2016 Gainesville Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Rivers & Reservoirs Unit
2016

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Tombigbee River Basin

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LIST OF ACRONYMS

A&I	Agriculture and Industry water supply use classification
ADEM	Alabama Department of Environmental Management
AGPT	Algal Growth Potential Test
APCO	Alabama Power Company
CHL *a*	Chlorophyll *a*
DO	Dissolved Oxygen
EMT	Escatawpa Mobile Tombigbee
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

Gainesville Reservoir was established in 1978 by the U.S. Army Corps of Engineers with the completion of Howell Heflin Lock and Dam. The Reservoir is a 6,400 acre run-of-the-river reservoir located just east of Gainesville, Alabama, on the Tennessee-Tombigbee Waterway.

The Alabama Department of Environmental Management (ADEM) monitored Gainesville Reservoir as part of the 2016 assessment of the Escatawpa, Mobile, and Tombigbee River (EMT) Basins 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 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).

In 2005, the ADEM implemented a specific water quality criterion for nutrient management at one location on Gainesville Reservoir. This criterion represents the maximum growing season mean (April-October) chlorophyll *a* (chl *a*) concentration allowable while still fully supporting the reservoir's Swimming and Fish & Wildlife (S/F&W) use classifications.

The purpose of this report is to summarize data collected at six stations in Gainesville Reservoir during the 2016 growing season 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 criterion.

METHODS

Sampling stations were selected using historical data and previous assessments (Figure 1). Specific location information can be found in Table 1. Gainesville Reservoir was sampled in the dam forebay, mid reservoir, and upper reservoir. Tributary embayment stations monitored include: Bogue Chitto and Lubbub Creeks and the Sipsey River.

Water quality assessments were 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 2017), Surface Water Quality Assurance Project Plan (ADEM 2017) and Quality Management Plan (ADEM 2018).

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

Figure 1. Gainesville Reservoir with 2016 sampling locations.

