RESULTS FROM ISLAND-WIDE WATER MONITORING DURING THE SUMMER OF 2019

TROPHIC STATE INDEX (TSI) ANALYSIS: 2019

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4 February 2020

LES CHENEAUX WATERSHED COUNCIL

TSI ANALYSIS: 2019 4 February 2020

Summary: Ratings of 2019 water samples fell within expected trophic (nutrient) ranges for inner and outer island zones of the Les Cheneaux Islands. Analytical values for all test sites were within the range of samples quantified at the Univ Michigan Biological Station (UMBS) during the previous six seasons. The relation of three key variables: Total Phosphorus, Soluble Reactive Phosphorus and Chlorophyll-a were as expected and Les Cheneaux waters remain of a highly desirable quality for recreational use.

Results and Discussion: Variables quantified for Les Cheneaux water samples were: Total Phosphorus (TP), Soluble Reactive Phosphorus (SRP) and Chlorophyll-a (Chl-a). SRP is a component of TP and is, therefore, expected to be a value less than TP although, in some situations, TP and SRP values have been found to be about equal in concentration. SRP can be readily used by phytoplankton whereas TP must undergo a conversion before being of use as a nutrient by phytoplankton. Chlorophyll-a is used as an indirect measure of phytoplankton concentration and is derived by solvent extraction followed by photometrically measuring the chlorophyll-a species from phytoplankton samples. Since SRP is a primary phytoplankton nutrient, as Chl-a values increase the SRP is metabolized and, therefore, expected to decrease. Conversely, as Chl-a levels decrease the SRP concentration typically increases. Past annual surveys have shown the expected relationship of these variables in that TP was in greater concentration than SRP and Chl-a was recovered in lower concentration than TP and SRP.

Averaged seasonal values for all sample sites are shown for TP, SRP and Chl-a in Fig. 1 and were calculated based on data in Table 1 (App). Fig. 1A is a standard plot and indicates the highest TP was observed at sites 4, 4a, 4c and 5. Concentrations of both SRP and Chl-a were also highest at these inner island sites. To better illustrate differences in Chl-a levels during the season the same data are shown in a log plot in Fig. 1B. These curves show that the trophic, or nutrient, level observed for all sites during the 2019 season were ranked within the oligotrophic range using the Carlson index (Fig.7). Waters ranked in this range are highly desirable quality for recreational use.

When TP levels for individual sample sites are considered, TP was maximum in May, June and July for all stations (Fig. 2). SRP was at maximum in May at eight sites and in July at 4 sites. Bimodal maxima were observed at sites five and nine.

SRP was present at higher levels than Chl-a at all sample sites (Fig.3) as is the norm. The greatest demand on SRP by phytoplankton was at sites 4b, 4c and 5 as shown by the lower differential between the respective curves at those sites. Peak SRP for all sites was May, suggesting that the demand for phosphorus by phytoplankton was lowest during that period.

Seasonal 2019 temperatures ranged from an average of 10.5 C (51F) to 16.5 C (62F), again, reflecting the inner and outer island zones (Fig. 4, 5). The lowest temperature observed was 7C and the highest 19C. Plateau temps for June and July at sites 5,6 and 7 reflect their position on a west-east axis and the influence of prevailing westerlies.

Water clarity remained high to a point that the Secchi disk could be read when lying on the bottom at sites 2, 4a,8 and 9 where the depth ranged from 10ft to 45ft (Fig. 6). Water was clearest at all sites in June which correlates with low phytoplankton densities (low Chl-a values) during the same month.

Appendix.

Table 1. 2019 raw data analysis by

Figure 1. Averaged seasonal values to TP, SRP and Chl-a

Figure 2. Plot of Total phosphorus vs Soluble Reactive Phosphorus

Figure 3. Plot of SRP vs Chl-a

Figure 4. Temperature curves for each sample site

Figure 5. Averaged seasonal temperatures

Figure 6. Water clarity values

Table 1. TSI Field Data for 2019 analyzed by UMBS
<TSIDAT2019UMBS RAW 091219 SHT2> C4 SHT5 F375

