Mitchell 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
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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INTRODUCTION

Mitchell Reservoir is an impoundment of the Coosa River located 10 miles east of Clanton, AL, in Chilton and Coosa Counties. The 5,850 acre reservoir is situated between Lay Reservoir and Jordan Reservoir. Mitchell was completed in 1922 by the Alabama Power Company (APCO) to provide hydroelectric power to the area. In addition to power generation, the reservoir provides recreational opportunities, including boating, fishing, and swimming.

Mitchell Reservoir was placed on Alabama's 1996 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its Public Water Supply (PWS)/Swimming (S)/Fish & Wildlife (F&W) water use classifications. The reservoir was listed for impairments caused by nutrients and organic enrichment/dissolved oxygen (OE/DO). After reviewing DO data collected in Mitchell Reservoir between 1995 and 2000, the ADEM removed the OE/DO segments from the §303(d) list in 2004 as data showed that stations met the minimum DO criteria of 5.0 mg/L in more than 10% of samples. A TMDL developed to address the nutrient impairment in Mitchell Reservoir, as well as the entire Coosa River reservoir chain, was approved by the USEPA in 2008 (ADEM 2008).

The Alabama Department of Environmental Management (ADEM) monitored Mitchell Reservoir as part of the 2016 and 2019 assessments of the Coosa River basins under the Rivers and Reservoirs Monitoring Program (RRMP). Implemented in 1990, the 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).

In 2010, the ADEM implemented specific water quality criteria for nutrient management at the lower and upper Mitchell Reservoir stations, which have been monitored by ADEM since 1990 (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 Mitchell Reservoir's PWS/S/F&W use classifications.

The purpose of this report is to summarize data collected at four stations in Mitchell Reservoir during the 2016 and 2019 growing seasons and to evaluate growing season trends in lake trophic status and nutrient concentrations using ADEM's historical 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. Mitchell Reservoir was sampled in the mainstem at the dam forebay and upper reservoir. Two tributary embayment stations were also monitored, Walnut Creek and Hatchet Creek.

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 APCO flow data and ADEM's previously collected data to help interpret the 2016 and 2019 results.

Figure 1. Mitchell Reservoir with 2016 and 2019 sampling locations.

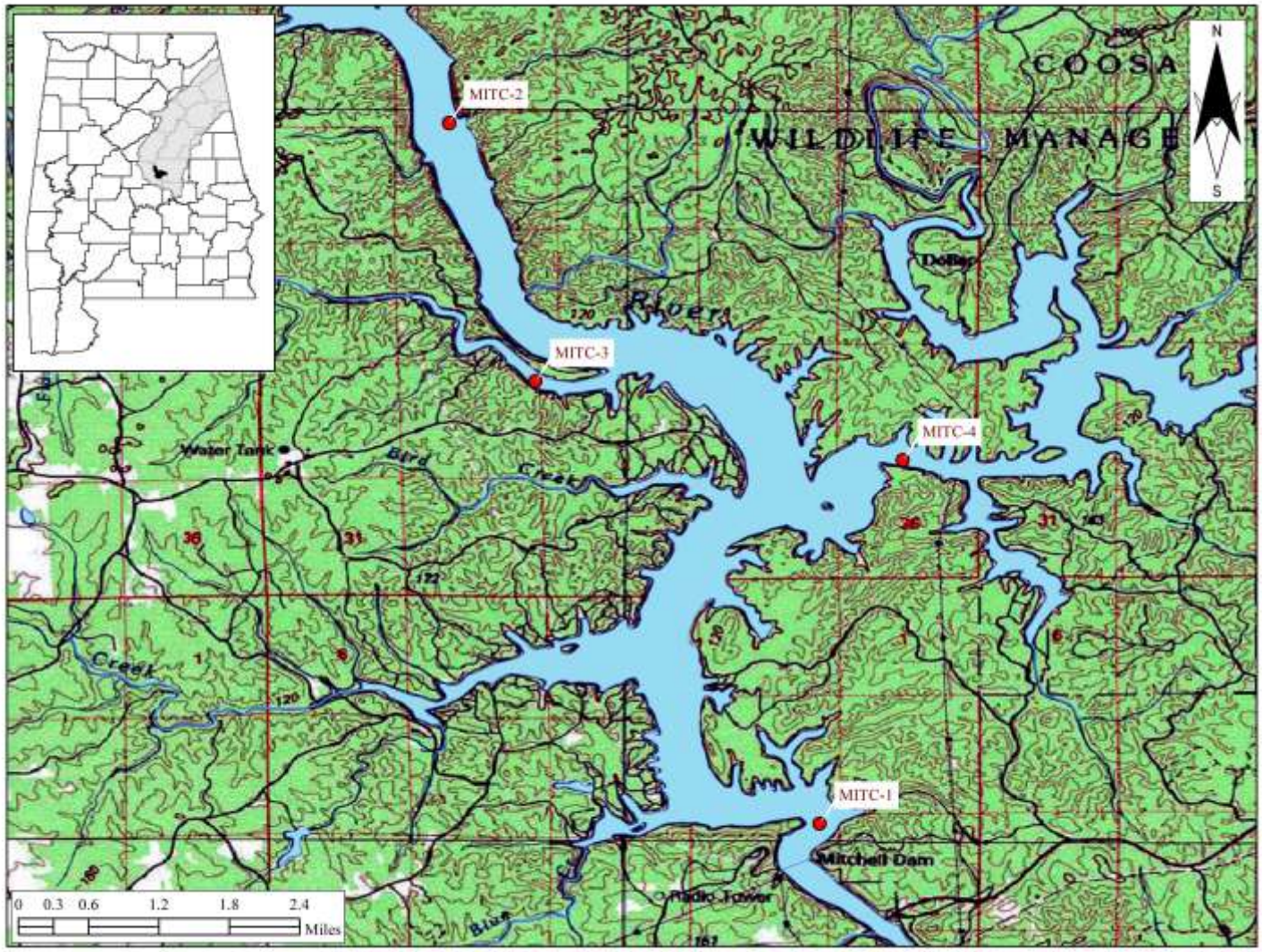


Table 1. Descriptions of the 2016 and 2019 monitoring stations in Mitchell Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
031501070803	Coosa	MITC-1*	Lower	Coosa R	Deepest point, main river channel, dam forebay.	14 µg/L	32.81065	-86.44197
031501070803	Coosa	MITC-2*	Upper	Coosa R	Deepest point, main river channel, downstream of Foshee Islands	16 µg/L	32.89716	-86.48774
031501070802	Chilton	MITC-3	Walnut Ck	Walnut Ck	Deepest point, main creek channel, Walnut Creek embayment, approximately 0.5 miles upstream of lake confluence.		32.86525	-86.47711
031501070709	Coosa	MITC-4	Hatchet Ck	Hatchet Ck	Deepest point, main creek channel, Hatchet Creek embayment, approximately 0.5 miles upstream of lake confluence.		32.85550	-86.43171

*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 and 3). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided (Figures 4-9 and 14-15). 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 10-13. 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 that these stations may be potential candidates for reference waterbodies and watersheds.

In 2016, the mean growing season TN values in Mitchell Reservoir mainstem stations were similar, though the upper station was slightly higher (Figure 2). Walnut Creek had the highest mean TN concentrations of the embayment stations. In 2019, the lower station and Hatchet Creek had the highest TN values for mainstem and embayment stations, respectively. Mean TN values in the upper reservoir have been variable in the years monitored, but the 2019 value was the lowest observed since 1997. Concentrations in the lower reservoir have shown an overall increase over time. Mean TN at Walnut Creek increased 2000-2016, but decreased in 2019. Values in Hatchet Creek increased 2000-2010, but were slightly lower in 2016. Monthly TN concentrations reached historic high values in September and October at the upper station and in June and October at the lower station in 2016 (Figure 4). In 2019, mean monthly values were at, or below, historic means throughout the growing season at the upper station. A historic high was recorded at the lower station in April.

In both 2016 and 2019, mean growing season TP values in mainstem Mitchell Reservoir stations were higher in the upper station than the lower (Figure 2). Mean TP concentrations were higher in Walnut Creek than Hatchet Creek both years. Mean growing season TP values calculated in Mitchell Reservoir mainstem stations have declined overall from 1997-2019, with

the 2019 values being the lowest calculated in the reservoir since monitoring began. Mean TP values in Hatchet Creek decreased 2005-2019, but values in Walnut Creek were more variable. Monthly TP concentrations were below historic means at both the upper and lower stations in 2016 and 2019 (Figure 5). Historic low values were measured at the upper station in April and the lower station in July of 2016. In 2019, historic lows were measured at the upper station in April, May, and September, and in the lower station in May-July and September.

Specific water quality criteria for nutrient management have been established for the lower and upper stations on Mitchell Reservoir. The growing season mean chl *a* value calculated in the lower station was in compliance with the criteria limit in both 2016 and 2019 (Figure 3). However, the growing season mean chl *a* value calculated for the upper station exceeded the criteria limit in 2016. Overall, mean chl *a* concentrations in the mainstem stations decreased 2004-2013, but increased in 2016. Similarly, mean values in Walnut Creek and Hatchet Creek decreased 2005-2013, but increased in 2016. The mean chl *a* concentrations calculated in 2019 were the lowest observed at all stations since monitoring began. In 2016, the highest monthly chl *a* concentrations were measured in October at the upper station and in August at the lower station (Figure 6). In 2019, monthly chl *a* concentrations were lower than 2016 values in all months at both stations. Historic low monthly values were measured in May, September, and October at the upper station and in April, June, and September at the lower station that year.

The upper station and Walnut Creek had the highest mean growing season TSS values calculated for mainstem and embayment stations, respectively, in both 2016 and 2019 (Figure 3). However, all mean TSS values were <5.0 mg/L in both years. Mean TSS concentrations have decreased overall since monitoring of Mitchell Reservoir began, but annual means appear variable across years. In 2019, Hatchet Creek had the lowest mean TSS value on record at 1.6 mg/L. Historic low monthly TSS concentrations were measured in May and September at the upper station and in May, June, and September at the lower station in 2016 (Figure 7). In 2019, historic low monthly TSS values were measured in June at both the upper and lower stations.

