impervious (acres)[1]*	*% of Bass Lake Watershed*	*Dominant land uses[2]*
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. Measured Flow

With BL3 having a pond just upstream of the monitoring site, the site does not respond as quickly to rainfall events and so there is a delayed peak after a storm event and a prolonged flow period (Figure 3.4.2).

- Measured flow of east culvert was 9% lower than measured flow in west culvert
    - West culvert sits slightly lower than east culvert, resulting in slightly more flow
- Largest average daily flow event of east and west culvert combined
    - 28 cfs on 7/16 after largest precipitation event of 2.85 inches on 7/15
- Has a sustained baseflow

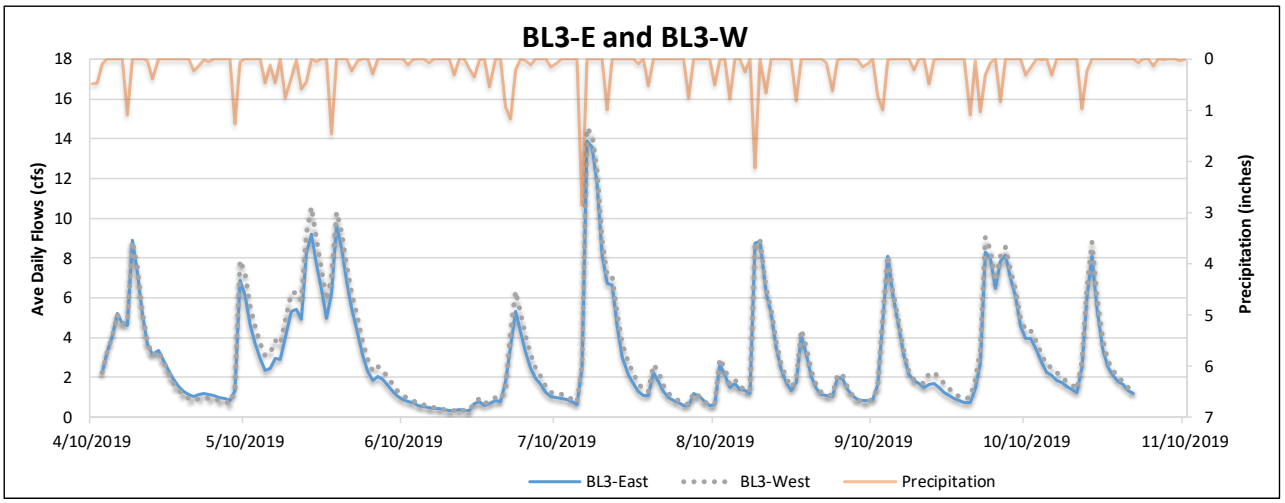


Figure 3.4.2 Average daily flow for Bass Lake Site 3 East and West (BL3-E and BL3-W)

3.4.3. Concentrations

Summary of Table 3.4.2.

- Number of water samples collected:
  - 24 samples: 7 automated composites and 17 grab samples
- SRP to TP ratio: on average, SRP made up 46% 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	**93 (28 - 233)**	**43 (7 - 135)**	**1.2 (0.6 - 1.9)**	**3.9 (0.8 - 17.2)**

3.4.4. Loading

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

- With increased precipitation of about 12 inches between 2018 to 2019, there was an increase in flow of 71%
  - From 2015 to 2019 there has been a positive correlation ($r^2 = 0.78$) between flow and precipitation
- Flow-weighted concentrations of TP, SRP, TN and TSS
  - All lower in 2019 compared to 2018
  - All lower in 2019 than average of 2015-2019
  - Similar to 2017 concentrations

- Loading
    - With the increase in flows and decrease in concentrations in 2019
        - TP, SRP and TSS loading are within 10% of average 2015-2019 loading
        - TN loading is within 23% of average 2015-2019 loading

The unit area loads (UAL) by year are listed in Table 3.4.4.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.38 versus 1.35 lbs/acre for residential land use
    - TSS: 16 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										
	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)
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
Ave	695	290	7,973	29,547	108	44	1.23	4.7	2.75	33.9

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

Bass Lake - Site 3				
	Load/Acre			
Year	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
Average	0.38	0.16	4.32	16

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). One site was monitored upstream of Gleason Lake along Gleason Creek (GC-1). This site receives runoff from 62% of the watershed area. Gleason Lake has been classified as impaired for excess nutrients since 2010.

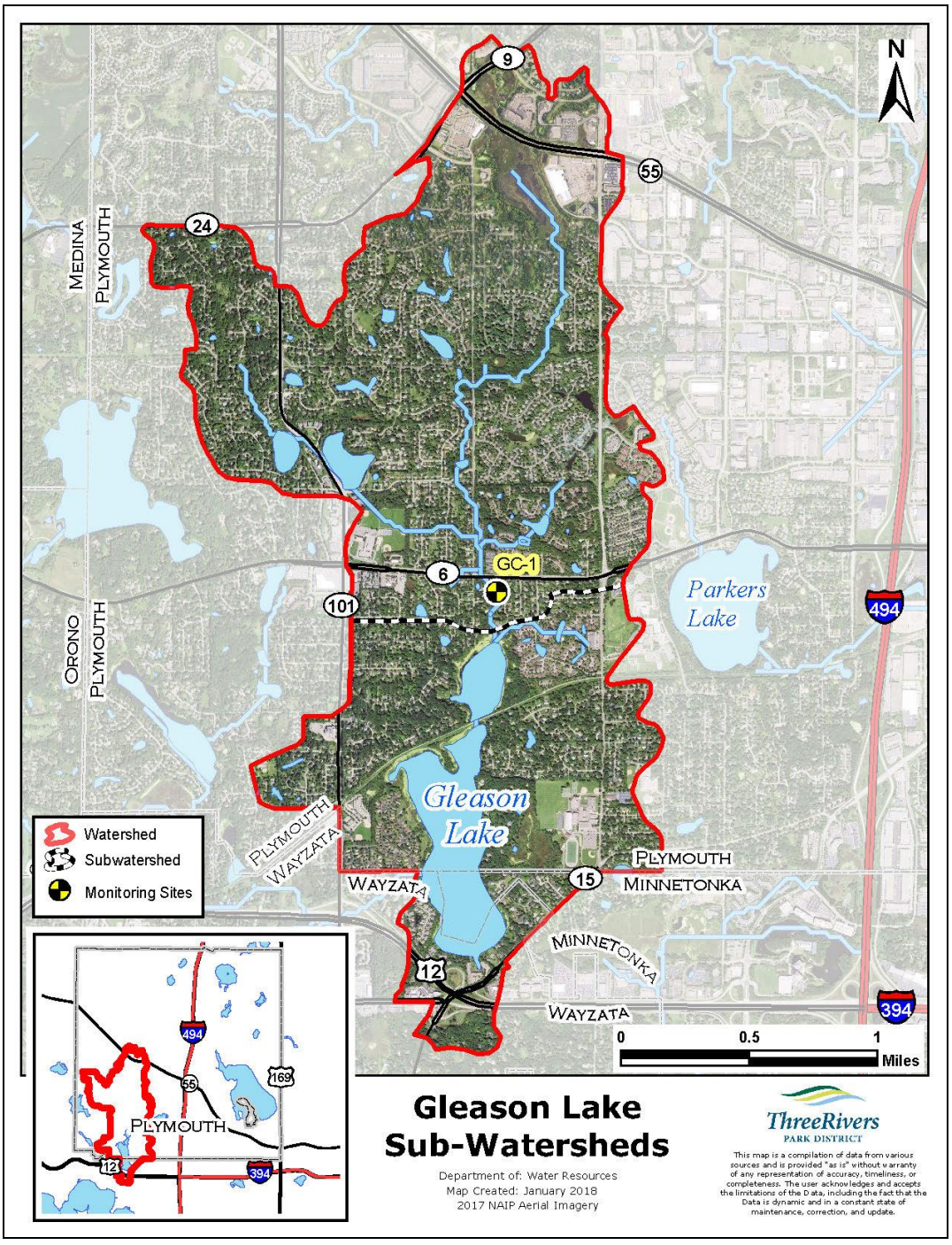


Figure 3.5.1 Gleason Creek sub-watershed map

3.5.1. Stormwater Monitoring

The GC-1 (Gleason Creek site 1) monitoring site is an open channel just north of Gleason Lake off a bike path that connects Highway 6 and Black Oaks Lane North. Details of the site are listed in Table 3.5.1.

Table 3.5.1 Summary of watershed characteristics for sites GC-1

Site	*Sub watershed 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. Measured Flow

The GC-1 flow responds immediately following precipitation events, but has a delayed receding limb following storm events that persists for several days (Figure 3.5.2).

- Largest average daily flow event
  - 21.7 cfs on 7/16 after largest precipitation event of 2.85 inches on 7/15
  - Over the sampling period, the average flow was 4.3 cfs

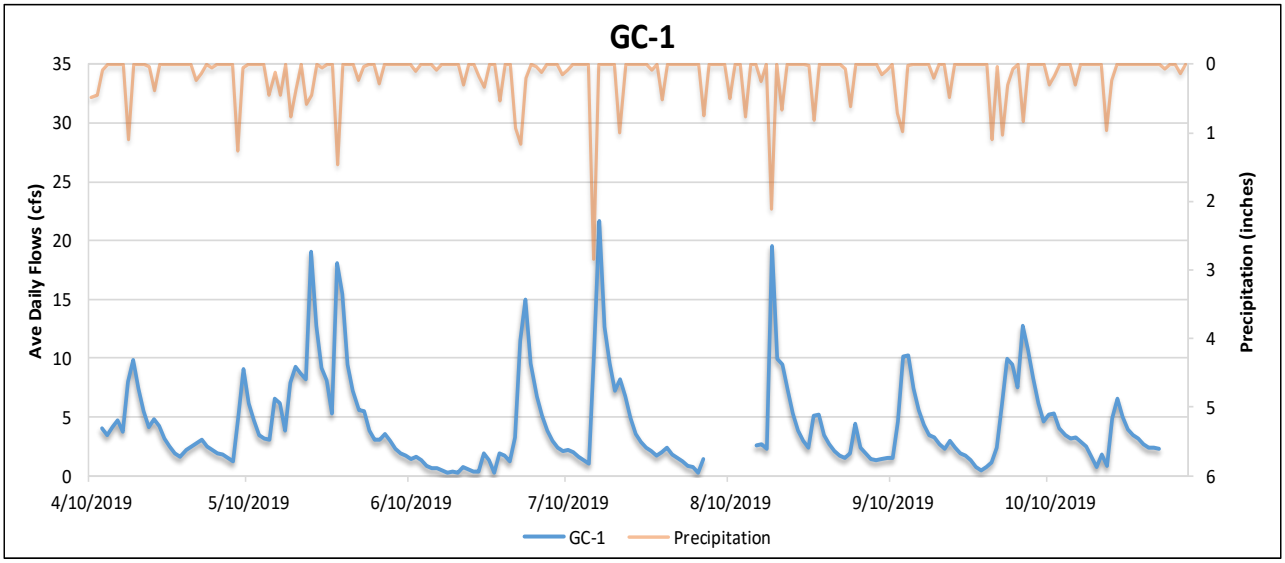


Figure 3.5.2 Average daily flow for Gleason Creek site 1 (GC-1)

3.5.3. Concentrations

Summary of Table 3.5.2

- Number of water samples collected:
    - 25 samples: 8 automated composites and 17 grab samples
    - SRP to TP ratio: on average, SRP made up 40% of TP
    - Chloride concentrations were not over state standard of 230 mg/L

Table 3.5.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS 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	Ave Cl (min-max) mg/L
GC-1	150 (77 - 340)	60 (19 - 96)	1.3 (0.8 - 2.7)	32 (2.4 - 279)	96 (34 - 166)

3.5.4. Loading

At GC-1, data has been collected since 2007 by 2 different agencies. Minnehaha Creek Watershed District (MCWD) and Three Rivers Park District (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 collect 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 total loads
- Increased precipitation of 12 inches between 2018 to 2019, increased flows by 174%
    - From 2017 to 2019 there is a positive correlation ($r^2 = 0.98$) between flow and precipitation
- Flow-weighted concentrations of TP, SRP, TN and TSS
    - All lower in 2019 compared to 2018
    - All 2019 concentrations are within 20% of 2017-2019 average
- Loading
    - With the large increase in flow and decrease in concentrations, the load of all parameters increased compared to 2018:
        - TSS: 20%
        - TP, SRP, TN: Between 100-140%

The unit area loads (UAL) by year are listed in Table 3.5.4.

- Average UAL versus MPCA Stormwater manual UAL
    - TP: 0.40 versus 1.35 lbs/acre for residential land use
    - TSS: 111 versus 77 lbs/acre for residential land use

Table 3.5.3 Loading and flow weighted concentrations of TP, SRP, TN and TSS 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)

GC1 - Gleason Lake Sub watershed										
Year	Nutrient Loading				Nutrient Concentration				Flow Volume (x 106 M3)	Annual Precipitation (inches)
	TP (lbs)	SRP (lbs)	TN (lbs)	TSS (lbs)	TP (µg/L)	SRP (µg/L)	TN (mg/L)	TSS (mg/L)		
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 (2005-2016)	301	117	1,969	19,382	158	53	1.08	11	1.59	28.6
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	160	58	1.36	37	2.85	43.3
Average (2017-2019)	662	200	5,528	183,006	196	53	1.62	58	1.62	34.0

*** 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 and TSS for GC-1

GC-1				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (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
Average	0.40	0.12	3.35	111

3.6. Elm Creek Watershed

A portion of Elm Creek runs through the northwest corner of the City of Plymouth (Figure 3.6.1).

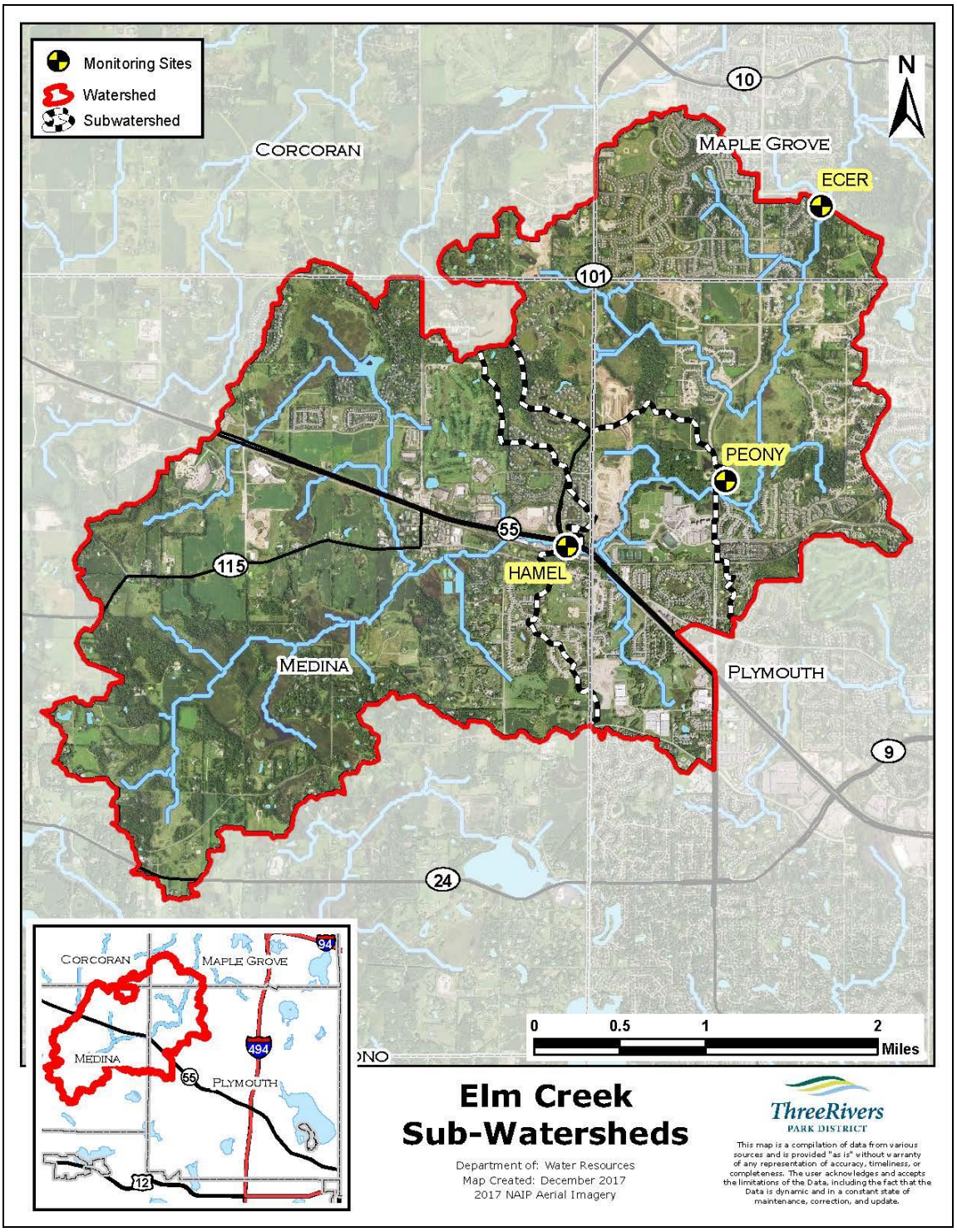


Figure 3.6.1 Elm Creek sub-watershed map

- Elm Creek impairments:
    - Since 2010: E. Coli
    - Since 2014: Chlorides and Dissolved Oxygen
    - 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 installed along the segment of Elm Creek through the City of Plymouth
    - 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 included
        - Large precipitation event on 7/15/19 washed out part of sand filter

3.6.1. Stormwater Monitoring Sites

To assess the portion of Elm Creek that flows through the City of Plymouth, three sites were monitored. Details of the watersheds 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 N
    - Downstream of BMP's completed in 2016 and 2019
    - Site is in floodplain
        - When level rises to about 2.2 ft on staff gauge, a side channel is created that bypasses the mainstream channel
        - More work to be done in the floodplain in 2021
- ECER: After Elm Creek leaves the City of Plymouth
    - Located in Maple Grove on the south side of Elm Road along a walking path
    - 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, Peony and ECER

Site	*Sub watershed 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. Measured Flow

Since these three sites are cumulative, the flow increases with watershed size and distance downstream. There is an increase in the lag time of the flow pulse at downstream sites after a precipitation event due to watershed size (Figure 3.6.2).