							mcg/L	mcg/L	mcg/L
SITE	MONTH	SAMP DT	TEMP F	TEMP C	SECCHI FT	BTM	Chl-a	PO4-P	TP
1	MAY	6-Jun	45	7	30	36	0.215	3.00	6.40
	JUN	2-Jul	60	15.5	27	36	0.353	6.88	13.47
	JUL	31-Jul	59	15	33	35	0.324	2.65	5.11
	AUG	5-Sep	53	11.5	36	36	0.334	<1	4.44
2	MAY	6-Jun	50	10	19	19	0.239	3.25	3.38
	JUN	2-Jul	63	17	19.5	19.5	0.405	2.52	4.37
	JUL	31-Jul	61	16	19.5	19.5	0.438	2.69	3.92
	AUG	5-Sep	55	13	19	19	0.194	2.00	<2
3	MAY	6-Jun	53	11.5	7	11.5	0.924	3.90	4.75
	JUN	2-Jul	64	18	13.5	13.5	0.563	3.87	17.18
	JUL	31-Jul	63	17	12	12	0.409	2.71	<2
	AUG	5-Sep	58	14.5	13	13	0.369	1.69	6.05
4	MAY	6-Jun	52	11	10	16	0.843	5.02	5.85
	JUN	2-Jul	65	18.5	14	16.5	0.592	2.98	3.99
	JUL	31-Jul	63	17	16	17	0.741	8.78	15.64
	AUG	5-Sep	59	15	14	16	0.454	4.88	8.81
4A	MAY	6-Jun	53	11.5	11	11	1.450	4.48	4.71
	JUN	2-Jul	65	18.5	12	12	0.624	2.89	14.13
	JUL	31-Jul	62	16.5	12	12	0.660	6.53	9.89
	AUG	5-Sep	59	15	12	12	0.527	1.96	4.86
4B	MAY	6-Jun	54	12	10.5	12.5	2.140	6.55	9.44
	JUN	2-Jul	66	19	10	12	0.677	3.38	4.64
	JUL	31-Jul	64	17.5	12	12	1.090	3.41	4.19
	AUG	5-Sep	59	15	12	12	0.466	2.44	5.64
4C	MAY	6-Jun	54	12	7	9	0.952	5.73	6.62
	JUN	2-Jul	66	19	9	9.5	0.458	2.41	9.45
	JUL	31-Jul	64	18	9	9.5	1.500	3.89	4.72
	AUG	5-Sep	61	16	9	9	0.608	3.44	4.42
5	MAY	6-Jun	53	11.5	6	9.5	2.504	6.14	8.17
	JUN	2-Jul	66	19	7	11	1.480	4.17	20.86
	JUL	31-Jul	66	19	10	10	1.078	5.50	8.76
	AUG	5-Sep	31	16	10	10	0.474	3.10	3.10
6	MAY	6-Jun	50	10	12	32	1.114	2.89	35.10
	JUN	2-Jul	63	17	12	33	0.514	2.79	5.96
	JUL	31-Jul	63	17	14	32	0.847	2.50	2.50
	AUG	5-Sep	52	11	22	31	0.365	3.85	4.78
7	MAY	6-Jun	47	8.5	30	44	0.207	5.35	6.24
	JUN	2-Jul	59	15	18	44	0.429	1.86	3.21
	JUL	31-Jul	59	15	22	44	0.685	2.05	39.35
	AUG	5-Sep	52	11	28	45	0.328	1.56	3.51
8	MAY	6-Jun	45	7	23	23	0.409	3.86	7.56
	JUN	2-Jul	57	14	21	22	0.348	<1.4	42.46
	JUL	31-Jul	54	12	27	27	0.239	1.57	<2
	AUG	5-Sep	48	9	24	24	0.235	<1.4	<2
9	MAY	6-Jun	45	7	18	18	0.239	2.04	79.71
	JUN	2-Jul	58	14.5	19	19	0.296	1.41	2.62
	JUL	31-Jul	53	11.5	20	20	0.247	2.25	2.93
	AUG	5-Sep	48	9	16	16	0.190	1.61	<2

Fig 1A. Avg 2019 seasonal values for each sample site reported as µ/L

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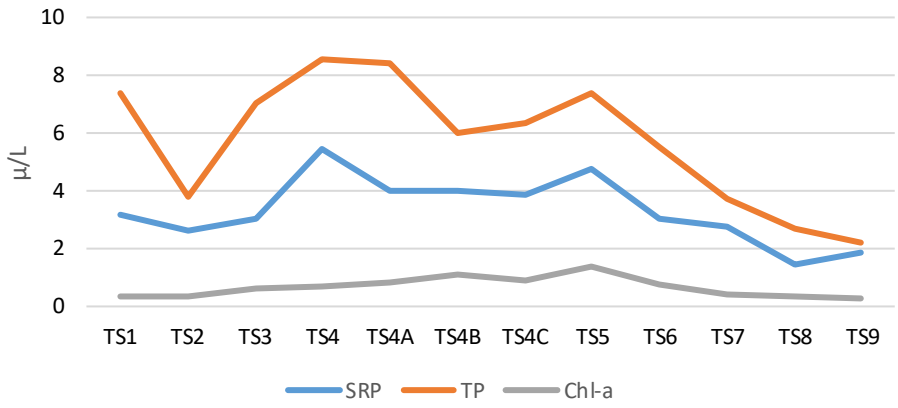

Fig 1B. Log plot of Avg 2019 seasonal values for each sample site reported as µ/L