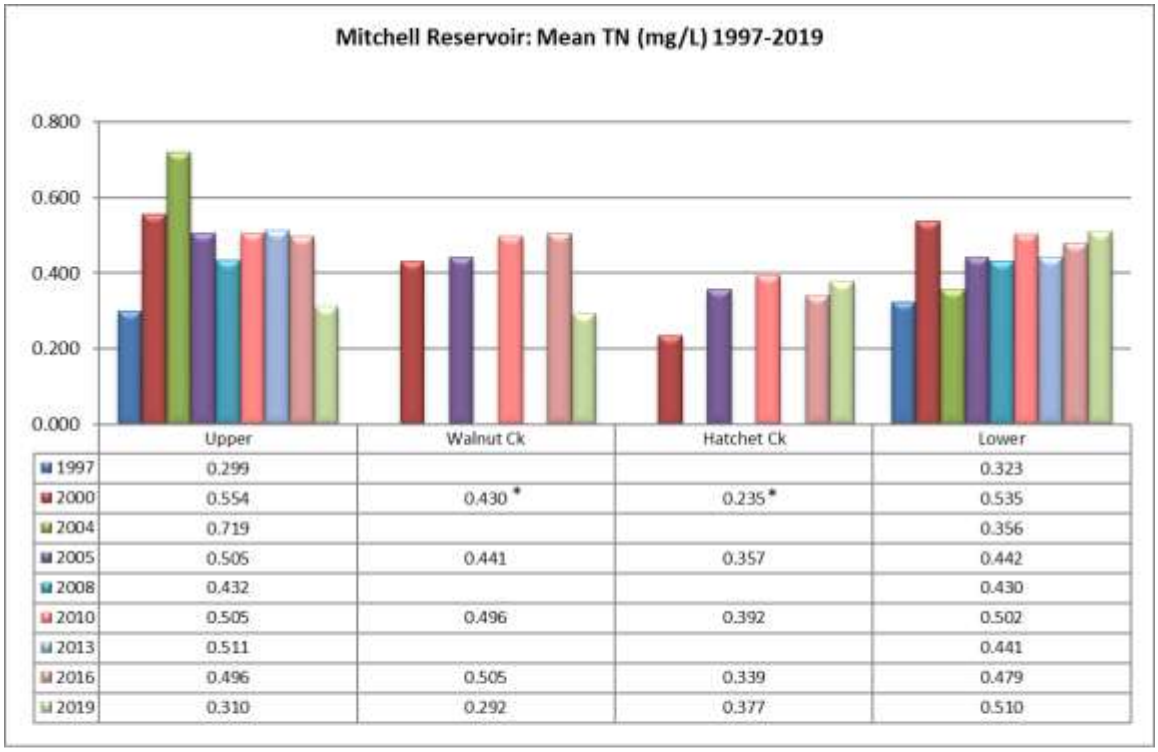
AGPT results for the upper station have remained primarily nitrogen-limited in the years monitored, 2016 and 2019 included (Table 2). The lower station was not sampled in 2016, but it was phosphorus-limited in 2019. Raschke and Schultz (1987) defined a mean standing crop

(MSC) value of 5.0 mg/L as protective of reservoir and lake systems. The MSC values measured in the upper and lower stations were below 5.0 mg/L in both 2016 and 2019.

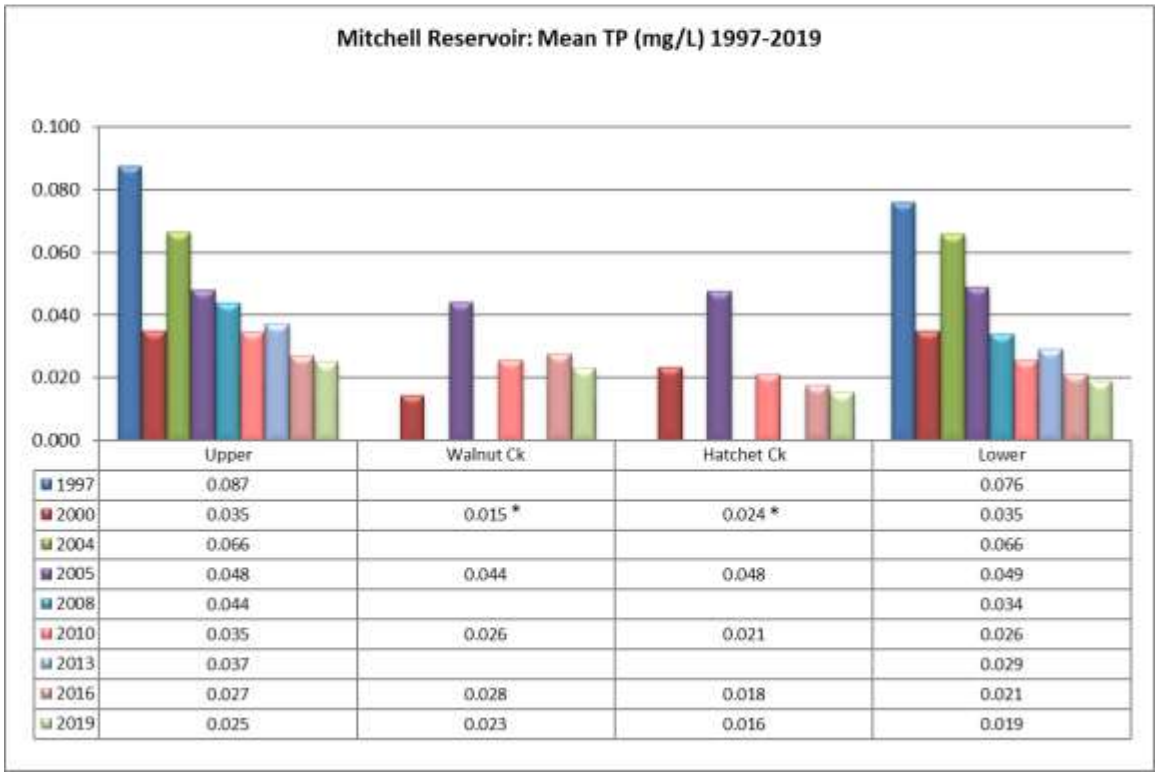
All measurements of dissolved oxygen (DO) concentrations in Mitchell Reservoir mainstem and tributary stations were at or above the ADEM criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) in 2016 and 2019 (Figure 8-9). Based on monthly DO profiles, the lower and upper stations were stratified April-September in 2016 (Figures 10-11). At the lower station, the water column was completely deoxygenated below 12 meters from June-August. There also appeared to be a thermocline present at the lower station from June-August. In 2019, the lower and upper stations were stratified May-September (Figures 12-13). The water column at the lower station was completely deoxygenated below 17 meters from July-September. Highest water temperatures were observed in July and August in both 2016 and 2019.

Monthly TSI values were calculated using chl *a* concentrations and Carlson's Trophic State Index. In 2016, all mainstem and tributary stations were eutrophic from April-October (Figure 14). In 2019, the upper station was mesotrophic in April and May, eutrophic from June-September, and oligotrophic in October (Figure 15). The lower station was only eutrophic in May. Walnut Creek was eutrophic from June-October, while Hatchet Creek was eutrophic from June-August.

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



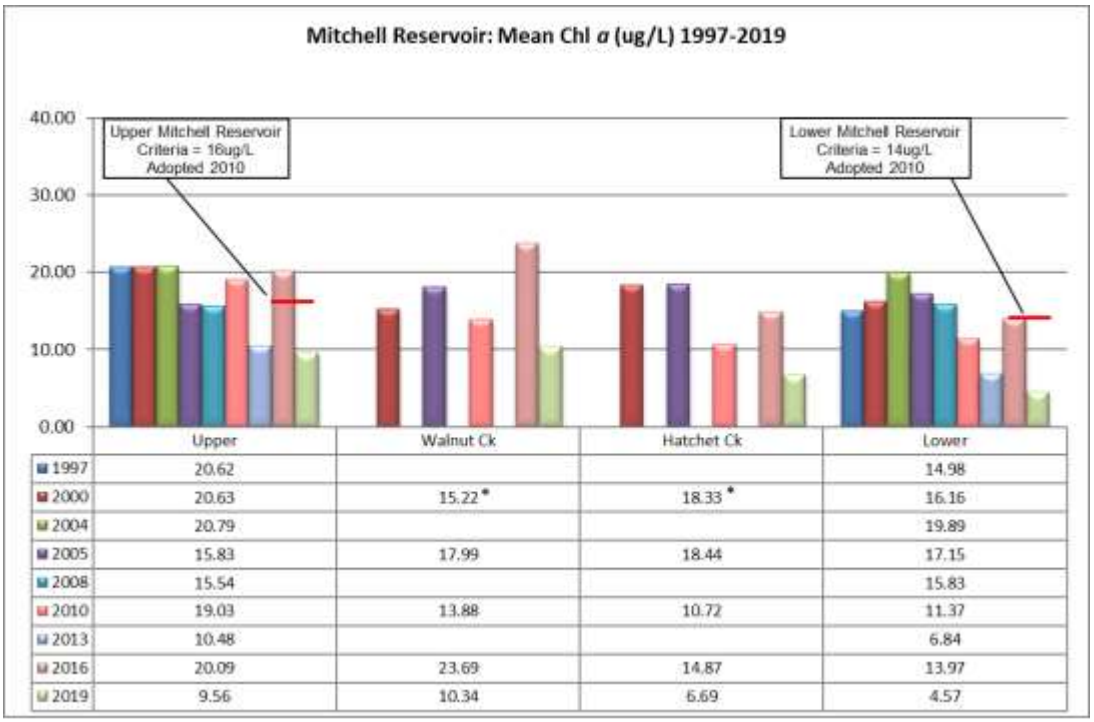
	Upper	Walnut Ck	Hatchet Ck	Lower
1997	0.299			0.323
2000	0.554	0.430 *	0.235 *	0.535
2004	0.719			0.356
2005	0.505	0.441	0.357	0.442
2008	0.432			0.430
2010	0.505	0.496	0.392	0.502
2013	0.511			0.441
2016	0.496	0.505	0.339	0.479
2019	0.310	0.292	0.377	0.510