- Largest average daily flow events
  - Occurred on 7/16 after the largest precipitation of 2.85 inches on 7/15
    - Hamel: 65 cfs
    - Peony: 74 cfs
    - ECER: 239 cfs
- Flows at Peony are only slightly higher than upstream Hamel
  - ECER flows are nearly double Hamel and Peony flows during rain events

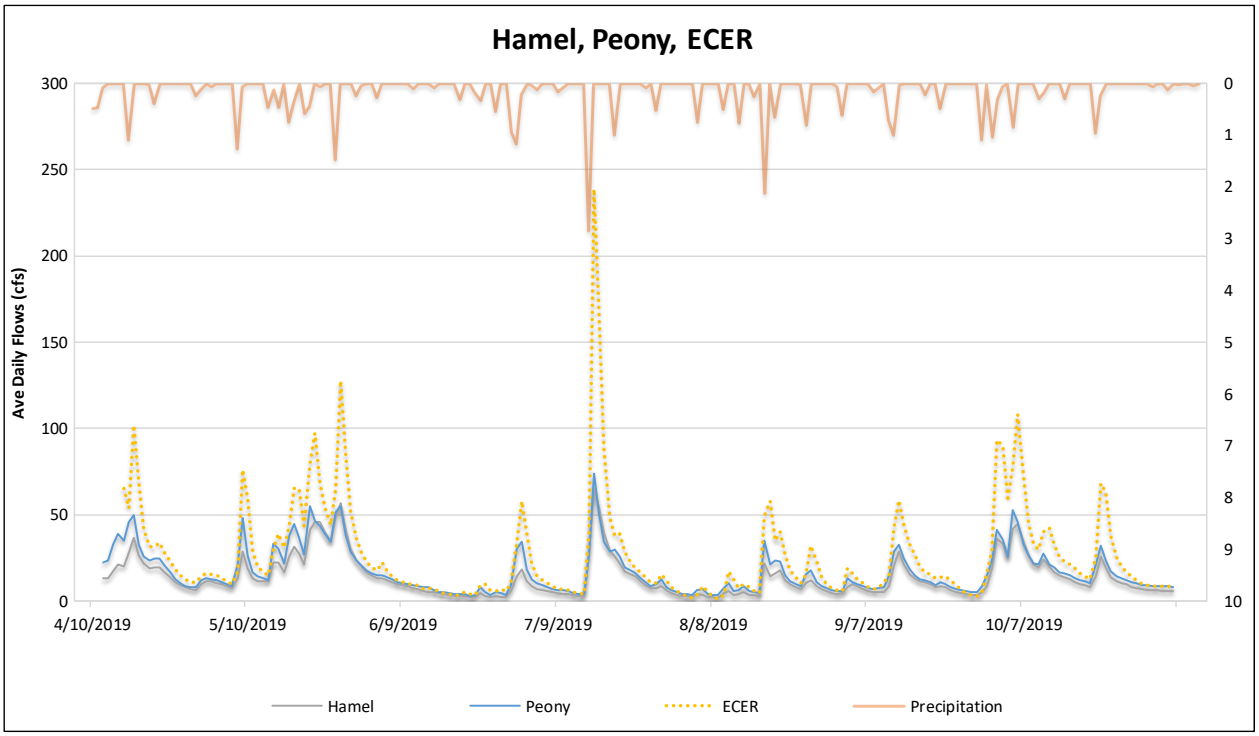


Figure 3.6.2 Average daily flow for Elm Creek watershed sites: Hamel, Peony and ECER

3.6.3. Concentrations

Summary of Table 3.6.2 and Figure 3.6.3. In general, the parameters increase in concentration between Hamel and Peony and then decrease between Peony and ECER.

- Number of samples collected:
    - Hamel: 31 samples: 16 automated composites and 15 grab sample
    - Peony: 31 samples: 15 automated composites and 16 grab sample
    - ECER: 23 samples: 5 automated composites and 18 grab sample
- Sand filter partially washed out on 7/15 resulted in increased TSS concentrations
    - Other parameters also increased but not enough to affect overall average concentration more than 20%
    - Hamel: Upstream of filter; highest concentration of TP, TN and TSS on 7/15
        - When 7/15 TSS concentration is removed from dataset, average concentration is decreased 23% (from 42 to 34 mg/L)
        - While this site was not affected by the filter, this large event increased TSS enough to cause a difference in the average TSS value
    - Peony: Downstream of filter, had highest TP, TN and TSS concentration on 7/15
        - When 7/15 TSS concentration is removed from dataset, average concentration is decreased by 42% (from 176 to 102 mg/L)
    - ECER: Had highest concentrations of TP, TN and TSS on 7/15
        - When 7/15 TSS concentration is removed from dataset, average concentration is decreased by 75% (from 42 to 10 mg/l)
    - Disregarding the washout of the filter, the large wetland complex between Peony and ECER allowed for settling of particulates and reductions in nutrient concentrations of:
        - TSS by 90%
        - TP by 55%; SRP by 25%
        - TN by 45%
- SRP to TP ratio
    - Hamel: On average, SRP made up 29% of TP
    - Peony: On average, SRP made up 34% of TP
    - ECER: On average, SRP made up 52% of TP

Table 3.6.2 Summary of average, minimum and maximum concentrations for TP, SRP, TN and TSS 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
HAMEL	267 (34 - 853)	78 (24 - 226)	2.0 (0.8 - 7.7)	44 (1.2 - 355)
PEONY	392 (78 - 1124)	134 (43 - 295)	2.6 (0.8 - 13.4)	176 (3.2 - 2383)
ECER	200 (59 - 927)	103 (27 - 156)	1.5 (0.8 - 7.0)	42 (1.6 - 737)

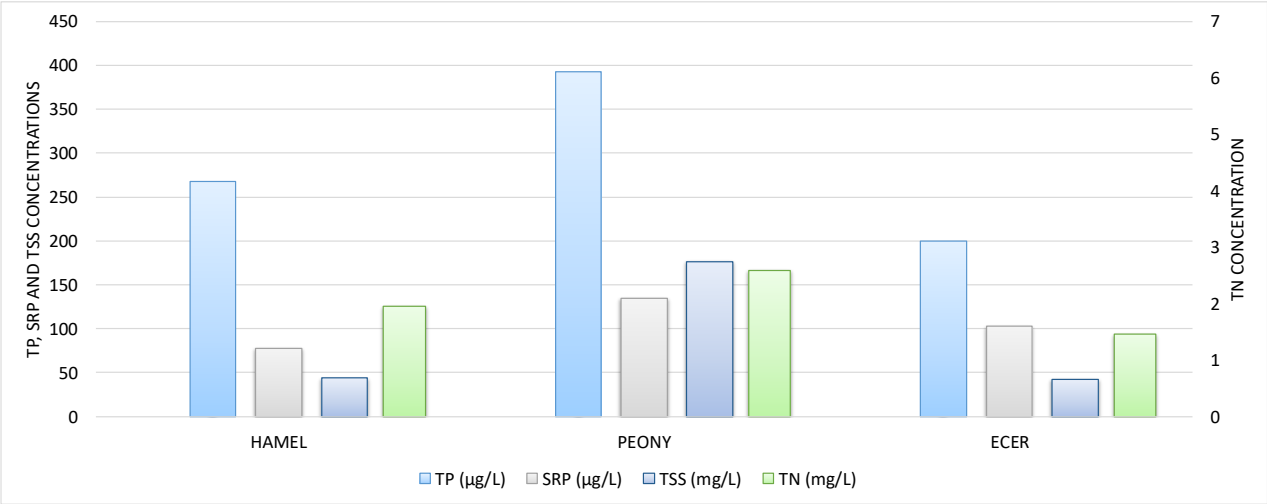


Figure 3.6.3 Average concentrations of TP, SRP, TSS and TN for the Elm Creek Watershed sites including: Hamel, Peony and ECER

3.6.4. Loading

In general, flow weighted nutrient concentrations and sediment loading increases between Hamel and Peony and then decrease between Peony and ECER.

Hamel

At Hamel, data has been collected since 2000 except for 2004-2006 and 2013-2015 (Table 3.6.3). The data is averaged by 2 groupings: prior to 2016 and 2016 and after.

- Comparing flow weighted concentrations of 2016-2019 average to 2000-2012 average:
    - TP and TN are within 20%
    - SRP has decreased by 28%
    - TSS has increased by 45%
- Flow has increased by 119% between the 2 time periods
    - Development in the watershed may have led to increased flows
    - Precipitation has also increased

- There is a weak correlation between flow and precipitation for the entire data set (r^2=0.40); from 2016 to 2019 there is a positive correlation (r^2= 0.99)

- Increased flows and changes in concentrations resulted in increased loading between the 2016-2019 average and the 2000-2012 average:
  - TP and TN increased 127% and 146%, respectively
  - SRP increased by 62%
  - TSS increased by 276%

The unit area loads (UAL) by year for Hamel are listed in Table 3.6.4.

- Average UAL versus MPCA Stormwater manual UAL
  - TP: 0.59 lbs/acre versus 1.35 lbs/acre for residential land use
    - 2019 UAL of 1.17 lbs/acres is about 2x higher than average UAL
    - 3 monitored years had UAL's over the MPCA UAL
  - TSS: 109 lbs/acre versus 77 lbs/ for residential land use
    - 2019 UAL of 310 lbs/acre is about 3x higher than average UAL
    - 7 of the 14 monitored years have TSS UAL's higher than the MPCA UAL with 6 occurring in the past 7 monitoring periods

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

Hamel										
	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)
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	331	111	1.51	25	2.95	31.2
2011	4,021	1,004	36,604	365,365	301	75	2.74	27	6.07	26.3
2012	2,459	853	20,583	645,515	349	121	2.92	92	3.20	26.7
Average (2000-2012)	1,858	721	12,895	260,384	280	113	2.10	49	2.88	28.6
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
Average (2016-2019)	4,221	1,171	31,673	979,154	285	82	2.22	71	6.31	35.1
% Change	127	62	146	276	1	-28	6	45	119	23

Table 3.6.4 Unit area loading for TP, SRP, TN and TSS at Hamel

Hamel				
	Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (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
2011	0.94	0.24	8.57	86
2012	0.58	0.20	4.82	151
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
Average	0.59	0.20	4.27	109

Peony

At Peony, data has been collected since 2016 (Table 3.6.5).

- Flow weighted concentrations were lower in 2019 than 2018 for TP, SRP and TSS
    - TN was similar to 2018
- Increased precipitation of 12 inches between 2018 to 2019, increased flows by 138%
    - Between 2016 to 2019 there is has been a positive correlation ($r^2 = 0.89$) between flow and precipitation
- Loading increased in 2019 due to the increased flows since concentrations were lower

The unit area loads (UAL) by year for Peony are listed in

Table 3.6.6. The UAL's were assessed as the whole watershed and as a subsection of the contributing area minus the upstream Hamel area using the following formula:

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

- Average UAL versus MPCA Stormwater manual UAL in the Hamel to Peony portion
    - TP: 2.83 lbs/acre versus 1.35 lbs/acre for residential land use

        - 2019 UAL of 4.02 lbs/acres is about 40% higher than average
    - TSS: 3,607 lbs/acre versus 77 lbs/ for residential land use
        - 2019 UAL of 4,055 lbs/acre is higher than average UAL

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

Peony										
	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)
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
Ave	7,498	2,311	43,133	5,151,943	442	136	2.47	334	7.68	33.3

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)	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)
2016	2.11	0.47	10.01	789	3.17	0.60	3.77	2513
2017	0.69	0.29	4.15	947	1.84	0.93	4.88	3863
2018	0.95	0.31	5.18	952	2.30	0.63	7.69	3996
2019	1.77	0.64	12.43	1108	4.02	1.79	23.28	4055
Average	1.38	0.43	7.94	949	2.83	0.99	9.90	3607

ECER

At ECER, data has been collected since 2000 except for 2004-2006 and 2013-2015 (Table 3.6.7). The data is averaged by 2 groupings: prior to 2016 and 2016 and later.

- As with Peony, the ECER 2019 flow weighted concentrations were all lower compared to 2018 concentrations
    - 2019 ECER flow weighted concentrations of TP, TN and TSS were lower than all other monitored years
- Increased precipitation of 12 inches between 2018 to 2019, increased flows by 70%
    - There has been a shift in flow versus precipitation values

        - From 2001-2010 there was a positive correlation (r^2=0.72) between flow and precipitation
        - From 2011-2019 there was a positive correlation (r^2 =0.80) between flow and precipitation but the data shifted; there is more flow for the same precipitation
- Loading: With the increased flows and lower concentrations:
    - TP and TN had similar loading in 2019 compared to 2018 and compared to the 2016-2019 average
    - SRP increased by 28% in 2019 compared to 2018
    - TSS decreased by 79% in 2019 compared to 2018
    - Data supports wetland function of reducing sediment,
        - Wetland may be a source of SRP
            - Possibly due to decomposition and anoxia in the wetland

The unit area loads (UAL) by year are listed in Table 3.6.8. The UAL's were assessed as the whole watershed and as a subsection of the contributing area minus the upstream Peony area using the following formula:

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

- Average UAL versus MPCA Stormwater manual UAL in the Peony to ECER portion
    - TP: -0.54 lbs/acre versus 1.35 lbs/acre for residential land use
        - Average for whole watershed: 0.49
    - TSS: -1,617 lbs/acre versus 77 lbs/ for residential land use
        - Average for whole watershed: 73 lbs/acre
    - Shows importance of large wetland complex and how settling of suspended sediments can have a positive impact of water quality

Table 3.6.7 Loading and flow weighted concentrations of TP, SRP, TN and TSS at ECER

ECER - Elm Creek @ Elm Road										
	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)
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	381	218	2.02	77	5.19	31.2
2011	5,615	2,753	18,313	147,238	287	141	1.98	16	9.81	26.3
2012	2,784	1,890	22,641	284,335	209	142	1.70	21	7.08	26.7
Average (2000-2012)	2,974	1,432	15,789	358,984	280	146	1.92	52	4.76	28.6
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
Average (2016-2019)	6,154	2,811	42,935	1,123,273	241	109	1.70	47	11.85	35.1
% Change	107	96	172	213	-14	-25	-12	-10	149	23

Table 3.6.8 Unit area loads for TP, SRP, TN and TSS at ECER along with loadings adjusted for Peony loading

	ECER				ECER adjusted for Peony loading			
	Load/Acre				Load/Acre			
Year	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (lbs/acre)	TP (lbs/acre)	SRP (lbs/acre)	TN (lbs/acre)	TSS (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				
2011	0.71	0.35	2.31	19				
2012	0.35	0.24	2.86	36				
2016	1.04	0.34	6.87	151	-1.31	0.06	0.01	-1239
2017	0.41	0.24	3.37	58	-0.18	0.14	1.68	-1877
2018	0.81	0.37	5.54	296	0.49	0.50	6.30	-1134
2019	0.85	0.47	5.91	62	-1.16	0.10	-8.31	-2217
Average	0.49	0.23	2.97	73	-0.54	0.20	-0.08	-1617

3.6.5. Camelot Lake

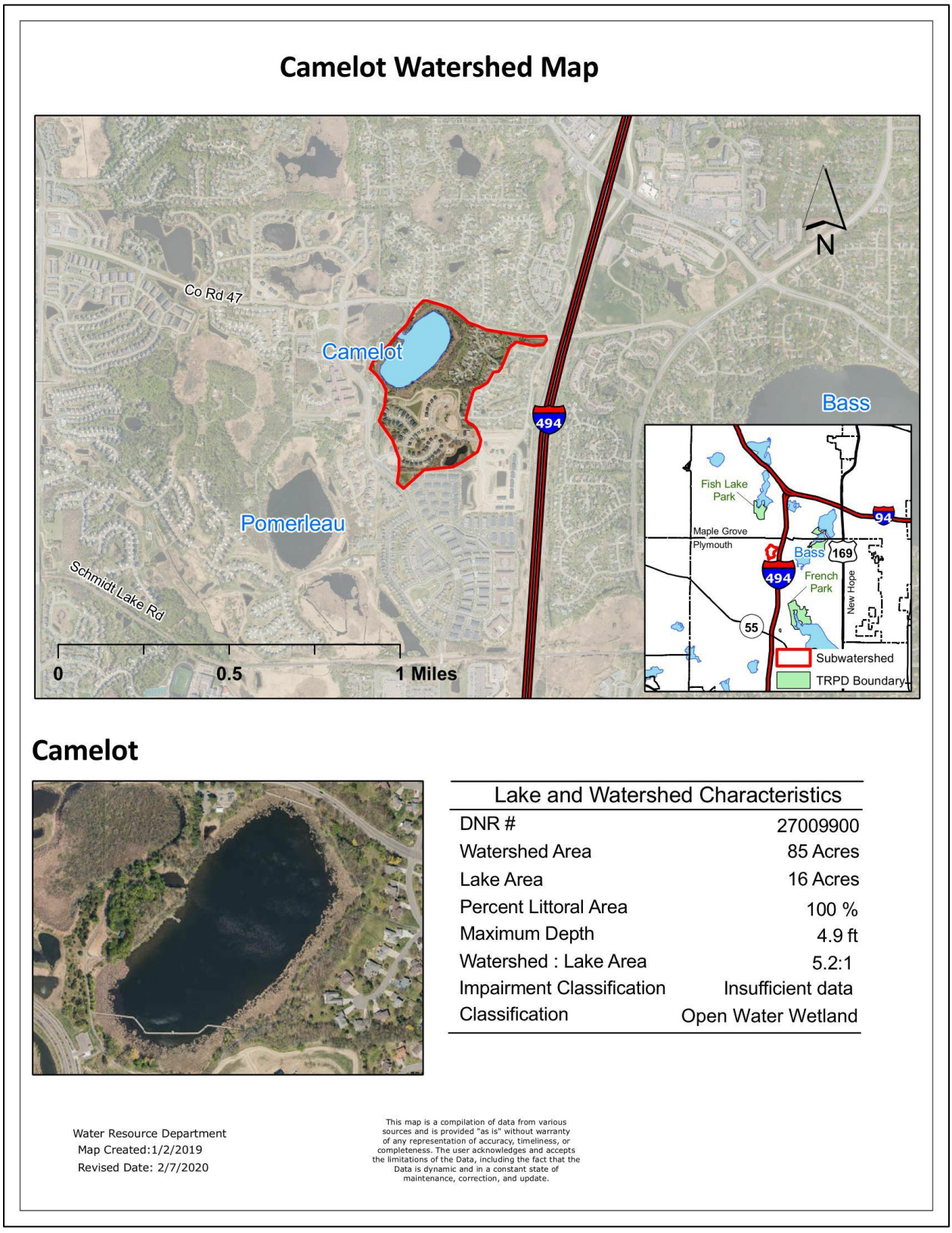
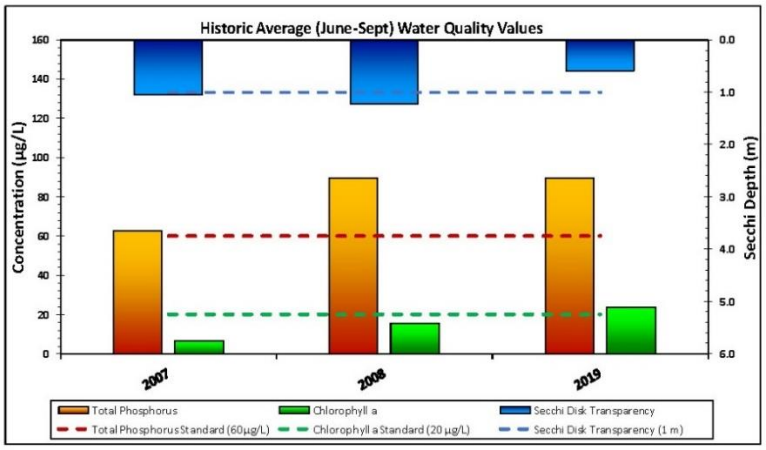