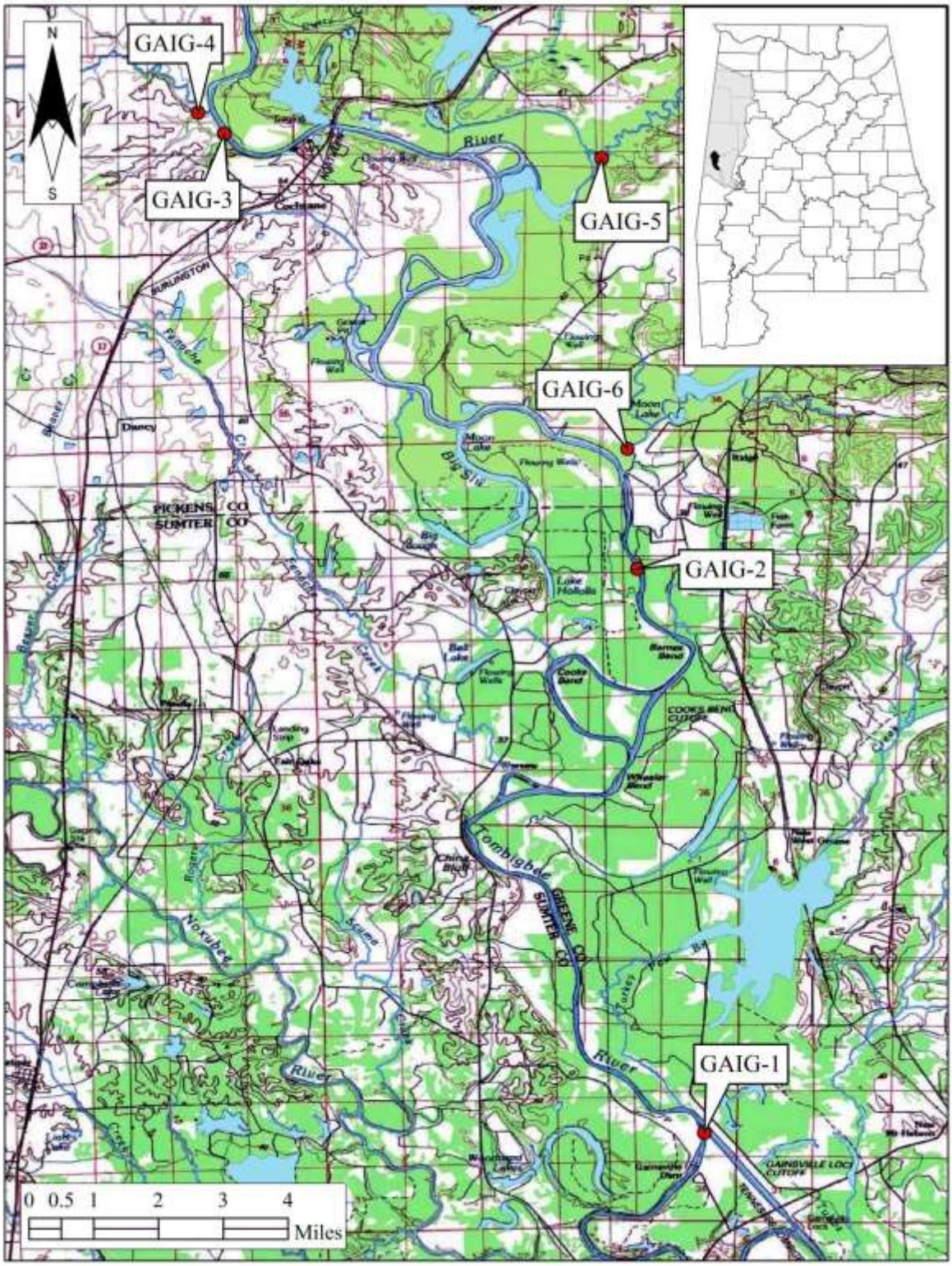


Table 1. Descriptions of the 2016 monitoring stations in Gainesville Reservoir.

HUC	County	Station Number	Report Designation	Waterbody	Station Description	Chl *a* Criteria	Latitude	Longitude
031601060609	Greene	GAIG-1*	Lower	Gainesville Res	Deepest point, main river channel, dam forebay.	14µg/L	32.8559	-88.1545
031601060603	Sumter	GAIG-2	Mid	Gainesville Res	Deepest point, Tombigbee River, approximately 1.5 miles downstream of Sipsey River confluence.		32.9818	-88.1694
031601060505	Pickens	GAIG-3	Upper	Gainesville Res	Deepest point, main river channel, approximately 0.5 miles downstream of Bogue Chitto Creek confluence.		33.0789	-88.2618
031601060504	Pickens	GAIG-4	Bogue Chitto Ck	Bogue Chitto Ck	Deepest point, main creek channel, Bogue Chitto Creek embayment, approximately 0.5 miles upstream of confluence with Tombigbee River.		33.0837	-88.2676
031601060507	Pickens	GAIG-5	Lubbub Ck	Lubbub Ck	Deepest point, main creek channel, Lubbub Creek embayment, approximately 0.5 miles upstream of confluence with Tombigbee River.		33.0734	-88.1774
031601070306	Greene	GAIG-6	Sipsey R	Sipsey R	Deepest point, main river channel, Sipsey River embayment, approximately 0.5 miles upstream of confluence with Tombigbee River.		33.0086	-88.1716

*Growing season mean chl a criterion implemented at this station in 2005.

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, dissolved oxygen (DO), and TSI are also provided (Figures 6-9 and 14). 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 11-13. Summary statistics of all data collected during 2016 are presented in Appendix Table 1. The table contains the minimum, maximum, median, mean, and standard deviation of each parameter analyzed.

Stations with the highest concentrations of nutrients, chl *a*, and TSS are noted in the paragraphs to follow. Though stations with lowest concentrations may not always be mentioned, review of the graphs included in this report 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 Gainesville Reservoir mainstem stations was in the upper station, while the lowest value was in the mid station (Figure 2). The highest value calculated among tributary stations was in Bogue Chitto Creek. Mean growing season TN values at all stations decreased from the previous growing season that they were sampled, except Lubbub Creek, which increased in 2016. The highest monthly TN concentrations measured during the sampling season were in April at the lower mainstem station, in August at the mid mainstem station, and in May at the upper mainstem station (Figure 6). Historic high monthly TN concentrations occurred at the upper station in July.

In 2016, mean growing season TP values among Gainesville Reservoir mainstem stations were lower than in previous sampling years (Figure 3). The highest mean growing season TP value calculated among tributary stations was in Lubbub Creek. All mean growing season TP values among Gainesville Reservoir mainstem and tributary stations were the lowest they have been since monitoring began. The highest monthly TP concentrations in all mainstem stations were measured during the first sampling event in April (Figure 7). Monthly TP concentrations were below historic means in all Gainesville Reservoir mainstem stations April-October, 2016.