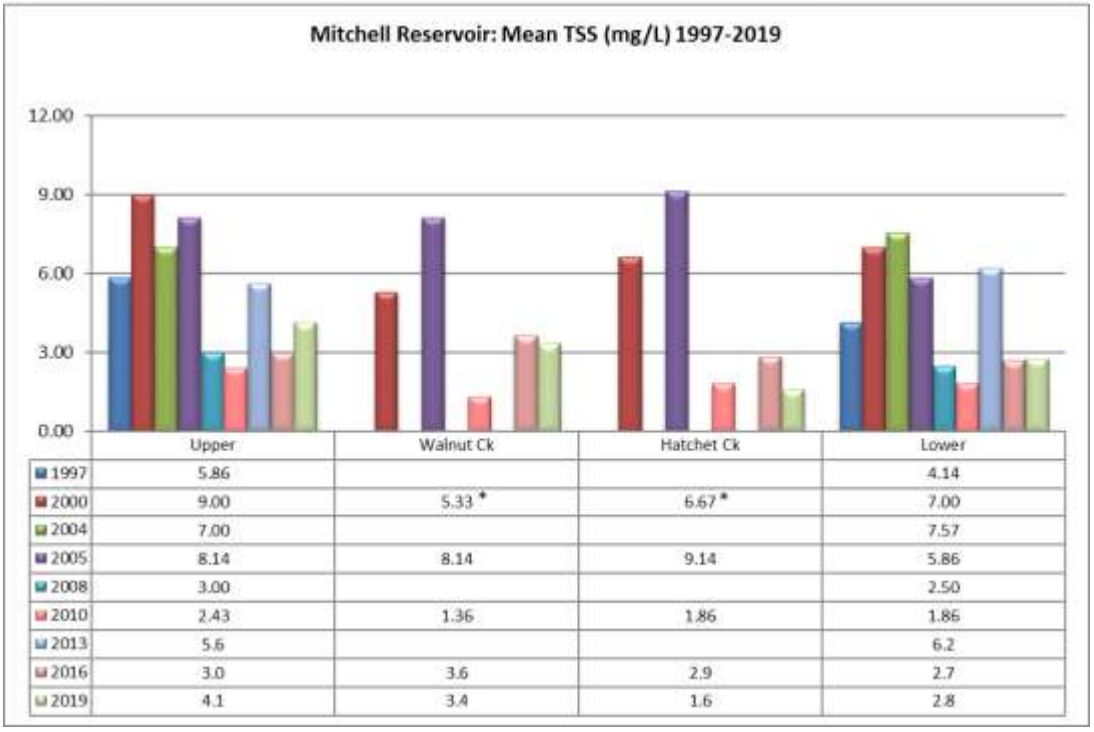
	Upper	Walnut Ck	Hatchet Ck	Lower
1997	0.087			0.076
2000	0.035	0.015 *	0.024 *	0.035
2004	0.066			0.066
2005	0.048	0.044	0.048	0.049
2008	0.044			0.034
2010	0.035	0.026	0.021	0.026
2013	0.037			0.029
2016	0.027	0.028	0.018	0.021
2019	0.025	0.023	0.016	0.019

*Mean of April/June/August only.

Figure 3. Mean growing season chl *a* and TSS measured in Mitchell 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 lower and upper stations.



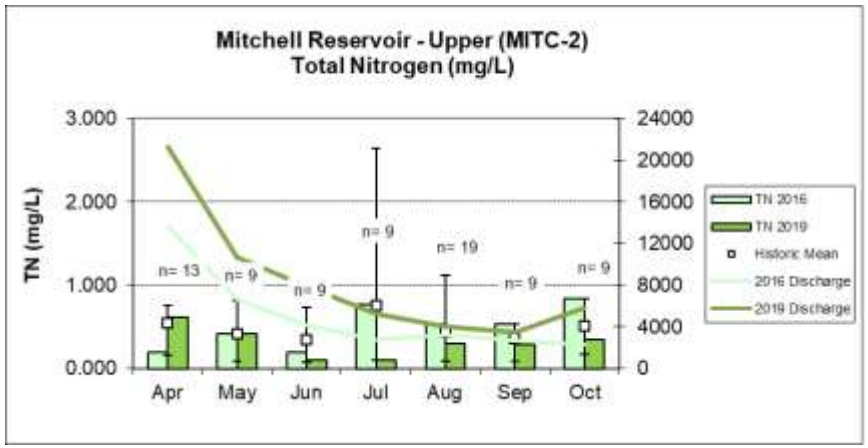
	Upper	Walnut Ck	Hatchet Ck	Lower
1997	20.62			14.98
2000	20.63	15.22 *	18.33 *	16.16
2004	20.79			19.89
2005	15.83	17.99	18.44	17.15
2008	15.54			15.83
2010	19.03	13.88	10.72	11.37
2013	10.48			6.84
2016	20.09	23.69	14.87	13.97
2019	9.56	10.34	6.69	4.57



	Upper	Walnut Ck	Hatchet Ck	Lower
1997	5.86			4.14
2000	9.00	5.33 *	6.67 *	7.00
2004	7.00			7.57
2005	8.14	8.14	9.14	5.86
2008	3.00			2.50
2010	2.43	1.36	1.86	1.86
2013	5.6			6.2
2016	3.0	3.6	2.9	2.7
2019	4.1	3.4	1.6	2.8

*Mean of April/June/August only.

Figure 4. Monthly TN concentrations measured in Mitchell Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Discharge provided by APCO. 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.



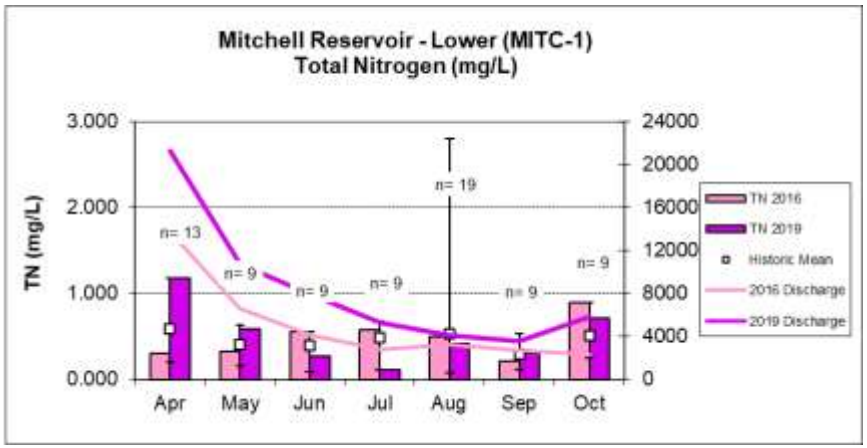
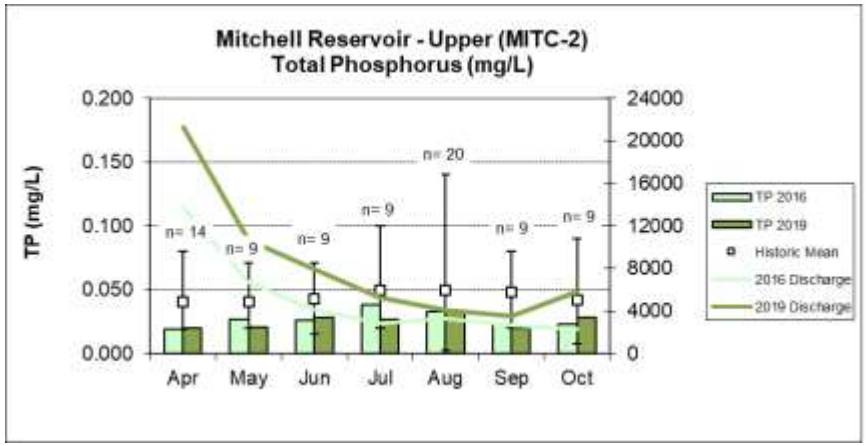


Figure 5. Monthly TP concentrations measured in Mitchell Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.



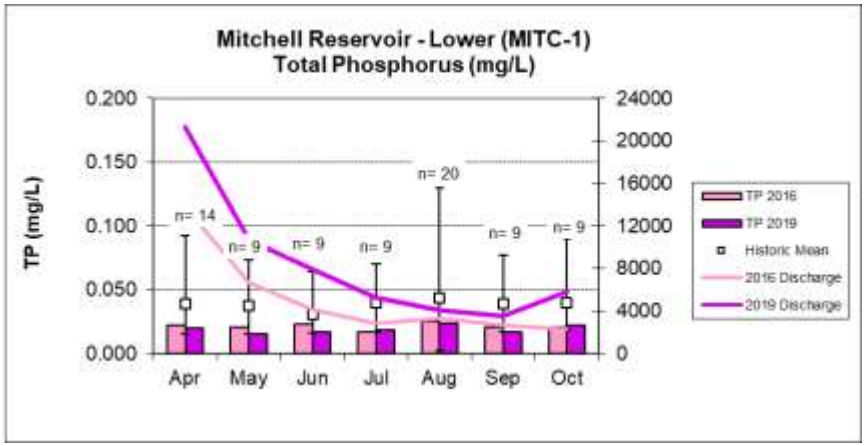
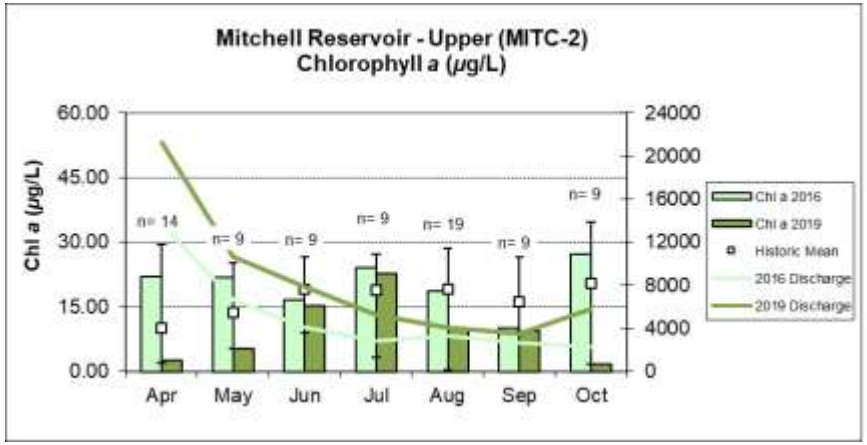


Figure 6. Monthly chl *a* concentrations measured in Mitchell Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.



