Logan Martin Reservoir Report 2016 & 2019

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Rivers and Reservoirs Unit
April 2022

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LIST OF ACRONYMS

A&I	Agricultural and Industrial Water Supply
ADEM	Alabama Department of Environmental Management
AGPT	Algal Growth Potential Test
APCo	Alabama Power Company
CHL *a*	Chlorophyll *a*
DO	Dissolved Oxygen
F&W	Fish and Wildlife
MAX	Maximum
MDL	Method Detection Limit
MIN	Minimum
MSC	Mean Standing Crop
NTU	Nephelometric Turbidity Units
OAW	Outstanding Alabama Waters
ONRW	Outstanding National Resource Water
PWS	Public Water Supply
QAPP	Quality Assurance Project Plan
RRMP	Rivers and Reservoirs Monitoring Program
S	Swimming and Other Whole Body Water-Contact Sports
SD	Standard Deviation
SOP	Standard Operating Procedures
TEMP	Temperature
TN	Total Nitrogen
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSI	Trophic State Index
TSS	Total Suspended Solids
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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INTRODUCTION

Logan Martin Reservoir is located in east central Alabama on the Coosa River approximately 30 miles east of Birmingham. It was the second dam built as a part of an Alabama Power Company construction program that further developed the Coosa River in the late 1950s and 1960s. Construction started on the 15,260 acre reservoir on July 18, 1960, and it was placed in service August 10, 1964. The lake borders St. Clair and Talladega counties and offers many recreational activities, including boating, skiing, and swimming.

The Alabama Department of Environmental Management (ADEM) monitored Logan Martin Reservoir as part of the 2016 and 2019 assessments of the Coosa River basin under the Rivers and Reservoirs Monitoring Program (RRMP). ADEM began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program (now known as RRMP) was initiated by the Field Operations Division of the ADEM. The current objectives of this program are to provide data that can be used to assess current water quality conditions, to identify trends in water quality conditions, and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM's 2017 Monitoring Strategy (ADEM 2017).

Logan Martin Reservoir was placed on Alabama's 1996 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its Swimming (S)/Fish & Wildlife (F&W) water use classifications. The reservoir was listed for impairments caused by priority organics (PCBs), nutrients, and organic enrichment/dissolved oxygen (OE/DO). A TMDL developed to address the nutrient and OE/DO impairment in Logan Martin, as well as the entire Coosa River reservoir chain, was approved by the USEPA in 2008 (ADEM 2008). TMDL development for the remaining segments of Logan Martin that remain on the §303(d) list with impairments due to PCBs is to be determined based upon ongoing RCRA/CERCLA program activities.

In 2010, the ADEM implemented specific water quality criteria for nutrient management at the forebay and mid stations of Logan Martin Reservoir (ADEM Admin. Code R. 335-6-10-.11). These criteria represent a growing season mean (April-October) chlorophyll *a* (chl *a*)

concentration that is protective of Logan Martin Reservoir's S/F&W use classifications. These criteria are denoted in Table 1.

The purpose of this report is to summarize data collected at nine stations in Logan Martin Reservoir during the 2016 and 2019 growing seasons and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chl *a*; algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson's trophic state index (TSI)] were compared to ADEM's historical data and established criteria.

METHODS

Sampling stations were selected using historical data and previous assessments (Figure 1). Specific location information can be found in Table 1. Logan Martin Reservoir was sampled in the dam forebay, mid, and upper reservoir along with six tributary stations: Cane, Blue Eye, Choccolocco, Dye, Cropwell, and Clear Creeks.

Water quality sampling was conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2019), Surface Water Quality Assurance Project Plan (ADEM 2018a), and Quality Management Plan (ADEM 2018b).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions at each site. Monthly concentrations of these parameters were graphed with the closest available Alabama Power Company (APCo) dam discharge data and ADEM's previously collected data to help interpret the 2016 and 2019 results.

Figure 1. Logan Martin Reservoir with 2016 and 2019 sampling locations.

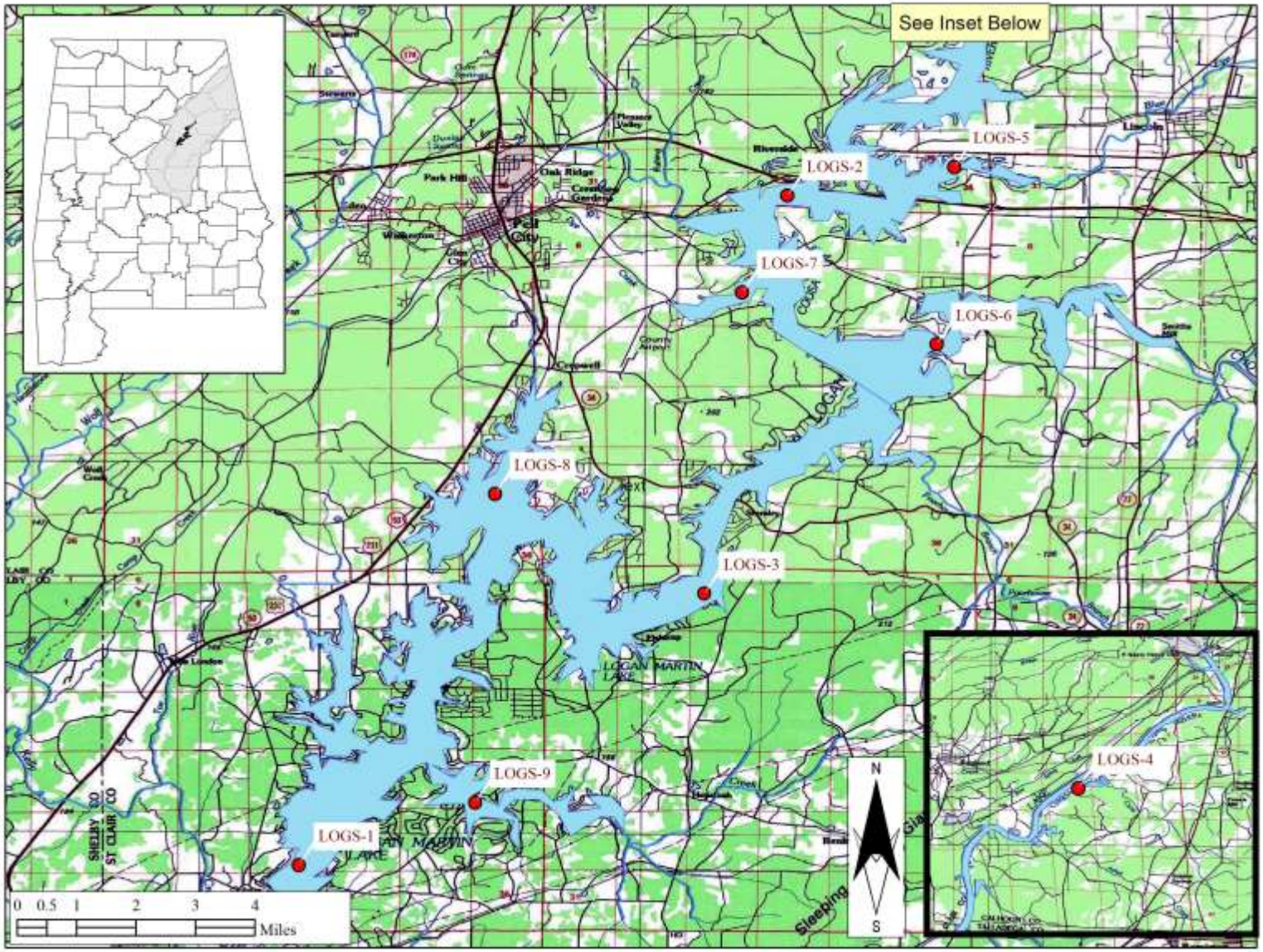


Table 1. Descriptions of the 2016 and 2019 monitoring stations in Logan Martin Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
031501060803	St Clair	LOGS-1*	Lower	Coosa R	Deepest point, main river channel, dam forebay.	17 µg/L	33.43158	-86.33055
031501060605	Talladega	LOGS-2	Upper	Coosa R	Deepest point, main river channel. Downstream of I-20 bridge, immediately upstream of Riverside Marina.		33.59443	-86.21167
031501060803	St Clair	LOGS-3*	Mid	Coosa R	Deepest point, main river channel. Approx. 1.5 miles downstream of Alabama Hwy 34 bridge.	17 µg/L	33.49759	-86.23190
031501060408	Calhoun	LOGS-4	Cane Ck	Cane Ck	Deepest point, main creek channel, Cane Creek embayment, approx. 0.25 miles upstream of Coosa River confluence.		33.73065	-86.10230
031501060604	Talladega	LOGS-5	Blue Eye Ck	Blue Eye Ck	Deepest point, main creek channel, Blue Eye Creek embayment, approx. 0.5 miles upstream of lake confluence.		33.60139	-86.17107
031501060514	Talladega	LOGS-6	Choccolocco Ck	Choccolocco Ck	Deepest point, main creek channel, Choccolocco Creek embayment, approx. 1.0 miles upstream of lake confluence.		33.55822	-86.17536
031501060605	St Clair	LOGS-7	Dye Ck	Dye Ck	Deepest point, main creek channel, Dye Creek embayment, approx. 0.5 miles upstream of lake confluence.		33.57086	-86.22271
031501060803	St Clair	LOGS-8	Cropwell Ck	Cropwell Ck	Deepest point, main creek channel, Cropwell Creek embayment, approx. 0.5 miles upstream of lake confluence.		33.52186	-86.28285
031501060802	Talladega	LOGS-9	Clear Ck	Clear Ck	Deepest point, main creek channel, Clear Creek embayment, immediately upstream of Talladega Co. Rd. 191 bridge.		33.44679	-86.28765

*Growing season mean chl *a* criteria implemented at this station in 2010.

RESULTS

Growing season mean graphs for TN, TP, chl *a*, and TSS are provided in this section (Figures 2-5). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided (Figures 6-11 and 16-17). Mean monthly discharge is included in monthly graphs for TN, TP, chl *a*, TSS, and TSI as an indicator of flow and retention time in the months sampled. AGPT results appear in Table 2. Depth profile graphs of temperature, DO, and conductivity appear in Figures 12-15. Summary statistics of all data collected during 2016 and 2019 are presented in Appendix Table 1 and Appendix Table 2. The tables contain the minimum, maximum, median, mean, and standard deviation of each parameter analyzed.

Stations with the highest concentrations of nutrients, chlorophyll *a*, and TSS are noted in the paragraphs to follow. Though stations with lowest concentrations may not always be mentioned, review of the graphs that follow will indicate these stations that may be potential candidates for reference waterbodies and watersheds.

In 2016, the highest mean growing season TN value calculated among mainstem stations was in the mid station (Figure 2). The highest mean growing season TN value calculated among embayment stations was Blue Eye Creek. In 2019, the highest mainstem TN concentration was in the upper station, while the highest concentration among embayment stations was in Cane Creek. Growing season mean TN concentrations at the mid and lower mainstem stations have decreased overall from 2005-2019. While it appears that TN concentrations in Blue Eye, Choccolocco, and Cropwell Creeks have stabilized since 2010, values in Dye Creek appeared to decrease 2005-2019, and values in Clear Creek increased 2010-2019. Monthly TN concentrations reached historic highs at the upper station in September and at the lower station in October of 2016 (Figure 6). In 2019, historic highs were recorded in April and October at the upper station and in April at the mid station. Historic lows were also observed in 2019 at the mid station in June and at the mid and lower stations in October.

In both 2016 and 2019, the highest mean growing season TP value calculated among mainstem stations was the upper station (Figure 3). The highest mean growing season TP value calculated among embayment stations was Choccolocco Creek in both 2016 and 2019. Overall, mean TP concentrations in the mainstem stations have decreased since 2004, with the values

calculated in 2016 and 2019 being very similar. Mean TP concentrations at embayment stations also appeared to decrease 2000-2019. Monthly TP concentrations were below historic means for all months sampled in 2016 and 2019 (Figure 7). In 2016, historic low concentrations were measured in August at the upper station, in July and August at the mid station, and in April and June at the lower station. In 2019, historic low TP concentrations were recorded at the upper station in April and at the upper and mid stations in September.

In 2016, the highest mean growing season chl *a* value calculated among mainstem stations was in the mid station (Figure 4). The highest mean growing season chl *a* values calculated among embayment stations was in Clear Creek. In 2019, the highest mean growing season chl *a* values calculated among mainstem stations was in the upper station. Choccolocco Creek had the highest mean concentrations among embayment stations. Overall, mean chl *a* concentrations in mainstem stations have decreased 1997-2019. Concentrations in embayment stations have also decreased 2000-2019, with 2019 values being the lowest concentrations recorded for all tributaries sampled. The growing season mean chl *a* concentration for the mid station was above the criteria limit in 2016. The growing season mean chl *a* value for the lower station was in compliance with the criteria limit in 2016 and 2019. Monthly chl *a* concentrations reached historic highs in June and October at the mid reservoir station and in October at the lower and upper stations in 2016 (Figure 8). Historic lows were recorded in 2016 at the mid station during September. In 2019, historic lows were recorded at the mid station in August and at the lower station in October.