Figure 3.6.4 A summary of the watershed characteristics for Camelot Lake within the Elm Creek Watershed

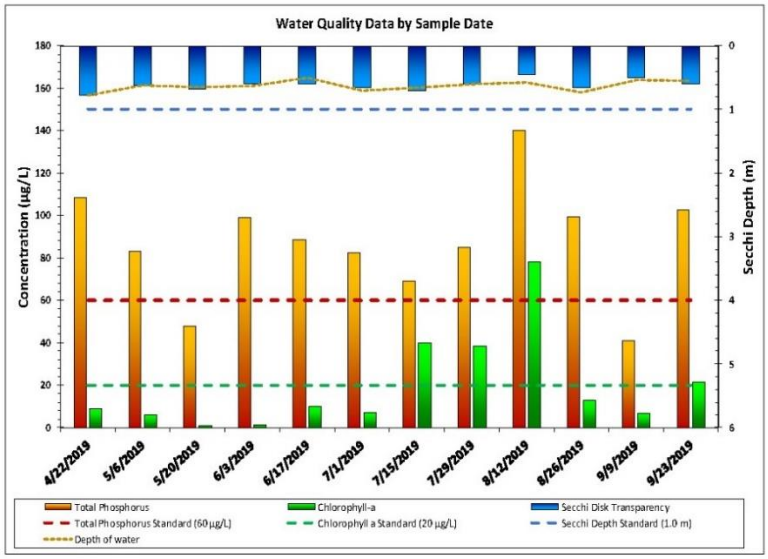


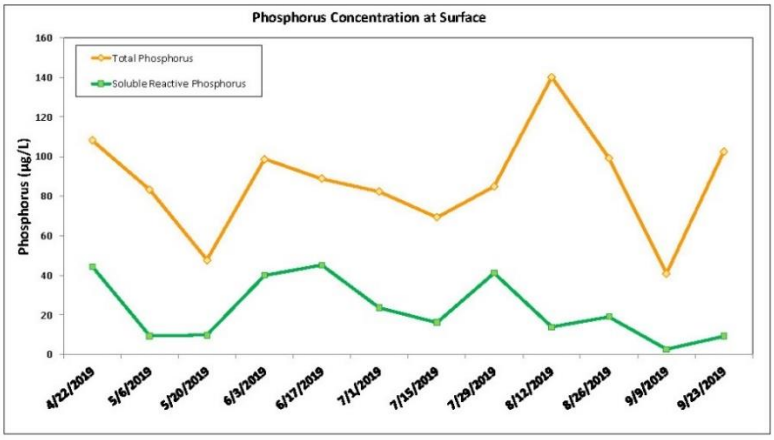
Camelot Water Quality Report Card				
Year	TP	Chl-a	Secchi	Avg Grade
2007	C	A	D	C+
2008	D	B	C	C
2019	D	C	F*	D
MPCA Standard	C	C	D	C-

Met Council Grading System for Lake Water Quality

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

** 2019 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*





ThreeRivers PARK DISTRICT
Division of Water Resources
January 2020

Figure 3.6.5 Summary of the total phosphorus, secchi and chlorophyll-a June-September averages as they relate to the MPCA standards for a shallow lake even though Camelot Lake is classified as a wetland, the results of each 2019 sample, the phosphorus concentrations and a "report card" grade as defined by the Met Council and as the water quality relates to the MPCA guidelines

Sonde results

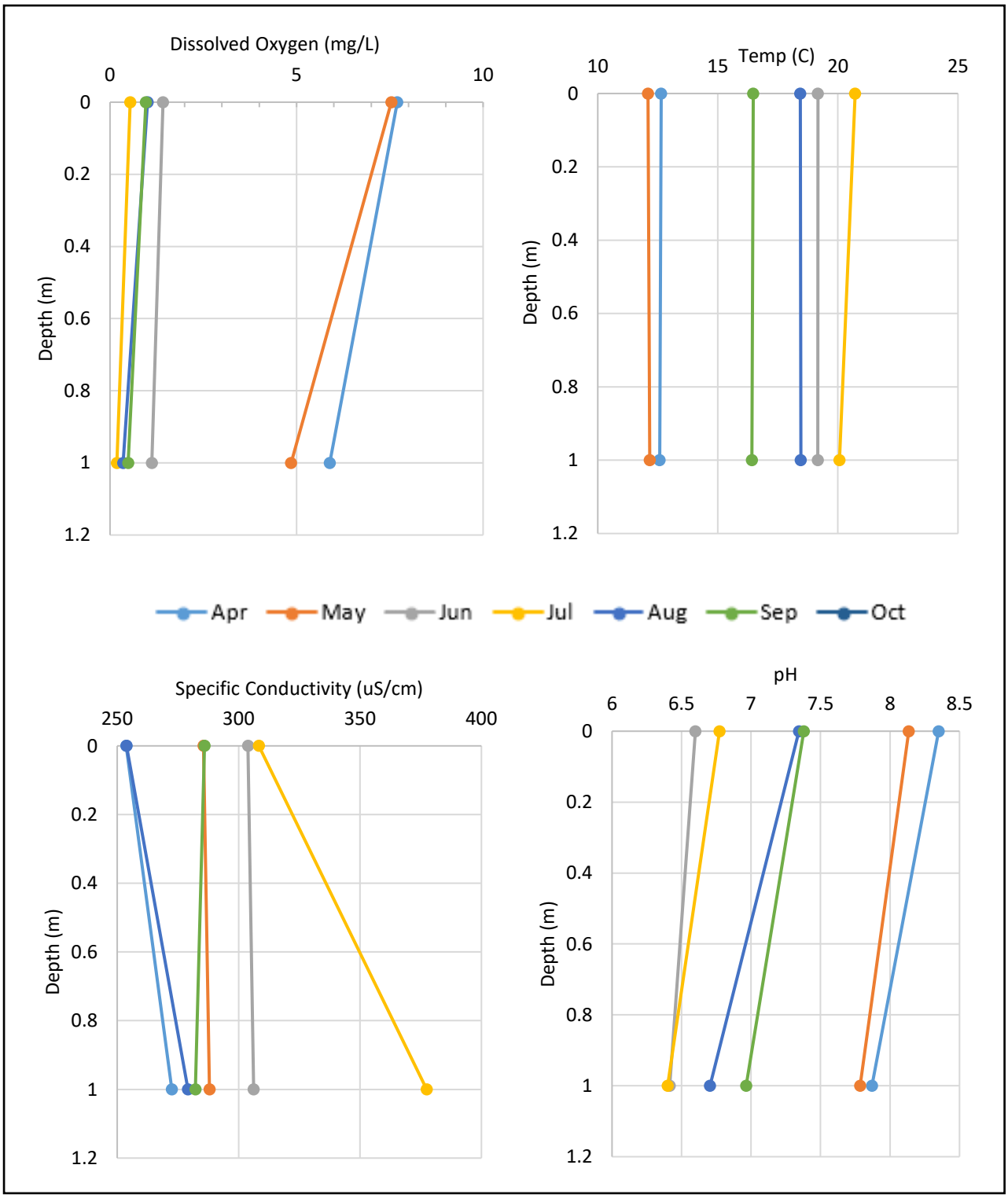


Figure 3.6.6 Sonde readings with depth (from the surface of the lake to near the bottom) averaged by month at Camelot Lake for dissolved oxygen, temperature, specific conductivity and pH

Concentrations

Table 3.6.9 Number of samples collected at Camelot Lake with average, minimum and maximum concentrations for Total Phosphorus, Soluble Reactive Phosphorus, Total Nitrogen, Chlorophyll-A for the entire sampling season

	TP (ug/L)				SRP (ug/L)				TN (mg/L)				CHL-a (ug/L)				
Site	#	Ave	Min	Max	#	Ave	Min	Max	#	Ave	Min	Max	#	Ave	Min	Max	Ave TP:SRP ratio
CAM																	
S	12	87	41	140	12	22.8	2.5	45	12	1.48	0.85	2.82	12	19	0.91	78	26%

Discussion

Figure 3.6.4 shows the Camelot Lake watershed and some characteristics of the watershed. Figure 3.6.5 shows the concentrations of total phosphorus, chlorophyll-a and secchi depths. Table 3.6.9 lists the concentrations for the sampling season.

Water Quality

- Camelot Lake, while called a lake, is classified as an open water wetland in the Circular 39 (Shaw and Fredine, 1956)
    - While there are no standards for wetland water quality, the collected data was compared to the MPCA standards for a shallow lake
- Camelot Lake is not meeting water quality standards for TP or Chl-a concentrations
    - Secchi readings are skewed lower due to the location of the measurement
        - Depth of water is only 0.5-0.8 meters
        - Water quality standards cannot be met at that depth
- Higher chlorophyll-a concentrations started in mid-July and persisted until mid-August
- The highest TP and Chl-a sample was collected August 12th with a TP concentration of 140 µg/L and a Chl-a concentration of 78 µg/L
    - The lowest TP sample was collected September 9th with a concentration of 41 µg/L
- Due to dense vegetation, it is difficult to get water samples without vegetation and organic debris towards the end of August
    - No sample collected in October due to thickness of vegetation
- SRP makes up about 26% of the TP

Sonde profiles

Figure 3.6.6 shows the sonde profiles for dissolved oxygen, temperature, specific conductivity and pH averaged by month.

- 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
- The wetland went anoxic in June and stayed anoxic through September
    - No sample taken in October due to thick vegetation

3.7. Ponderosa Rain Garden (PRG)

An iron enhanced rain garden was installed near 2625 Garland Lane North in the summer of 2016. The water going in and out of the rain garden were monitored during storm events.

- PRG-In: Water samples collected from street runoff flowing into rain garden
- PRG-Out: Water samples collected at outlet of a perforated pipe that runs under the rain garden to a nearby storm drain

3.7.1. Concentration

Summary of Figure 3.7.2 and Table 3.7.1

- Number of samples collected during rain events
    - 10 total: 5 PRG-in and 5 PRG-out
- TP lower in outlet sample compared to inlet sample – occurred on 2 sampling dates
    - First time TP in out sample has been lower than in sample
    - 6/20 decreased by 8%
    - 10/21 decreased by 62%
        - During leaf off which would have increased the TP in runoff more than other sampling times
    - SRP also decreased by 6% during those occurrences
- SRP to TP Ratio
    - On average, SRP made up 45% of TP at PRG-In
    - On average, SRP made up 72% of TP at PRG-Out
- TN increased between PRG-In and PRG-Out sample during each collection
    - Increased between 51% and 711%
    - Other years had similar TN increases

- TSS was reduced between PRG-In and PRG-Out for each collection
    - Reductions ranged from 63% to 98%
    - Other years had reductions in TSS
- The coloration of the out sample shows that the water is picking up dissolved ions as the water passes through the rain garden since TSS is being reduced (Figure 3.7.1)
- Year to year comparison show the rain garden may be starting to perform better for TP, SRP and TSS in the "Out" sample compared to the "In" sample
    - In 2019, the average TP increase was 0.8%
        - 2017 and 2018: each year had average TP increases of about 75%
    - In 2019, the average SRP increase was 38%
        - 2017 and 2018: each year had average SRP increases of about 85%
    - In 2019, the average TSS decrease was 506%
        - 2017 and 2018: average TSS decrease was 206% and 290%, respectively

Figure 3.7.1 PRG-In sample (left) and PRG-Out sample (right) collected on 8/26/2019 shows the color difference that occurs by the rain water going through the raingarden

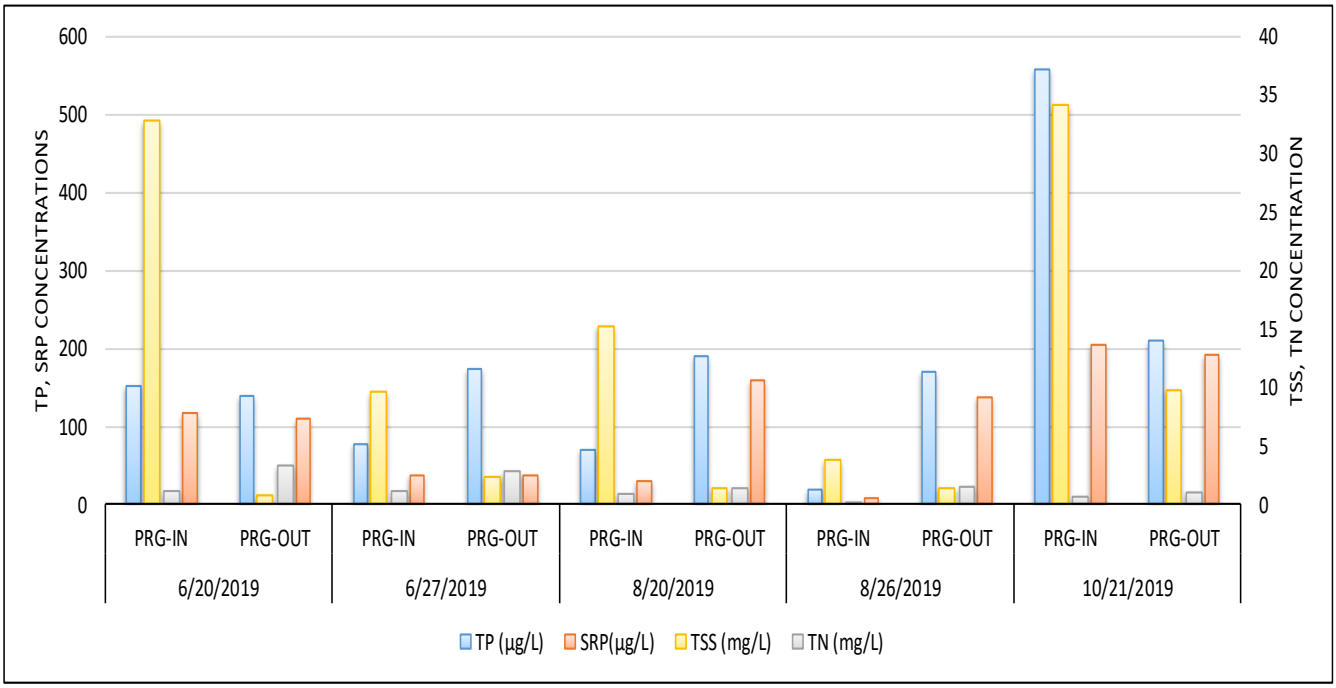


Figure 3.7.2 Concentrations of TP, SRP, TSS and TN for the Ponderosa Rain Garden inlet versus outlet for each sampling occurrence

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	Ave TP (min-max) µg/L	Ave SRP (min-max) µg/L	Ave TN (min-max) mg/L	Ave TSS (min-max) mg/L	TP: SRP 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

3.7.2. Observations

In 2019, the rain garden seemed to perform better.

- This was the first year the rain garden reduced TP in the outlet samples
    - While TP was reduced on only two occurrences, the hope is that this trend will continue
    - Possibly due to the plants becoming more established and using more nutrients

- As with the past 2 years, the garden continues to be effective at removing/filtering sediments
- Timing of events and sample collection could be a sampling bias
    - PRG-in samples are not always collected in "first flush"
        - In order to get an "Out" sample at the same time as an "In" sample, have to give the rain garden time to filter water through to outlet pipe
        - This may result in "In" samples having a lower concentration than if collected earlier in a storm event
        - According to the MPCA Stormwater Manual, the median TP concentration for residential areas is 260 µg/L (MPCA, 2017)
            - Only the October In sample had a value over 260 µg/L
            - The range of TP concentrations can be anywhere from less than 10 to 19,900 µg/L (MPCA, 2017), so there is a wide range of TP concentrations in runoff

3.8. Mooney Lake Watershed

Five locations around Mooney Lake watershed were monitored (Figure 3.8.1).