The specific water quality criterion for nutrient management was established for the lower station in Gainesville Reservoir. The growing season mean chl *a* value calculated in the lower station in Gainesville Reservoir during 2016 was in compliance with the criterion limit of 14µg/L (Figure 4) (ADEM Admin. Code R. 335-6-10-.11). In 2016, the highest mean growing season chl *a* value calculated among Gainesville Reservoir mainstem stations was in the upper station. The highest value calculated among tributary stations was in the Bogue Chitto Creek. Mean growing season chl *a* values in the mid and lower mainstem stations seem to be trending downward over time. However, mean growing season chl *a* values in the upper station increased from 2014 to 2016. The highest monthly chl *a* concentrations were measured in July in the upper station, in June and August in the mid station, and in July and September in the lower station (Figure 8). Historic, or near historic, high monthly chl *a* concentrations were measured in the upper and lower stations in October.

In 2016, the highest mean growing season TSS value calculated among Gainesville Reservoir mainstem stations was in the upper station, while the lowest value was in the mid station (Figure 5). The highest value calculated among tributary stations was in the Bogue Chitto Creek station, while the lowest value was in the Sipsey River. Overall, mean growing season TSS values among Gainesville Reservoir mainstem stations have declined in the years monitored. Monthly TSS concentrations in the mainstem stations were highest in the spring and much lower in the summer and fall months (Figure 9). Monthly TSS concentrations were at or below historic means in all Gainesville Reservoir mainstem stations for the months monitored, except for May in the lower station.

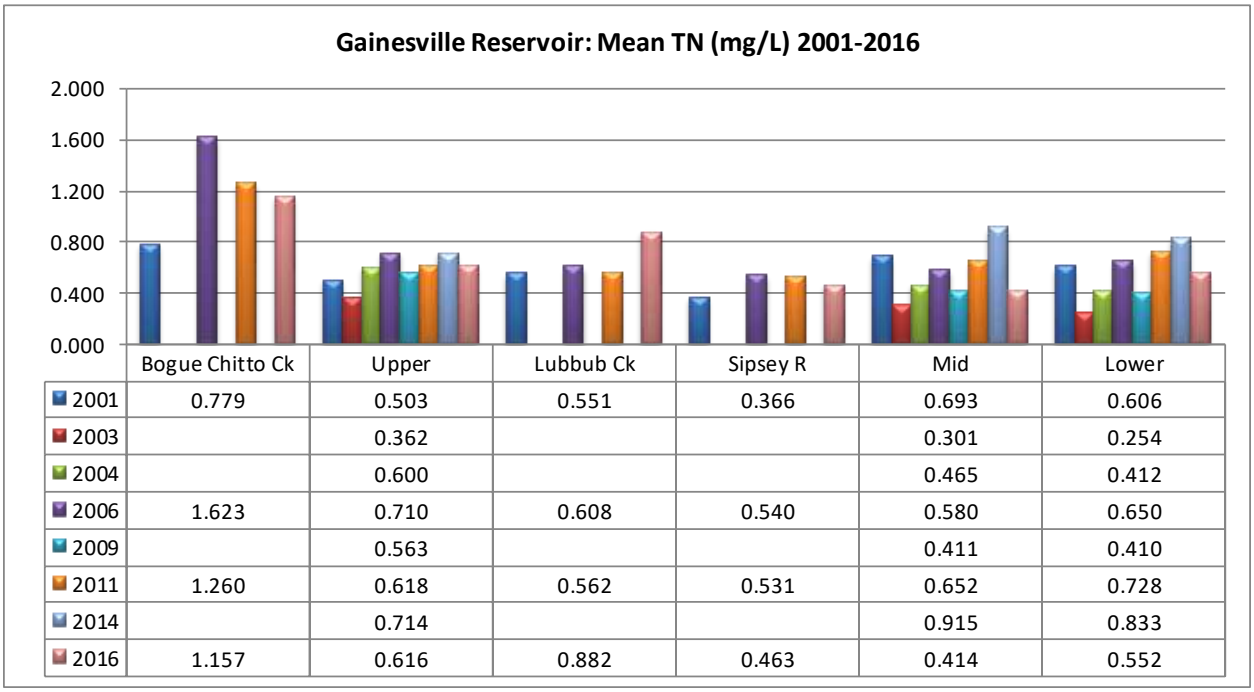
AGPT results for the lower and upper Gainesville Reservoir stations indicate they were nitrogen-limited in all years sampled (Table 2). In 2016, the MSC value calculated for the lower station was above 5.0 mg/L, the value that Raschke et al. (1996) defined as protective of reservoir and lake systems.