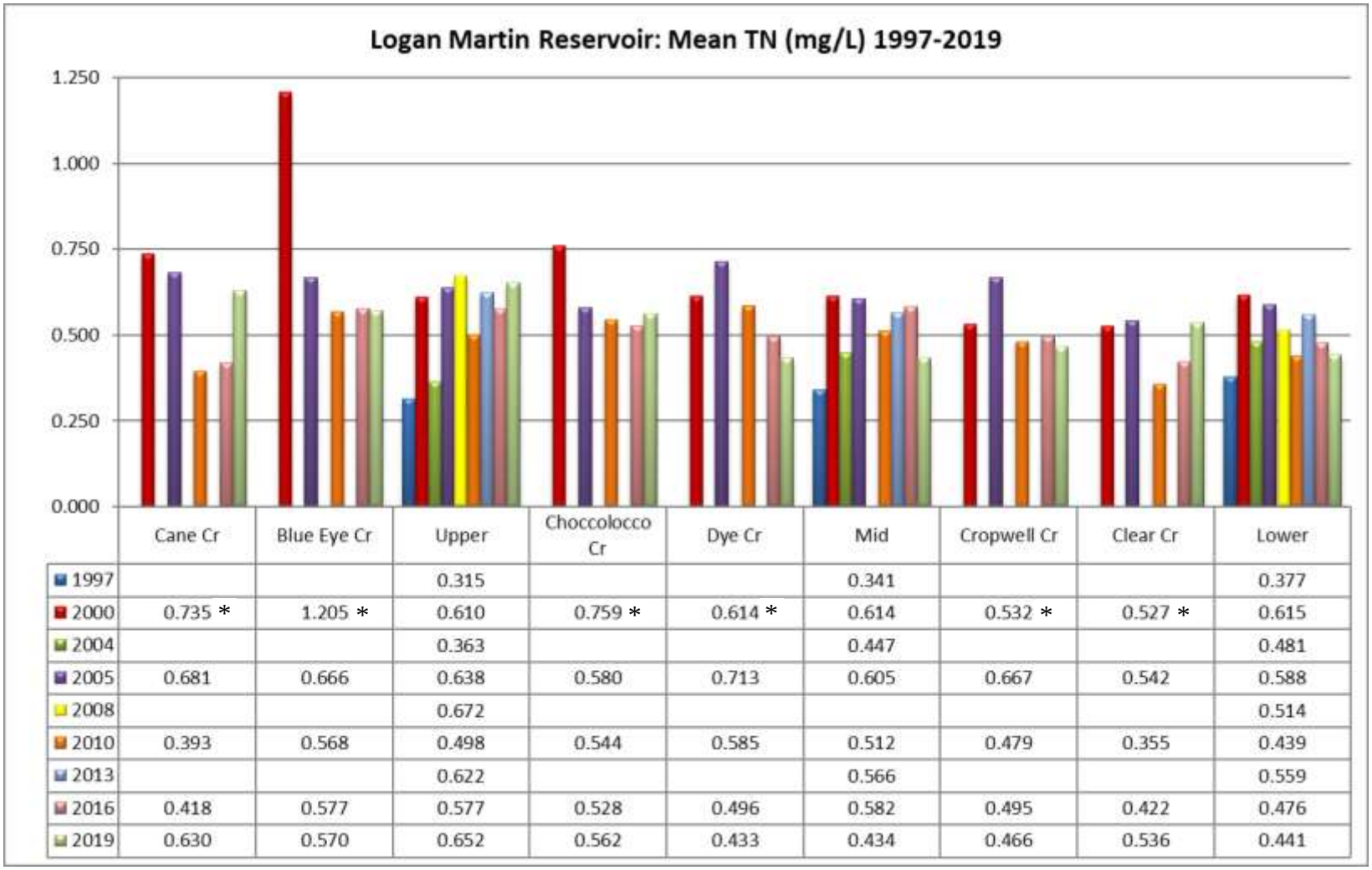
The highest mean growing season TSS value calculated among mainstem stations was in the upper station in both 2016 and 2019 (Figure 5). In 2016, the embayment station with the highest mean TSS concentration was Blue Eye Creek. Cane Creek had the highest concentration among embayment stations in 2019. Overall, mean TSS concentrations appeared to decrease over time at all locations sampled. Mean TSS concentrations also appeared to decrease from upstream to downstream along the length of the reservoir. Monthly TSS concentrations reached historic lows in April at both the mid and lower stations in 2016 (Figure 9). In 2019, all monthly TSS values were at or below historic means. Historic lows were recorded in September at the upper station, in June and August at the mid station, and in June at the lower station.

AGPT results for the upper station showed the reservoir to be nitrogen-limited in 2016 (Table 2). All stations sampled in 2019 were also nitrogen-limited. Due to resource constraints, AGPT was not collected in 2016 for the mid and lower stations. Raschke and Schultz (1987) defined a mean standing crop (MSC) value of 5.0 mg/L as protective of reservoir and lake systems. All locations sampled in 2016 and 2019 had MSC values that were less than 5.0 mg/L.

All measurements of dissolved oxygen concentrations in Logan Martin Reservoir collected in 2016 and 2019 were at or above the ADEM criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) (Figures 10-11). Based on monthly DO profiles, in 2016 anoxic conditions existed at some point in the water column in the lower station May-July and September and in the mid station May-September (Figure 11). Both stations also showed slight thermal stratification April-June. The mid station also showed a slight chemocline June-August of 2016. In 2019, anoxic conditions existed at some point in the water column in the lower station in June, August, and September and in the mid station during July-September (Figure 12). Highest water temperatures for both years were measured in July and August.

Monthly TSI values were calculated using chl *a* concentrations and Carlson's Trophic State Index (Figures 16 and 17). In both 2016 and 2019, trophic state was variable throughout the growing season, but conditions were generally within the eutrophic range in most months monitored.

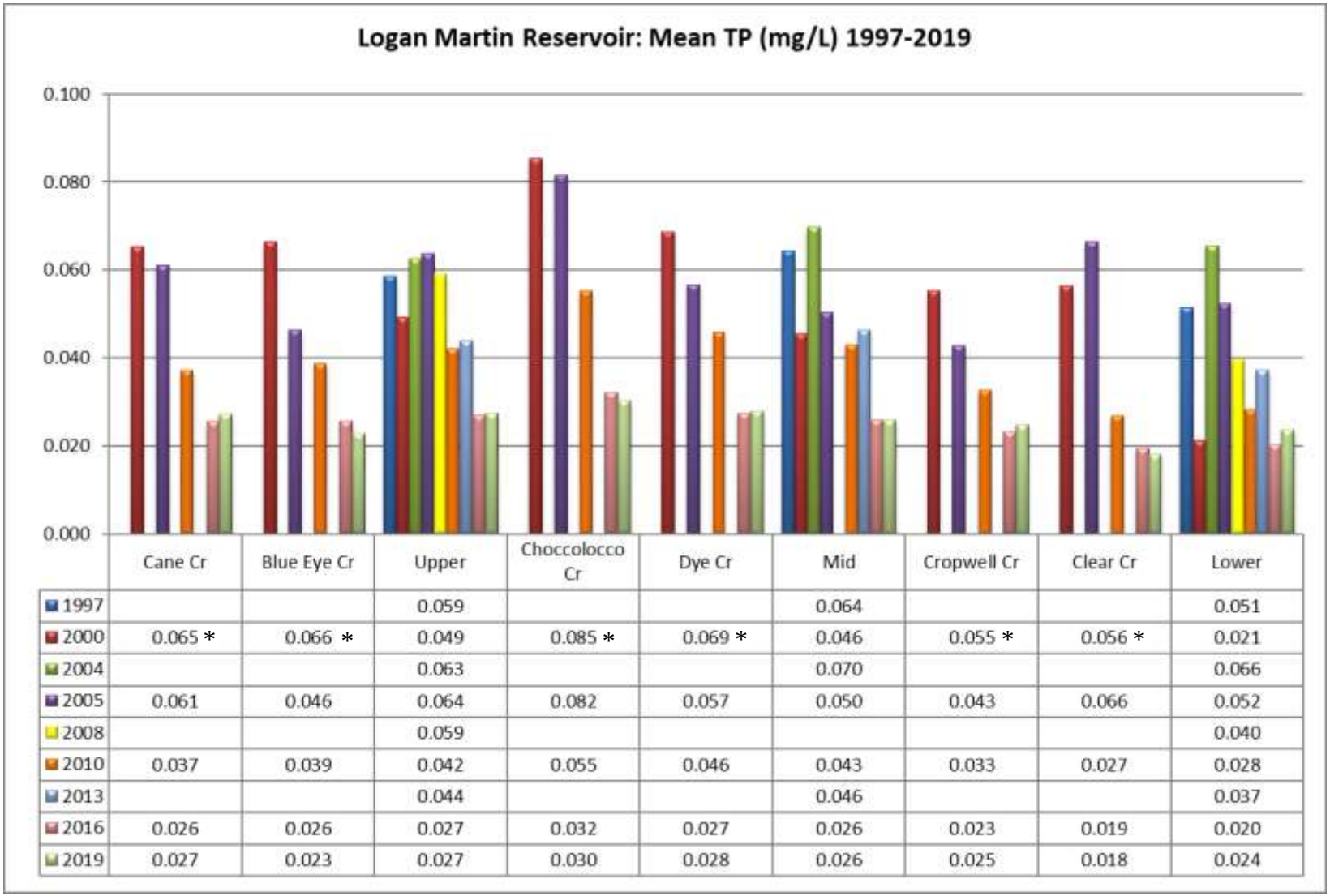
Figure 2. Mean growing season TN measured in Logan Martin Reservoir, April-October, 1997-2019. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Cane Cr	Blue Eye Cr	Upper	Choccolocco Cr	Dye Cr	Mid	Cropwell Cr	Clear Cr	Lower
1997			0.315			0.341			0.377
2000	0.735 *	1.205 *	0.610	0.759 *	0.614 *	0.614	0.532 *	0.527 *	0.615
2004			0.363			0.447			0.481
2005	0.681	0.666	0.638	0.580	0.713	0.605	0.667	0.542	0.588
2008			0.672						0.514
2010	0.393	0.568	0.498	0.544	0.585	0.512	0.479	0.355	0.439
2013			0.622			0.566			0.559
2016	0.418	0.577	0.577	0.528	0.496	0.582	0.495	0.422	0.476
2019	0.630	0.570	0.652	0.562	0.433	0.434	0.466	0.536	0.441

*Mean of April/June/August only.

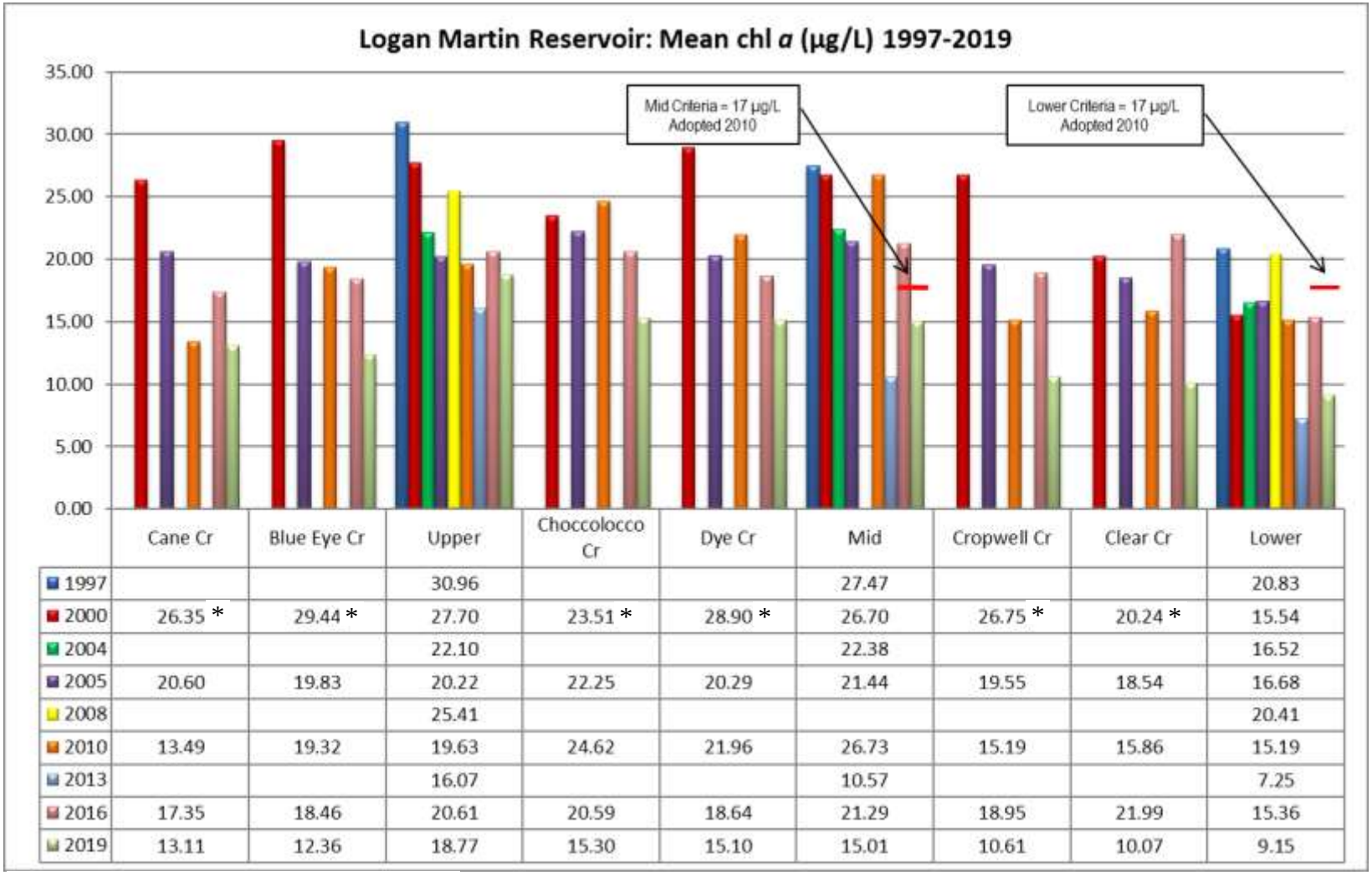
Figure 3. Mean growing season TP measured in Logan Martin Reservoir, April-October, 1997-2019. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Cane Cr	Blue Eye Cr	Upper	Choccolocco Cr	Dye Cr	Mid	Cropwell Cr	Clear Cr	Lower
1997			0.059			0.064			0.051
2000	0.065 *	0.066 *	0.049	0.085 *	0.069 *	0.046	0.055 *	0.056 *	0.021
2004			0.063			0.070			0.066
2005	0.061	0.046	0.064	0.082	0.057	0.050	0.043	0.066	0.052
2008			0.059						0.040
2010	0.037	0.039	0.042	0.055	0.046	0.043	0.033	0.027	0.028
2013			0.044			0.046			0.037
2016	0.026	0.026	0.027	0.032	0.027	0.026	0.023	0.019	0.020
2019	0.027	0.023	0.027	0.030	0.028	0.026	0.025	0.018	0.024

*Mean of April/June/August only.