- MOO SW1
    - Can become stagnant in culvert but still have water running into the storm sewer during rain events – collected from storm sewer if culvert was stagnant
- MOO SW2
    - TRPD monitored this culvert from 2012-2015
    - Only culvert that has a baseflow, but it does go stagnant after periods of no rain
- MOO SW3
    - Only has flow during storm events
    - Samples taken from culvert into lake
- MOO SW4 and MOO SW5
    - Only have flow during storm events
    - Samples taken from storm sewer in street

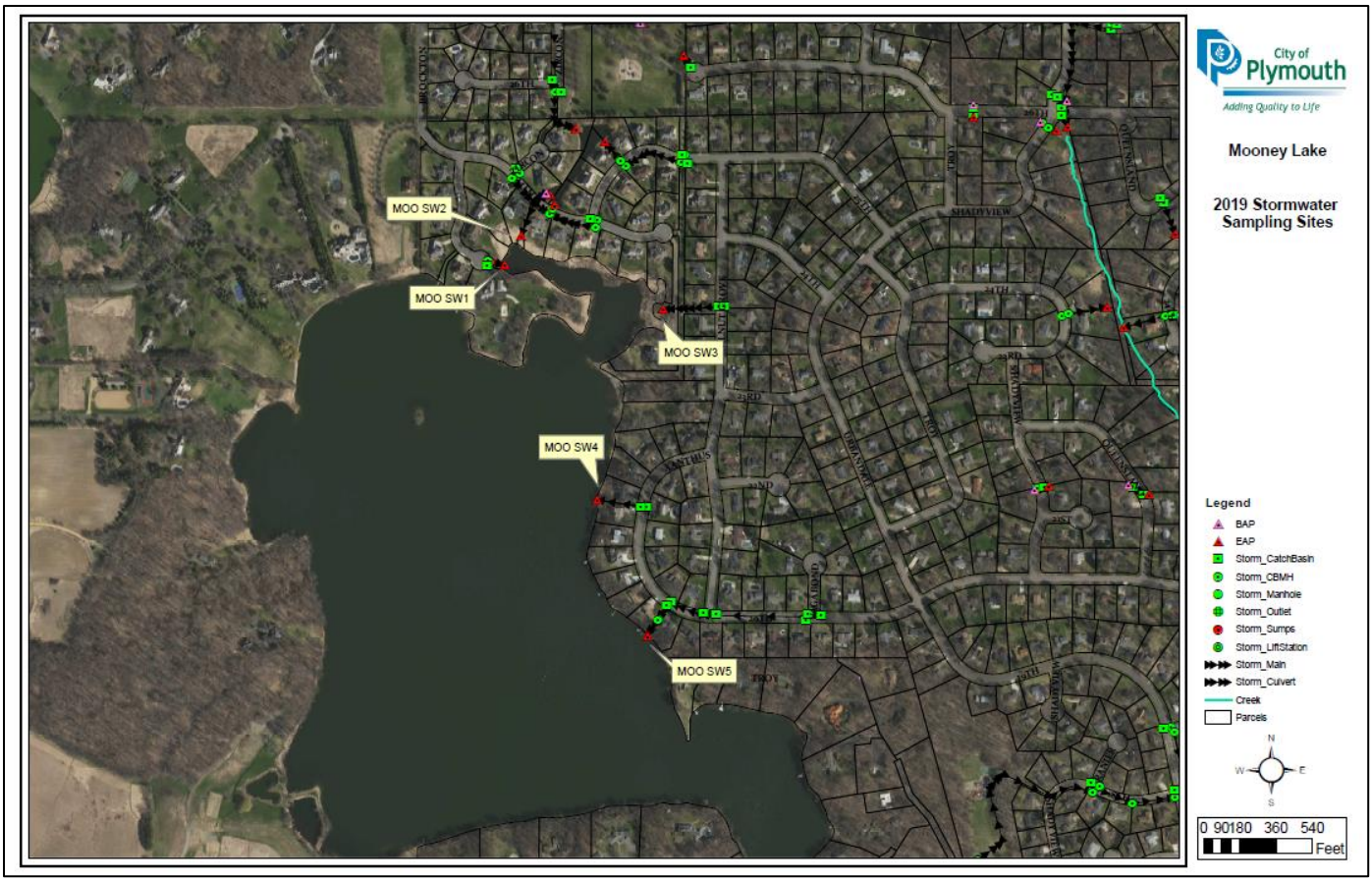


Figure 3.8.1 Mooney Lake sampling locations

3.8.1. Concentration

Summary of Figure 3.8.2 and Table 3.8.1.

- Of the 5 locations, MOO SW2 had the most samples since it had flow during some bi-weekly grabs
- MOO SW3, MOO SW4 and MOO SW5, which only had storm event collections:
    - Had similar TP, SRP and TN values
    - MOO SW5 had higher TSS values than SW3 or SW4
- MOO SW1 and MOO SW2, which had collections during baseflow conditions in addition to storm events, had lower concentrations of SRP and TSS

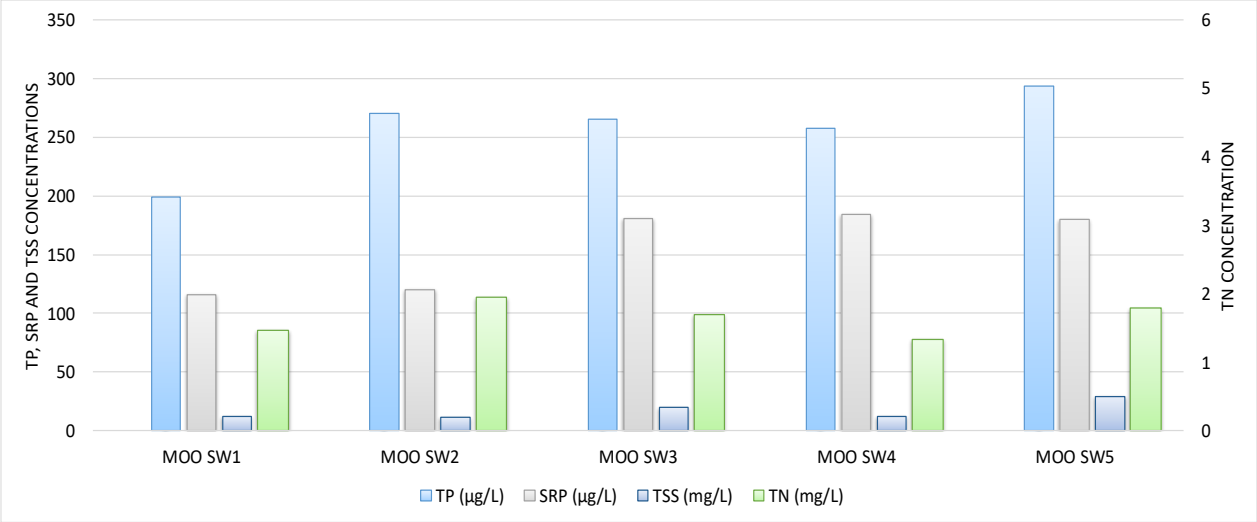


Figure 3.8.2 Average concentrations of TP, SRP, TSS and TN for the Mooney watershed sites

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	Ave TP (min-max) µg/L	Ave SRP (min-max) µg/L	Ave TN (min-max) mg/L	Ave TSS (min-max) mg/L
MOO SW1	**6**	**199 (70 - 400)**	**116 (5 - 318)**	**1.5 (0.6 - 2.5)**	**11.9 (5.0 - 24.8)**
MOO SW2	**8**	**271 (123 - 352)**	**120 (46 - 231)**	**2.0 (1.7 - 2.5)**	**11.3 (2.4 - 20.6)**
MOO SW3	**4**	**265 (95 - 397)**	**181 (61 - 288)**	**1.7 (0.5 - 3.5)**	**20.1 (6.8 - 46.7)**
MOO SW4	**3**	**257 (85 - 359)**	**184 (46 - 267)**	**1.3 (0.4 - 3.0)**	**12.2 (8.2 - 15.0)**
MOO SW5	**5**	**294 (114 - 487)**	**180 (56 - 387)**	**1.8 (0.7 - 3.0)**	**29.1 (9.6 - 64.7)**

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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
4/10/2019						11.88		19.657			0.247	0.48
4/11/2019						11.5		19.074			0.738	0.46
4/12/2019	2.257	2.254		4.008	13.196	15.67	5.492	25.687	22.493		1.297	0.09
4/13/2019	3.308	3.319		3.504	13.337	16.92	6.889	27.502	23.721		2.401	0
4/14/2019	4.054	4.055		4.089	17.253	20.7	7.641	29.468	32.708		2.115	0
4/15/2019	5.227	5.178		4.693	21.22	26	8.25	32.521	39.128		2.414	0
4/16/2019	4.715	4.73	65.394	3.794	20.246	22.73	6.276	29.217	34.97		1.999	0
4/17/2019	4.641	4.737	53.672	8.056	28.068	32.5	12.438	40.667	45.552		1.687	1.1
4/18/2019	8.906	8.848	102.2	9.805	36.643	49.31	12.736	54.627	49.833		4.258	0
4/19/2019	7.296	7.482	69.479	7.435	26.148	34.817	6.176	37.47	32.585		2.269	0
4/20/2019	5.164	5.23	41.708	5.472	21.484	22.598	4.611	26.264	25.987		1.389	0
4/21/2019	3.679	3.738	31.219	4.106	19.142	16.8	4.064	21.84	23.301		0.952	0.03
4/22/2019	3.16	3.124	31.432	4.837	19.708	18.179	6.403	25.074	24.728		0.882	0.39
4/23/2019	3.367	3.326	33.646	4.202	19.458	16.018	6.098	21.492	24.566		1.9	0
4/24/2019	2.842	2.815	28.11	3.165	16.749	12.291	3.732	18.215	20.346		0.959	0
4/25/2019	2.361	2.261	23.15	2.485	13.913	9.976	3.021	15.308	16.52		0.641	0
4/26/2019	1.876	1.694	18.263	1.945	11.047	8.201	2.449	13.397	12.356		0.365	0
4/27/2019	1.547	1.352	14.811	1.651	9.297	7.102	2.075	12.542	10.21		0.258	0
4/28/2019	1.306	1.121	12.548	2.188	7.941	6.32	1.75	11.268	8.746		0.215	0
4/29/2019	1.134	0.932	10.977	2.506	6.893	5.871	1.464	11.178	8.069		0.187	0
4/30/2019	1.019	0.816	10.63	2.74	6.305	5.987	2.555	9.703	7.738		0.174	0.23
5/1/2019	1.139	0.939	14.359	3.032	9.692	9.763	6.193	15.722	11.741		0.666	0.13
5/2/2019	1.204	0.99	16.294	2.494	11.297	7.868	3.756	12.441	12.985		1.28	0.01
5/3/2019	1.134	0.916	15.362	2.161	11.184	6.723	3.096	10.732	12.778		0.586	0.06
5/4/2019	1.087	0.923	14.956	1.874	10.564	6.786	2.091	10.256	11.95		0.414	0
5/5/2019	0.984	0.829	13.185	1.799	9.485	6.023	1.826	9.085	10.774		0.391	0
5/6/2019	0.946	0.764	11.493	1.516	8.433	5.305	2.037	8.159	9.825		0.233	0
5/7/2019	0.845	0.672	9.899	1.267	7.173	4.661	1.094	6.885	8.834		0.186	0
5/8/2019	1.322	1.459	16.892	4.98	13.452	14.411	12.805	25.632	21.206	2.756	0.156	1.27
5/9/2019	6.86	7.911	76.047	9.051	28.682	46.069	15.068	55.572	48.356	0.673	4.509	0.06
5/10/2019	6.141	7.26	59.683	6.2	18.806	37.26	6.286	47.632	26.416	0.144	3.02	0
5/11/2019	4.683	5.573	29.215	4.711	12.927	21.357	3.855	28.997	16.723	0.069	1.383	0
5/12/2019	3.692	4.556	19.879	3.453	11.533	14.119	1.176	20.553	14.104	0.035	0.832	0
5/13/2019	2.961	3.73	16.728	3.162	11.249	10.099	0.312	15.399	12.971	0.021	0.477	0
5/14/2019	2.375	3.105	15.097	3.095	11.626	8.206	0.815	11.923	11.904	0.263	0.297	0.46
5/15/2019	2.429	3.207	30.515	6.555	22.498	19.774	2.126	30.361	33.427	0.316	0.508	0.12
5/16/2019	2.96	3.848	38.83	6.217	22.327	21.612	2.149	35.805	30.12	0.586	1.743	0.46

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
5/17/2019	2.907	3.684	31.114	3.865	16.443	15.208	0.734	27.688	21.668	0.086	2.042	0
5/18/2019	4.028	4.879	43.257	7.873	25.911	29.517	8.029	49.904	37.683	0.925	0.857	0.76
5/19/2019	5.314	6.246	65.376	9.308	31.767	33.504	8.329	58.184	44.847	0.705	2.598	0.37
5/20/2019	5.414	6.283	65.365	8.662	27.557	30.069	4.647	49.741	36.758	0.216	2.296	0.01
5/21/2019	4.932	5.895	43.458	8.225	20.925	21.921	4.604	42.381	26.957	0.604	1.279	0.58
5/22/2019	8.245	9.255	79.765	19.023	41.027	44.025	11.846	74.969	54.818	1.644	2.128	0.45
5/23/2019	9.194	10.552	97.508	12.752	45.626	47.596	8.86	69.224	46.369	0.307	4.07	0
5/24/2019	7.686	8.963	68.524	9.155	45.749	38.751	3.981	60.779	43.487	0.229	1.513	0.06
5/25/2019	6.425	7.415	54.487	8.089	40.102	22.646	2.61	43.557	39.179	0.123	1.186	0
5/26/2019	4.98	5.886	43.876	5.333	34.339	15.216	2.042	23.901	34.572	0.057	0.829	0
5/27/2019	6.234	7.043	65.119	18.122	48.573	31.616	7.163	56.785	51.675	3.47	0.59	1.47
5/28/2019	9.65	10.298	127.796	15.473	56.721	57.323	7.831	66.98	54.905	0.674	7.081	0
5/29/2019	8.494	9.317	85.695	9.487	41.755	50.671	2.743	53.88	38.332	0.238	1.08	0
5/30/2019	6.834	7.632	51.975	7.227	30.601	27.013	1.714	35.615	28.652	0.132	0.294	0
5/31/2019	5.476	6.222	36.16	5.557	23.713	16.839	1.134	26.379	23.705	0.165	0.294	0.23
6/1/2019	4.221	4.983	28.276	5.491	19.765	14.473	1.203	23.21	20.759	0.104	0.386	0.04
6/2/2019	3.111	3.765	23.144	3.821	16.836	10.188	0.762	17.879	17.632	0.037	0.861	0
6/3/2019	2.325	2.906	19.501	3.052	14.605	7.984	0.513	18.09	15.753	0.023	0.357	0
6/4/2019	1.848	2.286	17.777	3.083	13.343	8.008	1.493	22.04	14.997	0.113	0.149	0.28
6/5/2019	2.026	2.529	22.25	3.59	13.279	10.882	3.189	26.743	15.048	0.039	0.358	0
6/6/2019	1.886	2.352	17.461	3.006	11.939	7.141	1.078	18.906	13.517	0.017	0.41	0
6/7/2019	1.589	2.011	14.33	2.325	10.957	5.851	0.656	16.257	12.524	0.011	0.169	0
6/8/2019	1.292	1.645	12.243	1.952	9.915	4.882	0.476	14.333	11.111	0.007	0.101	0
6/9/2019	1.058	1.316	11.105	1.728	9.358	4.261	0.536	13.312	10.164	0.003	0.084	0
6/10/2019	0.897	1.108	10.339	1.448	8.421	3.404	0.406	11.43	9.526	0.002	0.077	0
6/11/2019	0.767	0.953	9.254	1.617	7.496	3.409	0.345	10.927	8.982	0.024	0.074	0.11
6/12/2019	0.722	0.84	8.979	1.294	6.723	3.958	0.578	11.052	8.459	0.022	0.191	0.01
6/13/2019	0.578	0.701	6.786	0.826	5.745	3.058	0.34	7.065	8.088	0.005	0.233	0
6/14/2019	0.516	0.632	7.414	0.639	5.275	2.64	0	5.827	8.155	0.006	0.133	0
6/15/2019	0.502	0.538	6.67	0.666	5.054	2.813	0.334	5.876	6.349	0.024	0.073	0.08
6/16/2019	0.456	0.497	5.44	0.486	4.335	2.686	0.306	5.325	5.352	0.003	0.24	0
6/17/2019	0.43	0.474	4.577	0.283	3.995	2.346	1.268	4.934	5.377	0.001	0.155	0
6/18/2019	0.382	0.395	4.116	0.33	3.516	2.145	0.606	6.776	4.638	0	0.144	0
6/19/2019	0.346	0.376	3.509	0.312	2.943	2.219	0.302	1.501	3.838	0	0.073	0
6/20/2019	0.322	0.36	3.607	0.719	3.083	3.586	0.691	7.731	4.23	0.181	0.119	0.31
6/21/2019	0.396	0.414	4.867	0.565	2.72	4.508	1.08	5.653	4.246	0.019	0.639	0
6/22/2019	0.32	0.335	3.944	0.381	2.13	3.155	0.376	4.469	2.851	0.002	0.386	0
6/23/2019	0.327	0.348	3.517	0.386	2.203	3.624	0.978	3.963	3.528	0.098	0.093	0.18
6/24/2019	0.675	0.76	9.243	1.948	4.708	9.136	2.661	9.792	8.206	0.288	0.469	0.34
6/25/2019	0.797	0.93	9.803	1.29	2.636	5.299	0.613	3.691	5.098	0.017	1.262	0.01
6/26/2019	0.604	0.706	6.401	0.299	2.105	3.301	0.458	3.691	3.441	0	0.234	0
6/27/2019	0.666	0.782	5.74	1.883	2.927	7.19	1.197	7.099	4.984	0.364	0.117	0.54
6/28/2019	0.84	0.99	6.846	1.737	2.363	6.535	0.602	7.618	4.452	0.032	2.205	0
6/29/2019	0.779	0.891	5.499	1.194	2.142	3.192	0.562	3.678	3.22	0.007	0.368	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
6/30/2019	1.792	1.415	10.205	3.223	5.632	9.09	2.662	11.131	9.317	0.489	0.16	0.94
7/1/2019	3.537	4.313	33.998	11.539	14.336	30.984	5.881	43.553	30.162	1.319	2.729	1.17
7/2/2019	5.317	6.306	57.769	15.024	18.131	43.751	5.506	55.118	34.115	0.799	7.13	0.21
7/3/2019	4.269	5.208	39.454	9.592	11.488	28.444	1.234	39.055	18.058	0.111	4.261	0
7/4/2019	3.242	4.05	21.558	6.769	8.467	16.85	0.801	27.376	12.654	0.049	1.135	0.04
7/5/2019	2.442	3.133	14.873	5.068	6.96	13.068	0.687	22.79	10.372	0.086	0.522	0.12
7/6/2019	1.937	2.432	12.078	3.861	6.018	10.542	0.547	19.346	8.883	0.027	0.564	0
7/7/2019	1.637	2.072	10.059	2.933	5.521	7.189	0.472	12.974	8.057	0.005	0.475	0
7/8/2019	1.226	1.529	8.379	2.371	4.897	5.173	0.356	9.751	7.149	0.001	0.23	0
7/9/2019	1.017	1.232	6.952	2.112	4.345	3.192	1.28	9.564	6.289	0.105	0.168	0.16
7/10/2019	1.012	1.223	6.607	2.156	4.206	3.135	0.489	9.332	6.189	0.07	0.567	0.09
7/11/2019	0.945	1.151	6.178	2.002	3.749	2.289	0.366	6.801	5.537	0.007	0.583	0
7/12/2019	0.894	1.069	5.301	1.662	3.269	2.039	0.312	5.361	4.748	0	0.307	0
7/13/2019	0.768	0.88	4.497	1.339	2.959	1.881	0.301	4.552	4.264	0	0.153	0
7/14/2019	0.643	0.741	3.774	1.03	2.58	2.007	0.311	6.09	3.768	0	0.112	0
7/15/2019	2.502	2.642	40.24	10.653	28.081	7.521	10.827	24.927	27.353	1.256	0.08	2.85
7/16/2019	13.869	14.528	238.828	21.704	65.23	63.74	9.862	58.816	73.906	0.443	4.28	0
7/17/2019	13.605	14.17	167.322	12.664	54.47	91.883	0	69.369	50.421	0.077	0.086	0
7/18/2019	11.72	12.385	88.411	9.582	39.634	88.17	1.506	61.591	34.193	0.02	0.036	0
7/19/2019	8.159	8.877	47.996	7.194	29.086	57.796	1.382	40.761	28.421	0.005	0.036	0
7/20/2019	6.71	7.138	37.656	8.218	25.851	36.142	6.968	33.604	29.67	0.682	0.23	1
7/21/2019	6.634	7.064	38.884	6.732	21.688	29.864	3.695	27.106	25.699	0.109	0.731	0
7/22/2019	4.558	5.209	28.787	4.936	16.908	14.189	1.745	17.924	19.67	0	0.62	0
7/23/2019	2.999	3.686	22.13	3.586	15.669	9.183	1.191	12.534	17.637	0	0.37	0
7/24/2019	2.172	2.759	18.744	2.875	14.437	6.194	0.778	7.508	16.261	0	0.263	0
7/25/2019	1.675	2.188	16.436	2.383	11.524	4.476	0.643	9.273	13.186	0	0.262	0
7/26/2019	1.299	1.688	13.522	2.132	9.034	3.82	0.732	11.456	10.64	0.032	0.261	0.09
7/27/2019	1.088	1.376	10.914	1.754	7.269	3.111	0.907	9.941	8.653	0	0.278	0
7/28/2019	1.097	1.316	10.223	2.038	7.616	4.978	2.87	13.997	9.495	0.178	0.201	0.52
7/29/2019	2.245	2.649	15.724	2.396	8.731	11.818	1.689	20.409	12.315	0.02	0.819	0
7/30/2019	1.811	2.298	12.174	1.812	6.354	6.499	0.663	11.674	7.994	0	0.569	0
7/31/2019	1.276	1.58	8.144	1.556	4.653	4.886	0.548	8.378	6.151	0	0.241	0
8/1/2019	1.012	1.206	5.763	1.203	3.608	4.182	0.43	6.344	4.903	0	0.157	0
8/2/2019	0.855	1.011	3.96	0.893	3.039	3.598	0.495	6.126	4.28	0	0.169	0
8/3/2019	0.72	0.864	2.754	0.717	2.705	3.665	0.509	4.623	3.882	0	0.109	0
8/4/2019	0.592	0.734	1.91	0.292	2.434	3.777	1.405	5.516	3.634	0	0.08	0
8/5/2019	0.607	0.645	3.33	1.47	3.969	7.205	1.99	15.773	6.181	0.279	0.13	0.75
8/6/2019	1.21	1.248	8.837		3.549	11.935	1.039	17.415	6.754	0.015	0.344	0
8/7/2019	1.064	1.06	5.213		2.475	4.853	0.539	5.891	4.143	0	0.358	0
8/8/2019	0.796	0.769	2.808		2.112	3.713	0.244	4.325	3.609	0	0.233	0
8/9/2019	0.58	0.594	1.347		1.874	3.099	0.321	9.784	3.337	0.001	0.166	0
8/10/2019	0.641	0.678	3.391		4.297	4.325	3.526	7.815	7.184	0.201	0.128	0.5
8/11/2019	2.629	2.953	17.143		5.437	13.557	3.197	14.956	10.561	0.012	0.628	0.01
8/12/2019	2.172	2.43	12.697		3.317	9.111	1.562	7.627	5.596	0	0.505	0