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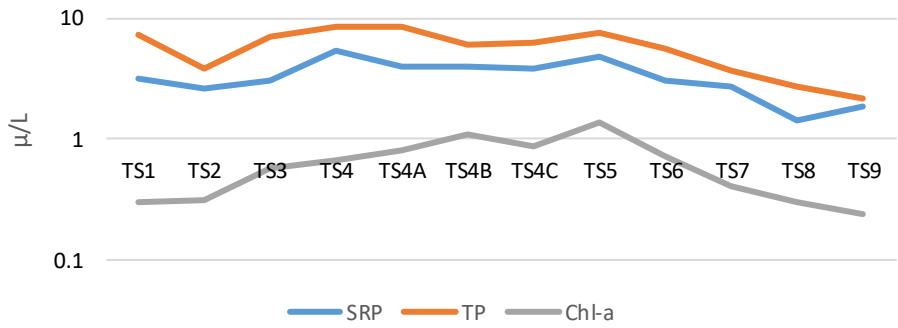

Fig2. Plots of Total Phosphorus vs Soluble Reactive Phosphorus (SRP = PO4-P) for 2019 season.
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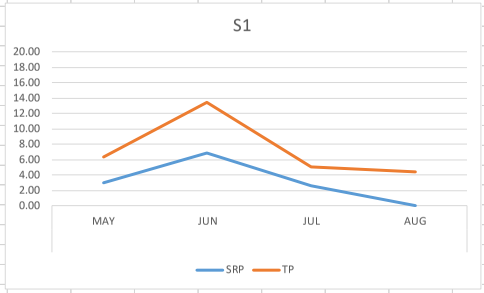