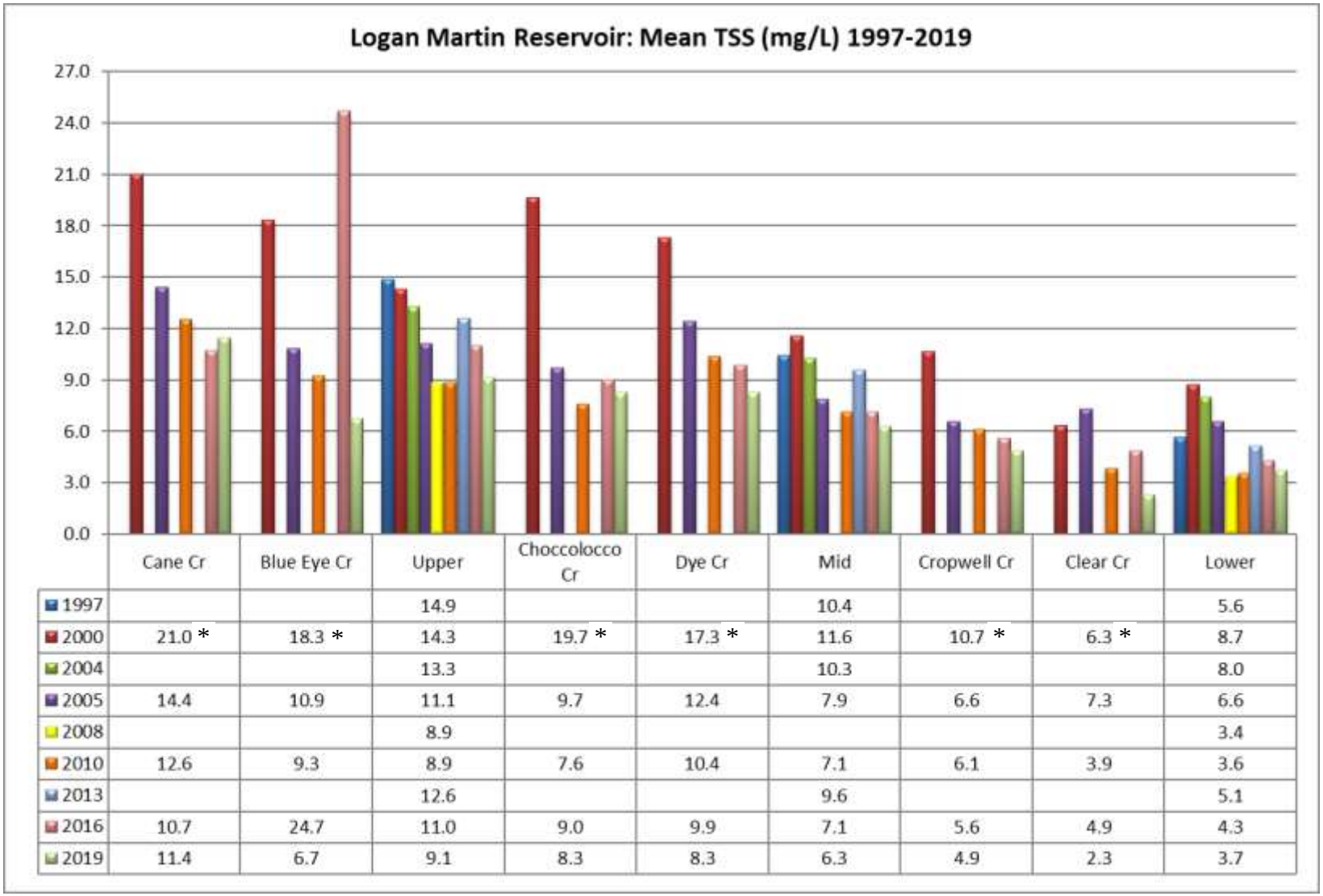
Figure 4. Mean growing season chl *a* measured in Logan Martin Reservoir, April-October, 1997-2019. Stations are illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria applies to the growing season mean of the mid and lower stations only.



	Cane Cr	Blue Eye Cr	Upper	Choccolocco Cr	Dye Cr	Mid	Cropwell Cr	Clear Cr	Lower
1997			30.96			27.47			20.83
2000	26.35 *	29.44 *	27.70	23.51 *	28.90 *	26.70	26.75 *	20.24 *	15.54
2004			22.10			22.38			16.52
2005	20.60	19.83	20.22	22.25	20.29	21.44	19.55	18.54	16.68
2008			25.41						20.41
2010	13.49	19.32	19.63	24.62	21.96	26.73	15.19	15.86	15.19
2013			16.07			10.57			7.25
2016	17.35	18.46	20.61	20.59	18.64	21.29	18.95	21.99	15.36
2019	13.11	12.36	18.77	15.30	15.10	15.01	10.61	10.07	9.15

*Mean of April/June/August only.

Figure 5. Mean growing season TSS measured in Logan Martin Reservoir, April-October, 1997-2019. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Cane Cr	Blue Eye Cr	Upper	Choccolocco Cr	Dye Cr	Mid	Cropwell Cr	Clear Cr	Lower
1997			14.9			10.4			5.6
2000	21.0 *	18.3 *	14.3	19.7 *	17.3 *	11.6	10.7 *	6.3 *	8.7
2004			13.3			10.3			8.0
2005	14.4	10.9	11.1	9.7	12.4	7.9	6.6	7.3	6.6
2008			8.9						3.4
2010	12.6	9.3	8.9	7.6	10.4	7.1	6.1	3.9	3.6
2013			12.6			9.6			5.1
2016	10.7	24.7	11.0	9.0	9.9	7.1	5.6	4.9	4.3
2019	11.4	6.7	9.1	8.3	8.3	6.3	4.9	2.3	3.7

*Mean of April/June/August only.

Figure 6. Monthly TN concentrations measured in Logan Martin Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Monthly discharge acquired from APCo at Logan Martin Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max ranges are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

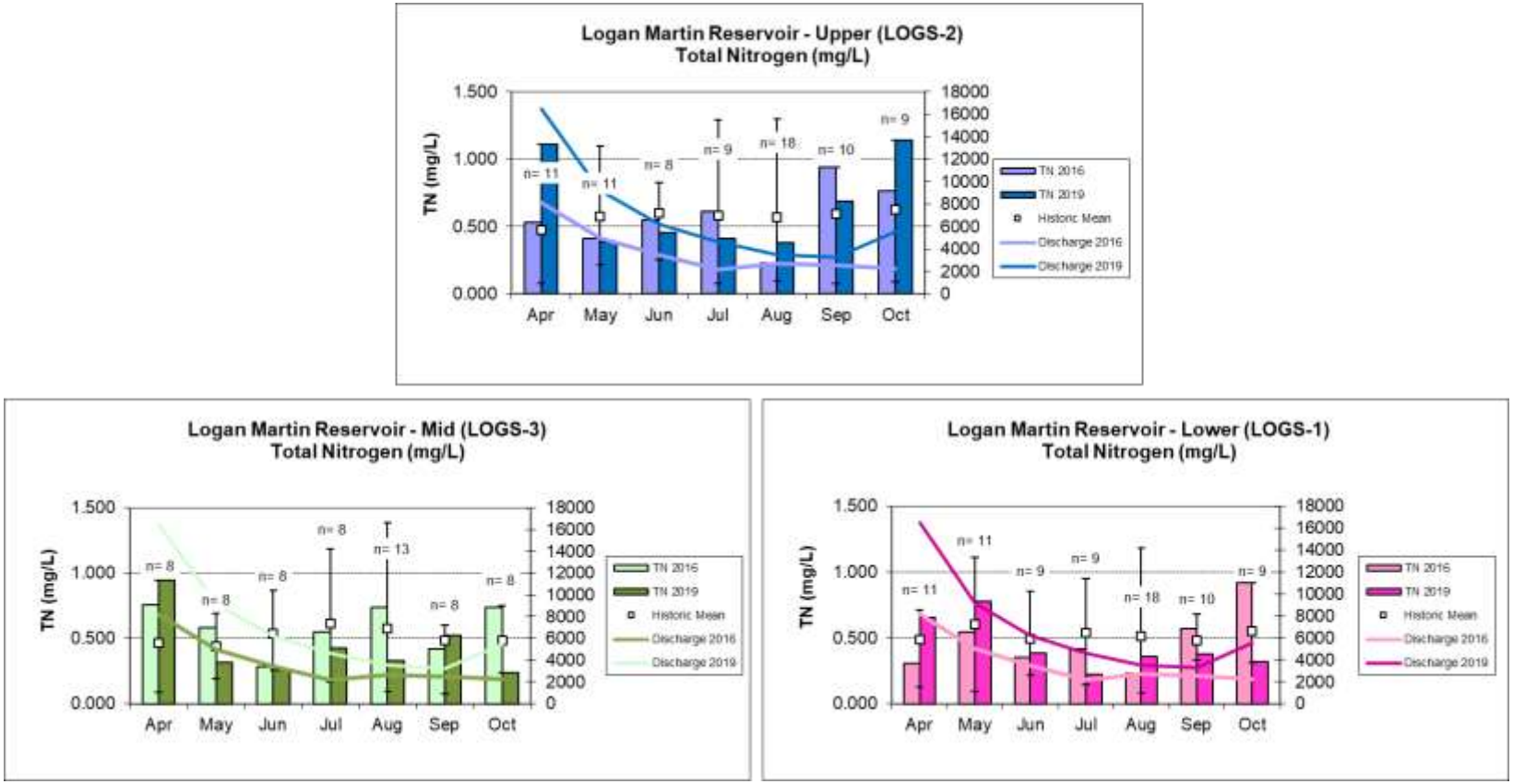


Figure 7. Monthly TP concentrations measured in Logan Martin Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Monthly discharge acquired from APCo at Logan Martin Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max ranges are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