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8/13/2019	1.488	1.646	7.244		3.893	13.065	6.395	16.008	6.131	0.573	0.249	0.77
8/14/2019	1.706	1.877	9.952		4.97	31.463	2.656	35.855	8.767	0.075	0.494	0
8/15/2019	1.417	1.507	7.859	2.617	3.418	13.071	1.046	17.367	5.468	0.004	0.392	0
8/16/2019	1.352	1.429	5.823	2.732	3.384	13.922	2.016	21.643	5.199	0.252	0.311	0.25
8/17/2019	1.205	1.278	4.755	2.274	3.01	8.871	0.983	13.22	4.658	0.006	0.325	0
8/18/2019	8.728	8.685	49.06	19.556	21.614	58.323	18.5	49.023	34.842	2.775	0.155	2.12
8/19/2019	8.831	8.904	57.813	9.937	14.56	54.183	7.337	29.371	21.47	0.177	0.976	0
8/20/2019	6.302	6.491	34.857	9.474	15.872	45.107	4.952	27.156	23.263	0.926	0.281	0.66
8/21/2019	5.235	5.448	40.282	7.327	17.554	30.254	2.588	20.565	22.674	0.206	0.398	0
8/22/2019	3.519	3.821	27.093	5.346	12.178	16.81	1.459	11.69	14.624	0.029	0.257	0
8/23/2019	2.425	2.671	17.878	3.848	9.69	11.15	0.979	8.458	11.414	0.008	0.217	0
8/24/2019	1.763	2.005	13.483	3.002	8.149	8.535	0.932	7.793	9.6	0	0.128	0
8/25/2019	1.351	1.489	10.56	2.35	6.869	6.88	0.759	6.544	8.344	0.001	0.087	0.02
8/26/2019	1.739	1.878	15.237	5.08	10.236	16.149	5.145	14.864	15.319	0.689	0.123	0.81
8/27/2019	4.09	4.394	32.115	5.246	12.07	24.318	3.237	15.281	17.656	0.168	0.412	0
8/28/2019	3.159	3.526	22.812	3.427	8.506	11.741	1.618	10.678	10.939	0.025	0.316	0
8/29/2019	2.043	2.31	13.795	2.649	6.663	8.576	0.933	10.473	8.479	0.006	0.303	0
8/30/2019	1.44	1.584	9.648	2.084	5.737	6.796	0.652	8.56	7.317	0	0.176	0
8/31/2019	1.157	1.233	7.61	1.743	4.8	6.049	0.036	7.712	6.304	0.002	0.129	0
9/1/2019	1.091	1.138	6.403	1.562	4.108	5.493	0.552	7.8	5.707	0.081	0.122	0.07
9/2/2019	1.034	1.071	5.985	1.896	4.419	5.392	0.933	8.511	5.474	0.421	0.224	0.62
9/3/2019	1.978	2.152	19.139	4.422	8.282	17.917	2.432	23.256	13.116	0.313	0.237	0.01
9/4/2019	1.949	2.171	16.068	2.382	9.488	7.058	1.24	10.653	11.121	0.026	0.414	0
9/5/2019	1.412	1.509	12.805	1.875	8.549	5.044	0.737	10.156	9.988	0.003	0.289	0
9/6/2019	1.089	1.096	10.288	1.403	7.03	4.409	0.443	7.641	8.503	0	0.17	0
9/7/2019	0.881	0.856	8.01	1.314	5.825	4.237	0.356	5.844	7.282	0.001	0.145	0.01
9/8/2019	0.823	0.787	6.91	1.422	5.026	4.107	0.547	5.928	6.695	0.068	0.14	0.15
9/9/2019	0.832	0.808	7.355	1.493	5.275	4.903	0.716	5.842	7.459	0	0.383	0.09
9/10/2019	0.896	0.875	10.662	1.556	5.021	5.348	0.543	5.354	7.819	0.01	0.302	0
9/11/2019	1.645	1.535	14.807	4.647	8.303	19.838	5.283	25.806	14.65	0.681	0.271	0.71
9/12/2019	4.818	5.013	42.452	10.161	20.865	36.016	6.713	43.196	28.469	1.501	0.494	0.99
9/13/2019	8.115	8.148	58.131	10.239	28.84	45.377	5.114	46.516	32.448	0.348	0.639	0.02
9/14/2019	6.202	6.331	43.877	7.415	21.259	27.577	1.899	33.054	24.454	0.079	0.359	0
9/15/2019	4.51	4.75	32.563	5.595	15.63	16.845	0.939	21.31	18.317	0.019	0.399	0
9/16/2019	3.111	3.312	27.092	4.31	13.069	11.482	0.684	14.476	14.929	0.018	0.451	0
9/17/2019	2.15	2.278	20.25	3.43	11.334	8.423	0.508	10.886	12.626	0.005	0.321	0
9/18/2019	1.835	1.912	16.394	3.266	10.734	9.252	1.1	10.907	12.229	0.09	0.249	0.21
9/19/2019	1.686	1.736	15.314	2.676	9.596	7.362	0.718	8.611	11.045	0.006	0.348	0
9/20/2019	1.482	1.686	13.095	2.334	7.967	5.926	0.72	7.39	9.366	0	0.257	0
9/21/2019	1.668	2.189	13.844	2.932	8.428	12.264	3.362	15.443	10.938	0.288	0.205	0.48
9/22/2019	1.697	2.234	14.09	2.383	7.745	7.46	1.759	9.679	9.725	0.013	0.459	0.01
9/23/2019	1.474	1.994	11.895	1.945	6.419	4.701	1.023	6.933	8.21	0.002	0.259	0
9/24/2019	1.266	1.696	8.949	1.72	5.246	3.196	0.716	5.153	6.939	0	0.136	0
9/25/2019	1.091	1.455	6.432	1.321	4.592	2.06	0.784	6.025	6.301	0	0.137	0

Date	BL3-East	BL3-West	ECER	GC-1	Hamel	IP2	NLS	PC2	Peony	PL1	PL2	Precipitation
9/26/2019	0.921	1.205	4.351	0.759	4.081	1.866	0.5	4.292	5.664	0.001	0.13	0
9/27/2019	0.83	1.063	3.226	0.481	3.676	2.96	0.465	5.365	5.265	0.001	0.125	0
9/28/2019	0.715	0.921	2.81	0.777	3.399	2.831	0.392	4.488	4.895	0.013	0.139	0
9/29/2019	0.762	0.982	5.282	1.128	5.188	3.193	1.068	4.825	8.533	0.258	0.101	1.1
9/30/2019	1.429	1.89	16.542	2.434	8.763	12.577	1.567	12.936	15.066	0.079	0.137	0.03
10/1/2019	2.716	3.396	29.048	6.054	19.151	21.042	8.058	24.769	23.324	0.776	0.247	1.03
10/2/2019	8.292	9.058	93.448	9.936	35.933	51.584	12.16	50.518	40.96	0.492	0.641	0.31
10/3/2019	7.987	8.378	89.887	9.432	33.039	48.563	5.936	48.896	35.749	0.321	0.512	0.07
10/4/2019	6.459	6.844	59.519	7.492	24.533	31.693	2.38	34.023	25.733	0.061	0.28	0
10/5/2019	7.842	8.098	77.447	12.763	41.748	40.925	11.255	46.926	52.426	1.113	0.115	0.84
10/6/2019	8.12	8.526	108.06	10.753	44.665	49.234	6.561	45.667	45.969	0.294	5.942	0
10/7/2019	7.005	7.409	71.875	8.275	34.516	35.2	2.158	35.572	32.841	0.099	1.563	0
10/8/2019	6.058	6.414	45.268	6.14	26.67	19.938	1.149	21.983	26.241	0.028	0.663	0
10/9/2019	4.582	4.977	33.051	4.58	21.4	13.836	0.605	17.106	21.901	0.008	0.25	0
10/10/2019	3.971	4.349	29.954	5.173	19.588	14.979	2.152	21.135	21.349	0.266	0.139	0.3
10/11/2019	3.982	4.361	40.043	5.257	24.142	20.633	2.461	28.699	27.524	0	1.35	0.17
10/12/2019	3.363	3.764	42.518	4.015	20.011	12.978	1.17	16.147	21.11	0	1.452	0
10/13/2019	2.762	3.159	32.804	3.484	16.807	10.605	0.524	13.025	19.238	0	0.456	0.01
10/14/2019	2.262	2.601	26.013	3.214	14.659	8.915	0.676	10.664	16.803	0	0.267	0
10/15/2019	2.082	2.479	23.173	3.296	13.789	9.97	2.223	13.6	16.283	0.073	0.154	0.3
10/16/2019	1.862	2.25	21.406	2.85	12.354	8.232	1.504	10.195	14.937	0.023	0.522	0
10/17/2019	1.722	1.989	18.64	2.532	10.952	7.179	1.194	8.8	13.327	0.012	0.148	0
10/18/2019	1.569	1.807	16.186	1.628	9.8	6.408	0.896	7.328	12.235	0.01	0.124	0
10/19/2019	1.406	1.62	14.498	0.709	8.975	5.746	0.656	7.742	11.467	0.005	0.142	0
10/20/2019	1.242	1.389	12.738	1.796	7.809	5.497	0.599	7.073	10.408	0.001	0.133	0
10/21/2019	2.525	2.806	25.079	0.834	14.486	22.66	7.72	31.953	21.073	0.853	0.121	0.97
10/22/2019	6.046	6.596	68.431	4.876	25.746	40.64	8.608	47.973	31.872	0.519	1.59	0.23
10/23/2019	8.097	8.778	62.975	6.532	19.325	26.96	3.569	34.219	23.602	0.124	3.25	0
10/24/2019	5.438	5.978	38.052	5.036	13.61	17.72	2.199	23.091	16.975	0.055	0.883	0
10/25/2019	3.370	3.795	25.325	3.954	11.501	12.98	1.307	15.929	14.381	0.03	0.423	0
10/26/2019	2.480	2.793	20.235	3.483	10.493	10.18	1.685	12.906	13.223	0.02	0.235	0
10/27/2019	2.113	2.353	16.845	3.206	9.538	8.284	1.157	11.327	12.266	0.011	0.178	0
10/28/2019	1.796	1.978	14.39	2.722	8.26	6.969	0.817	10.388	11.067	0.006	0.14	0
10/29/2019	1.625	1.794	12.135	2.428	7.361	6.133	0.755	9.348	10.131	0.004	0.138	0
10/30/2019	1.360	1.488	9.761	2.349	6.6	5.515	0.506	7.776	9.306	0.003	0.129	0
10/31/2019	1.215	1.333	8.915	2.326	6.272	5.105	0.804	7.33	8.879	0.003	0.129	0
11/1/2019			8.382		6.035			7.329	8.676			0.07
11/2/2019			8.615		6.032				8.703			0
11/3/2019			8.694		5.849				8.536			0
11/4/2019			8.54		5.733				8.33			0.13
11/5/2019			8.211		5.498				8.111			0