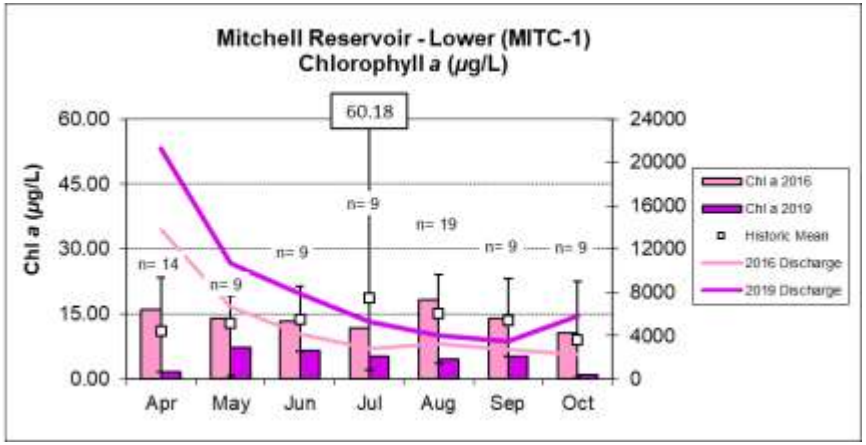


Figure 7. Monthly TSS concentrations measured in Mitchell Reservoir, April-October 2016 and 2019 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2019) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

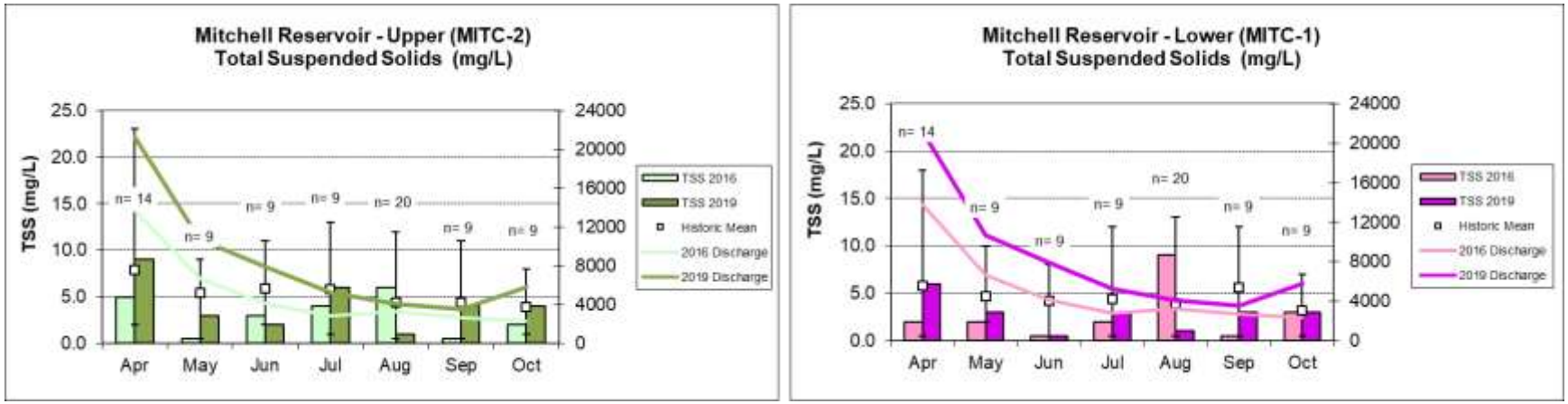
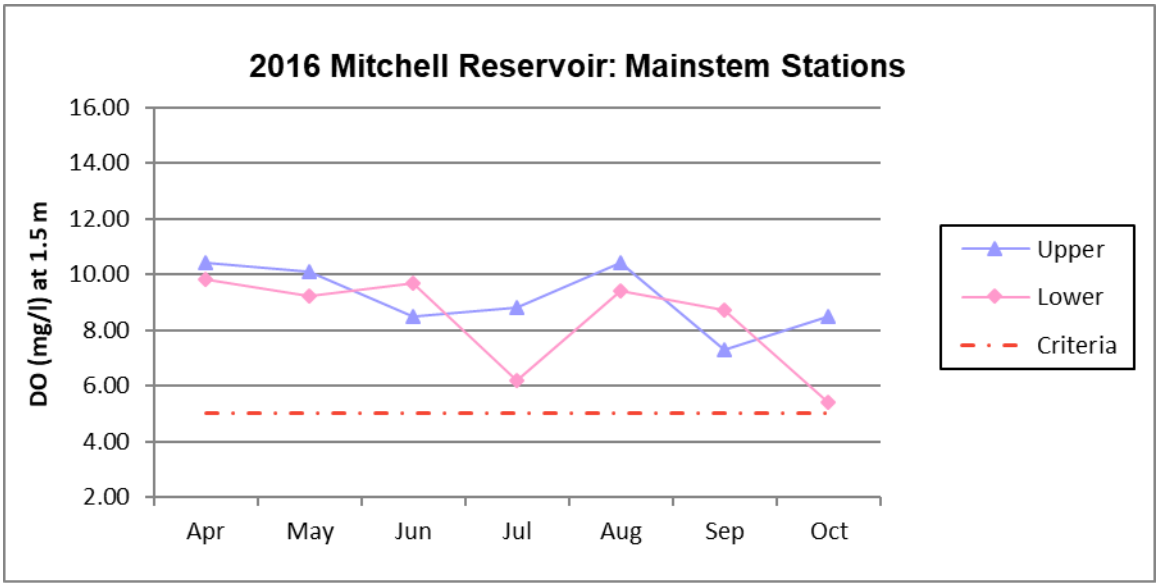


Table 2. Algal growth potential test results, Mitchell Reservoir, 1997-2019 (expressed as mean Maximum Standing Crop (MSC) dry weights of Selenastrum capricornutum in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers. (Raschke and Schultz 1987).

Station	**Upper (MITC-2)**		**Lower (MITC-1)**	
	MSC	**Limiting Nutrient**	**MSC**	**Limiting Nutrient**
1997	6.05	NITROGEN	7.17	CO-LIMITING
2000	4.17	NON-LIMITING	2.01	NON-LIMITING
2005	8.38	NITROGEN	2.12	NITROGEN
2010	2.49	NITROGEN	---	---
2016	3.79	NITROGEN	---	---
2019	3.32	NITROGEN	4.54	PHOSPHORUS

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for Mitchell 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).



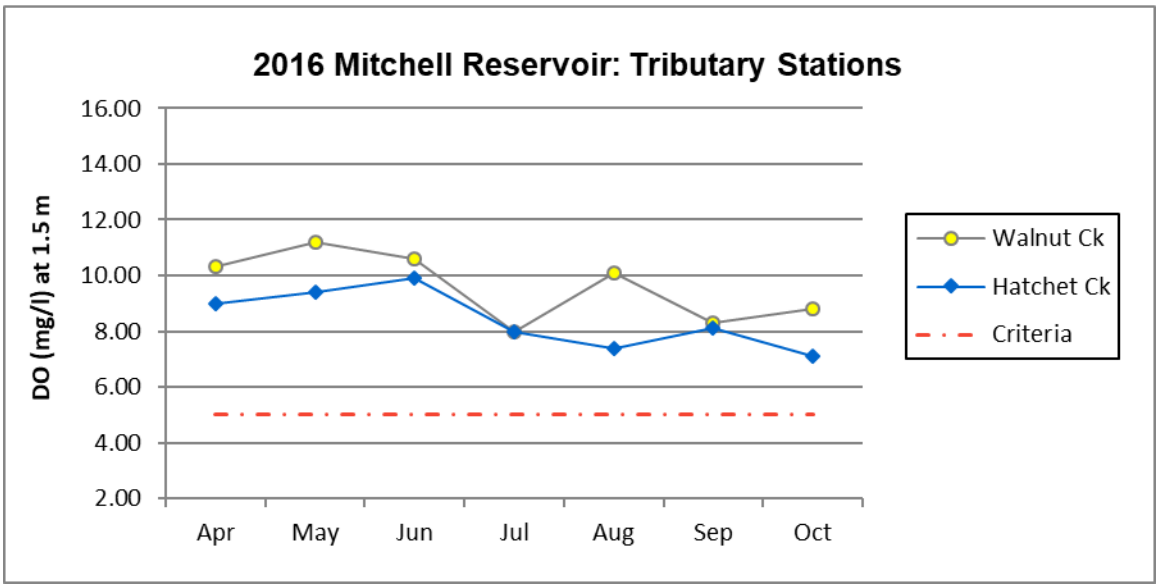
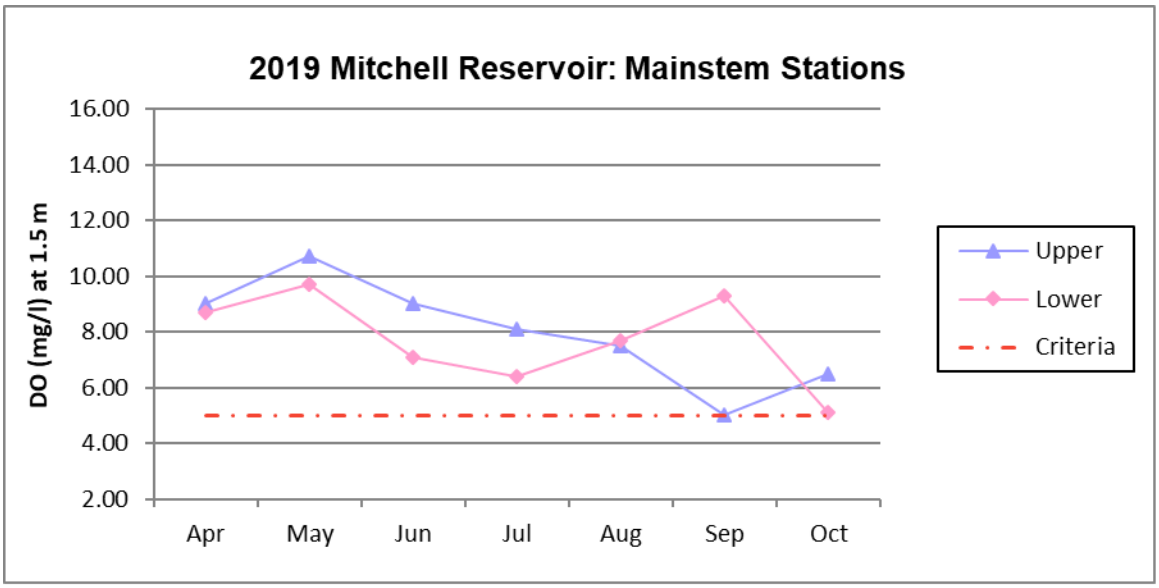


Figure 9. Monthly DO concentrations at 1.5 m (5 ft) for Mitchell Reservoir stations collected April-October 2019. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth (ADEM Admin. Code R. 335-6-10-.09).