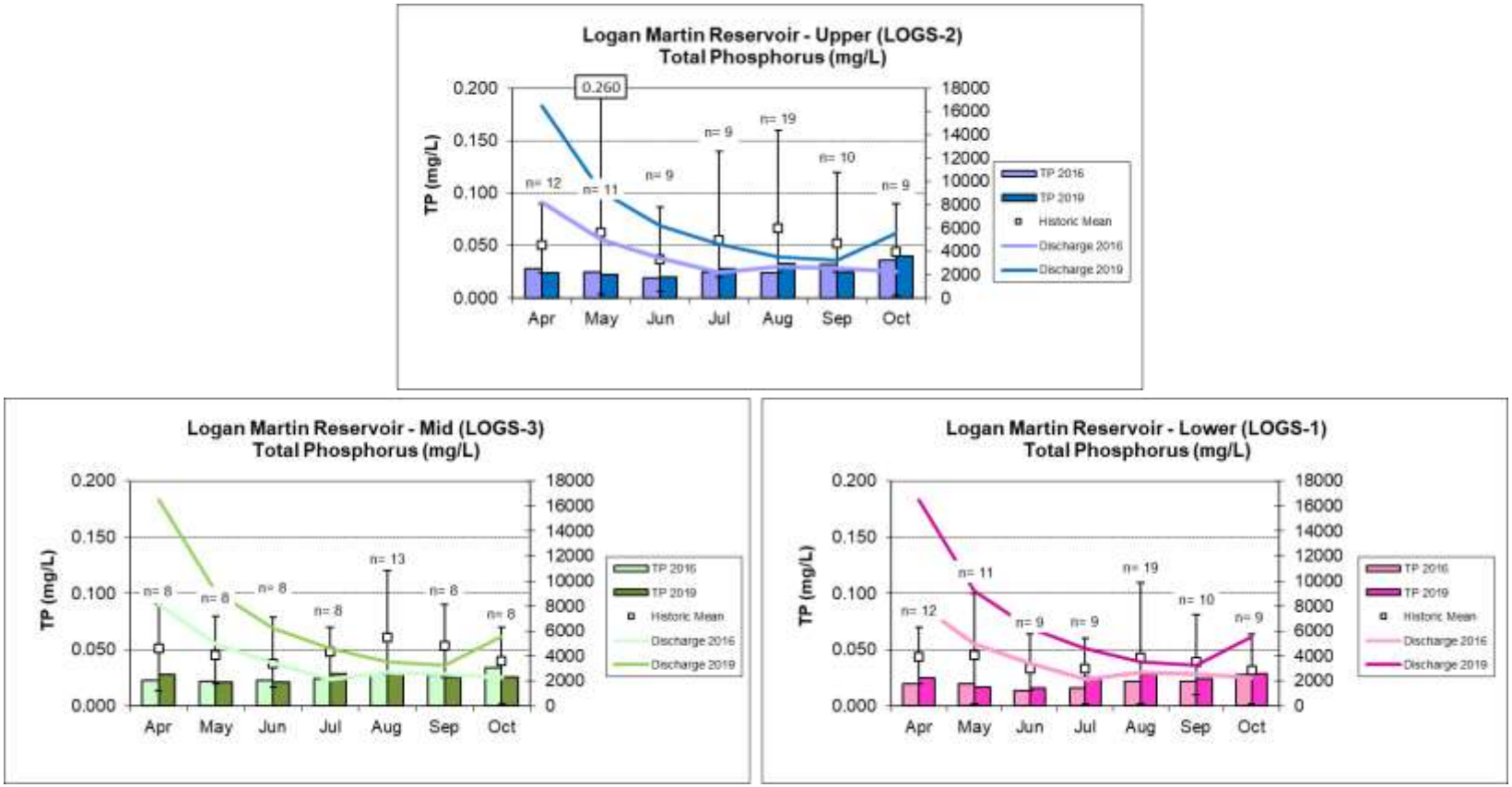
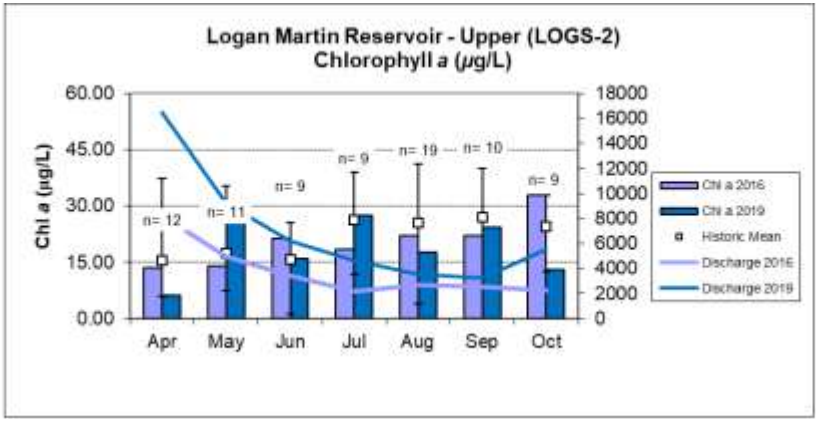
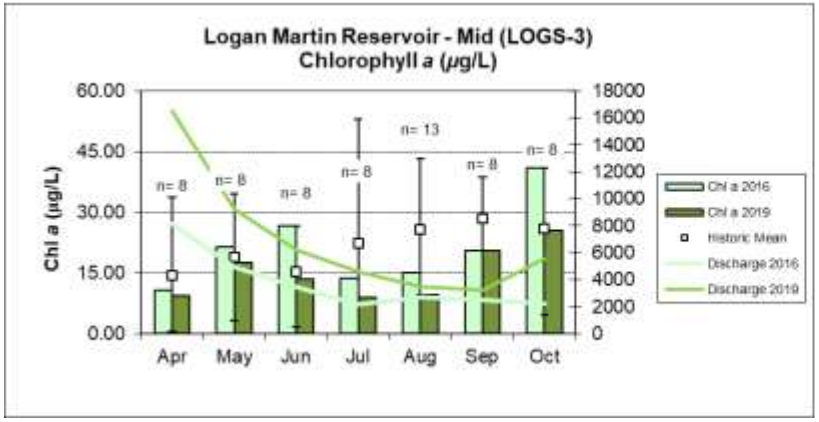


Figure 8. Monthly chl *a* concentrations measured in Logan Martin Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Monthly discharge acquired from APCo at Logan Martin Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max ranges are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





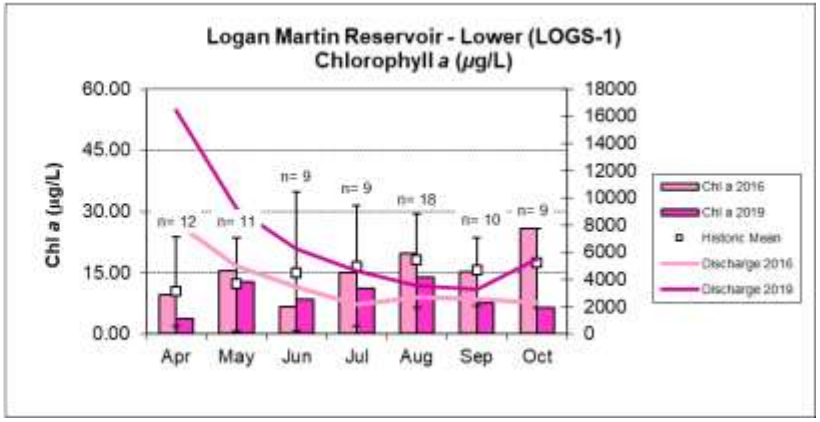


Figure 9. Monthly TSS concentrations measured in Logan Martin Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Monthly discharge acquired from APCo at Logan Martin Dam. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

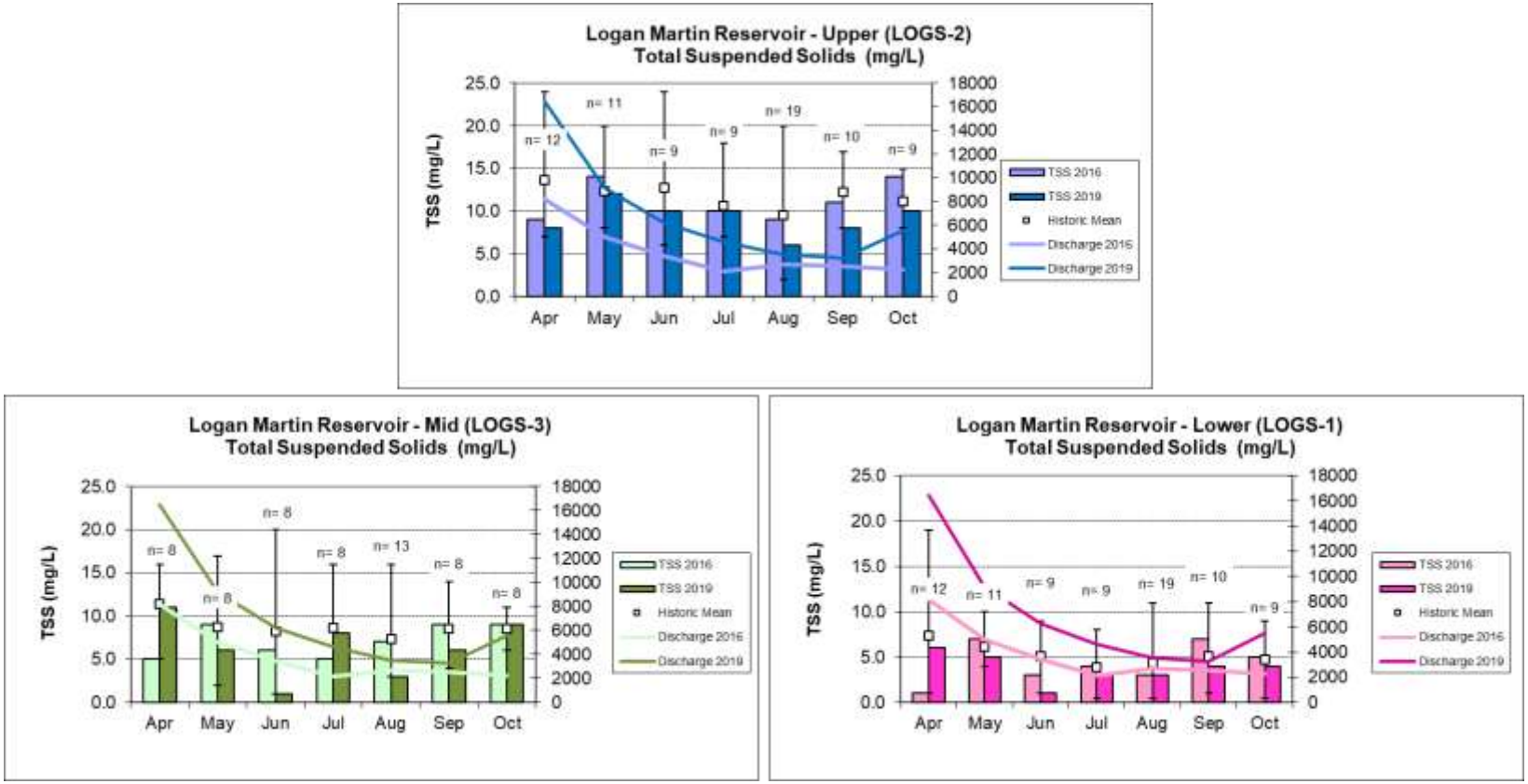


Table 2. Algal growth potential test results, Logan Martin Reservoir, 1999-2019 (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers. (Raschke and Schultz 1987).

Station	Upper (LOGS-2)		Mid (LOGS-3)		Lower (LOGS-1)	
	Control mean MSC	**Limiting Nutrient**	**Control mean MSC**	**Limiting Nutrient**	**Control mean MSC**	**Limiting Nutrient**
1997	2.71	NITROGEN	2.42	CO-LIMITING	2.26	CO-LIMITING
2000	4.23	NON-LIMITING	3.7	NITROGEN	1.17	PHOSPHORUS
2005	2.75	NON-LIMITING	2.25	NITROGEN	2.93	NITROGEN
2010	4.98	PHOSPHORUS	---	---	---	---
2016	3.81	NITROGEN	---	---	---	---
2019	2.84	NITROGEN	2.32	NITROGEN	2.49	NITROGEN

Figure 10. Monthly DO concentrations at 1.5 m (5 ft) for Logan Martin Reservoir stations collected April-October 2016. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth (ADEM Admin. Code R. 335-6-10-.09).

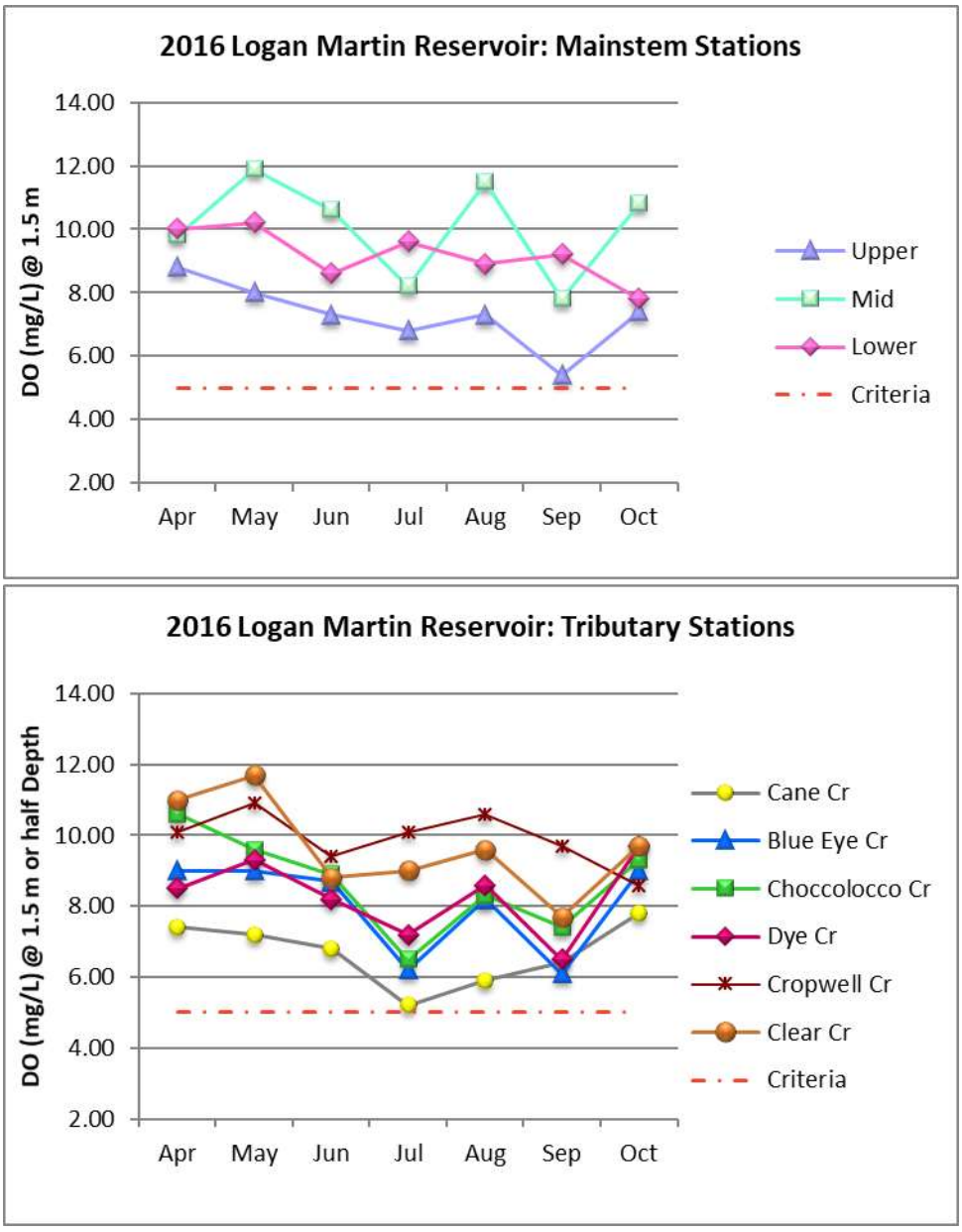


Figure 11. Monthly DO concentrations at 1.5 m (5 ft) for Logan Martin Reservoir stations collected April-October 2019. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth (ADEM Admin. Code R. 335-6-10-.09).