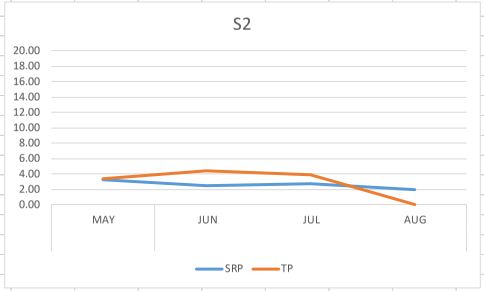

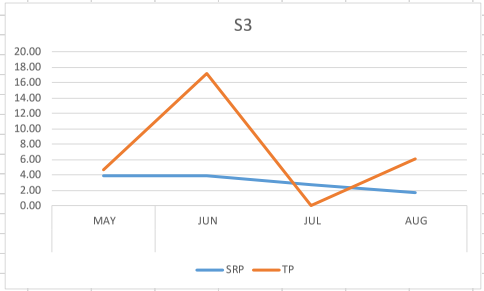

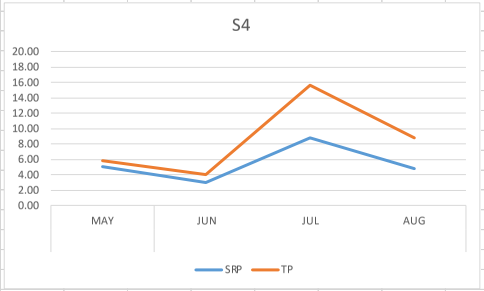

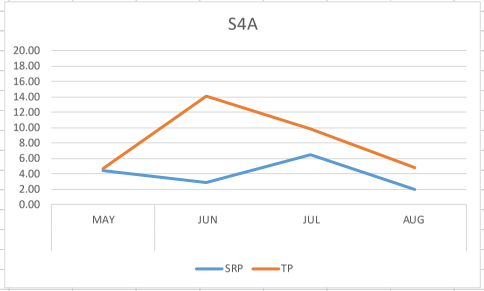

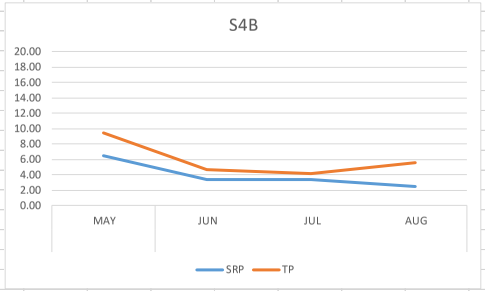

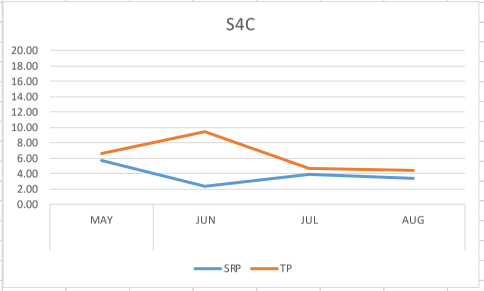

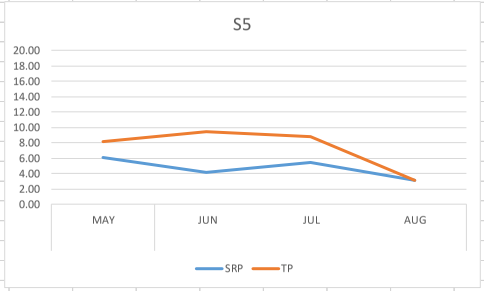

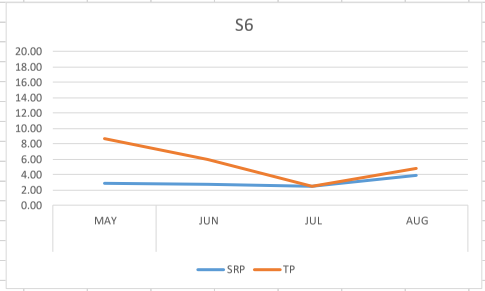

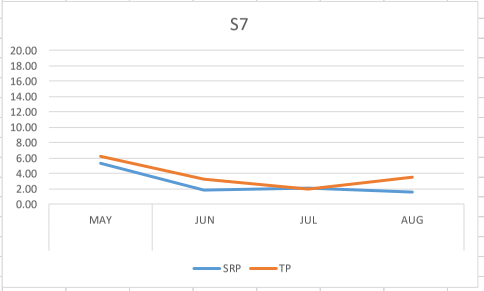

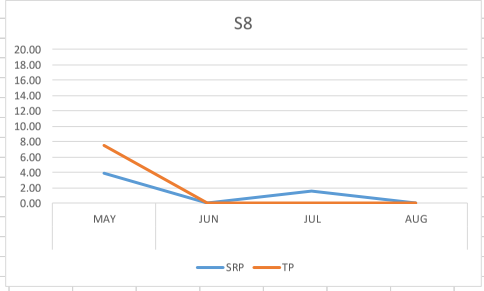

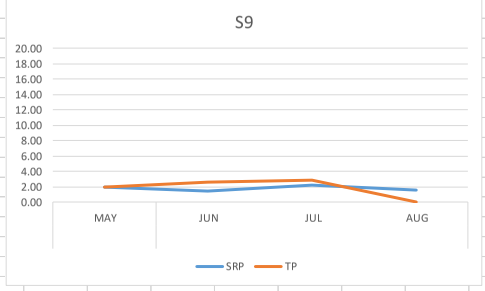

Fig2. Plots of Total Phosphorus vs Soluble Reactive Phosphorus (SRP = PO4-P) for 2019 season.
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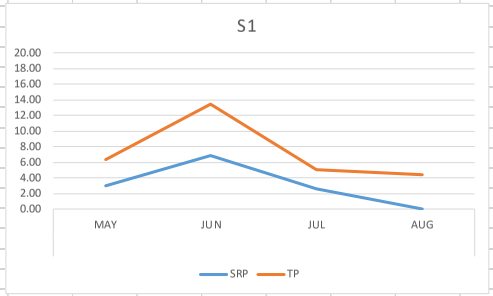