Dissolved oxygen concentrations were near or below the ADEM Criterion (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) in the Lubbub Ck tributary station in June and September (Figure 10). All measurements of DO concentrations in the mainstem stations and the Bogue Chitto Creek and Sipsey River tributary stations were above the ADEM criterion

for all months sampled. Based on monthly DO profiles, DO concentrations were above 5.0 mg/L in the majority of the water column in all of the mainstem stations throughout the sampling period. Highest water temperatures were reached during July (Figures 11-13).

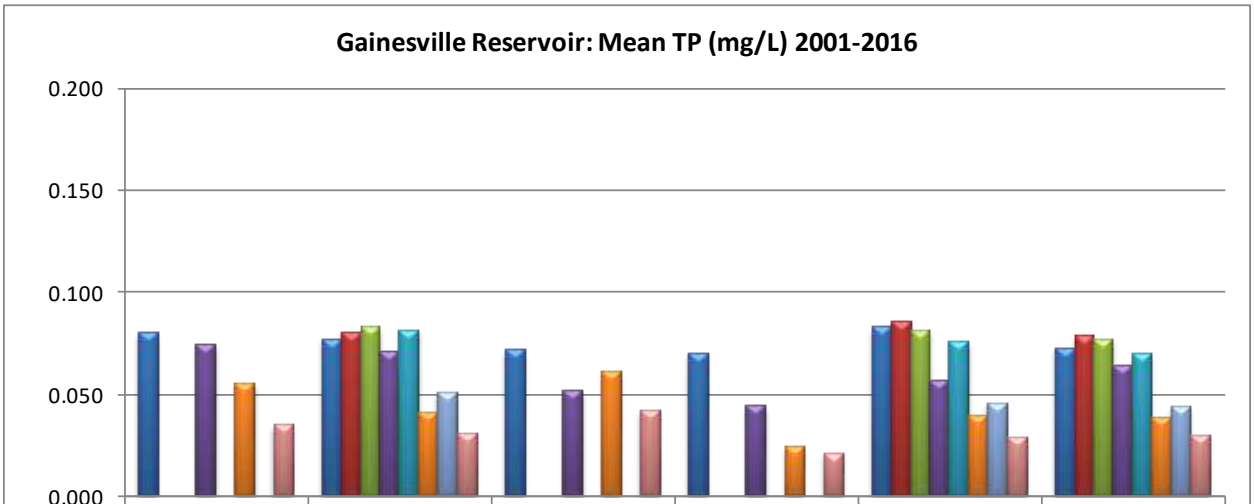
TSI values were calculated using monthly chl *a* concentrations and Carlson's Trophic State Index. TSI values in the upper mainstem station were eutrophic April-October (Figure 14). The mid and lower stations varied from mesotrophic to eutrophic during the months monitored. Among the tributaries, Bogue Chitto Creek had the highest TSI value, reaching hypereutrophic conditions in April and May, while values in the Lubbub Creek and Sipsey River stations varied from oligotrophic to eutrophic during the months monitored.

Figure 2. Mean growing season TN measured in Gainesville Reservoir, April-October, 2001-2016. Stations are illustrated from upstream to downstream as the graph is read from left to right.



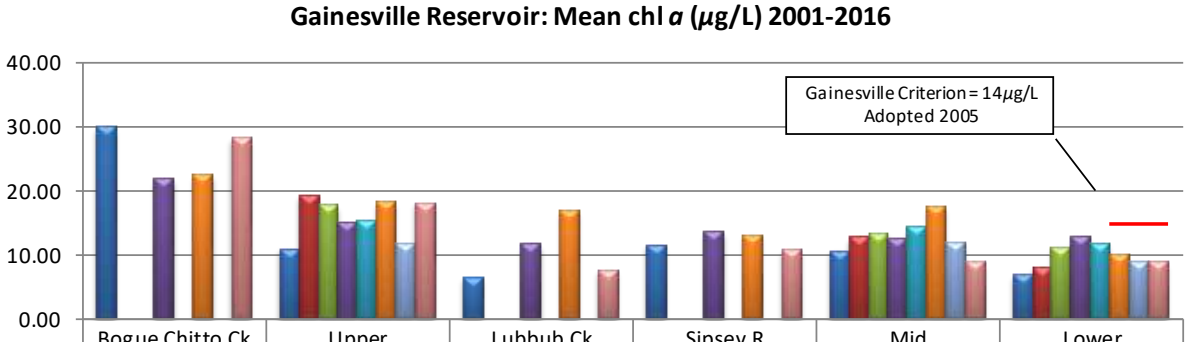
	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	0.779	0.503	0.551	0.366	0.693	0.606
2003		0.362			0.301	0.254
2004		0.600			0.465	0.412
2006	1.623	0.710	0.608	0.540	0.580	0.650
2009		0.563			0.411	0.410
2011	1.260	0.618	0.562	0.531	0.652	0.728
2014		0.714			0.915	0.833
2016	1.157	0.616	0.882	0.463	0.414	0.552

Figure 3. Mean growing season TP measured in Gainesville Reservoir, April-October, 2001-2016. Stations are illustrated from upstream to downstream as the graph is read from left to right.