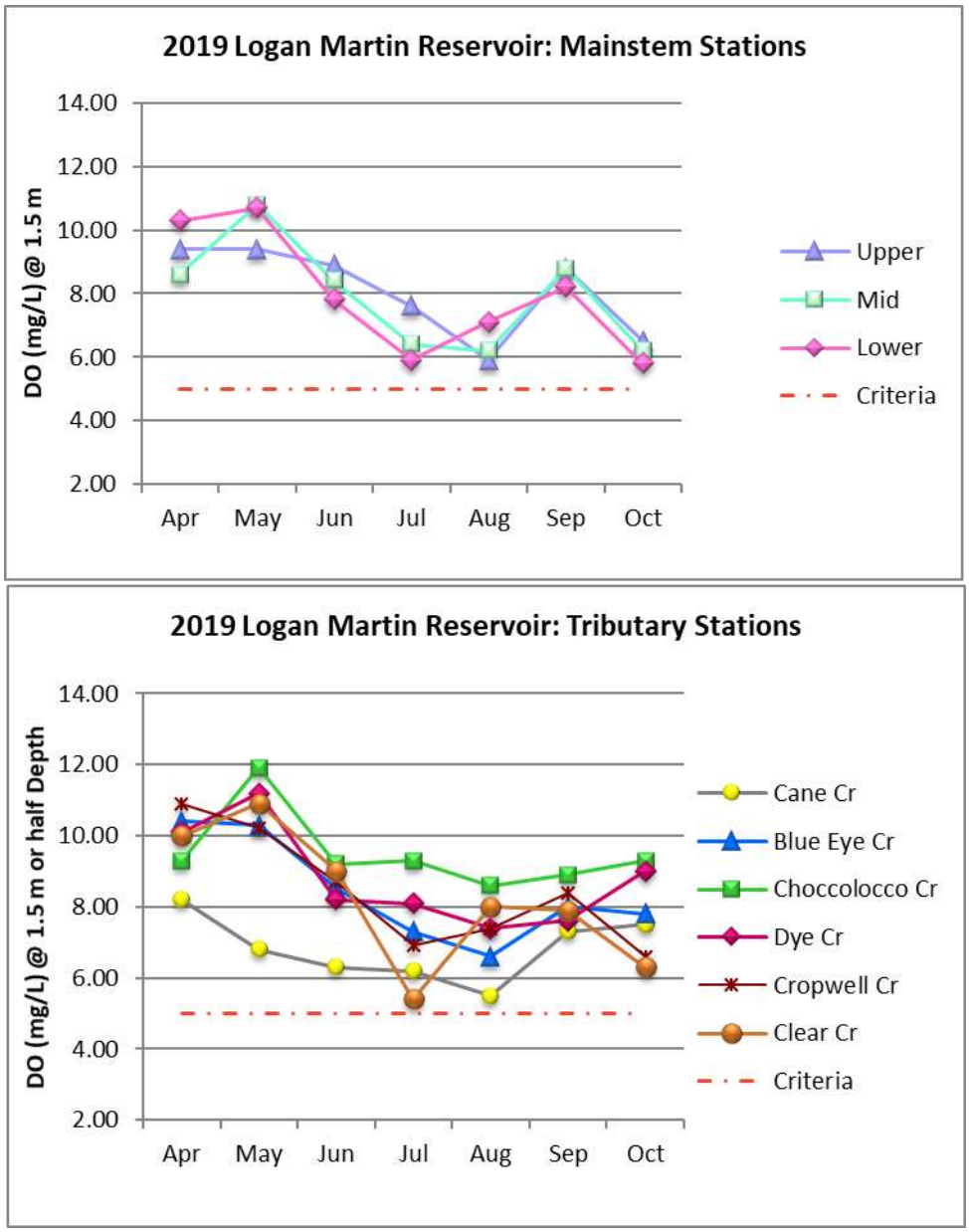


Figure 12. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Logan Martin Reservoir station, April-October 2016.

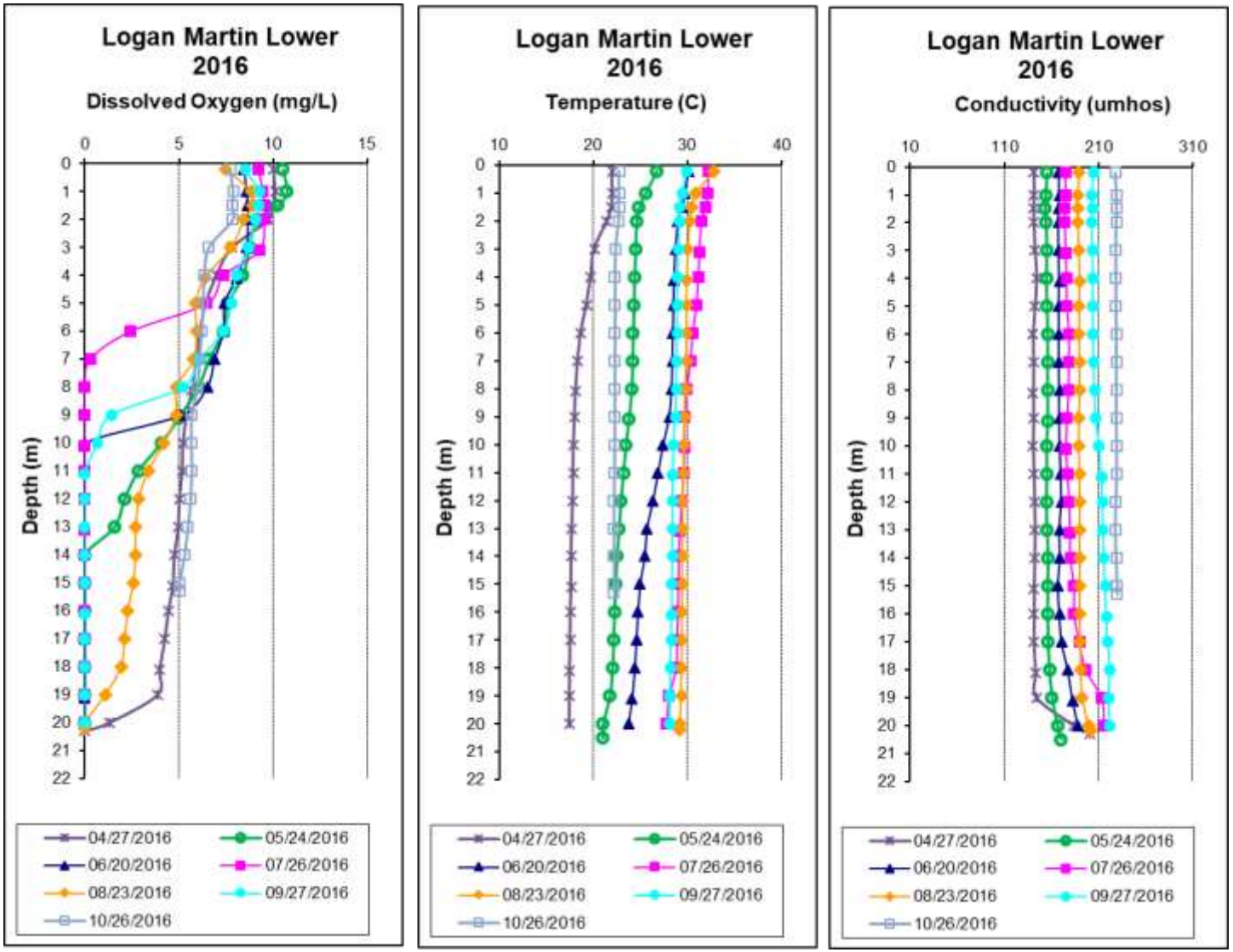


Figure 13. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the mid Logan Martin Reservoir station, April-October 2016.

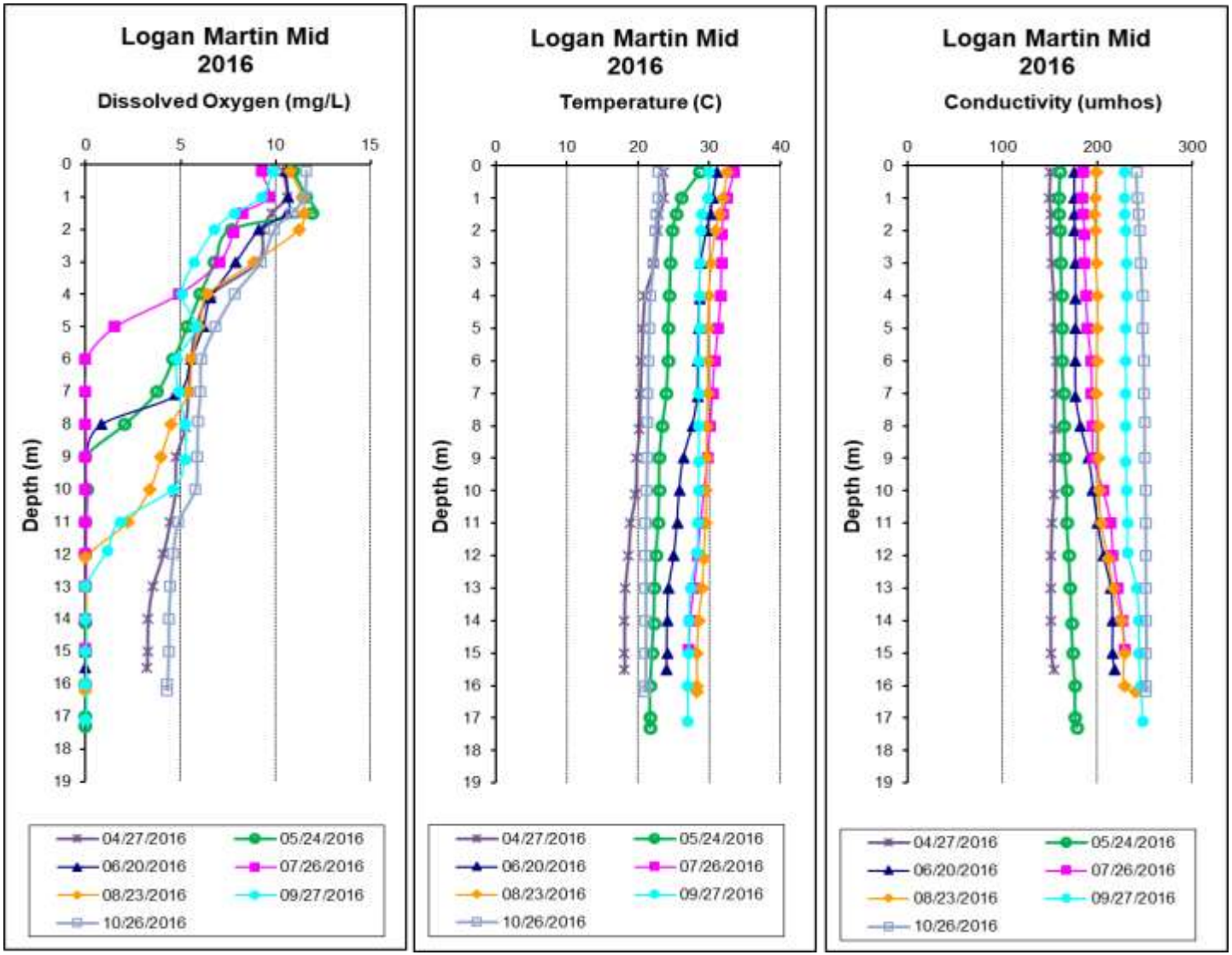


Figure 14. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Logan Martin Reservoir station, April-October 2019.