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) reported	Cl (mg/L)	Type
BL3-W	4/16/2019	4.66	55.35	14.59	1.830	5.60	<10		GRAB
BL3-W	4/29/2019	2.09	27.63	6.52	0.690	2.80	<10		GRAB
BL3-W	5/9/2019	3.78	52.44	12.21	0.840	2.80	<10		COMP
BL3-W	5/13/2019	5.84	28.90	14.31	0.720	0.80	<10		GRAB
BL3-W	5/16/2019	6.60	44.46	19.54	0.900	2.80	<10		COMP
BL3-W	5/28/2019	20.43	48.52	19.98	0.710	1.20	<10		GRAB
BL3-W	6/10/2019	1.97	155.11	93.93	1.500	2.40	<10		GRAB
BL3-W	6/24/2019	1.26	161.63	50.71	1.690	2.00	<10		GRAB
BL3-W	7/1/2019	8.03	156.20	43.26	1.700	2.80	<10		GRAB
BL3-W	7/8/2019	2.77	233.20	134.78	1.910	2.80	<10		GRAB
BL3-W	7/16/2019	8.72	176.10	49.87	1.720	10.40	10.40		COMP
BL3-W	7/22/2019	9.28	116.70	83.25	1.320	1.60	<10		GRAB
BL3-W	7/29/2019	4.81	198.70	75.64	1.840	17.20	17.20		COMP
BL3-W	8/5/2019	1.14	138.15	78.89	1.640	2.40	<10		GRAB
BL3-W	8/11/2019	4.59	110.90	47.55	1.260	6.60	6.60		COMP
BL3-W	8/18/2019	6.51	77.56	28.08	0.934	5.60	<10		COMP
BL3-W	8/19/2019	17.18	84.91	48.65	0.889	1.60	<5		GRAB
BL3-W	8/27/2019	8.94	64.46	58.55	0.740	5.00	5.00		GRAB
BL3-W	9/3/2019	4.38	48.22	25.37	0.880	1.40	<5		GRAB
BL3-W	9/16/2019	6.39	45.42	40.03	0.820	2.00	<5		GRAB
BL3-W	9/30/2019	3.33	72.59	25.39	1.010	2.80	<10		GRAB
BL3-W	10/1/2019	3.79	60.02	23.15	0.920	3.60	<10		COMP
BL3-W	10/14/2019	4.81	33.49	30.23	0.600	7.60	7.60		GRAB
BL3-W	10/28/2019	3.82	47.58	15.83	0.660	0.81	<3		GRAB
ECER	4/16/2019	81.96	121.40	46.86	2.010	4.80	<10		GRAB
ECER	4/29/2019	10.66	59.24	26.99	0.800	4.40	<10		GRAB
ECER	5/13/2019	16.69	85.11	59.47	0.770	4.00	<10		GRAB
ECER	5/28/2019	133.30	106.26	61.37	0.870	6.00	<10		GRAB
ECER	6/10/2019	10.50	173.47	117.33	1.100	1.60	<10		GRAB
ECER	6/24/2019	10.29	156.60	96.92	1.190	4.80	<10		GRAB
ECER	7/1/2019	33.10	220.30	155.51	1.270	16.00	16.00		GRAB
ECER	7/8/2019	8.73	179.10	131.73	1.300	3.60	<10		GRAB
ECER	7/15/2019	11.86	926.70	151.39	7.020	736.67	736.67		COMP
ECER	7/22/2019	27.80	403.50	134.72	1.940	11.20	11.20		GRAB
ECER	7/29/2019	16.78	278.40	134.80	1.980	20.80	20.80		GRAB
ECER	8/5/2019	1.66	152.90	109.30	1.640	2.80	<10		GRAB
ECER	8/19/2019	54.37	186.50	113.12	0.980	6.40	6.40		GRAB
ECER	8/27/2019	34.35	193.10	106.53	1.470	15.20	15.20		GRAB
ECER	9/3/2019	19.58	154.00	111.85	1.130	6.78	6.78		GRAB
ECER	9/16/2019	21.14	131.00	124.03	0.920	6.20	6.20		GRAB
ECER	9/29/2019	14.17	203.80	138.96	1.350	23.20	23.20		COMP
ECER	9/30/2019	17.23	128.60	117.44	0.960	3.60	<10		GRAB
ECER	10/1/2019	19.29	123.50	87.16	0.920	6.40	<10		COMP
ECER	10/2/2019	61.46	316.40	131.33	1.660	51.60	51.60		COMP
ECER	10/11/2019	36.77	127.34	98.77	0.800	21.20	21.20		COMP
ECER	10/14/2019	25.38	80.55	67.92	0.760	7.50	7.50		GRAB
ECER	10/28/2019	14.22	85.78	51.47	0.880	4.13	4.13		GRAB
GC-1	4/16/2019	3.85	126.10	19.38	1.970	3.60	<10		GRAB
GC-1	4/29/2019	2.19	76.89	23.00	0.840	8.80	<10	151.95	GRAB
GC-1	5/13/2019	2.51	87.22	24.94	0.890	6.00	<10		GRAB
GC-1	5/28/2019	13.53	122.65	48.82	1.300	14.40	14.40	93.97	GRAB
GC-1	6/10/2019	1.51	184.09	82.66	1.070	3.20	<10	145.95	GRAB
GC-1	6/24/2019	2.05	209.10	93.02	1.650	10.00	10.00	127.96	GRAB
GC-1	6/27/2019	4.36	275.00	55.03	2.500	278.67	278.67	47.99	COMP
GC-1	7/8/2019	2.39	132.30	71.37	0.960	5.60	<10	137.96	GRAB
GC-1	7/16/2019	18.96	199.60	93.92	1.390	21.20	21.20	57.98	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) reported	Cl (mg/L)	Type
GC-1	7/22/2019	4.98	147.70	93.54	1.100	3.60	<10	119.96	GRAB
GC-1	8/5/2019	0.00	101.17	95.72	1.070	5.20	<10	165.95	GRAB
GC-1	8/14/2019	0.00	152.13	74.18	1.120	8.40	8.40	109.97	GRAB
GC-1	8/16/2019	4.09	121.20	60.08	1.280	32.40	32.40	65.98	COMP
GC-1	8/18/2019	8.64	250.14	47.00	2.410	99.09	99.09	33.99	COMP
GC-1	8/19/2019	9.60	108.23	47.21	1.000	8.80	8.80	75.98	GRAB
GC-1	9/3/2019	3.88	115.55	48.68	1.070	6.00	6.00	109.97	GRAB
GC-1	9/11/2019	5.93	188.11	51.16	2.070	58.00	58.00	73.98	COMP
GC-1	9/12/2019	11.23	154.27	72.88	1.170	67.60	67.60	69.98	COMP
GC-1	9/16/2019	4.31	140.11	91.00	0.850	3.40	<5	91.97	GRAB
GC-1	9/30/2019	2.38	124.60	38.43	1.120	5.60	<10	111.97	GRAB
GC-1	10/1/2019	1.16	124.20	80.90	0.830	3.60	<10	93.97	COMP
GC-1	10/2/2019	12.06	339.70	58.31	2.710	107.20	107.20	51.98	COMP
GC-1	10/11/2019	6.08	105.96	47.17	0.920	22.80	22.80	73.98	COMP
GC-1	10/14/2019	3.22	81.47	41.30	0.790	13.20	13.20	89.97	GRAB
GC-1	10/28/2019	2.67	90.31	33.47	0.880	2.40	<5		GRAB
HAMEL	4/16/2019	19.46	99.82	33.72	1.120	4.40	<10		GRAB
HAMEL	4/29/2019	6.93	56.14	28.07	0.980	3.60	<10		GRAB
HAMEL	5/8/2019	18.15	33.67	30.70	1.510	66.40	66.40		COMP
HAMEL	5/13/2019	11.06	54.30	53.50	0.870	3.60	<10		GRAB
HAMEL	5/14/2019	22.10	251.10	24.19	1.380	138.80	138.80		COMP
HAMEL	5/28/2019	58.47	94.70	54.57	1.110	9.20	<10		GRAB
HAMEL	6/10/2019	8.62	418.77	99.94	2.650	12.00	12.00		GRAB
HAMEL	6/21/2019	3.52	188.60	111.44	1.400	13.20	13.20		COMP
HAMEL	6/23/2019	6.57	467.93	73.39	2.670	78.80	78.80		COMP
HAMEL	6/24/2019	4.35	170.99	69.22	1.500	5.20	<10		GRAB
HAMEL	6/27/2019	3.20	172.80	67.19	1.400	8.80	<10		COMP
HAMEL	6/30/2019	11.55	386.10	94.43	2.490	63.33	63.33		COMP
HAMEL	7/8/2019	5.01	527.40	182.59	2.990	15.60	15.60		GRAB
HAMEL	7/15/2019	51.97	853.10	107.14	7.710	355.00	355.00		COMP
HAMEL	7/22/2019	17.06	608.90	226.04	3.130	12.40	12.40		GRAB
HAMEL	7/28/2019	11.81	455.40	116.11	1.960	32.80	32.80		COMP
HAMEL	8/5/2019	2.34	209.86	94.29	1.910	6.80	<10		GRAB
HAMEL	8/6/2019	5.94	313.00	84.61	2.230	29.20	29.20		COMP
HAMEL	8/10/2019	10.42	416.54	98.35	2.510	68.00	68.00		COMP
HAMEL	8/19/2019	13.98	145.00	70.30	1.390	8.80	<10		GRAB
HAMEL	8/20/2019	24.04	238.90	79.72	1.780	59.75	59.75		COMP
HAMEL	9/2/2019	10.67	284.11	84.05	2.000	40.40	40.40		COMP
HAMEL	9/3/2019	7.72	158.00	62.44	1.480	11.20	11.20		GRAB
HAMEL	9/12/2019	15.99	241.63	64.48	1.850	55.60	55.60		COMP
HAMEL	9/16/2019	12.86	81.30	71.34	1.160	10.40	10.40		GRAB
HAMEL	9/30/2019	8.85	131.50	55.16	1.400	9.60	<10		GRAB
HAMEL	10/1/2019	27.54	743.60	66.43	4.560	170.00	170.00		COMP
HAMEL	10/11/2019	26.16	86.00	78.96	0.910	22.40	22.40		COMP
HAMEL	10/14/2019	14.61	159.05	35.25	0.810	6.00	<10		GRAB
HAMEL	10/21/2019	19.96	197.20	63.60	0.950	38.00	38.00		COMP
HAMEL	10/28/2019	8.27	40.27	23.70	0.900	1.20	<5		GRAB
IP2	4/16/2019	22.47	96.28	26.35	1.180	2.80	<10	179.94	GRAB
IP2	4/29/2019	6.04	66.94	8.48	1.020	2.40	<10	249.92	GRAB
IP2	5/8/2019	30.84	231.40	59.08	1.780	39.20	39.20	159.95	COMP
IP2	5/13/2019	9.96	80.73	20.59	1.040	3.60	<10	165.95	GRAB
IP2	5/27/2019	52.11	127.46	60.66	1.420	15.20	15.20	71.98	COMP
IP2	5/28/2019	54.50	92.30	67.14	1.120	8.00	<10	67.98	GRAB
IP2	6/10/2019	3.60	109.23	36.73	1.440	2.40	<10	209.93	GRAB
IP2	6/21/2019	5.24	86.23	56.39	2.410	7.60	<10	227.93	COMP
IP2	6/23/2019	10.37	100.10	34.17	1.350	7.60	<10	153.95	COMP
IP2	6/24/2019	9.55	82.52	36.71	1.010	1.60	<10	124.96	GRAB
IP2	6/27/2019	11.63	164.30	31.73	1.400			95.97	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) reported	Cl (mg/L)	Type
IP2	7/1/2019	31.95	163.30	92.59	1.120	8.00	<10		GRAB
IP2	7/8/2019	5.32	163.60	74.99	1.510	2.80	<10	119.96	GRAB
IP2	7/16/2019	61.77	203.50	112.80	1.450	12.00	12.00	55.98	GRAB
IP2	7/22/2019	15.70	223.60	122.38	1.580	3.60	<10	67.98	GRAB
IP2	7/29/2019	13.03	178.90	64.71	1.830	12.80	12.80	119.96	COMP
IP2	8/5/2019	1.56	105.45	71.72	1.510	4.00	<10	213.93	GRAB
IP2	8/6/2019	11.45	236.90	37.48	2.470	60.40	60.40	83.97	COMP
IP2	8/14/2019	38.28	170.99	74.64	1.390	17.00	17.00	67.98	COMP
IP2	8/19/2019	54.78	128.13	82.26	0.893	5.20	<10	39.99	GRAB
IP2	8/26/2019	34.83	142.00	57.81	1.350	19.80	19.80	51.98	COMP
IP2	9/2/2019	23.30	161.88	59.50	1.450	28.00	28.00	93.97	COMP
IP2	9/3/2019	16.73	100.57	47.90	0.960	4.40	<10	91.97	GRAB
IP2	9/11/2019	26.97	104.07	58.85	1.020	10.00	10.00	101.97	COMP
IP2	9/16/2019	11.93	81.95	78.53	0.980	2.40	<5	69.98	GRAB
IP2	9/30/2019	2.64	97.94	31.07	1.200	4.40	<10	129.96	GRAB
IP2	10/11/2019	23.15	116.21	53.84	0.980	48.40	48.40	75.98	COMP
IP2	10/14/2019	8.98	65.06	27.90	0.980	19.60	19.60	93.97	GRAB
IP2	10/28/2019	7.02	68.94	10.39	1.110	2.10	<4		GRAB
MOO SW1	4/16/2019		132.20	24.75	1.210	9.20	<10		GRAB
MOO SW1	4/30/2019		69.99	4.95	1.250	7.20	<10		GRAB
MOO SW1	6/27/2019		266.40	154.58	2.200	24.80	24.80		GRAB
MOO SW1	8/20/2019		226.60	139.73	2.480	8.80	8.80		GRAB
MOO SW1	8/26/2019		99.39	54.72	0.572	5.00	5.00		GRAB
MOO SW1	10/21/2019		399.70	318.09	1.050	16.63	16.63		GRAB
MOO SW2	5/28/2019		123.44	45.98	1.660	5.20	<10		GRAB
MOO SW2	6/24/2019		340.69	110.87	2.510	14.00	14.00		GRAB
MOO SW2	6/27/2019		269.20	60.20	2.210	19.20	19.20		GRAB
MOO SW2	8/5/2019		315.69	118.42	1.960	14.40	14.40		GRAB
MOO SW2	8/20/2019		247.30	128.14	1.690	7.60	7.60		GRAB
MOO SW2	8/26/2019		352.10	231.43	1.980	7.00	7.00		GRAB
MOO SW2	9/3/2019		261.69	143.70	1.880	2.40	<5		GRAB
MOO SW2	10/21/2019		254.00	121.32	1.730	20.62	20.62		GRAB
MOO SW3	6/27/2019		200.50	112.76	1.890	14.67	<17		GRAB
MOO SW3	8/20/2019		396.80	287.86	3.460	12.00	12.00		GRAB
MOO SW3	8/26/2019		94.57	60.72	0.540	6.80	6.80		GRAB
MOO SW3	10/21/2019		369.30	262.73	0.890	46.73	46.73		GRAB
MOO SW4	6/27/2019		359.10	239.59	3.010	15.00	<25		GRAB
MOO SW4	8/26/2019		84.71	46.01	0.410	8.20	8.20		GRAB
MOO SW4	10/21/2019		328.20	266.96	0.580	13.41	13.41		GRAB
MOO SW5	6/27/2019		234.60	120.88	2.120	29.20	29.20		GRAB
MOO SW5	8/5/2019		486.80	386.63	2.460	9.60	<10		GRAB
MOO SW5	8/20/2019		356.00	131.71	3.010	64.67	64.67		GRAB
MOO SW5	8/26/2019		113.80	55.73	0.740	22.80	22.80		GRAB
MOO SW5	10/21/2019		276.60	206.42	0.660	19.18	19.18		GRAB
NLS	4/16/2019	6.33	79.32	19.07	1.490	4.80	<10		GRAB
NLS	4/29/2019	1.39	80.32	16.08	1.910	6.80	<10		GRAB
NLS	5/13/2019	0.31	72.00	19.30	1.010	3.20	<10		GRAB
NLS	5/28/2019	0.00	110.22	72.04	1.570	6.00	<10		GRAB
NLS	6/10/2019	0.26	159.87	45.50	1.880	11.20	11.20		GRAB
NLS	6/23/2019	0.74	172.52	8.28	3.250	20.80	20.80		COMP
NLS	6/24/2019	1.25	143.02	54.12	1.120	5.60	<10		GRAB
NLS	6/27/2019	5.07	277.00	23.60	3.330	172.00	172.00		COMP
NLS	6/30/2019	13.07	334.90	18.04	4.850	311.20	311.20		COMP
NLS	7/9/2019	7.07	248.10	80.28	1.660	106.40	106.40		COMP
NLS	7/15/2019	19.92	638.50	55.62	4.260	410.00	410.00		COMP
NLS	7/22/2019	1.34	146.30	46.06	1.210	4.40	<10		GRAB
NLS	8/5/2019	8.54	161.30	76.91	1.990	50.40	50.40		COMP
NLS	8/16/2019	8.37	150.60	107.09	1.190	60.40	60.40		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) reported	Cl (mg/L)	Type
NLS	8/19/2019	5.79	150.90	79.11	0.910	4.20	<5		GRAB
NLS	8/20/2019	17.16	179.20	63.55	1.980	86.40	86.40		COMP
NLS	9/3/2019	2.81	98.06	44.57	1.030	3.20	<5		GRAB
NLS	9/11/2019	10.97	156.04	82.31	1.600	31.20	31.20		COMP
NLS	9/12/2019	15.05	147.20	95.58	1.140	27.60	27.60		COMP
NLS	9/16/2019	0.52	95.07	34.44	1.120	1.00	<5		GRAB
NLS	9/30/2019	0.25	77.89	27.16	0.940	8.00	<10		GRAB
NLS	10/1/2019	19.15	241.20	86.00	1.830	81.60	81.60		COMP
NLS	10/10/2019	1.60	141.67	96.28	0.840	34.00	34.00		COMP
NLS	10/14/2019	0.63	153.13	23.17	1.710	98.40	98.40		GRAB
NLS	10/21/2019	32.12	160.72	10.33	2.280	96.97	96.97		COMP
PC2	4/16/2019	30.19	87.26	22.24	0.960	7.20	<10	185.94	GRAB
PC2	4/29/2019	12.17	42.21	6.43	1.050	4.00	<10	249.92	GRAB
PC2	5/9/2019	55.75	197.10	47.27	2.080	67.20	67.20	131.96	COMP
PC2	5/13/2019	13.64	52.33	14.06	0.820	2.40	<10	193.94	GRAB
PC2	5/28/2019	58.02	97.77	27.74	1.050	9.60	<10	65.98	GRAB
PC2	6/10/2019	12.45	102.74	45.03	1.010	5.20	<10	203.94	GRAB
PC2	6/23/2019	17.44	130.62	48.31	1.320	18.40	18.40	151.95	COMP
PC2	6/24/2019	13.95	92.93	37.31	1.050	7.60	<10	153.95	GRAB
PC2	6/27/2019	3.69	116.90	40.73	1.230	9.60	<10	147.95	GRAB
PC2	7/8/2019	9.99	129.30	72.79	1.130	2.40	<10	159.95	GRAB
PC2	7/16/2019	84.14	350.00	68.33	4.250	158.00	158.00	49.98	COMP
PC2	7/22/2019	18.60	164.70	109.31	1.250	2.40	<10	99.97	GRAB
PC2	8/5/2019	7.92	120.52	66.67	1.080	5.20	<10	197.94	GRAB
PC2	8/6/2019	37.79	137.70	37.67	1.610	25.60	25.60	101.97	COMP
PC2	8/9/2019	10.88	130.98	87.59	1.140	10.60	10.60	151.95	COMP
PC2	8/18/2019	91.14	166.74	61.17	1.770	54.40	54.40	51.98	COMP
PC2	8/19/2019	28.60	128.97	73.98	0.857	7.14	7.14	43.99	GRAB
PC2	9/2/2019	41.24	116.70	27.25	1.470	27.60	27.60	81.97	COMP
PC2	9/3/2019	20.07	86.44	46.88	0.840	4.40	<5	95.97	GRAB
PC2	9/12/2019	55.95	86.22	45.59	0.970	31.00	31.00	49.98	COMP
PC2	9/16/2019	15.16	79.07	73.14	0.790	1.80	<5	85.97	GRAB
PC2	9/30/2019	4.50	68.07	56.77	0.770	3.20	<10	95.97	GRAB
PC2	10/2/2019	53.49	114.00	57.30	0.910	15.20	15.20	51.98	GRAB
PC2	10/14/2019	10.70	57.87	23.42	0.790	12.80	12.80	95.97	GRAB
PC2	10/28/2019	9.50	57.57	34.08	1.010	1.33	<4		GRAB
PEONY	4/16/2019	24.45	132.40	70.34	1.230	11.20	11.20		GRAB
PEONY	4/29/2019	8.38	77.52	42.79	0.980	6.80	<10		GRAB
PEONY	5/13/2019	12.38	92.06	84.88	0.850	3.20	<10		GRAB
PEONY	5/16/2019	12.89	437.80	50.25	1.840	426.00	426.00		COMP
PEONY	5/27/2019	74.96	146.84	120.74	1.310	58.80	58.80		COMP
PEONY	5/28/2019	36.51	178.75	111.72	1.350	48.80	48.80		GRAB
PEONY	6/10/2019	9.67	335.46	92.97	2.070	13.60	13.60		GRAB
PEONY	6/21/2019	6.05	207.60	76.52	1.750	39.20	39.20		COMP
PEONY	6/24/2019	7.14	252.57	143.49	1.250	9.20	<10		GRAB
PEONY	6/27/2019	5.83	269.70	174.62	1.280	25.20	25.20		COMP
PEONY	7/1/2019	24.42	495.20	295.09	1.980	44.80	44.80		GRAB
PEONY	7/8/2019	5.77	416.70	142.37	2.250	13.20	13.20		GRAB
PEONY	7/15/2019	36.13	1124.00	129.57	#####	2383.33	2383.33		COMP
PEONY	7/22/2019	19.32	655.90	247.64	3.000	25.60	25.60		GRAB
PEONY	7/28/2019	17.70	732.90	135.48	2.030	110.80	110.80		COMP
PEONY	8/5/2019	3.00	261.49	159.36	1.530	9.20	<10		GRAB
PEONY	8/6/2019	8.58	478.30	130.72	3.260	117.00	117.00		COMP
PEONY	8/10/2019	20.90	760.10	149.03	4.580	249.00	249.00		COMP
PEONY	8/18/2019	28.59	1064.15	202.63	7.250	698.00	698.00		COMP
PEONY	8/19/2019	18.67	307.76	233.16	1.500	14.40	14.40		GRAB
PEONY	8/20/2019	34.73	806.20	158.70	5.920	369.00	369.00		COMP
PEONY	9/2/2019	18.41	509.11	135.89	3.430	162.00	162.00		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) reported	Cl (mg/L)	Type
PEONY	9/3/2019	11.60	259.38	157.23	1.400	14.00	14.00		GRAB
PEONY	9/12/2019	52.76	294.90	165.62	1.830	59.20	59.20		COMP
PEONY	9/16/2019	14.38	145.60	118.29	1.160	4.40	<5		GRAB
PEONY	9/30/2019	16.00	228.70	133.30	1.400	42.00	42.00		GRAB
PEONY	10/1/2019	14.23	322.90	134.13	2.030	58.80	58.80		COMP
PEONY	10/2/2019	26.37	832.60	154.13	5.230	389.00	389.00		COMP
PEONY	10/11/2019	29.24	136.89	93.88	0.940	29.20	29.20		COMP
PEONY	10/14/2019	16.45	85.48	68.25	0.840	9.60	<10		GRAB
PEONY	10/28/2019	11.29	109.40	52.03	1.130	15.35	15.35		GRAB
PL1	5/8/2019	6.30	371.50	162.17	2.370	175.20	175.20	8.00	COMP
PL1	5/9/2019	0.55	239.50	138.10	1.700	4.80	<10	29.99	GRAB
PL1	6/21/2019	0.25	372.70	160.29	3.650	40.40	40.40	6.00	COMP
PL1	6/23/2019	0.28	294.12	102.63	2.690	60.80	60.80	2.00	COMP
PL1	6/27/2019	0.67	257.80	118.91	1.900	54.00	54.00	4.00	COMP
PL1	6/30/2019	0.96	313.60	93.91	3.160	108.40	108.40	2.00	COMP
PL1	7/9/2019	0.17	268.80	160.93	2.480	45.20	45.20	6.00	COMP
PL1	7/15/2019	11.11	366.90	99.69	3.730	176.00	176.00	4.00	COMP
PL1	7/28/2019	0.28	237.40	132.06	3.170	16.00	16.00	6.00	COMP
PL1	8/5/2019	0.96	406.20	117.39	3.710	192.80	192.80	6.00	COMP
PL1	8/10/2019	1.18	159.77	80.89	1.830	36.40	36.40	2.00	COMP
PL1	8/16/2019	4.68	152.00	105.96	1.240	39.60	39.60	2.00	COMP
PL1	8/18/2019	8.63	167.51	77.72	1.790	42.40	42.40	4.00	COMP
PL1	8/20/2019	9.58	326.20	81.54	3.690	152.67	152.67	4.00	COMP
PL1	9/2/2019	0.23	340.64	99.88	3.070	128.00	128.00	2.00	COMP
PL1	9/12/2019	2.10	138.20	71.18	1.210	30.80	30.80	4.00	COMP
PL2	4/16/2019	1.47	109.50	48.57	2.400	4.00	<10	235.93	GRAB
PL2	4/29/2019	0.18	63.64	6.59	0.850	6.40	<10	417.87	GRAB
PL2	5/8/2019	7.15	431.20	68.77	3.030	185.60	185.60	169.95	COMP
PL2	5/13/2019	0.37	114.71	45.03	1.160	14.40	14.40	149.95	GRAB
PL2	5/28/2019	2.10	82.31	25.83	0.940	3.60	<10	69.98	GRAB
PL2	6/10/2019	0.06	161.02	127.16	1.160	7.60	<10	186.94	GRAB
PL2	6/20/2019	1.84	201.50	68.36	1.340	91.12	91.12	159.95	COMP
PL2	6/23/2019	2.67	282.36	108.54	2.340	116.40	116.40	187.94	COMP
PL2	6/24/2019	1.00	184.93	123.51	1.300	6.40	<10	223.93	GRAB
PL2	6/27/2019	8.33	241.80	92.24	2.290	346.67	346.67	117.96	COMP
PL2	6/30/2019	12.00	374.10	78.41	3.490	206.67	206.67	79.98	COMP
PL2	7/8/2019	0.16	172.10	130.80	0.800	3.60	<10	91.97	GRAB
PL2	7/9/2019	1.52	153.20	63.88	1.00	16.40	16.40	67.98	COMP
PL2	7/16/2019	0.08	191.40	77.89	1.620	15.20	15.20	55.98	GRAB
PL2	7/22/2019	0.37	266.70	106.61	1.090	2.00	<10	89.97	GRAB
PL2	7/25/2019	0.26	219.80	158.36	2.600	1.60	<10	16.00	GRAB
PL2	8/5/2019	0.13	180.87	153.55	0.820	2.00	<10	119.96	GRAB
PL2	8/6/2019	0.50	172.60	70.69	1.260	22.00	22.00	97.97	COMP
PL2	8/10/2019	1.79	140.96	75.72	1.140	31.40	31.40	93.97	COMP
PL2	8/16/2019	0.40	125.00	85.73	1.110	38.80	38.80	65.98	COMP
PL2	8/18/2019	2.92	178.57	65.41	1.350	56.80	56.80	23.99	COMP
PL2	8/19/2019	0.24	116.06	71.99	0.880	3.60	<5	35.99	GRAB
PL2	8/20/2019	0.39	121.70	64.82	1.010	10.40	10.40	35.99	COMP
PL2	9/2/2019	0.58	171.08	38.93	1.510	65.20	65.20	61.98	COMP
PL2	9/3/2019	0.62	84.34	48.38	0.740	3.20	<10	73.98	GRAB
PL2	9/12/2019	1.23	141.14	82.26	0.970	32.40	32.40	45.99	COMP
PL2	9/16/2019	0.33	100.30	83.74		1.20	<5	53.98	GRAB
PL2	9/30/2019	0.14	90.27	45.54	0.690	3.20	<10	87.97	GRAB
PL2	10/11/2019	4.30	150.40	78.61	0.670	71.60	71.60	35.99	COMP
PL2	10/14/2019	0.19	66.58	51.49	0.710	16.00	16.00	63.98	GRAB
PL2	10/28/2019	0.16	103.40	42.28	0.840	3.33	<4		GRAB
PRG-IN	6/20/2019		151.10	117.42	1.170	32.80	32.80		GRAB
PRG-OUT	6/20/2019		139.20	110.41	3.290	0.80	<10		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) reported	Cl (mg/L)	Type
PRG-IN	6/27/2019		77.10	36.44	1.100	9.60	<10		GRAB
PRG-OUT	6/27/2019		173.70	36.44	2.800	2.40	<10		GRAB
PRG-IN	8/20/2019		70.40	29.19	0.910	15.20	15.20		GRAB
PRG-OUT	8/20/2019		189.40	159.94	1.370	1.40	<5		GRAB
PRG-IN	8/26/2019		19.63	7.25	0.191	3.80	<5		GRAB
PRG-OUT	8/26/2019		170.80	138.13	1.550	1.40	<5		GRAB
PRG-IN	10/21/2019		558.40	204.96	0.700	34.20	34.20		GRAB
PRG-OUT	10/21/2019		210.50	192.36	1.060	9.79	9.79		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
22-Apr-19	11:05:29 AM	CAM	0.264	0.000	12.642	72.6	7.70	253.7	8.35
22-Apr-19	11:07:23 AM	CAM	0.775	1.000	12.580	55.4	5.89	272.5	7.87
6-May-19	10:02:07 AM	CAM	0.304	0.000	14.593	65.6	6.67	283.0	8.02
6-May-19	10:04:13 AM	CAM	0.615	1.000	14.596	16.3	1.66	285.4	7.56
20-May-19	9:43:31 AM	CAM	0.328	0.000	9.591	73.9	8.41	288.1	8.25
20-May-19	9:44:18 AM	CAM	0.652	1.000	9.732	70.9	8.05	290.6	8.01
3-Jun-19	10:04:00 AM	CAM	0.325	0.000	18.966	22.9	2.13	287.0	6.87
3-Jun-19	10:04:42 AM	CAM	0.628	1.000	18.907	17.6	1.64	306.5	6.50
17-Jun-19	9:54:26 AM	CAM	0.277	0.000	19.376	7.7	0.71	320.7	6.33
17-Jun-19	9:55:20 AM	CAM	0.504	1.000	19.418	6.6	0.60	305.9	6.33
1-Jul-19	9:29:35 AM	CAM	0.305	0.000	21.357	5.9	0.52	318.8	7.27
1-Jul-19	9:31:18 AM	CAM	0.696	1.000	20.256	0.6	0.06	393.3	6.54
15-Jul-19	9:11:26 AM	CAM	0.270	0.000	20.832	3.6	0.32	338.9	6.59
15-Jul-19	9:14:12 AM	CAM	0.657	1.000	20.162	1.1	0.10	411.7	6.32
29-Jul-19	9:12:22 AM	CAM	0.323	0.000	19.969	8.5	0.78	267.3	6.46
29-Jul-19	9:12:59 AM	CAM	0.588	1.000	19.780	4.3	0.39	327.4	6.34
12-Aug-19	9:20:00 AM	CAM	0.340	0.000	19.005	9.0	0.84	211.3	7.92
12-Aug-19	9:20:53 AM	CAM	0.582	1.000	19.088	4.0	0.37	225.8	6.87
26-Aug-19	9:54:17 AM	CAM	0.386	0.000	17.864	12.3	1.17	296.4	6.77
26-Aug-19	9:55:29 AM	CAM	0.731	1.000	17.831	3.5	0.33	332.5	6.54
9-Sep-19	9:20:26 AM	CAM	0.309	0.000	15.427	9.5	0.95	271.0	7.03
9-Sep-19	9:22:13 AM	CAM	0.542	1.000	15.562	5.2	0.52	283.9	6.42
23-Sep-19	9:49:14 AM	CAM	0.331	0.000	17.523	10.1	0.97	300.9	7.73
23-Sep-19	9:49:40 AM	CAM	0.547	1.000	17.273	4.7	0.45	280.5	7.51
22-Apr-19	3:20:45 PM	PAR	0.335	0.000	10.213	120.7	13.51	1012.0	8.75
22-Apr-19	3:21:36 PM	PAR	1.013	1.000	10.217	124.7	13.96	1013.0	8.86
22-Apr-19	3:22:08 PM	PAR	2.025	2.000	10.215	125.7	14.07	1013.0	8.86
22-Apr-19	3:22:30 PM	PAR	3.074	3.000	10.209	126.2	14.14	1013.0	8.86
22-Apr-19	3:23:16 PM	PAR	4.078	4.000	7.834	120.2	14.24	1023.0	8.77
22-Apr-19	3:24:00 PM	PAR	5.097	5.000	6.774	114.2	13.89	1028.0	8.66
22-Apr-19	3:24:33 PM	PAR	6.079	6.000	5.109	96.0	12.18	1135.0	8.45
22-Apr-19	3:25:43 PM	PAR	7.062	7.000	4.234	45.0	5.83	1426.0	8.06
22-Apr-19	3:26:43 PM	PAR	8.019	8.000	3.576	24.7	3.25	1883.0	7.76
22-Apr-19	3:27:21 PM	PAR	9.015	9.000	3.719	18.5	2.43	1992.0	7.63
22-Apr-19	3:27:58 PM	PAR	10.037	10.000	3.763	14.9	1.95	2034.0	7.55
22-Apr-19	3:28:50 PM	PAR	11.095	11.000	3.870	11.6	1.52	2005.0	7.33
22-Apr-19	3:29:21 PM	PAR	11.186	11.000	3.879	10.3	1.34	1981.0	7.23
6-May-19	2:31:11 PM	PAR	0.275	0.000	13.937	101.5	10.44	1038.0	8.44
6-May-19	2:31:42 PM	PAR	1.042	1.000	13.868	104.5	10.76	1037.0	8.51
6-May-19	2:32:29 PM	PAR	2.027	2.000	13.825	106.9	11.02	1037.0	8.53
6-May-19	2:32:40 PM	PAR	2.982	3.000	13.798	107.2	11.06	1038.0	8.53