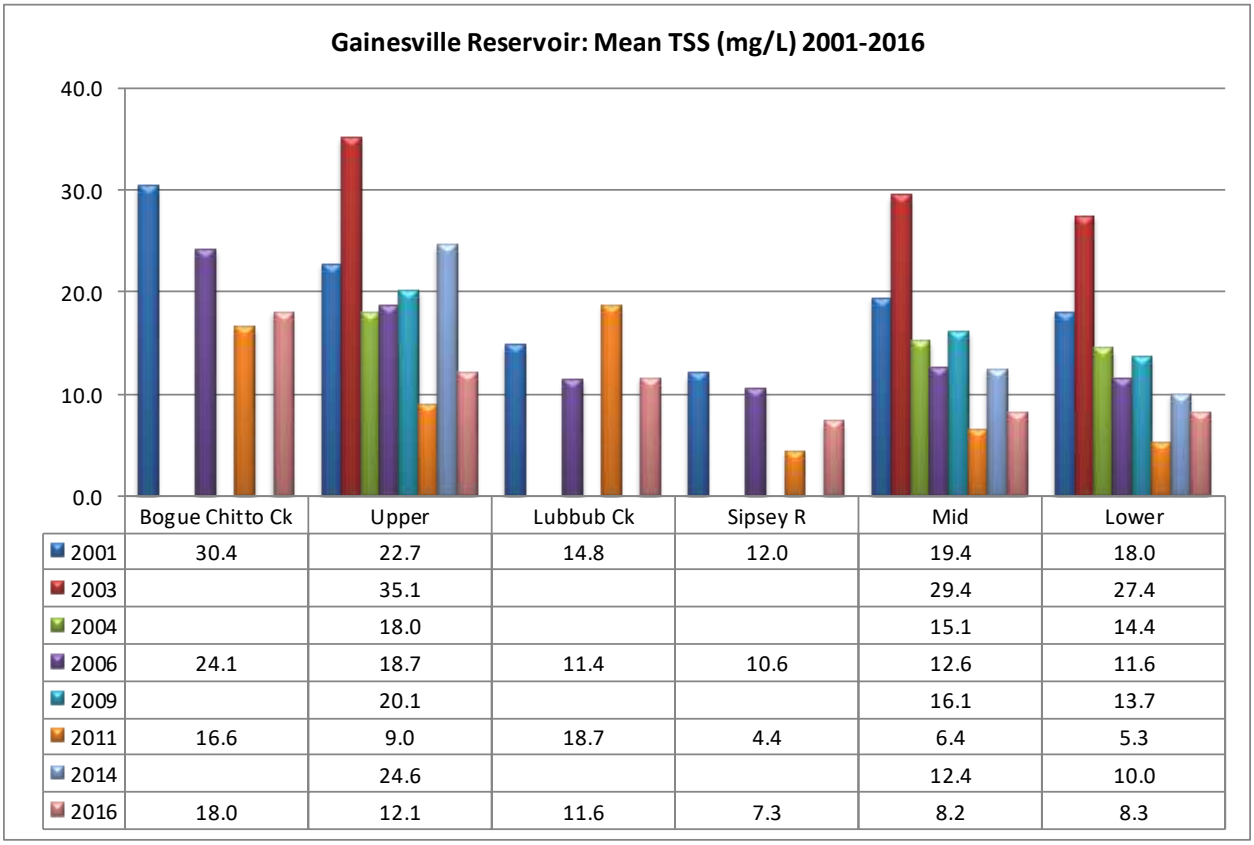
	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	0.080	0.077	0.071	0.070	0.083	0.073
2003		0.081			0.086	0.078
2004		0.083			0.082	0.077
2006	0.074	0.071	0.051	0.044	0.057	0.064
2009		0.081			0.076	0.070
2011	0.055	0.041	0.061	0.024	0.039	0.039
2014		0.051			0.046	0.044
2016	0.035	0.031	0.042	0.021	0.029	0.030

Figure 4. Mean growing season chl *a* measured in Gainesville Reservoir, April-October, 2001-2016. Stations are illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criterion applies to the growing season means of the lower station.