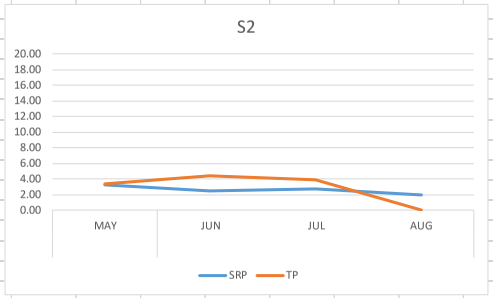

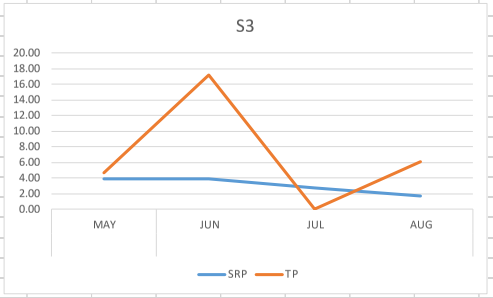

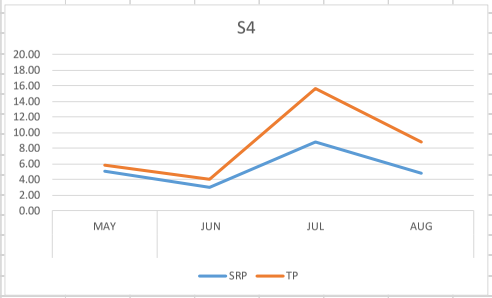

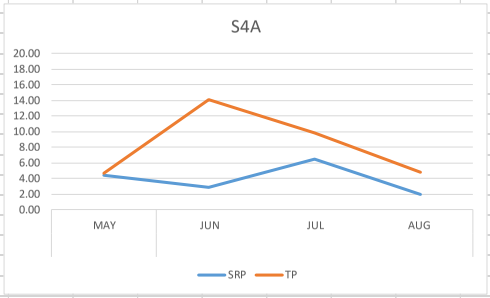

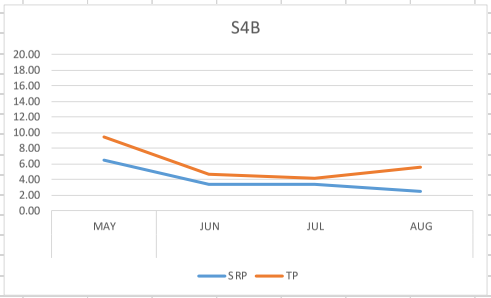

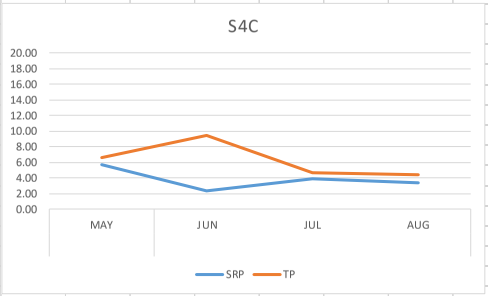

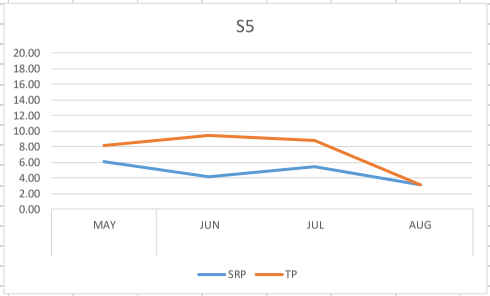

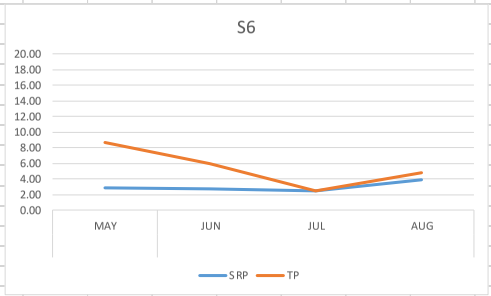

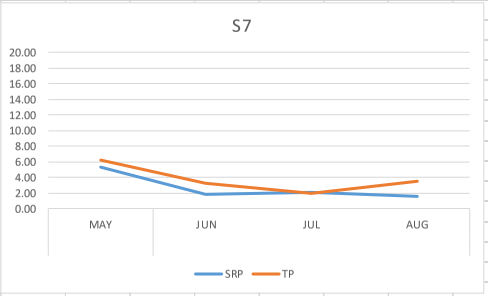

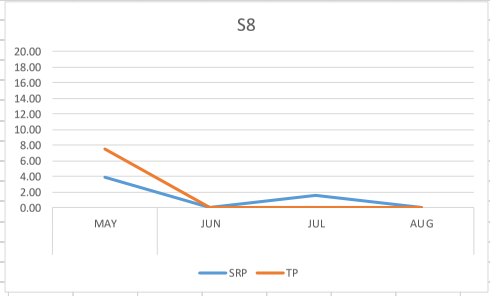

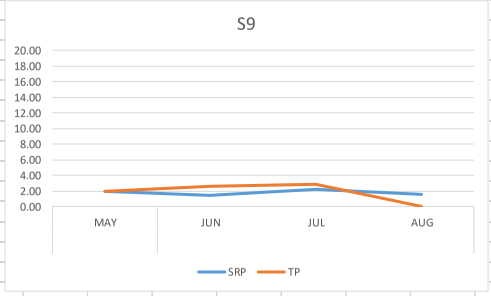

Fig 4. Sample site temperature profiles for 2019
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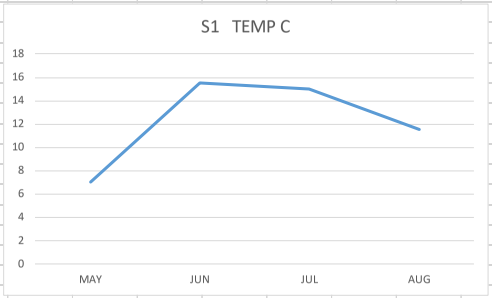