Date	Time	Site	Depth Measured (m)	Depth Rounded(m)	Temp (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Specific Conductivity (uS/cm)	pH
6-May-19	2:32:53 PM	PAR	4.009	4.000	11.422	100.3	10.92	1041.0	8.54
6-May-19	2:33:02 PM	PAR	5.012	5.000	10.880	93.4	10.28	1041.0	8.53
6-May-19	2:33:14 PM	PAR	6.024	6.000	6.760	81.5	9.91	1091.0	8.49
6-May-19	2:34:50 PM	PAR	7.034	7.000	4.923	15.1	1.92	1392.0	7.78
6-May-19	2:35:34 PM	PAR	7.973	8.000	4.174	11.3	1.46	1831.0	7.58
6-May-19	2:36:05 PM	PAR	8.978	9.000	3.979	9.8	1.28	1981.0	7.45
6-May-19	2:36:19 PM	PAR	10.006	10.000	3.949	9.4	1.22	2007.0	7.41
6-May-19	2:36:29 PM	PAR	10.956	11.000	3.968	9.1	1.18	2028.0	7.37
6-May-19	2:36:51 PM	PAR	11.052	11.000	4.003	8.5	1.10	2037.0	7.14
20-May-19	1:47:55 PM	PAR	0.341	0.000	14.364	96.5	9.84	964.0	8.24
20-May-19	1:48:42 PM	PAR	1.006	1.000	14.249	96.6	9.87	964.0	8.33
20-May-19	1:49:37 PM	PAR	2.022	2.000	13.797	96.1	9.92	965.0	8.40
20-May-19	1:50:01 PM	PAR	3.009	3.000	13.532	96.2	9.99	965.0	8.42
20-May-19	1:51:01 PM	PAR	4.058	4.000	13.374	94.9	9.89	964.0	8.46
20-May-19	1:52:00 PM	PAR	5.020	5.000	12.388	86.6	9.22	999.0	8.39
20-May-19	1:52:37 PM	PAR	6.025	6.000	10.271	75.5	8.44	1040.0	8.33
20-May-19	1:53:26 PM	PAR	7.007	7.000	6.230	38.9	4.79	1423.0	8.13
20-May-19	1:53:52 PM	PAR	8.064	8.000	4.772	29.1	3.72	1854.0	7.99
20-May-19	1:54:28 PM	PAR	9.013	9.000	4.263	21.6	2.80	1982.0	7.88
20-May-19	1:55:00 PM	PAR	10.008	10.000	4.163	17.6	2.28	2022.0	7.79
20-May-19	1:55:39 PM	PAR	11.011	11.000	4.134	14.2	1.84	2019.0	7.61
20-May-19	1:56:35 PM	PAR	11.200	11.000	4.217	11.3	1.47	2021.0	7.48
3-Jun-19	3:56:04 PM	PAR	0.308	0.000	21.120	120.2	10.66	868.0	8.93
3-Jun-19	3:56:20 PM	PAR	1.036	1.000	21.066	123.6	10.98	867.0	8.92
3-Jun-19	3:56:46 PM	PAR	2.046	2.000	18.517	144.8	13.53	882.0	9.06
3-Jun-19	3:57:29 PM	PAR	2.997	3.000	16.592	111.5	10.84	900.0	8.64
3-Jun-19	3:57:46 PM	PAR	3.996	4.000	15.435	103.0	10.26	924.0	8.52
3-Jun-19	3:58:49 PM	PAR	5.019	5.000	13.673	80.5	8.34	949.0	8.27
3-Jun-19	3:59:27 PM	PAR	6.008	6.000	10.887	52.6	5.79	1061.0	7.78
3-Jun-19	4:00:43 PM	PAR	6.967	7.000	8.034	14.9	1.76	1247.0	7.46
3-Jun-19	4:01:09 PM	PAR	7.969	8.000	5.567	12.1	1.51	1817.0	7.31
3-Jun-19	4:01:35 PM	PAR	9.033	9.000	4.658	10.5	1.35	1967.0	7.21
3-Jun-19	4:01:49 PM	PAR	9.982	10.000	4.491	9.9	1.28	2001.0	7.16
3-Jun-19	4:02:05 PM	PAR	11.023	11.000	4.452	9.4	1.21	1965.0	7.11
17-Jun-19	2:40:07 PM	PAR	0.333	0.000	22.309	118.7	10.29	859.0	9.06
17-Jun-19	2:40:44 PM	PAR	1.046	1.000	22.291	120.1	10.42	859.0	9.05
17-Jun-19	2:41:12 PM	PAR	2.042	2.000	21.795	119.7	10.49	860.0	9.03
17-Jun-19	2:41:41 PM	PAR	3.042	3.000	20.663	101.6	9.10	901.0	8.46
17-Jun-19	2:42:09 PM	PAR	4.080	4.000	16.830	89.9	8.70	927.0	8.36
17-Jun-19	2:43:27 PM	PAR	5.051	5.000	14.150	72.8	7.46	951.0	8.15
17-Jun-19	2:45:31 PM	PAR	6.037	6.000	10.645	22.5	2.49	1125.0	7.66
17-Jun-19	2:46:21 PM	PAR	7.053	7.000	7.768	16.2	1.92	1475.0	7.58
17-Jun-19	2:46:51 PM	PAR	8.043	8.000	5.808	13.7	1.70	1856.0	7.45