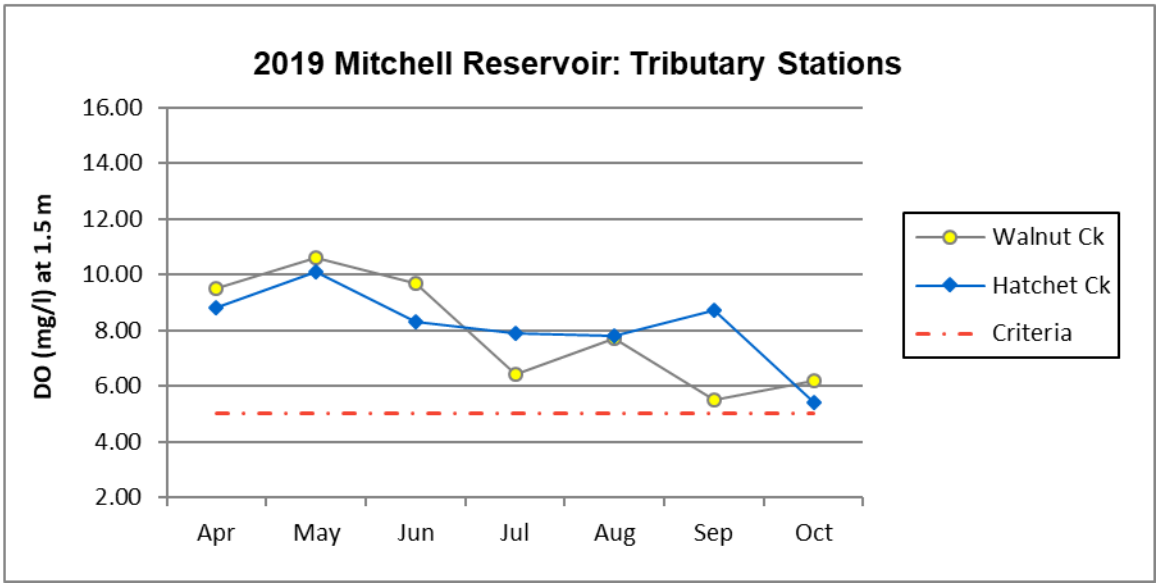
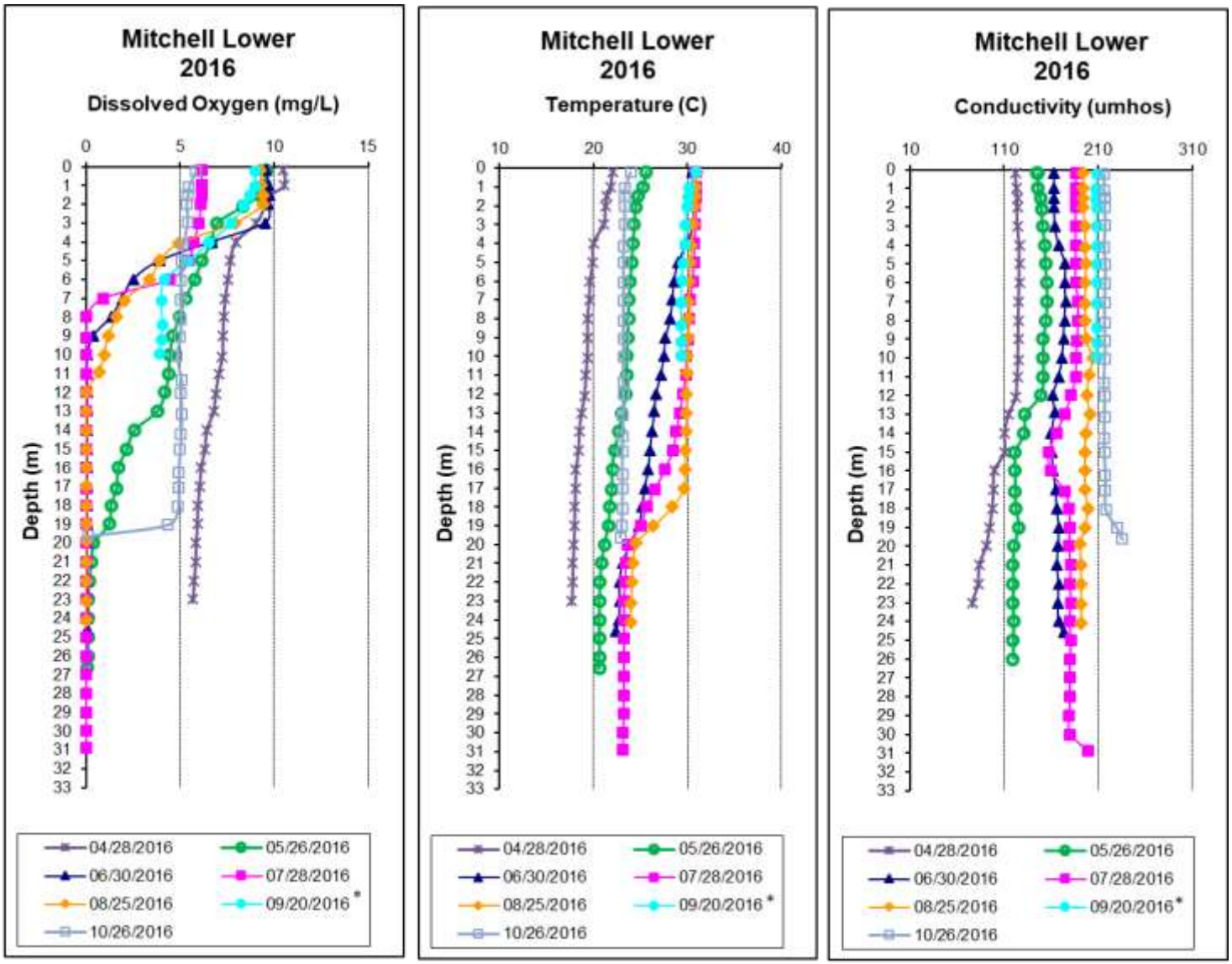
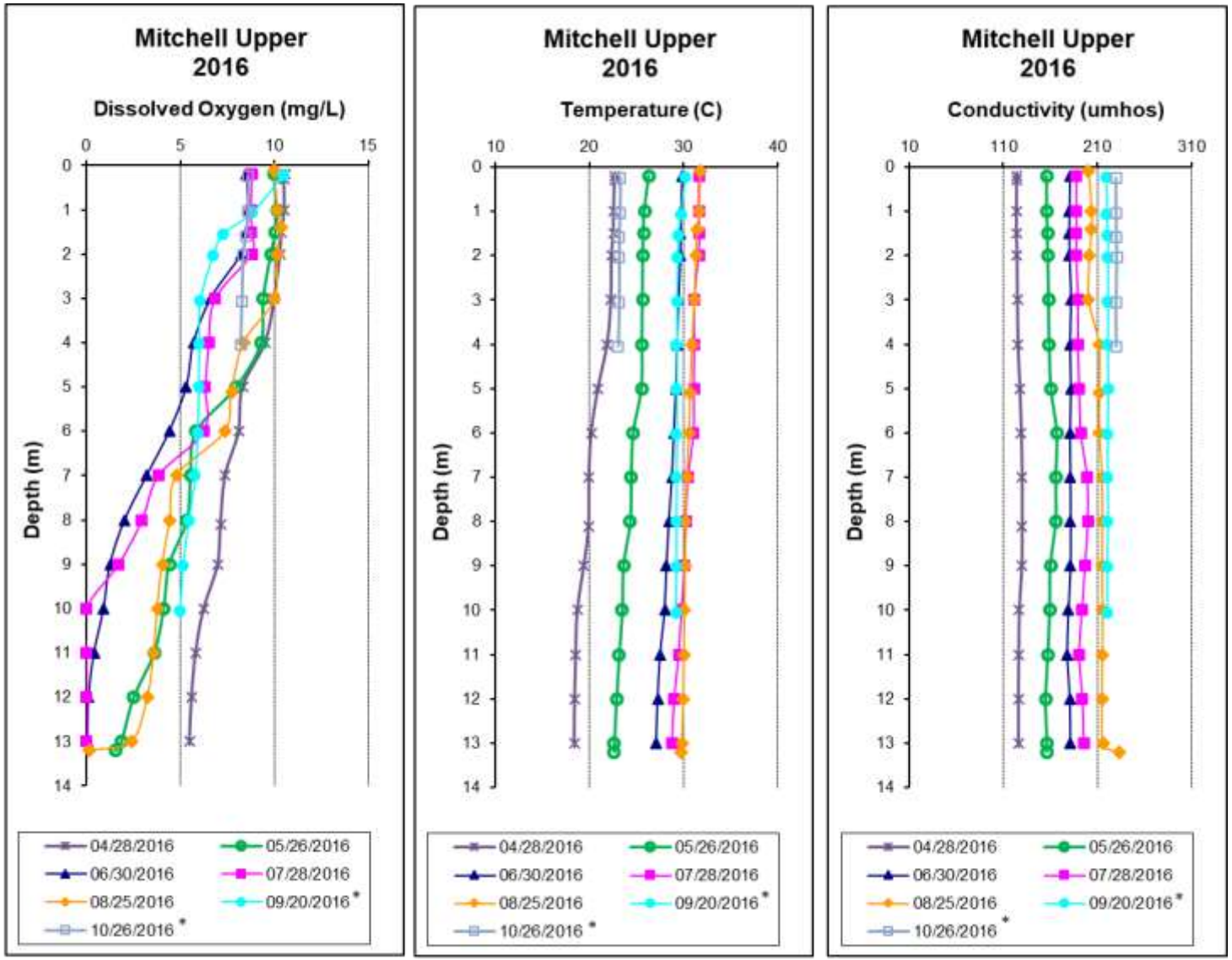


Figure 10. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Mitchell Reservoir station, April-October 2016.



* Datasonde malfunction resulted in incomplete profiles.

Figure 11. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the upper Mitchell Reservoir station, April-October 2016.



* Datasonde malfunction resulted in incomplete profiles.

Figure 12. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Mitchell Reservoir station, April-October 2019.