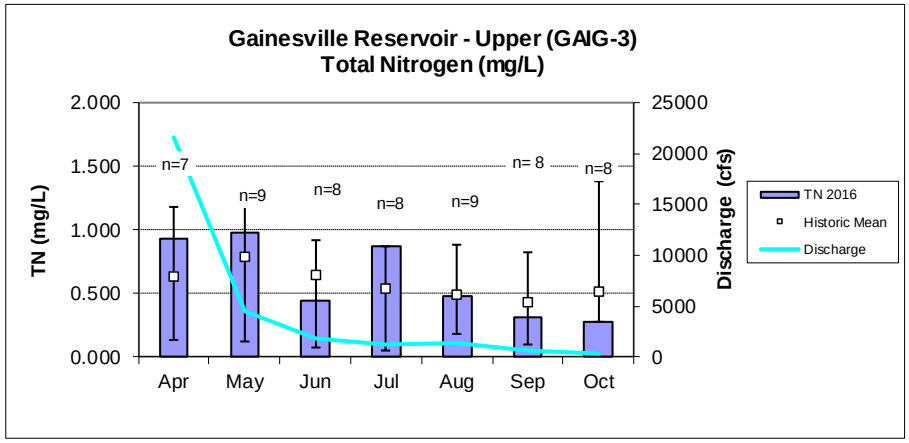
	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	29.91	10.91	6.42	11.41	10.71	6.87
2003		19.22			12.69	8.14
2004		17.65			13.38	11.21
2006	21.87	15.09	11.61	13.55	12.55	12.77
2009		15.35			14.42	11.70
2011	22.43	18.26	16.93	13.12	17.47	9.99
2014		11.60			11.84	8.92
2016	28.26	18.09	7.66	10.83	8.82	8.86

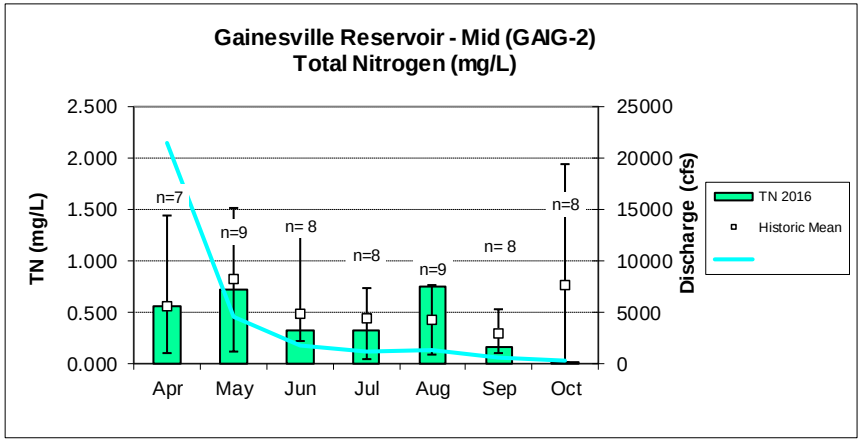
Figure 5. Mean growing season TSS measured in Gainesville Reservoir, April-October, 2001-2016. Stations are illustrated from upstream to downstream as the graph is read from left to right.



	Bogue Chitto Ck	Upper	Lubbub Ck	Sipsey R	Mid	Lower
2001	30.4	22.7	14.8	12.0	19.4	18.0
2003		35.1			29.4	27.4
2004		18.0			15.1	14.4
2006	24.1	18.7	11.4	10.6	12.6	11.6
2009		20.1			16.1	13.7
2011	16.6	9.0	18.7	4.4	6.4	5.3
2014		24.6			12.4	10.0
2016	18.0	12.1	11.6	7.3	8.2	8.3

Figure 6. Monthly TN concentrations measured in Gainesville Reservoir, April-October, 2016, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin Lock and Dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2016) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