Date	Time	Site	Depth Measured (m)	Depth Rounded(m)	Temp (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Specific Conductivity (uS/cm)	pH
17-Jun-19	2:47:31 PM	PAR	9.002	9.000	4.889	11.8	1.50	1954.0	7.32
17-Jun-19	2:48:23 PM	PAR	10.083	10.000	4.608	10.1	1.29	1982.0	7.23
17-Jun-19	2:51:16 PM	PAR	10.861	11.000	4.616	7.4	0.94	1925.0	7.00
1-Jul-19	1:35:29 PM	PAR	0.328	0.000	24.695	130.7	10.84	820.0	8.99
1-Jul-19	1:36:39 PM	PAR	1.083	1.000	24.661	130.5	10.83	821.0	9.01
1-Jul-19	1:37:15 PM	PAR	2.024	2.000	24.556	127.2	10.58	818.0	8.98
1-Jul-19	1:37:43 PM	PAR	3.055	3.000	22.993	99.4	8.51	842.0	8.67
1-Jul-19	1:38:20 PM	PAR	4.039	4.000	19.836	73.0	6.65	920.0	8.13
1-Jul-19	1:38:57 PM	PAR	5.026	5.000	15.717	65.5	6.48	952.0	8.06
1-Jul-19	1:40:29 PM	PAR	6.050	6.000	11.461	7.7	0.84	1127.0	7.65
1-Jul-19	1:41:05 PM	PAR	7.065	7.000	9.092	1.3	0.15	1383.0	7.55
1-Jul-19	1:41:57 PM	PAR	8.073	8.000	6.560	0.0	0.00	1777.0	7.38
1-Jul-19	1:42:32 PM	PAR	9.045	9.000	5.483	0.0	0.00	1927.0	7.23
1-Jul-19	1:43:01 PM	PAR	10.060	10.000	5.199	0.0	0.00	1951.0	7.15
1-Jul-19	1:43:29 PM	PAR	11.062	11.000	5.046	0.0	0.00	1936.0	7.08
1-Jul-19	1:45:36 PM	PAR	11.220	11.000	5.185	0.0	0.00	1938.0	6.94
15-Jul-19	1:17:06 PM	PAR	0.493	1.000	27.876	142.1	11.12	769.0	9.25
15-Jul-19	1:17:53 PM	PAR	1.020	1.000	27.748	140.3	11.01	770.0	9.21
15-Jul-19	1:18:21 PM	PAR	2.046	2.000	26.297	96.9	7.79	786.0	8.93
15-Jul-19	1:18:44 PM	PAR	3.071	3.000	24.203	50.9	4.26	780.0	8.49
15-Jul-19	1:19:08 PM	PAR	4.079	4.000	20.308	64.4	5.80	927.0	8.25
15-Jul-19	1:19:31 PM	PAR	4.973	5.000	16.173	70.3	6.89	963.0	8.24
15-Jul-19	1:20:02 PM	PAR	6.097	6.000	12.163	7.3	0.78	1109.0	7.98
15-Jul-19	1:20:27 PM	PAR	7.041	7.000	8.773	2.5	0.29	1466.0	7.82
15-Jul-19	1:20:42 PM	PAR	8.070	8.000	6.652	1.2	0.14	1828.0	7.71
15-Jul-19	1:21:01 PM	PAR	9.125	9.000	5.661	0.4	0.05	1938.0	7.50
15-Jul-19	1:21:19 PM	PAR	10.068	10.000	5.388	0.0	0.00	1961.0	7.34
15-Jul-19	1:21:33 PM	PAR	10.986	11.000	5.325	0.0	0.00	1920.0	7.12
15-Jul-19	1:21:49 PM	PAR	11.077	11.000	5.320	0.0	0.00	1922.0	7.06
29-Jul-19	1:47:10 PM	PAR	0.389	0.000	25.548	106.7	8.71	681.0	8.90
29-Jul-19	1:47:36 PM	PAR	1.029	1.000	25.545	106.9	8.73	681.0	8.91
29-Jul-19	1:48:32 PM	PAR	2.093	2.000	25.538	106.9	8.73	681.0	8.90
29-Jul-19	1:49:08 PM	PAR	3.046	3.000	25.514	106.5	8.70	681.0	8.90
29-Jul-19	1:50:17 PM	PAR	4.083	4.000	22.386	10.0	0.87	842.0	8.01
29-Jul-19	1:51:13 PM	PAR	5.016	5.000	17.426	20.3	1.94	959.0	7.87
29-Jul-19	1:52:35 PM	PAR	6.072	6.000	12.620	1.2	0.13	1098.0	7.66
29-Jul-19	1:53:08 PM	PAR	7.070	7.000	9.377	0.0	0.00	1438.0	7.58
29-Jul-19	1:53:53 PM	PAR	8.021	8.000	7.025	0.0	0.00	1775.0	7.42
29-Jul-19	1:54:32 PM	PAR	9.069	9.000	5.970	0.0	0.00	1886.0	7.25
29-Jul-19	1:55:23 PM	PAR	10.064	10.000	5.665	0.0	0.00	1907.0	7.13
29-Jul-19	1:55:58 PM	PAR	11.228	11.000	5.639	0.0	0.00	1879.0	6.93
12-Aug-19	12:56:34 PM	PAR	0.391	0.000	24.846	127.0	10.51	629.0	9.54
12-Aug-19	12:57:03 PM	PAR	1.029	1.000	24.722	122.6	10.16	629.0	9.49

Date	Time	Site	Depth Measured (m)	Depth Rounded(m)	Temp (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Specific Conductivity (uS/cm)	pH
12-Aug-19	12:58:18 PM	PAR	1.998	2.000	24.625	109.8	9.12	628.0	9.37
12-Aug-19	12:59:09 PM	PAR	3.007	3.000	24.417	60.4	5.04	631.0	8.95
12-Aug-19	12:59:54 PM	PAR	4.091	4.000	22.936	4.8	0.41	725.0	8.06
12-Aug-19	1:00:35 PM	PAR	4.961	5.000	18.303	1.2	0.12	898.0	8.00
12-Aug-19	1:01:08 PM	PAR	6.006	6.000	13.367	0.4	0.04	1037.0	8.14
12-Aug-19	1:01:43 PM	PAR	7.023	7.000	9.598	0.0	0.00	1399.0	8.34
12-Aug-19	1:02:19 PM	PAR	8.046	8.000	7.362	0.0	0.00	1663.0	9.05
12-Aug-19	1:02:48 PM	PAR	9.022	9.000	6.387	0.0	0.00	1747.0	9.18
12-Aug-19	1:03:37 PM	PAR	10.019	10.000	5.931	0.0	0.00	1782.0	8.67
12-Aug-19	1:04:07 PM	PAR	11.005	11.000	5.818	0.0	0.00	1787.0	8.27
12-Aug-19	1:04:32 PM	PAR	11.164	11.000	5.807	0.0	0.00	1789.0	8.08
26-Aug-19	1:50:54 PM	PAR	0.354	1.000	22.765	84.6	7.27	608.0	8.51
26-Aug-19	1:51:11 PM	PAR	1.084	1.000	22.756	84.6	7.28	607.0	8.58
26-Aug-19	1:51:33 PM	PAR	2.017	2.000	22.767	84.3	7.25	608.0	8.64
26-Aug-19	1:51:58 PM	PAR	3.088	3.000	22.752	83.4	7.17	609.0	8.68
26-Aug-19	1:52:31 PM	PAR	4.047	4.000	22.666	78.6	6.78	613.0	8.67
26-Aug-19	1:52:58 PM	PAR	5.120	5.000	19.102	8.3	0.76	933.0	8.33
26-Aug-19	1:53:15 PM	PAR	6.313	7.000	11.902	4.0	0.41	1253.0	8.23
26-Aug-19	1:53:29 PM	PAR	7.236	8.000	10.138	2.8	0.31	1532.0	8.13
26-Aug-19	1:53:50 PM	PAR	8.129	8.000	7.975	1.9	0.23	1740.0	7.97
26-Aug-19	1:54:12 PM	PAR	9.023	9.000	6.916	1.5	0.18	1849.0	7.80
26-Aug-19	1:54:44 PM	PAR	10.107	10.000	6.310	1.0	0.13	1881.0	7.61
26-Aug-19	1:55:01 PM	PAR	11.018	11.000	6.196	0.8	0.09	1819.0	7.50
26-Aug-19	1:55:17 PM	PAR	11.207	11.000	6.274	0.6	0.07	1807.0	7.44
9-Sep-19	2:05:52 PM	PAR	0.308	0.000	19.947	84.2	7.65	627.0	8.27
9-Sep-19	2:06:35 PM	PAR	1.025	1.000	19.953	84.1	7.64	627.0	8.36
9-Sep-19	2:07:18 PM	PAR	2.036	2.000	19.957	83.8	7.62	627.0	8.42
9-Sep-19	2:07:49 PM	PAR	3.011	3.000	19.955	83.8	7.61	627.0	8.44
9-Sep-19	2:08:11 PM	PAR	4.025	4.000	19.945	83.3	7.57	627.0	8.45
9-Sep-19	2:08:59 PM	PAR	4.987	5.000	19.565	78.7	7.20	634.0	8.44
9-Sep-19	2:09:43 PM	PAR	6.008	6.000	13.944	6.8	0.70	1161.0	8.09
9-Sep-19	2:10:15 PM	PAR	7.021	7.000	10.055	3.3	0.37	1519.0	7.88
9-Sep-19	2:10:38 PM	PAR	8.039	8.000	7.930	2.2	0.25	1801.0	7.75
9-Sep-19	2:11:08 PM	PAR	8.995	9.000	6.765	1.5	0.18	1898.0	7.59
9-Sep-19	2:11:38 PM	PAR	10.018	10.000	6.430	1.1	0.14	1919.0	7.47
9-Sep-19	2:13:12 PM	PAR	10.955	11.000	6.394	0.6	0.08	1867.0	7.13
23-Sep-19	1:36:20 PM	PAR	0.312	0.000	21.629	115.1	10.12	619.0	8.88
23-Sep-19	1:37:18 PM	PAR	1.011	1.000	21.531	115.4	10.16	619.0	8.89
23-Sep-19	1:37:48 PM	PAR	2.058	2.000	21.152	105.9	9.39	620.0	8.86
23-Sep-19	1:38:21 PM	PAR	3.015	3.000	18.977	70.9	6.57	619.0	8.27
23-Sep-19	1:38:55 PM	PAR	4.050	4.000	18.258	39.4	3.70	618.0	7.90
23-Sep-19	1:39:26 PM	PAR	5.028	5.000	17.678	29.3	2.79	623.0	7.72
23-Sep-19	1:39:53 PM	PAR	6.006	6.000	15.444	6.5	0.65	1108.0	7.45

Date	Time	Site	Depth Measured (m)	Depth Rounded(m)	Temp (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Specific Conductivity (uS/cm)	pH
23-Sep-19	1:40:17 PM	PAR	7.040	7.000	10.794	2.6	0.29	1535.0	7.32
23-Sep-19	1:40:30 PM	PAR	8.082	9.000	8.334	1.7	0.20	1759.0	7.12
23-Sep-19	1:40:48 PM	PAR	9.020	9.000	7.154	1.1	0.14	1862.0	7.02
23-Sep-19	1:41:07 PM	PAR	10.036	11.000	6.629	0.9	0.11	1892.0	6.92
23-Sep-19	1:41:37 PM	PAR	11.031	11.000	6.444	0.7	0.09	1884.0	6.80
23-Sep-19	1:42:38 PM	PAR	11.115	11.000	6.624	0.8	0.09	1892.0	6.81
7-Oct-19	1:36:25 PM	PAR	0.303	0.000	14.029	85.8	8.83	603.0	8.22
7-Oct-19	1:36:48 PM	PAR	1.058	1.000	13.868	85.9	8.86	602.0	8.22
7-Oct-19	1:37:11 PM	PAR	2.062	2.000	13.572	83.9	8.72	603.0	8.20
7-Oct-19	1:37:46 PM	PAR	3.043	3.000	13.476	79.3	8.25	601.0	8.11
7-Oct-19	1:38:07 PM	PAR	4.101	4.000	13.427	79.1	8.25	601.0	8.09
7-Oct-19	1:38:35 PM	PAR	5.055	5.000	13.359	76.6	8.00	603.0	8.07
7-Oct-19	1:39:38 PM	PAR	6.055	6.000	13.287	78.1	8.16	597.0	8.09
7-Oct-19	1:40:25 PM	PAR	7.074	7.000	11.887	7.5	0.81	1318.0	7.40
7-Oct-19	1:41:15 PM	PAR	8.058	8.000	8.832	2.2	0.26	1684.0	7.09
7-Oct-19	1:41:40 PM	PAR	9.092	9.000	7.287	1.4	0.16	1800.0	6.96
7-Oct-19	1:42:01 PM	PAR	10.075	10.000	6.735	1.1	0.13	1833.0	6.89
7-Oct-19	1:42:19 PM	PAR	11.043	11.000	6.548	0.8	0.10	1825.0	6.80
7-Oct-19	1:43:03 PM	PAR	11.229	11.000	6.600	0.8	0.09	1810.0	6.73

8.0 LAKE SAMPLE DATA

Date	Time	Site	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)	TP:SRP ratio	Sample Type
22-Apr-19	11:05:29 AM	CAM	108.20	44.38	0.99		9.15	<10	(bottom)	41.02%	S
6-May-19	10:02:07 AM	CAM	83.25	9.31	0.99		5.89	<10	0.63 (bottom)	11.18%	S
20-May-19	9:43:31 AM	CAM	47.74	9.75	0.85		0.91	<10	.68 (bottom)	20.42%	S
3-Jun-19	10:04:00 AM	CAM	98.78	39.92	1.09		1.28	<10	.6 (bottom)	40.41%	S
17-Jun-19	9:54:26 AM	CAM	88.74	45.13	1.50		9.92	<10	.6 (bottom)	50.86%	S
1-Jul-19	9:29:35 AM	CAM	82.30	23.63	1.39		6.99	<10	.65 (bottom)	28.71%	S
15-Jul-19	9:11:26 AM	CAM	69.28	16.09	1.37		39.72	39.72	.7 (bottom)	23.22%	S
29-Jul-19	9:12:22 AM	CAM	84.91	41.13	1.71		38.37	38.37	.6 (bottom)	48.44%	S
12-Aug-19	9:20:00 AM	CAM	140.14	13.78	2.82		78.17	78.17	.45 (Vegetation)	9.83%	S
26-Aug-19	9:54:17 AM	CAM	99.28	18.99	1.77		12.82	12.82	.65 veg	19.13%	S
9-Sep-19	9:20:26 AM	CAM	40.83	2.52	1.11		6.64	<33	VEG	6.17%	S
23-Sep-19	9:49:14 AM	CAM	102.54	9.14	2.21		21.49	<50	0.60	8.91%	S
22-Apr-19	3:20:45 PM	PAR	62.29	9.04	0.54		20.54	20.54	1.54	14.51%	S
22-Apr-19	3:24:00 PM	PAR	81.71	17.05						20.87%	M
22-Apr-19	3:28:50 PM	PAR	537.60	382.36						71.12%	B
6-May-19	2:31:11 PM	PAR	22.97	8.01	0.49	231.93	0.58	<10	6.92	34.87%	S
6-May-19	2:33:02 PM	PAR	31.10	7.62						24.50%	M
6-May-19	2:36:19 PM	PAR	379.41	314.03		419.87				82.77%	B
20-May-19	1:47:55 PM	PAR	19.69	3.28	0.83	211.93	2.99	<10	5.04	16.66%	S
20-May-19	1:52:37 PM	PAR	25.08	10.47						41.75%	M
20-May-19	1:55:39 PM	PAR	719.19	614.08		501.84				85.38%	B
3-Jun-19	3:56:04 PM	PAR	14.79	2.59	0.01	202.94	0.27	<10	6.34	17.51%	S
3-Jun-19	3:58:49 PM	PAR	16.55	2.12						12.81%	M
3-Jun-19	4:01:49 PM	PAR	354.30	294.39		372.88				83.09%	B
17-Jun-19	2:40:07 PM	PAR	13.06	2.06	0.64		1.66	<10	6.74	15.77%	S
17-Jun-19	2:43:27 PM	PAR	15.00	7.68						51.20%	M
17-Jun-19	2:48:23 PM	PAR	750.80	628.90						83.76%	B
1-Jul-19	1:35:29 PM	PAR	16.64	5.47	0.49	193.94	6.03	<13	5.90	32.87%	S
1-Jul-19	1:40:29 PM	PAR	58.22	40.43						69.44%	M
1-Jul-19	1:43:29 PM	PAR	960.90	793.05		475.85				82.53%	B
15-Jul-19	1:17:06 PM	PAR	16.09	2.04	0.48		4.15	<10	2.90	12.68%	S
15-Jul-19	1:20:02 PM	PAR	41.21	13.06						31.69%	M
15-Jul-19	1:21:33 PM	PAR	773.97	613.75						79.30%	B
29-Jul-19	1:47:10 PM	PAR	26.76	11.42	0.80		13.63	13.63	3.45	42.68%	S
29-Jul-19	1:52:35 PM	PAR	27.89	17.86						64.04%	M
29-Jul-19	1:55:58 PM	PAR	1144.00	1127.13						98.53%	B
12-Aug-19	12:56:34 PM	PAR	25.59	7.81	0.78		45.92	45.92	1.75	30.52%	S
12-Aug-19	12:59:54 PM	PAR	49.12	21.82						44.42%	M
12-Aug-19	1:04:07 PM	PAR	677.15	549.80						81.19%	B
26-Aug-19	1:50:54 PM	PAR	31.52	6.56	0.63	133.96	21.62	21.62	1.40	20.81%	S

Date	Time	Site	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)	TP:SRP ratio	Sample Type
26-Aug-19	1:52:58 PM	PAR	34.63	4.58						13.23%	M
26-Aug-19	1:55:01 PM	PAR	656.30	526.78		449.86				80.27%	B
9-Sep-19	2:05:52 PM	PAR	35.49	5.38	0.76		13.45	<14	0.80	15.16%	S
9-Sep-19	2:09:43 PM	PAR	84.69	27.22						32.14%	M
9-Sep-19	2:11:38 PM	PAR	858.30	626.11						72.95%	B
23-Sep-19	1:36:20 PM	PAR	33.41	11.03	0.80	125.96	22.67	22.67	1.35	33.01%	S
23-Sep-19	1:39:53 PM	PAR	26.23	16.33						62.26%	M
23-Sep-19	1:41:37 PM	PAR	714.10	103.20		91.97				14.45%	B
7-Oct-19	1:36:25 PM	PAR	46.36	3.70	0.91		23.70		1.55	7.98%	S
7-Oct-19	1:40:25 PM	PAR	49.67	1.70						3.42%	M
7-Oct-19	1:42:19 PM	PAR	829.70	595.80						71.81%	B