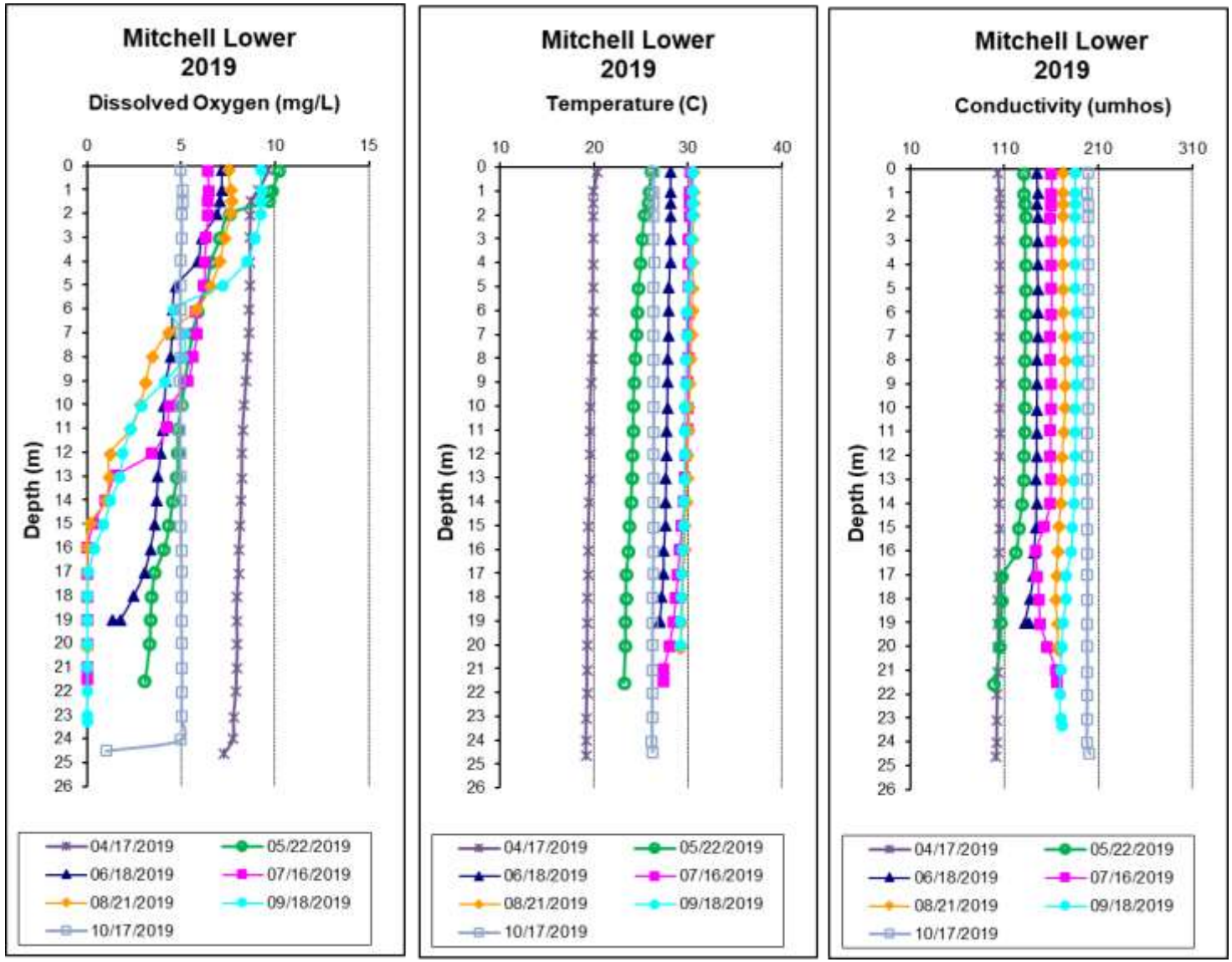


Figure 13. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the upper Mitchell Reservoir station, April-October 2019.

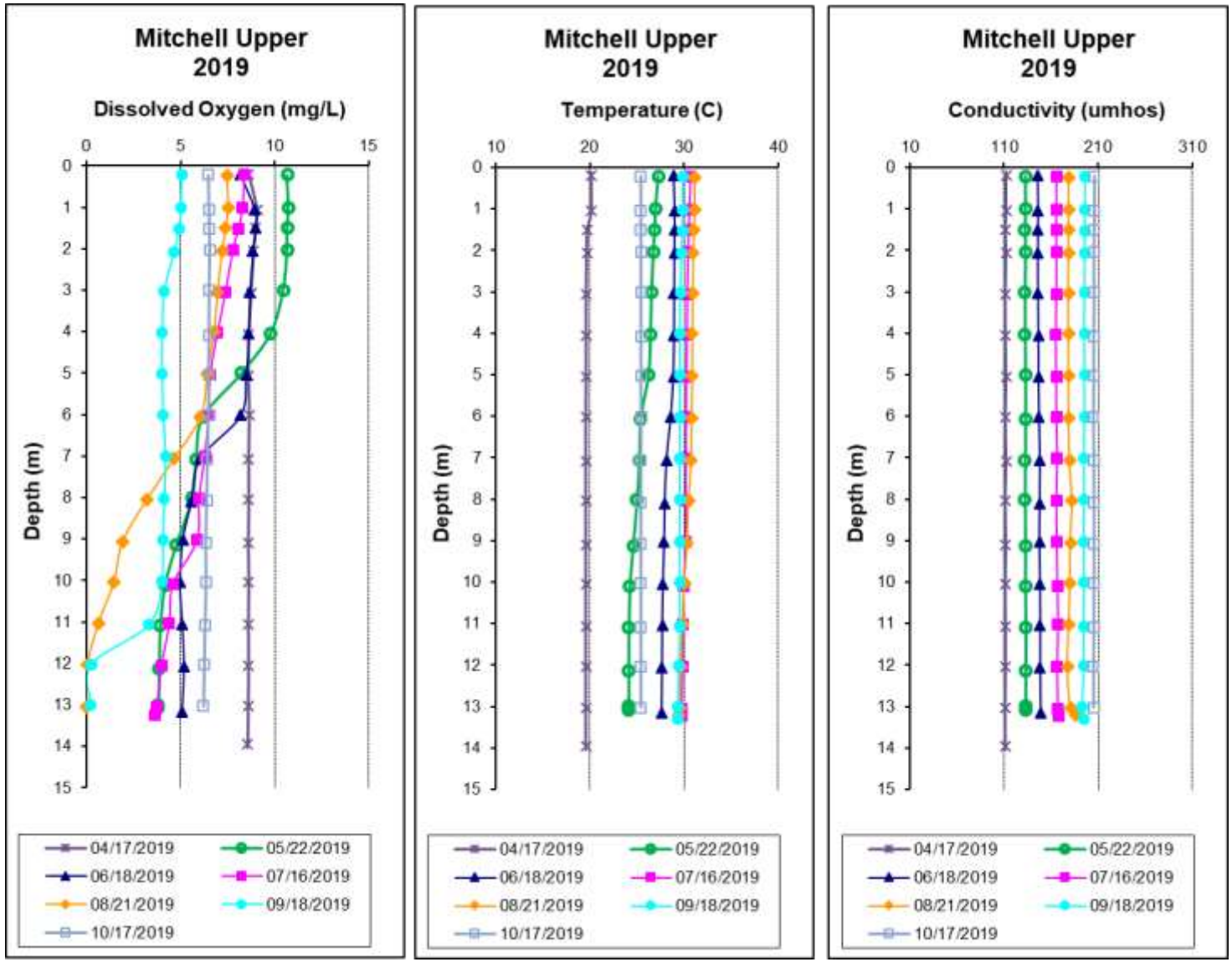
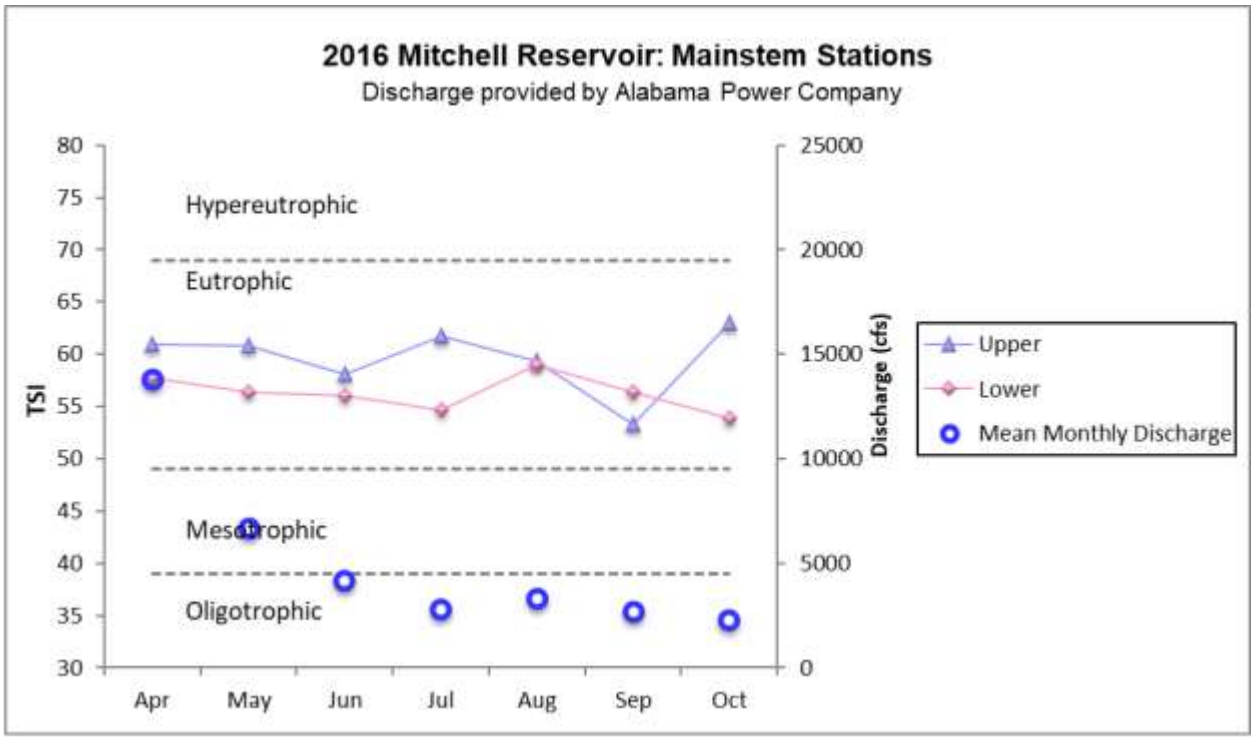


Figure 14. Monthly TSI values calculated for mainstem and tributary Mitchell Reservoir stations in 2016 using chl *a* concentrations and Carlson's Trophic State Index calculation (Carlson 1977). Monthly discharge provided by APCO.