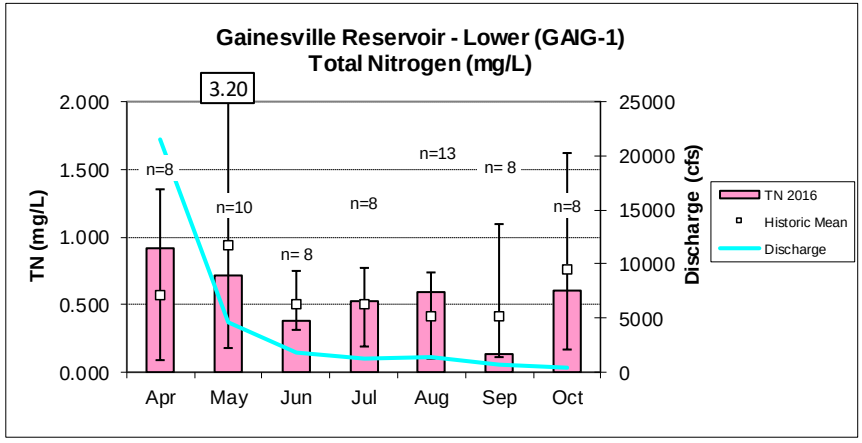
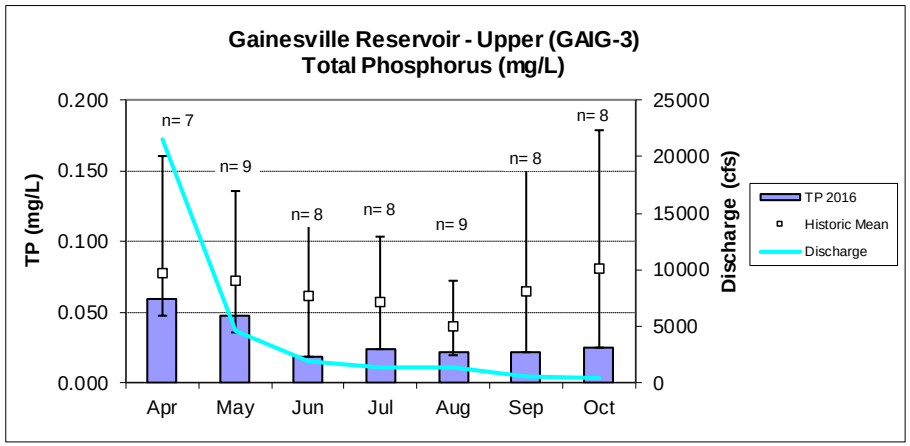
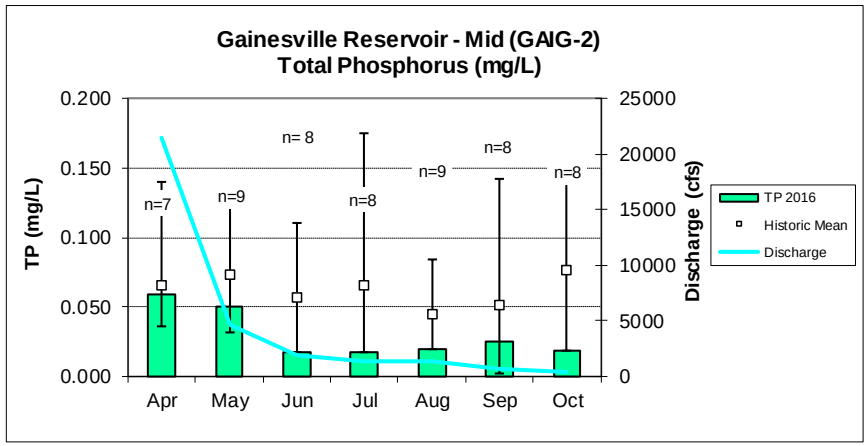


Figure 7. Monthly TP concentrations measured in Gainesville Reservoir, April-October, 2016, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin Lock and Dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2016) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





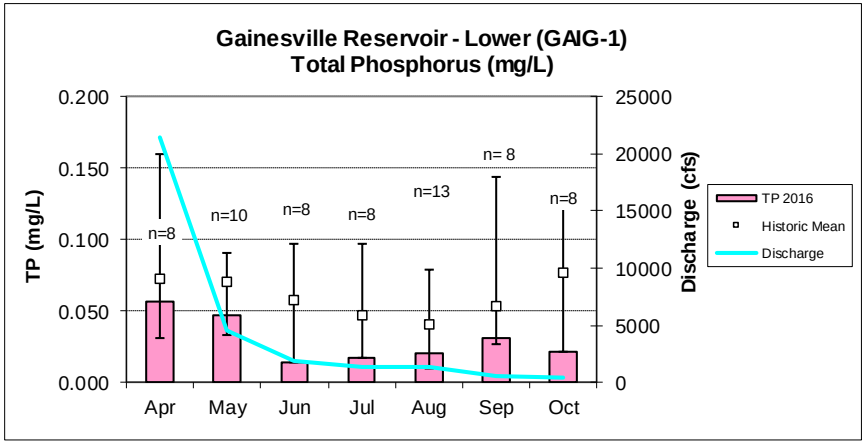


Figure 8. Monthly chl *a* concentrations measured in Gainesville Reservoir, April-October, 2016, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin Lock and Dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2016) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