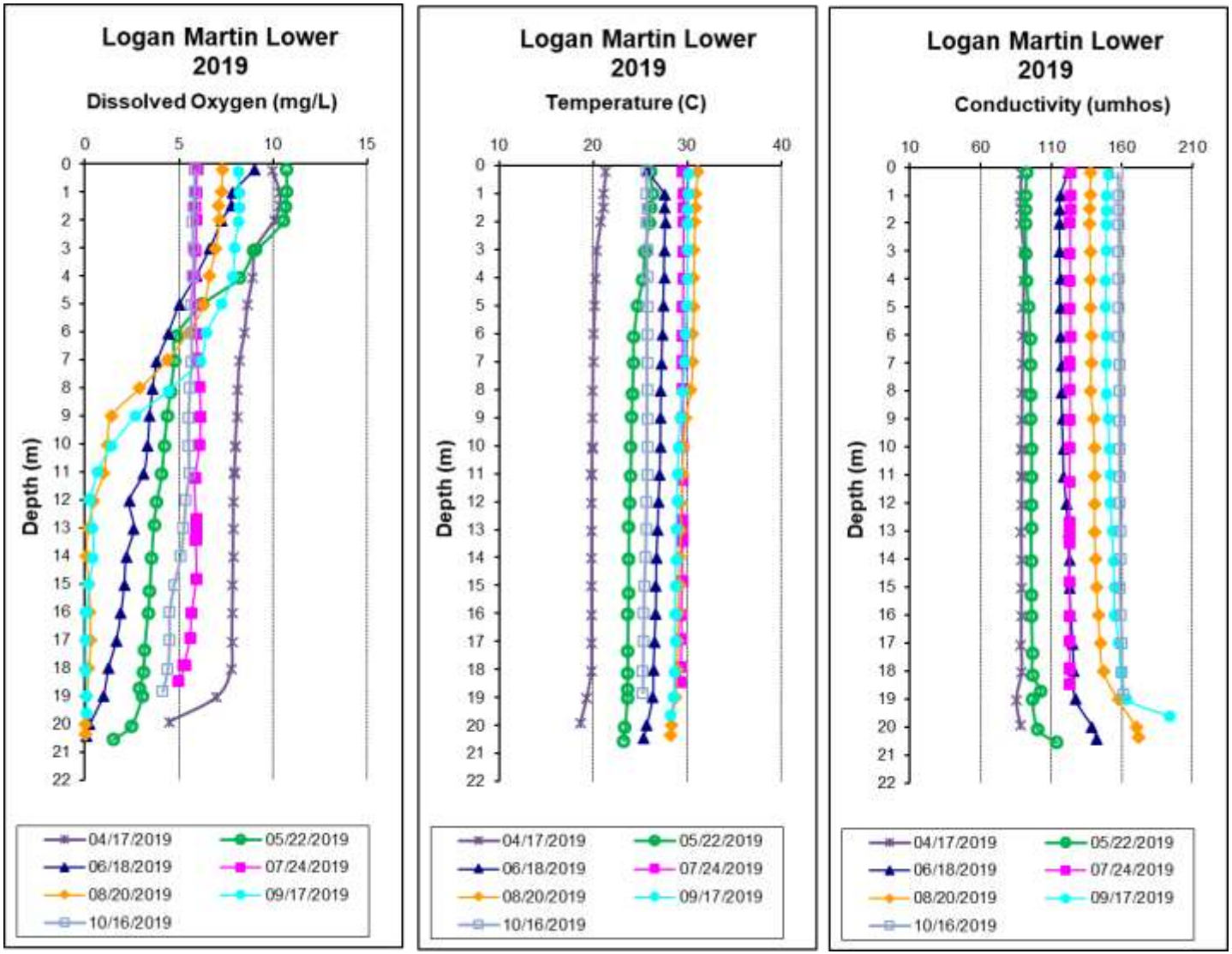


Figure 15. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the mid Logan Martin Reservoir station, April-October 2019.

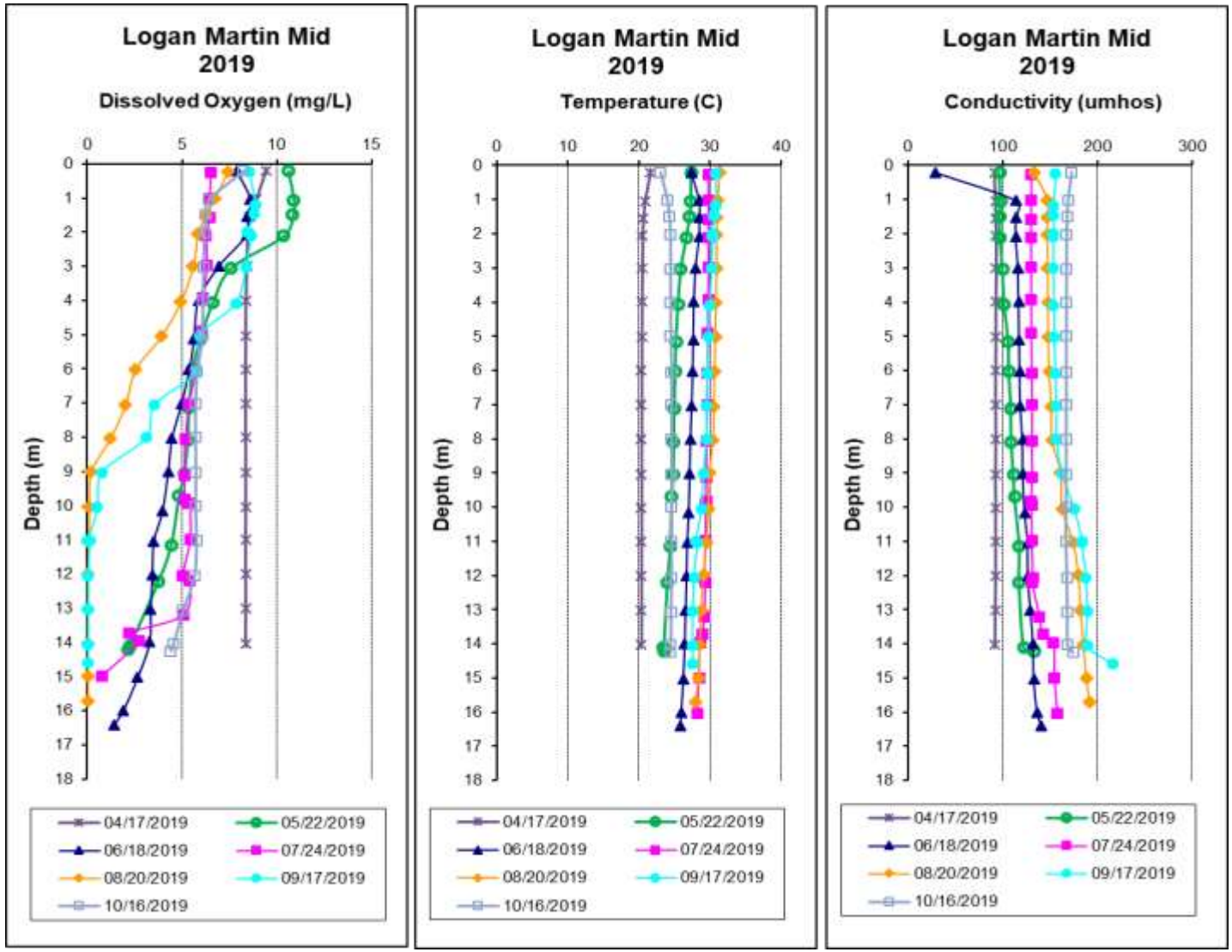


Figure 16. Monthly TSI values calculated for mainstem and tributary Logan Martin Reservoir stations in 2016 using chl *a* concentrations and Carlson's Trophic State Index calculation (Carlson 1977). Monthly discharge acquired from APCo at Logan Martin Dam.

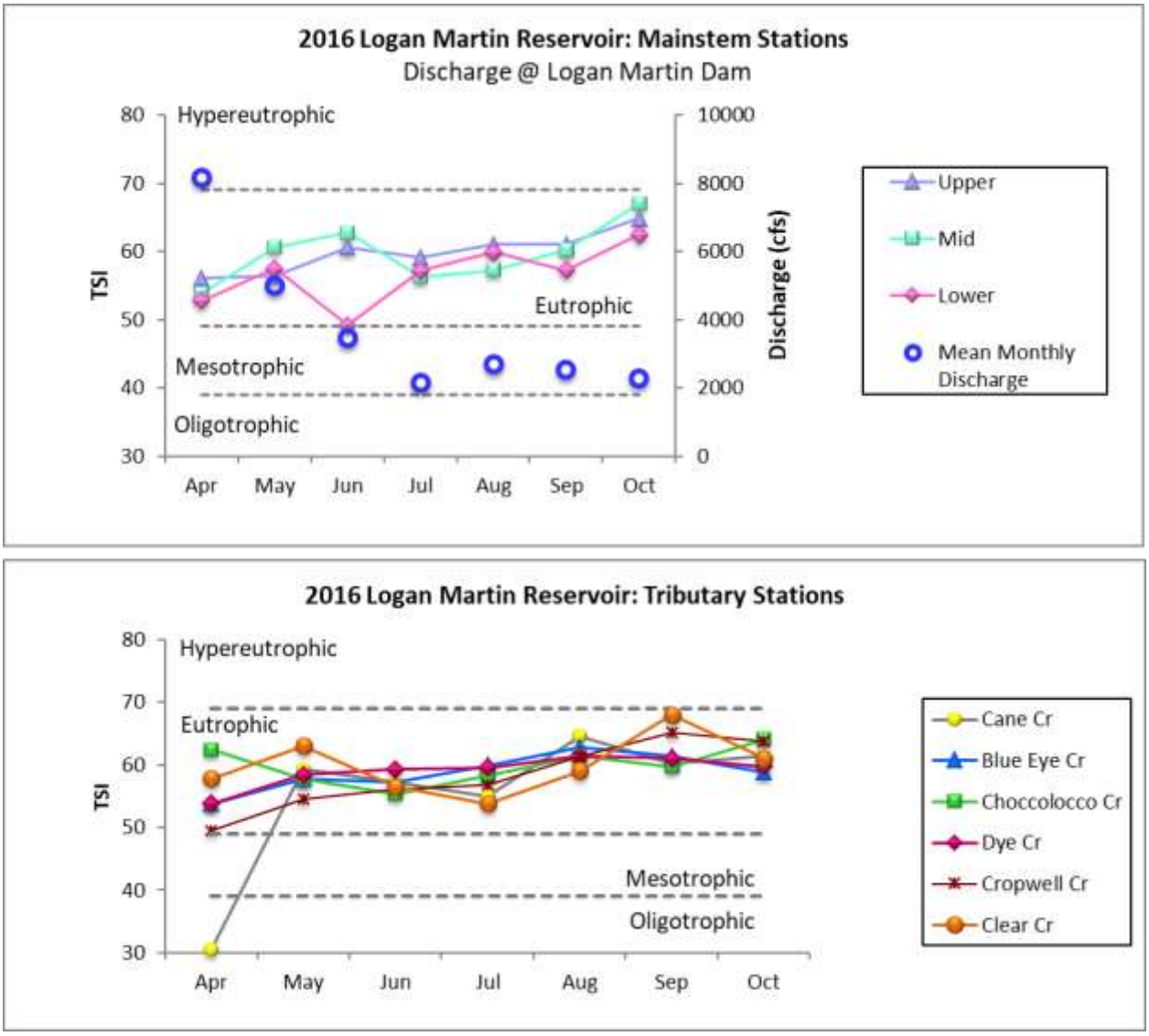
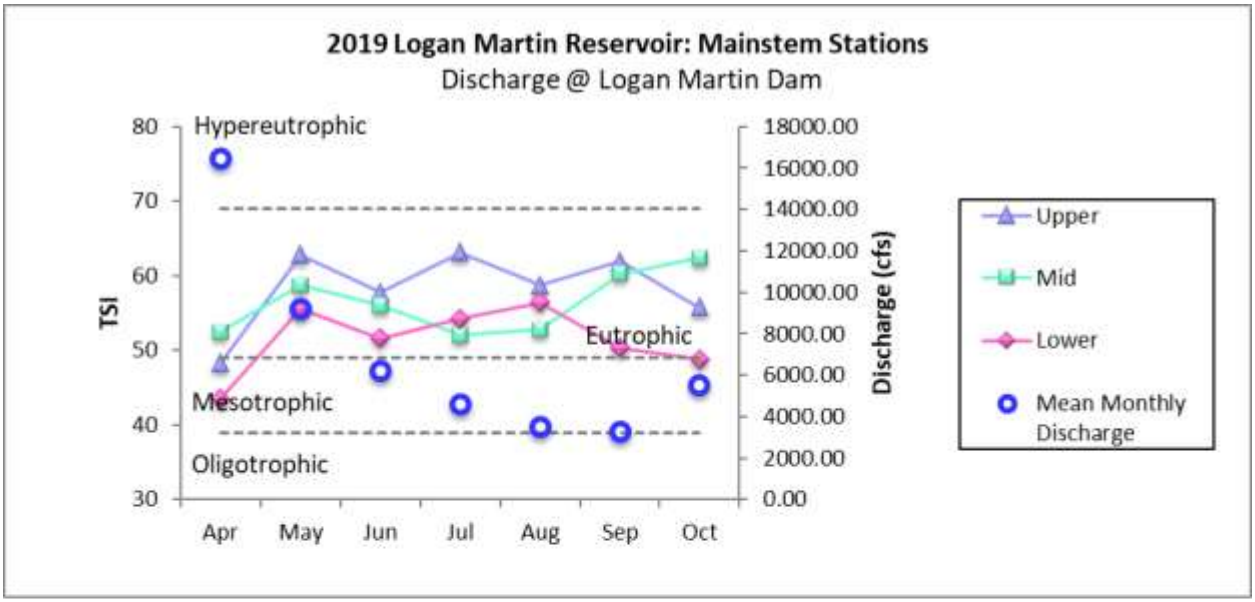
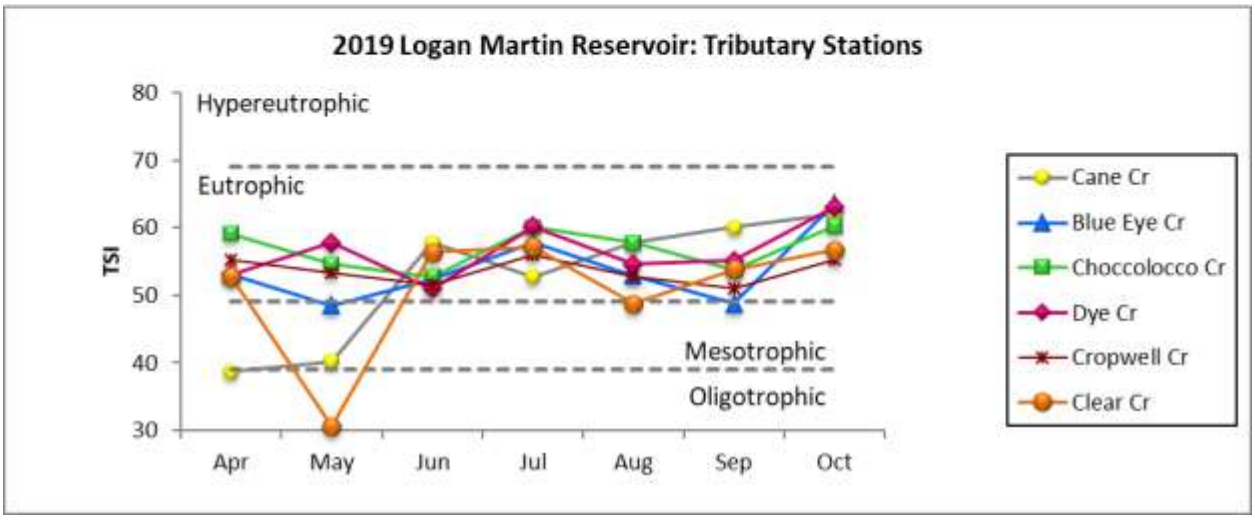


Figure 17. Monthly TSI values calculated for mainstem and tributary Logan Martin Reservoir stations in 2019 using chl *a* concentrations and Carlson's Trophic State Index calculation (Carlson 1977). Monthly discharge acquired from APCo at Logan Martin Dam.