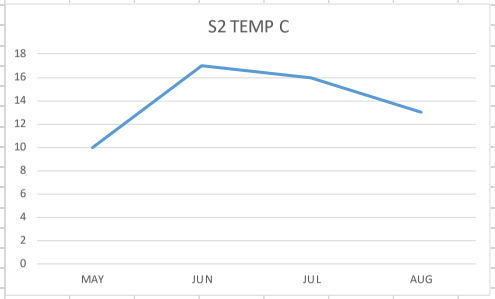

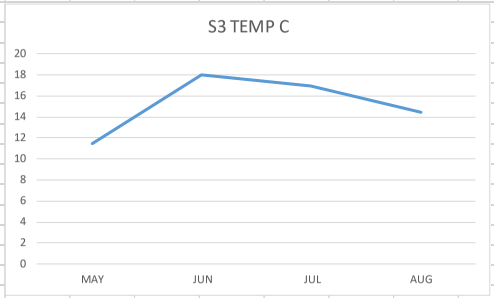

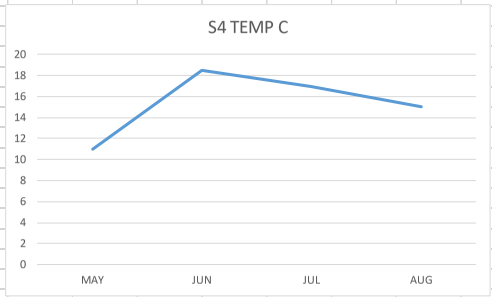

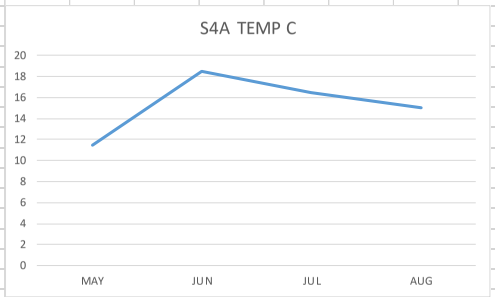

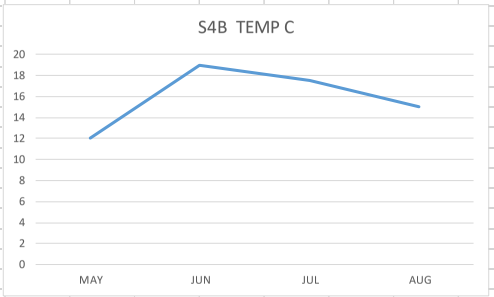

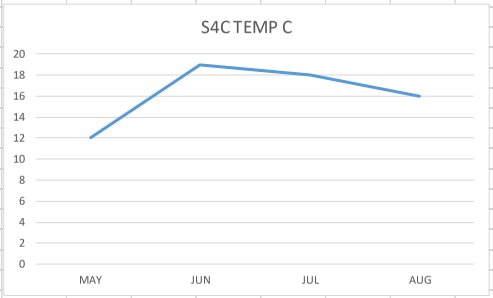

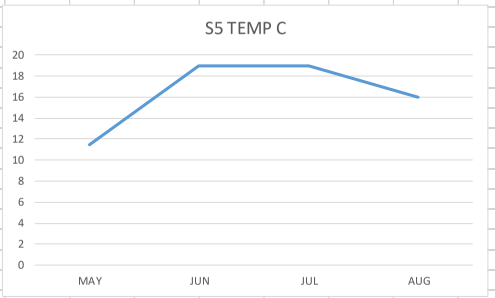

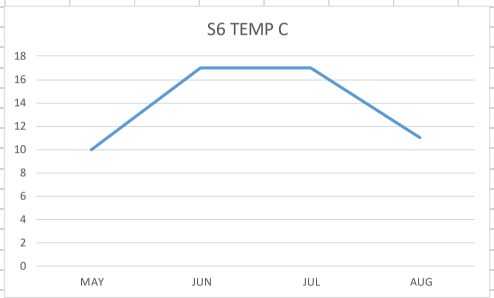

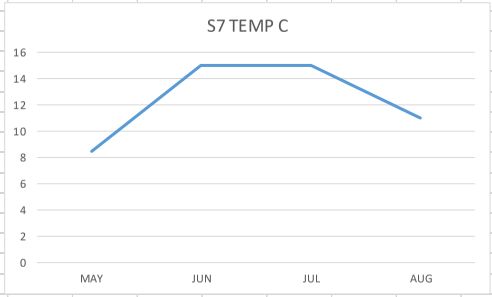

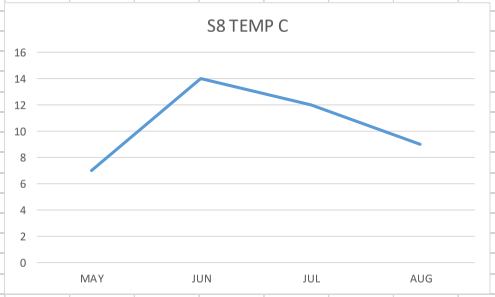

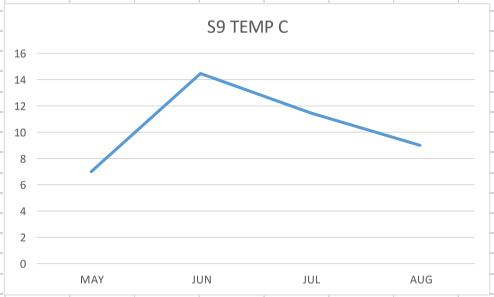

Fig 5. Sample site temperature profiles for 2019
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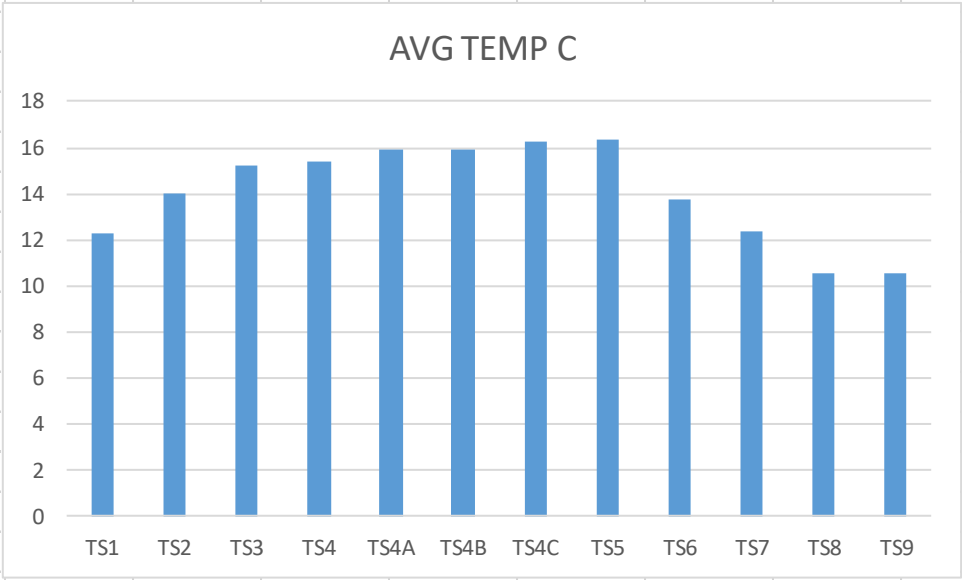