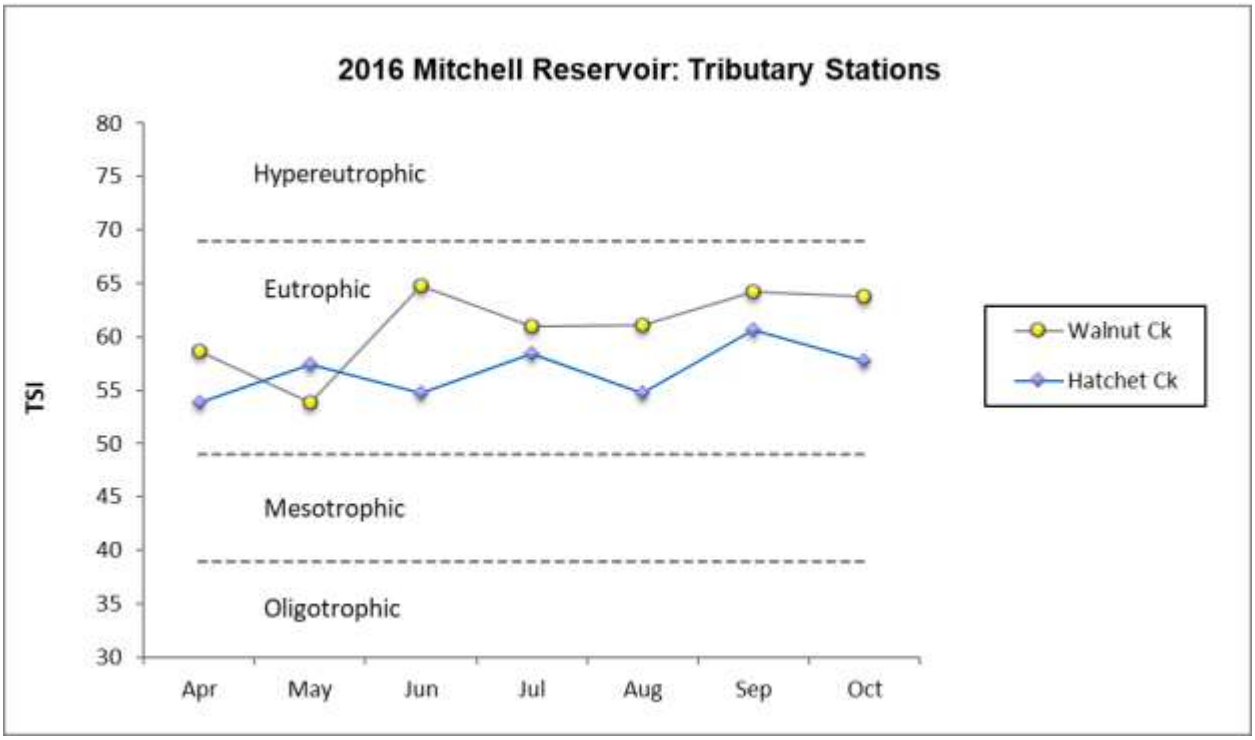
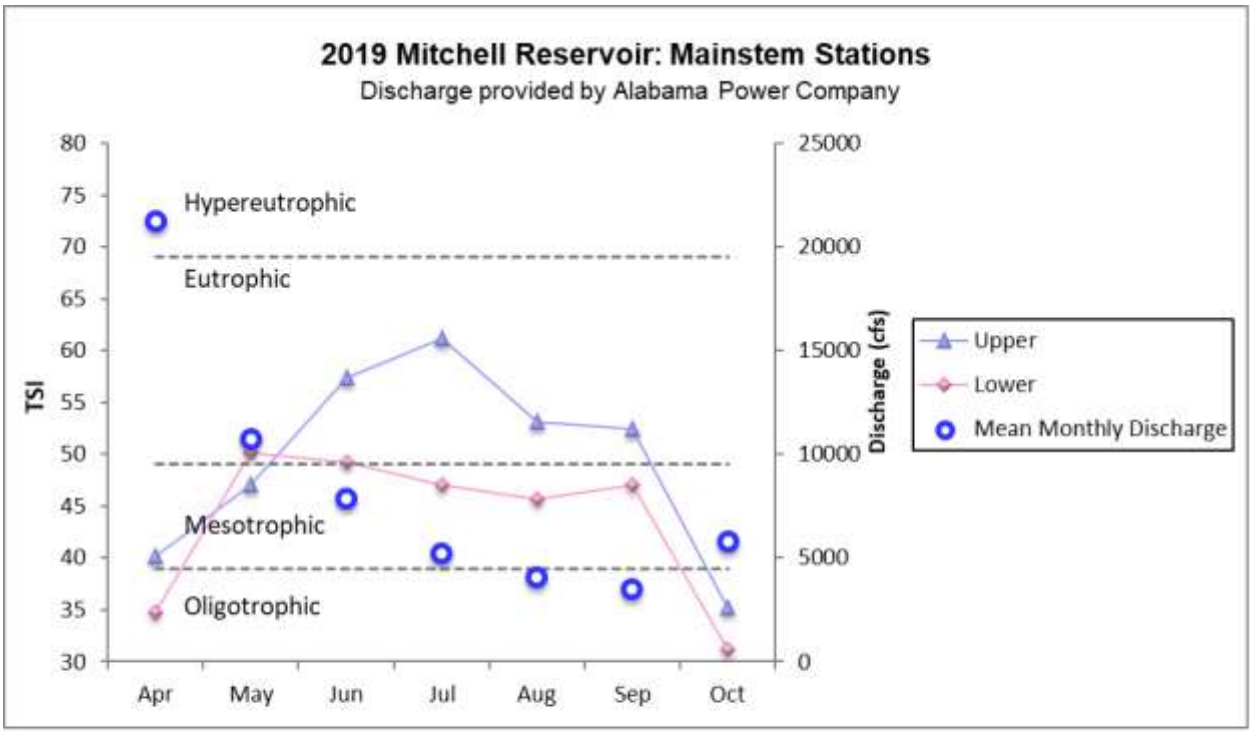
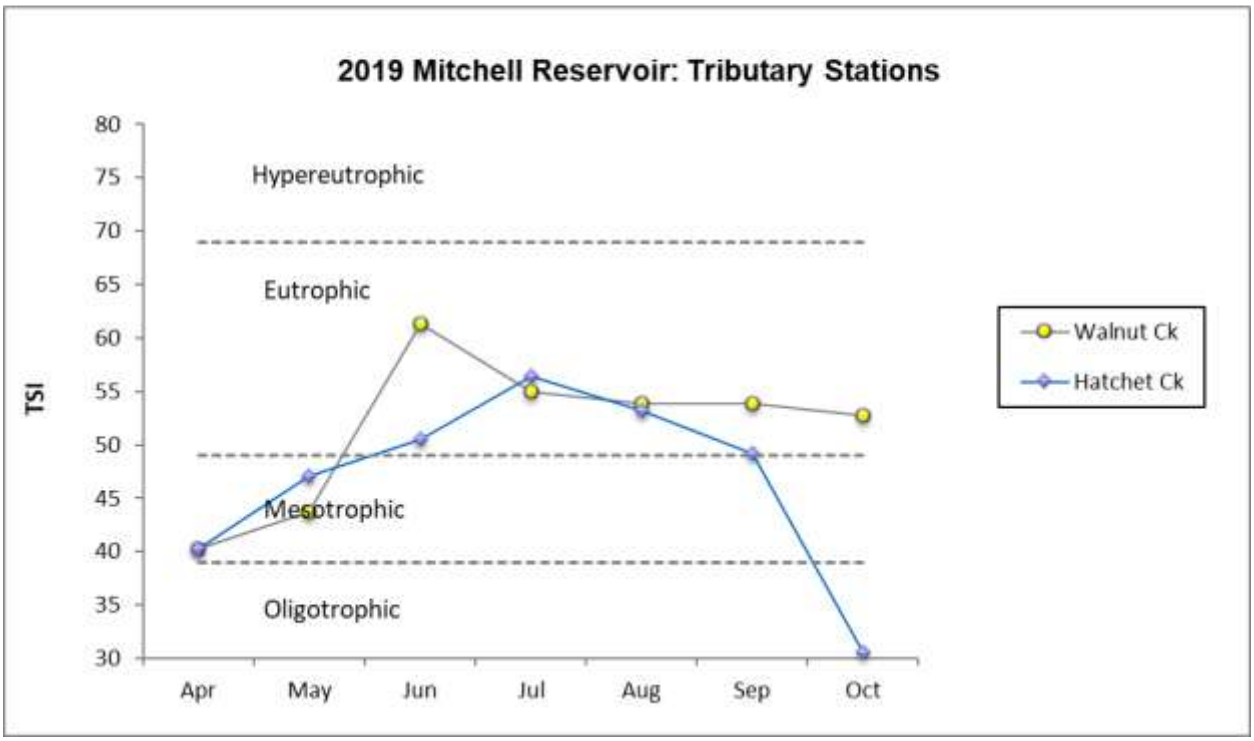


Figure 15. Monthly TSI values calculated for mainstem and tributary Mitchell Reservoir stations in 2019 using chl *a* concentrations and Carlson's Trophic State Index calculation (Carlson 1977). Monthly discharge provided by APCO.