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APPENDIX

Appendix Table 1. Summary of Logan Martin Reservoir water quality data collected April-October, 2016. Minimum (min) and maximum (max) values calculated using minimum detection limits when results were less than this value. Median (med), mean, and standard deviation (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-1	**Physical**							
	Turbidity (NTU)	7		2.6	6.0	3.3	3.5	1.1
	Total Dissolved Solids (mg/L)	7		76.0	193.0	94.0	105.6	40.7
	Total Suspended Solids (mg/L)	7		1.0	7.0	4.0	4.3	2.2
	Hardness (mg/L)	4		73.1	81.8	77.4	77.4	3.6
	Alkalinity (mg/L)	7		64.8	94.3	80.2	80.2	10.2
	Photic Zone (m)	7		3.35	6.24	5.04	5.06	0.92
	Secchi (m)	7		0.88	1.99	1.31	1.36	0.34
	Bottom Depth (m)	7		15.3	20.5	20.0	19.4	1.8
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.058	0.015	0.017	0.019
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.019	0.002	0.006	0.007
	Total Kjeldahl Nitrogen (mg/L)	7		0.227	0.901	0.412	0.470	0.227
	Total Nitrogen (mg/L)[J]	7	<	0.684	2.760	0.413	0.476	0.231
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.003	0.003	0.002	0.001
	Total Phosphorus (mg/L)	7		0.014	0.028	0.020	0.020	0.004
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.5	10.8	5.3	6.1	2.6
	Biological							
	Chlorophyll a (mg/m³)	7		6.68	25.80	15.10	15.36	6.29
	E. coli (MPN/DL)[J]	4		1	1	1	1	0
LOGS-2	**Physical**							
	Turbidity (NTU)	7		8.3	21.6	9.3	11.5	4.7
	Total Dissolved Solids (mg/L)	7		89.0	144.0	107.0	109.7	22.9
	Total Suspended Solids (mg/L)	7		9.0	14.0	10.0	11.0	2.2
	Hardness (mg/L)	4		73.1	88.7	80.4	80.6	6.4
	Alkalinity (mg/L)	7		69.0	96.5	87.1	85.2	10.4
	Photic Zone (m)	7		2.09	3.24	2.92	2.85	0.44
	Secchi (m)	7		0.70	0.93	0.81	0.83	0.08
	Bottom Depth (m)	7		9.3	11.0	10.5	10.3	0.6
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.041	0.004	0.012	0.014
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.019	0.002	0.005	0.007
	Total Kjeldahl Nitrogen (mg/L)	7		0.230	0.933	0.550	0.572	0.229
	Total Nitrogen (mg/L)[J]	7	<	0.693	2.820	0.552	0.577	0.230
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L)	7		0.019	0.036	0.025	0.027	0.006
	CBOD-5 (mg/L)	7	<	2.0	2.2	1.0	1.2	0.4
	Chlorides (mg/L)	7		3.8	14.8	7.3	8.0	4.2
	Biological							
	Chlorophyll a (mg/m³)	7		13.40	32.90	21.40	20.61	6.57
	E. coli (MPN/DL)[J]	4	<	1	3	1	1	1

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-3	**Physical**							
	Turbidity (NTU)	7		3.8	7.3	5.5	5.6	1.0
	Total Dissolved Solids (mg/L)	7		60.0	126.0	95.0	94.7	21.7
	Total Suspended Solids (mg/L)[J]	7		5.0	9.0	7.0	7.1	1.9
	Hardness (mg/L)	4		75.5	87.6	80.0	80.8	5.0
	Alkalinity (mg/L)	7		69.8	97.3	83.2	83.5	10.0
	Photic Zone (m)	7		2.91	4.76	3.60	3.59	0.59
	Secchi (m)	7		0.78	1.19	0.94	0.98	0.14
	Bottom Depth (m)	7		14.9	17.3	16.2	16.1	0.9
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.050	0.004	0.014	0.017
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.015	0.001	0.003	0.005
	Total Kjeldahl Nitrogen (mg/L)	7		0.280	0.745	0.580	0.579	0.180
	Total Nitrogen (mg/L)[J]	7	<	0.846	2.280	0.582	0.582	0.182
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L)	7		0.022	0.034	0.024	0.026	0.004
	CBOD-5 (mg/L)	7	<	2.0	2.7	2.1	1.8	0.8
	Chlorides (mg/L)	7		3.6	13.0	6.4	7.4	3.5
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	40.90	20.50	21.29	10.19
	E. coli (MPN/DL)[J]	4		1	1	1	1	0
LOGS-4	**Physical**							
	Turbidity (NTU)	7		8.7	23.7	11.7	13.2	5.4
	Total Dissolved Solids (mg/L)	7		80.0	145.0	113.0	110.6	20.0
	Total Suspended Solids (mg/L)	7		8.0	15.0	9.0	10.7	2.9
	Hardness (mg/L)	4		78.8	99.4	90.4	89.7	9.0
	Alkalinity (mg/L)	7		81.3	125.0	98.7	97.9	14.5
	Photic Zone (m)	7		1.30	2.50	2.00	1.88	0.42
	Secchi (m)	7		0.53	0.82	0.72	0.70	0.09
	Bottom Depth (m)	7		1.3	2.5	2.0	2.0	0.4
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.051	0.015	0.016	0.017
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7		0.010	0.259	0.035	0.076	0.086
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.050	0.580	0.362	0.342	0.169
	Total Nitrogen (mg/L)[J]	7	<	0.852	1.812	0.408	0.418	0.098
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.010	0.003	0.004	0.003
	Total Phosphorus (mg/L)	7		0.020	0.031	0.025	0.026	0.004
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		2.1	15.2	6.3	7.4	4.6
	Biological							
	Chlorophyll a (mg/m³)	7	<	0.10	32.00	18.70	17.35	9.94
	E. coli (MPN/DL)	4		3	34	16	17	14

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-5	**Physical**							
	Turbidity (NTU)	7		6.6	23.0	8.6	11.6	5.9
	Total Dissolved Solids (mg/L)	7		92.0	140.0	112.0	113.9	19.8
	Total Suspended Solids (mg/L)	7		7.0	110.0	10.0	24.7	37.7
	Hardness (mg/L)	4		84.9	96.9	87.6	89.2	5.3
	Alkalinity (mg/L)[J]	7		77.1	110.0	90.9	92.7	11.3
	Photic Zone (m)	7		2.16	3.10	2.46	2.57	0.31
	Secchi (m)	7		0.54	1.12	0.87	0.84	0.20
	Bottom Depth (m)	7		2.4	3.8	3.3	3.2	0.4
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.030	0.004	0.010	0.008
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.018	0.002	0.004	0.006
	Total Kjeldahl Nitrogen (mg/L)	7		0.404	0.869	0.527	0.573	0.168
	Total Nitrogen (mg/L)[J]	7	<	1.218	2.610	0.528	0.577	0.170
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.003	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.020	0.039	0.023	0.026	0.007
	CBOD-5 (mg/L)	7	<	2.0	2.3	1.0	1.6	0.7
	Chlorides (mg/L)	7		3.4	11.8	6.1	6.8	3.0
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	26.70	17.80	18.46	5.31
	E. coli (MPN/DL)	4		2	13	11	9	5
LOGS-6	**Physical**							
	Turbidity (NTU)	7		8.7	12.1	9.6	9.8	1.1
	Total Dissolved Solids (mg/L)	7		30.0	133.0	105.0	94.7	34.7
	Total Suspended Solids (mg/L)	7		1.0	12.0	9.0	9.0	3.9
	Hardness (mg/L)	4		78.8	89.5	80.7	82.4	4.8
	Alkalinity (mg/L)	7		81.6	103.0	86.7	88.7	7.9
	Photic Zone (m)	7		1.87	3.20	2.49	2.49	0.39
	Secchi (m)	7		0.63	0.96	0.81	0.79	0.13
	Bottom Depth (m)	7		7.3	8.8	8.3	8.2	0.5
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.009	0.030	0.015	0.015	0.008
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.062	0.002	0.010	0.023
	Total Kjeldahl Nitrogen (mg/L)	7		0.200	0.784	0.450	0.518	0.251
	Total Nitrogen (mg/L)[J]	7	<	0.606	2.364	0.451	0.528	0.241
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.005	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.024	0.052	0.029	0.032	0.009
	CBOD-5 (mg/L)	7	<	2.0	2.1	1.0	1.3	0.5
	Chlorides (mg/L)	7		3.2	12.6	6.1	7.2	3.5
	Biological							
	Chlorophyll a (mg/m³)	7		12.50	30.30	19.60	20.59	6.19
	E. coli (MPN/DL)	4		1	6	3	3	2

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-7	**Physical**							
	Turbidity (NTU)	7		7.2	12.7	8.7	10.0	2.4
	Total Dissolved Solids (mg/L)	7		81.0	137.0	111.0	103.0	21.0
	Total Suspended Solids (mg/L)	7		7.0	14.0	10.0	9.9	2.1
	Hardness (mg/L)	4		74.2	88.2	79.0	80.1	5.8
	Alkalinity (mg/L)	7		71.3	96.5	83.0	82.9	9.7
	Photic Zone (m)	7		1.87	4.20	2.82	2.79	0.76
	Secchi (m)	7		0.50	1.05	0.89	0.84	0.19
	Bottom Depth (m)	7		2.3	3.7	3.3	3.2	0.5
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.056	0.004	0.015	0.019
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.013	0.001	0.003	0.004
	Total Kjeldahl Nitrogen (mg/L)	7		0.270	0.671	0.510	0.493	0.122
	Total Nitrogen (mg/L)[J]	7	<	0.816	2.016	0.512	0.496	0.122
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.003	0.002	0.002	0.001
	Total Phosphorus (mg/L)	7		0.021	0.035	0.026	0.027	0.005
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.1	0.4
	Chlorides (mg/L)	7		3.9	14.6	6.8	8.0	3.9
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	23.10	19.10	18.64	4.06
	E. coli (MPN/DL)[J]	4	<	1	2	1	1	1
LOGS-8	**Physical**							
	Turbidity (NTU)	7		3.8	5.7	4.5	4.6	0.8
	Total Dissolved Solids (mg/L)	7		74.0	118.0	97.0	95.0	15.1
	Total Suspended Solids (mg/L)	7		4.0	7.0	5.0	5.6	1.1
	Hardness (mg/L)	4		73.8	84.2	77.8	78.4	4.3
	Alkalinity (mg/L)	7		65.6	96.4	81.9	81.6	10.8
	Photic Zone (m)	7		3.09	5.32	4.00	4.06	0.79
	Secchi (m)	7		0.96	1.33	1.04	1.12	0.16
	Bottom Depth (m)	7		8.3	9.1	8.7	8.7	0.3
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.034	0.004	0.011	0.011
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.002	0.004	0.001	0.001	0.000
	Total Kjeldahl Nitrogen (mg/L)	7		0.186	0.856	0.536	0.494	0.235
	Total Nitrogen (mg/L)	7	<	0.564	2.571	0.537	0.495	0.234
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.016	0.032	0.022	0.023	0.005
	CBOD-5 (mg/L)	7	<	2.0	2.3	1.0	1.3	0.6
	Chlorides (mg/L)	7		3.5	11.4	5.6	6.4	2.8
	Biological							
	Chlorophyll a (mg/m³)	7		6.87	33.80	14.50	18.95	9.98
	E. coli (MPN/DL)[J]	3		1	2	1	1	1

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-9	**Physical**							
	Turbidity (NTU)	7		2.7	4.2	3.4	3.5	0.5
	Total Dissolved Solids (mg/L)	7		62.0	100.0	90.0	87.4	12.3
	Total Suspended Solids (mg/L)	7		3.0	7.0	4.0	4.9	1.5
	Hardness (mg/L)	4		68.1	78.5	73.3	73.3	4.3
	Alkalinity (mg/L)	7		58.7	91.2	76.7	75.3	11.4
	Photic Zone (m)	7		3.78	6.40	5.03	4.98	0.83
	Secchi (m)	7		0.95	1.60	1.47	1.39	0.22
	Bottom Depth (m)	7		10.2	11.0	10.5	10.5	0.3
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.041	0.004	0.012	0.014
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.004	0.001	0.002	0.001
	Total Kjeldahl Nitrogen (mg/L)[J]	7		0.110	0.576	0.478	0.420	0.163
	Total Nitrogen (mg/L)[J]	7	<	0.336	1.731	0.482	0.422	0.163
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L)	7		0.017	0.023	0.019	0.019	0.002
	CBOD-5 (mg/L)	7	<	2.0	2.4	1.0	1.2	0.5
	Chlorides (mg/L)	7		3.3	9.3	4.9	5.4	2.1
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	45.40	18.20	21.99	11.68
	E. coli (MPN/DL)[J]	4		1	1	1	1	0

J=one or more of the values provided are estimated; < = Actual value is less than the detection limit.