FIG. 6. SECCHI WATER CLARITY DATA 2019

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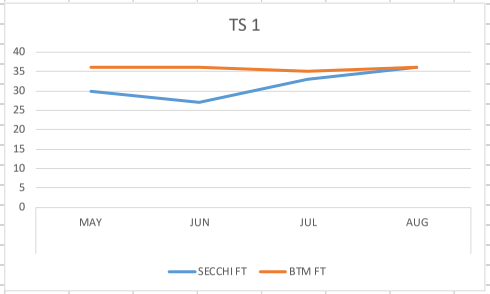
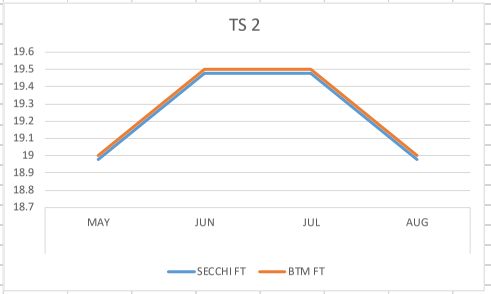
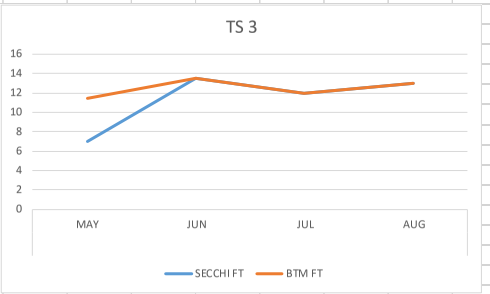
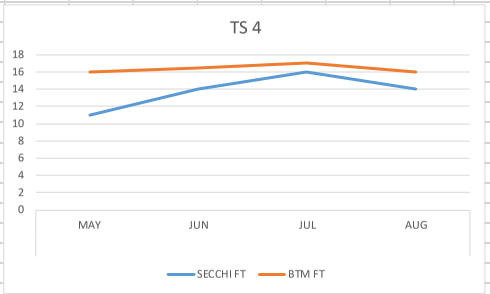
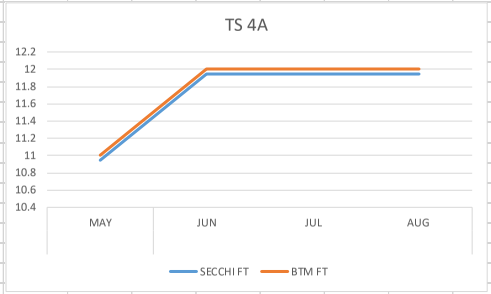
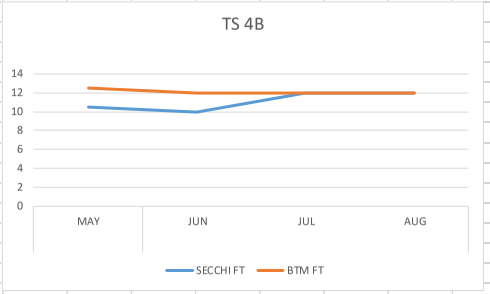