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APPENDIX

Appendix Table 1. Summary of Mitchell 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
MITC-1	**Physical**							
	Turbidity (NTU)	7		1.9	4.4	2.6	2.9	1.0
	Total Dissolved Solids (mg/L)	7		77.0	113.0	105.0	98.3	14.4
	Total Suspended Solids (mg/L)	7	<	1.0	9.0	2.0	2.7	2.9
	Hardness (mg/L)	4		69.0	83.7	78.3	77.3	6.3
	Alkalinity (mg/L)	7		55.3	88.6	80.9	76.2	12.2
	Photic Zone (m)	7		3.18	6.82	5.59	5.40	1.18
	Secchi (m)	7		1.00	2.92	1.31	1.61	0.64
	Bottom Depth (m)	7		19.6	33.0	24.6	26.0	4.6
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.030	0.004	0.010	0.007
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.117	0.002	0.022	0.043
	Total Kjeldahl Nitrogen (mg/L)	7		0.210	0.771	0.496	0.456	0.199
	Total Nitrogen (mg/L)[J]	7	<	0.633	2.664	0.497	0.479	0.227
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.004	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.017	0.025	0.021	0.021	0.002
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.6	9.3	6.6	6.5	2.2
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	18.20	13.90	13.97	2.52
	E. coli (MPN/DL)[J]	4	<	1	1	1	1	0
MITC-2	**Physical**							
	Turbidity (NTU)	7		2.0	3.7	3.1	3.0	0.6
	Total Dissolved Solids (mg/L)	7		72.0	126.0	108.0	102.6	22.0
	Total Suspended Solids (mg/L)[J]	7	<	1.0	6.0	3.0	3.0	2.1
	Hardness (mg/L)	4		75.5	87.9	79.2	80.4	5.9
	Alkalinity (mg/L)[J]	7		55.5	95.2	82.5	79.9	13.7
	Photic Zone (m)	7		3.83	5.50	4.80	4.70	0.62
	Secchi (m)	7		0.83	2.23	1.35	1.35	0.47
	Bottom Depth (m)	7		12.7	15.5	13.2	13.4	0.9
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.047	0.004	0.013	0.016
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.025	0.002	0.006	0.009
	Total Kjeldahl Nitrogen (mg/L)	7		0.189	0.816	0.519	0.490	0.248
	Total Nitrogen (mg/L)[J]	7	<	0.573	2.523	0.530	0.496	0.253
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.003	0.003	0.002	0.001
	Total Phosphorus (mg/L)	7		0.019	0.038	0.026	0.027	0.006
	CBOD-5 (mg/L)	7	<	2.0	2.7	1.0	1.2	0.6
	Chlorides (mg/L)	7		3.6	10.2	6.9	6.9	2.5
	Biological							
	Chlorophyll a (mg/m³)	7		10.10	27.20	21.90	20.09	5.58
	E. coli (MPN/DL)[J]	4	<	1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Avg	SD
MITC-3	**Physical**							
	Turbidity (NTU)	7		2.7	4.4	3.3	3.3	0.6
	Total Dissolved Solids (mg/L)	7		65.0	130.0	93.0	100.6	22.5
	Total Suspended Solids (mg/L)	7	<	1.0	9.0	4.0	3.6	2.9
	Hardness (mg/L)	4		68.4	85.8	75.5	76.3	8.9
	Alkalinity (mg/L)	7		43.2	93.8	74.7	74.8	17.0
	Photic Zone (m)	7		4.05	5.20	4.57	4.58	0.43
	Secchi (m)	7		0.91	1.92	1.49	1.46	0.32
	Bottom Depth (m)	7		9.9	12.8	11.3	11.3	1.0
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.052	0.004	0.012	0.018
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.051	0.003	0.015	0.020
	Total Kjeldahl Nitrogen (mg/L)	7		0.159	0.734	0.503	0.490	0.193
	Total Nitrogen (mg/L)[J]	7	<	0.630	2.205	0.512	0.505	0.181
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.022	0.035	0.027	0.028	0.005
	CBOD-5 (mg/L)	7	<	2.0	2.5	2.0	1.7	0.6
	Chlorides (mg/L)	7		3.6	10.0	6.3	6.8	2.5
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	32.60	22.40	23.69	7.92
	E. coli (MPN/DL)[J]	4	<	1	2	1	1	1
MITC-4	**Physical**							
	Turbidity (NTU)	7		2.4	6.1	2.8	3.5	1.4
	Total Dissolved Solids (mg/L)	7		51.0	124.0	92.0	88.9	24.2
	Total Suspended Solids (mg/L)	7		1.0	10.0	2.0	2.9	3.2
	Hardness (mg/L)	4		52.5	78.3	67.8	66.6	10.6
	Alkalinity (mg/L)	7		25.5	82.9	70.5	63.9	19.9
	Photic Zone (m)	7		3.91	6.39	5.68	5.40	0.92
	Secchi (m)	7		1.07	2.76	1.64	1.77	0.62
	Bottom Depth (m)	7		14.5	18.5	16.6	16.6	1.2
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.030	0.004	0.005	0.004
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.014	0.002	0.003	0.005
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.050	0.632	0.300	0.336	0.193
	Total Nitrogen (mg/L)[J]	7	<	0.081	1.899	0.302	0.339	0.194
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.005	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.014	0.021	0.019	0.018	0.002
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)[J]	7		2.1	8.2	5.0	5.4	2.2
	Biological							
	Chlorophyll a (mg/m³)	7		10.70	21.40	15.50	14.87	3.80
	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 Mitchell 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
MITC-1	**Physical**							
	Turbidity (NTU)	7		2.1	7.5	2.8	3.5	1.9
	Total Dissolved Solids (mg/L)	7		38.0	102.0	69.0	73.9	25.3
	Total Suspended Solids (mg/L)[J]	7	<	1.0	6.0	3.0	2.8	1.8
	Hardness (mg/L)	4		57.6	71.6	64.6	64.6	6.0
	Alkalinity (mg/L)	7		40.6	75.1	63.3	61.5	12.4
	Photic Zone (m)	7		3.49	9.20	5.26	6.08	2.19
	Secchi (m)	7		1.06	2.88	2.10	2.01	0.55
	Bottom Depth (m)	7		19.0	24.6	21.6	22.1	2.1
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.045	0.008	0.013	0.016
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.174	0.058	0.063	0.065
	Total Kjeldahl Nitrogen (mg/L)[J]	7	<	0.200	1.000	0.416	0.447	0.297
	Total Nitrogen (mg/L)[J]	7	<	0.333	3.522	0.418	0.510	0.355
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.009	0.002	0.003	0.002
	Total Phosphorus (mg/L)	7		0.015	0.024	0.018	0.019	0.003
	CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.2	7.8	5.1	5.4	1.6
	Biological							
	Chlorophyll a (mg/m³)	7		1.07	7.34	5.34	4.57	2.41
	E. coli (MPN/DL)[J]	4	<	1	3	1	1	1
MITC-2	**Physical**							
	Turbidity (NTU)	7		2.6	9.4	3.0	4.0	2.4
	Total Dissolved Solids (mg/L)[J]	7		45.0	115.0	78.0	78.0	23.2
	Total Suspended Solids (mg/L)[J]	7		1.0	9.0	4.0	4.1	2.7
	Hardness (mg/L)	4		58.1	73.8	67.4	66.6	6.9
	Alkalinity (mg/L)	7		44.6	80.3	66.7	64.7	13.2
	Photic Zone (m)	7		3.38	7.84	4.62	4.89	1.50
	Secchi (m)	7		0.91	2.05	1.63	1.59	0.38
	Bottom Depth (m)	7		13.0	14.0	13.2	13.3	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	0.199	0.038	0.060	0.072
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.200	0.418	0.242	0.250	0.123
	Total Nitrogen (mg/L)[J]	7	<	0.304	1.851	0.295	0.310	0.179
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.012	0.002	0.005	0.004
	Total Phosphorus (mg/L)	7		0.020	0.033	0.027	0.025	0.005
	CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.3	8.3	5.3	5.6	1.9
	Biological							
	Chlorophyll a (mg/m³)	7		1.60	22.70	9.34	9.56	7.47
	E. coli (MPN/DL)[J]	4	<	1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Avg	SD
MITC-3	**Physical**							
	Turbidity (NTU)	7		2.0	8.0	3.1	3.7	2.0
	Total Dissolved Solids (mg/L)	7		59.0	120.0	84.0	86.4	23.3
	Total Suspended Solids (mg/L)	7	<	1.0	6.0	3.0	3.4	1.8
	Hardness (mg/L)	4		58.3	71.3	64.2	64.5	5.8
	Alkalinity (mg/L)	7		40.8	78.8	64.1	62.5	13.2
	Photic Zone (m)	7		3.23	9.08	4.55	5.20	1.88
	Secchi (m)	7		1.15	2.27	1.71	1.79	0.38
	Bottom Depth (m)	7		8.3	11.8	11.0	10.8	1.2
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.004	0.041	0.008	0.015	0.015
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.183	0.016	0.048	0.068
	Total Kjeldahl Nitrogen (mg/L)[J]	7	<	0.129	0.455	0.279	0.244	0.139
	Total Nitrogen (mg/L)[J]	7	<	0.321	1.914	0.280	0.292	0.182
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.010	0.002	0.004	0.003
	Total Phosphorus (mg/L)	7		0.017	0.031	0.022	0.023	0.005
	CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		3.2	8.2	5.5	5.6	1.8
	Biological							
	Chlorophyll a (mg/m³)	7		2.67	22.90	10.70	10.34	6.62
	E. coli (MPN/DL)[J]	4	<	1	2	1	1	1
MITC-4	**Physical**							
	Turbidity (NTU)	7		1.9	6.6	2.9	3.5	1.6
	Total Dissolved Solids (mg/L)	7		48.0	107.0	78.0	75.7	20.2
	Total Suspended Solids (mg/L)	7	<	1.0	3.0	2.0	1.6	0.8
	Hardness (mg/L)	4		52.6	66.8	61.4	60.6	7.3
	Alkalinity (mg/L)	7		22.0	72.6	58.8	55.6	17.6
	Photic Zone (m)	7		4.20	8.44	5.38	5.67	1.44
	Secchi (m)	7		1.30	2.56	1.73	1.83	0.43
	Bottom Depth (m)	7		12.4	16.6	16.3	15.8	1.5
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.004	0.034	0.008	0.011	0.012
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.051	0.015	0.021	0.022
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.172	1.270	0.172	0.356	0.424
	Total Nitrogen (mg/L)[J]	7	<	0.304	3.960	0.223	0.377	0.436
	Dis Reactive Phosphorus (mg/L)	7	<	0.005	0.005	0.002	0.002	0.000
	Total Phosphorus (mg/L)	7		0.012	0.021	0.015	0.016	0.003
	CBOD-5 (mg/L)[J]	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		2.2	7.1	4.7	4.9	1.8
	Biological							
	Chlorophyll a (mg/m³)	7	<	1.00	14.00	6.68	6.69	4.50
	E. coli (MPN/DL)[J]	4	<	1	2	1	1	1

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