Appendix Table 2. Summary of Logan Martin Reservoir water quality data collected April-October, 2019. Minimum (min) and maximum (max) values calculated using minimum detection limits when results were less than this value. Median (med), mean, and standard deviation (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-1	**Physical**							
	Turbidity (NTU)	7		2.4	7.7	3.4	4.4	1.1
	Total Dissolved Solids (mg/L)[J]	7	<	1.0	124.0	76.0	71.4	38.9
	Total Suspended Solids (mg/L)[J]	7		1.0	6.0	4.0	3.7	1.6
	Hardness (mg/L)	4		62.8	71.2	69.7	68.4	3.8
	Alkalinity (mg/L)	7		49.9	74.2	66.6	62.5	10.0
	Photic Zone (m)	7		3.58	7.56	6.21	5.76	1.38
	Secchi (m)	7		1.30	2.72	1.96	2.02	0.54
	Bottom Depth (m)	7		18.4	20.5	19.9	19.7	0.8
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.016	0.008	0.007	0.004
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.177	0.017	0.042	0.063
	Total Kjeldahl Nitrogen (mg/L)[J]	7		0.219	0.741	0.366	0.399	0.171
	Total Nitrogen (mg/L)[J]	7	<	0.669	2.334	0.374	0.441	0.198
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.008	0.002	0.003	0.002
	Total Phosphorus (mg/L)	7		0.016	0.029	0.025	0.024	0.005
	CBOD-5 (mg/L)[J]	7	<	2.0	2.9	1.0	1.3	0.7
	Chlorides (mg/L)	7		3.3	7.5	5.2	5.2	1.6
	Biological							
	Chlorophyll a (mg/m³)	7		3.74	13.90	8.54	9.15	3.65
	E. coli (MPN/DL)[J]	4		1	1	1	1	0
LOGS-2	**Physical**							
	Turbidity (NTU)	7		6.1	13.8	11.3	10.3	2.6
	Total Dissolved Solids (mg/L)	7		56.0	133.0	86.0	88.4	27.5
	Total Suspended Solids (mg/L)	7		6.0	12.0	10.0	9.1	2.0
	Hardness (mg/L)	4		63.3	73.7	68.7	68.6	4.2
	Alkalinity (mg/L)	7		54.2	74.2	63.5	63.9	8.3
	Photic Zone (m)	7		2.26	3.40	2.86	2.77	0.41
	Secchi (m)	7		0.71	1.28	0.93	0.97	0.18
	Bottom Depth (m)	7		9.3	11.2	10.3	10.2	0.7
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.028	0.008	0.009	0.009
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.196	0.009	0.040	0.070
	Total Kjeldahl Nitrogen (mg/L)	7		0.346	1.110	0.456	0.612	0.299
	Total Nitrogen (mg/L)[J]	7	<	1.143	3.420	0.458	0.652	0.338
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.020	0.040	0.025	0.027	0.007
	CBOD-5 (mg/L)[J]	7	<	2.0	2.2	1.0	1.2	0.4
	Chlorides (mg/L)	7		3.5	8.6	6.0	5.9	2.0
	Biological							
	Chlorophyll a (mg/m³)	7		6.10	27.60	17.60	18.77	7.91
	E. coli (MPN/DL)[J]	4		1	4	1	2	2

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-3	**Physical**							
	Turbidity (NTU)	7		3.4	15.7	4.9	6.7	4.2
	Total Dissolved Solids (mg/L)	7		33.0	126.0	89.0	87.1	32.4
	Total Suspended Solids (mg/L)	7		1.0	11.0	6.0	6.3	3.4
	Hardness (mg/L)	4		62.4	74.6	70.8	69.7	5.5
	Alkalinity (mg/L)	7		50.7	75.6	68.0	64.1	9.7
	Photic Zone (m)	7		2.55	4.63	3.85	3.93	0.75
	Secchi (m)	7		0.90	2.04	1.18	1.33	0.47
	Bottom Depth (m)	7		14.0	16.4	14.6	15.0	1.0
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.025	0.008	0.008	0.008
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.212	0.012	0.040	0.077
	Total Kjeldahl Nitrogen (mg/L)	7		0.199	0.732	0.330	0.393	0.183
	Total Nitrogen (mg/L)[J]	7	<	0.711	2.832	0.332	0.434	0.246
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.021	0.030	0.026	0.026	0.004
	CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.4	8.3	6.0	5.7	1.9
	Biological							
	Chlorophyll a (mg/m³)	7		8.90	25.60	13.40	15.01	6.47
	E. coli (MPN/DL)[J]	4		1	1	1	1	0
LOGS-4	**Physical**							
	Turbidity (NTU)	7		10.0	29.9	13.5	15.6	7.5
	Total Dissolved Solids (mg/L)	7		83.0	112.0	103.0	98.6	11.4
	Total Suspended Solids (mg/L)[J]	7		8.0	17.0	11.0	11.4	3.7
	Hardness (mg/L)	4		68.0	77.8	71.6	72.2	4.4
	Alkalinity (mg/L)	7		65.0	108.0	72.9	79.9	15.8
	Photic Zone (m)	7		1.62	2.11	1.85	1.84	0.17
	Secchi (m)	7		0.52	0.82	0.73	0.70	0.10
	Bottom Depth (m)	7		1.6	2.6	2.0	2.2	0.4
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.063	0.008	0.017	0.021
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7		0.010	0.220	0.052	0.101	0.091
	Total Kjeldahl Nitrogen (mg/L)	7		0.233	0.808	0.603	0.529	0.217
	Total Nitrogen (mg/L)[J]	7		1.116	3.084	0.633	0.630	0.207
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.012	0.005	0.006	0.004
	Total Phosphorus (mg/L)	7		0.021	0.035	0.026	0.027	0.005
	CBOD-5 (mg/L)[J]	7	<	2.0	2.1	1.0	1.2	0.4
	Chlorides (mg/L)	7		2.1	8.4	6.3	5.4	2.6
	Biological							
	Chlorophyll a (mg/m³)	7		2.29	24.90	16.00	13.11	8.62
	E. coli (MPN/DL)[J]	4		13	27	26	23	7

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-5	**Physical**							
	Turbidity (NTU)	7		5.5	10.6	7.0	8.1	2.2
	Total Dissolved Solids (mg/L)	7		47.0	110.0	100.0	87.4	24.9
	Total Suspended Solids (mg/L)	7		3.0	10.0	6.0	6.7	2.7
	Hardness (mg/L)	4		76.0	87.5	79.7	80.7	5.1
	Alkalinity (mg/L)	7		69.6	91.6	78.6	79.3	7.0
	Photic Zone (m)	7		2.27	2.95	2.67	2.59	0.26
	Secchi (m)	7		0.75	1.26	0.99	0.99	0.18
	Bottom Depth (m)	7		2.6	3.6	3.4	3.3	0.3
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.016	0.008	0.005	0.003
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.003	0.156	0.002	0.024	0.058
	Total Kjeldahl Nitrogen (mg/L)[J]	7		0.210	0.953	0.539	0.546	0.247
	Total Nitrogen (mg/L)[J]	7	<	0.634	2.864	0.540	0.570	0.275
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.018	0.032	0.023	0.023	0.005
	CBOD-5 (mg/L)[J]	7	<	2.0	2.1	1.0	1.2	0.4
	Chlorides (mg/L)	7		2.1	7.1	5.1	5.0	2.0
	Biological							
	Chlorophyll a (mg/m³)	7		6.23	29.00	9.79	12.36	8.02
	E. coli (MPN/DL)[J]	4		1	9	4	4	3
LOGS-6	**Physical**							
	Turbidity (NTU)	7		5.8	10.8	7.9	8.3	2.0
	Total Dissolved Solids (mg/L)	7		65.0	114.0	97.0	89.9	21.2
	Total Suspended Solids (mg/L)[J]	7		5.0	13.0	8.0	8.3	2.9
	Hardness (mg/L)	4		66.2	78.5	71.1	71.7	5.7
	Alkalinity (mg/L)	7		60.6	81.7	70.5	70.5	7.1
	Photic Zone (m)	7		2.29	3.73	2.88	3.01	0.54
	Secchi (m)	7		0.72	1.34	0.82	0.95	0.23
	Bottom Depth (m)	7		7.3	8.8	8.2	8.1	0.5
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.016	0.008	0.005	0.003
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.003	0.576	0.002	0.084	0.217
	Total Kjeldahl Nitrogen (mg/L)	7		0.254	0.922	0.397	0.479	0.224
	Total Nitrogen (mg/L)	7	<	0.766	4.494	0.398	0.562	0.427
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.020	0.002	0.005	0.007
	Total Phosphorus (mg/L)	7		0.021	0.044	0.027	0.030	0.008
	CBOD-5 (mg/L)[J]	7	<	2.0	2.5	1.0	1.2	0.6
	Chlorides (mg/L)	7		3.1	7.9	5.7	5.6	1.9
	Biological							
	Chlorophyll a (mg/m³)	7		9.61	20.60	16.00	15.30	4.65
	E. coli (MPN/DL)[J]	4		1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-7	**Physical**							
	Turbidity (NTU)	7		6.2	14.5	8.9	9.0	3.1
	Total Dissolved Solids (mg/L)	7		24.0	108.0	86.0	76.6	33.4
	Total Suspended Solids (mg/L)	7		4.0	12.0	9.0	8.3	3.0
	Hardness (mg/L)	4		62.7	73.5	68.4	68.2	4.8
	Alkalinity (mg/L)	7		49.5	73.8	66.0	63.2	9.3
	Photic Zone (m)	7		1.98	2.81	2.50	2.48	0.31
	Secchi (m)	7		0.68	1.24	0.91	0.91	0.19
	Bottom Depth (m)	7		2.8	3.5	3.4	3.3	0.3
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.016	0.008	0.005	0.003
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.116	0.002	0.018	0.043
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.200	0.647	0.402	0.415	0.169
	Total Nitrogen (mg/L)[J]	7	<	0.304	2.289	0.404	0.433	0.198
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.020	0.042	0.026	0.028	0.008
	CBOD-5 (mg/L)[J]	7	<	2.0	2.4	1.0	1.2	0.5
	Chlorides (mg/L)	7		2.9	8.6	5.9	5.8	2.2
	Biological							
	Chlorophyll a (mg/m³)	7		8.01	27.50	12.20	15.10	6.85
	E. coli (MPN/DL)[J]	4		1	6	2	3	3
LOGS-8	**Physical**							
	Turbidity (NTU)	7		2.9	9.8	4.5	4.9	2.3
	Total Dissolved Solids (mg/L)	7		34.0	95.0	87.0	77.4	23.3
	Total Suspended Solids (mg/L)	7		2.0	7.0	5.0	4.9	1.7
	Hardness (mg/L)	4		62.2	72.2	68.2	67.7	4.6
	Alkalinity (mg/L)	7		47.8	75.3	66.0	62.7	10.8
	Photic Zone (m)	7		3.73	5.75	4.56	4.62	0.73
	Secchi (m)	7		1.20	2.20	1.67	1.64	0.32
	Bottom Depth (m)	7		6.6	9.0	8.8	8.3	0.9
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.016	0.008	0.005	0.003
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.003	0.125	0.002	0.024	0.046
	Total Kjeldahl Nitrogen (mg/L)	7		0.250	0.598	0.485	0.442	0.142
	Total Nitrogen (mg/L)	7	<	0.754	2.169	0.522	0.466	0.171
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.023	0.029	0.023	0.025	0.003
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.1	7.9	5.1	5.4	1.8
	Biological							
	Chlorophyll a (mg/m³)	7		8.01	13.40	10.10	10.61	2.07
	E. coli (MPN/DL)	4		1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Avg	SD
LOGS-9	**Physical**							
	Turbidity (NTU)	7		2.2	5.6	3.3	3.3	1.2
	Total Dissolved Solids (mg/L)	7		44.0	90.0	82.0	70.0	19.4
	Total Suspended Solids (mg/L)	7	<	1.0	5.0	2.0	2.3	1.7
	Hardness (mg/L)	4		54.9	68.3	64.1	62.8	5.7
	Alkalinity (mg/L)	7		41.3	73.6	60.7	58.4	11.7
	Photic Zone (m)	7		4.08	6.82	5.21	5.48	1.01
	Secchi (m)	7		1.52	2.38	1.94	1.94	0.26
	Bottom Depth (m)	7		9.5	11.0	10.6	10.4	0.5
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.016	0.008	0.005	0.003
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.127	0.002	0.023	0.046
	Total Kjeldahl Nitrogen (mg/L)	7		0.264	1.250	0.320	0.513	0.348
	Total Nitrogen (mg/L)[J]	7	<	0.796	4.131	0.322	0.536	0.393
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.015	0.021	0.018	0.018	0.002
	CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		2.9	7.2	4.3	4.6	1.6
	Biological							
	Chlorophyll a (mg/m³)	7	<	1.00	15.00	10.70	10.07	5.22
	E. coli (MPN/DL)[J]	4		1	1	1	1	0

J=one or more of the values provided are estimated; < = Actual value is less than the detection limit.