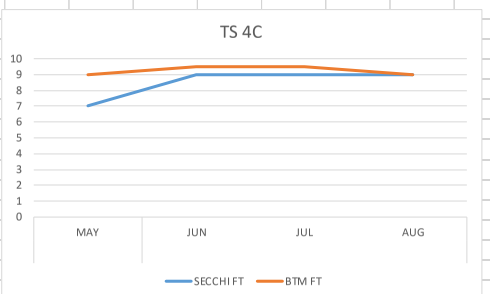


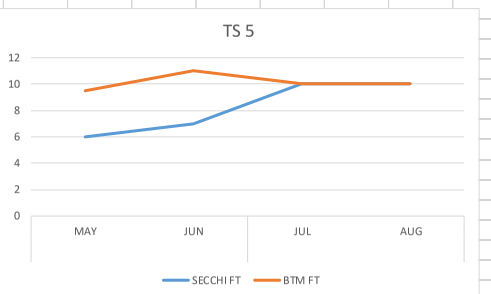


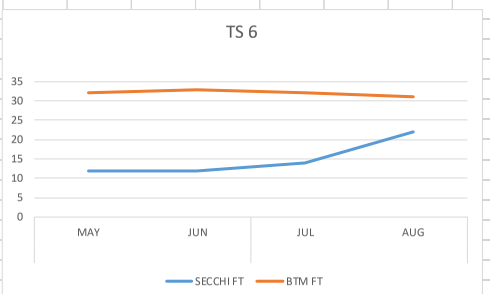


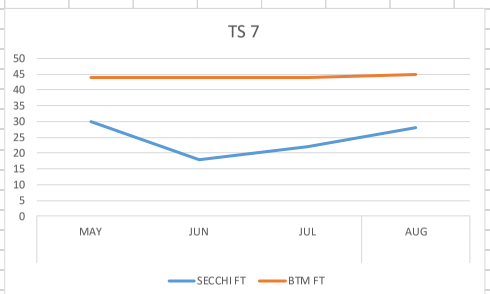


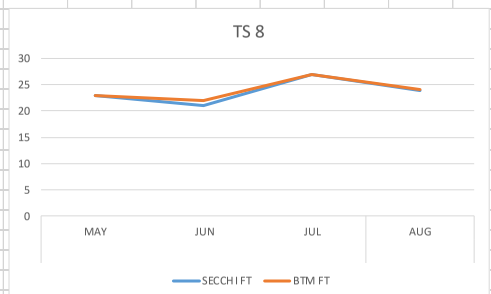












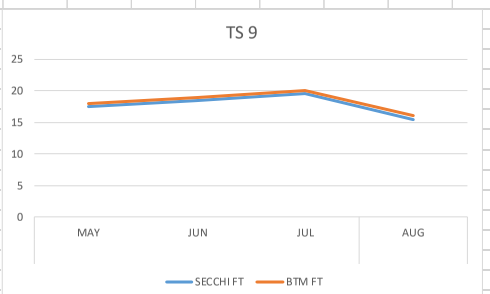
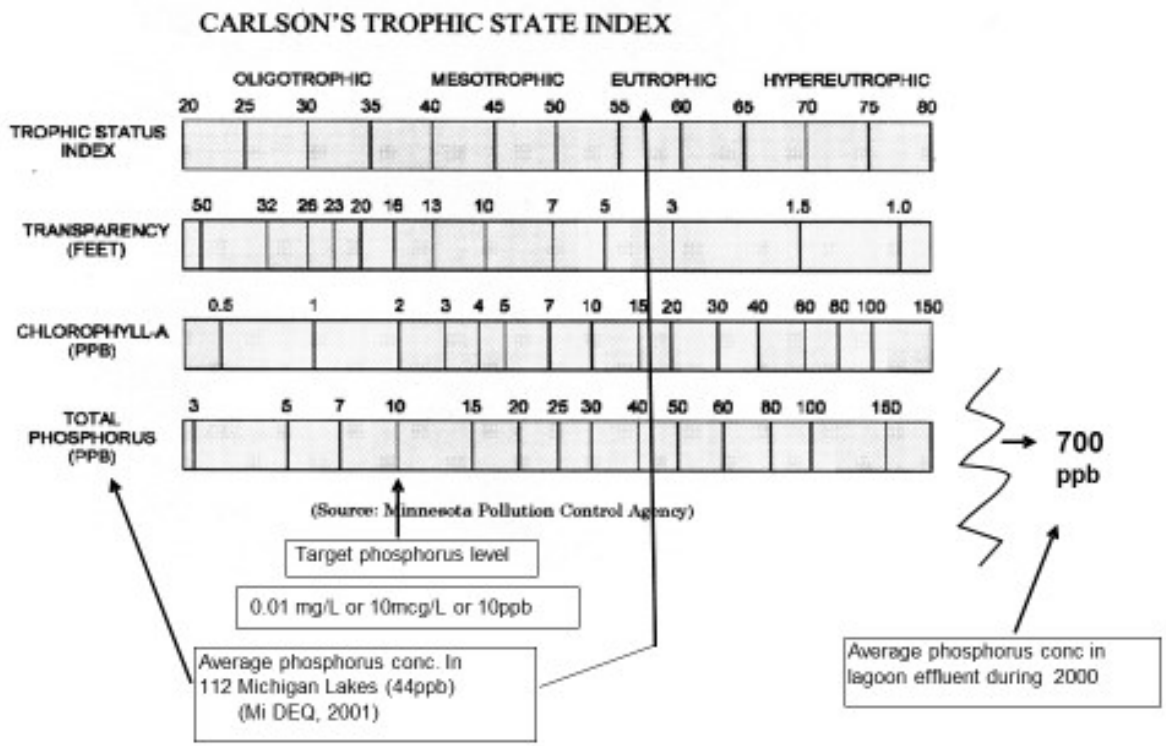


Fig. 7. Comparison of phosphorus concentration in Clark Township lagoons to DEQ measures of over 100 Michigan Lakes. Data from 2001.



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