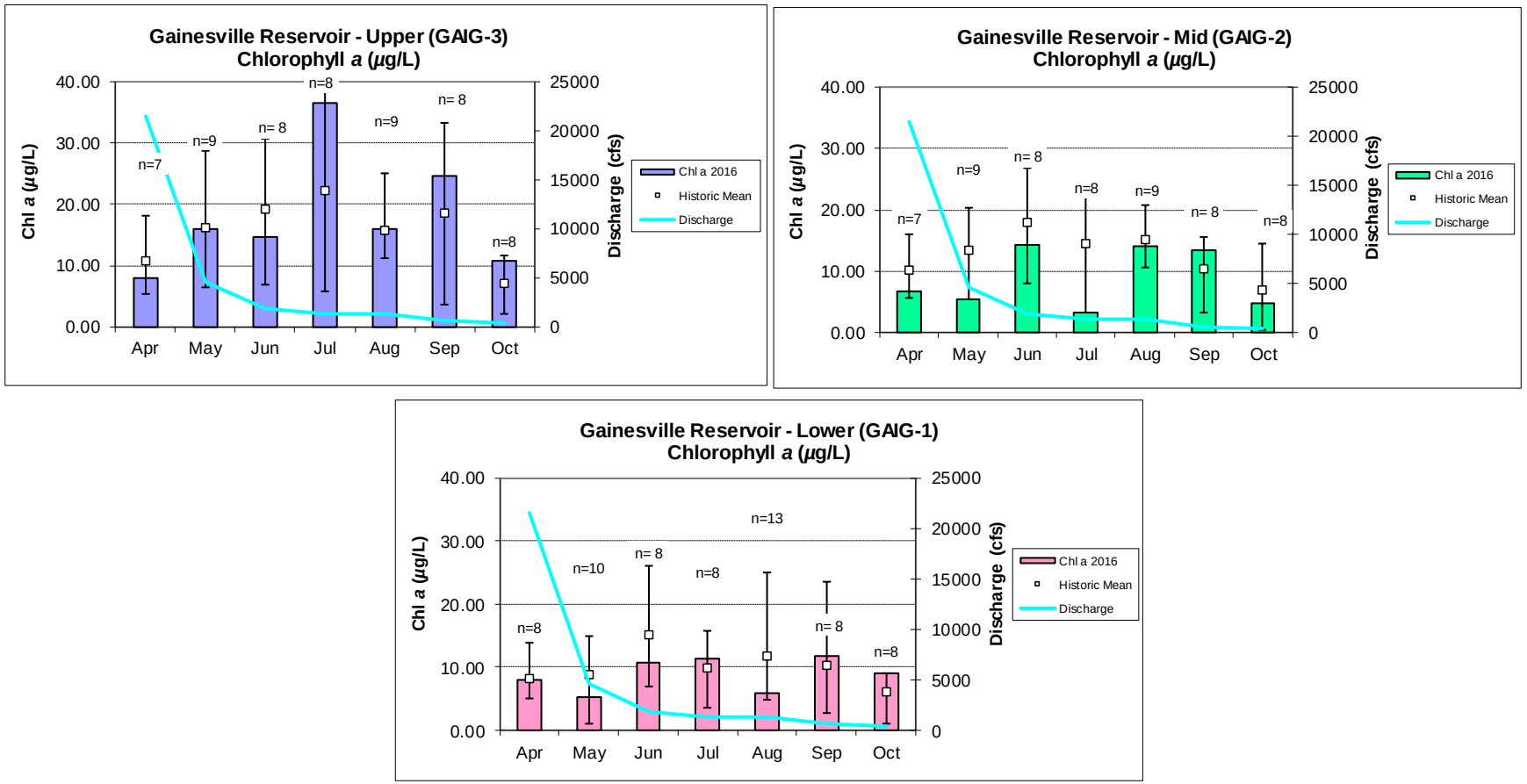


Figure 9. Monthly TSS concentrations measured in Gainesville Reservoir, April-October, 2016, vs. average monthly discharge. Discharge measured at USGS gage 02447025, Tombigbee River at Heflin Lock and Dam near Gainesville, AL. Each bar graph depicts monthly changes in each station. The historic mean (1992-2016) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

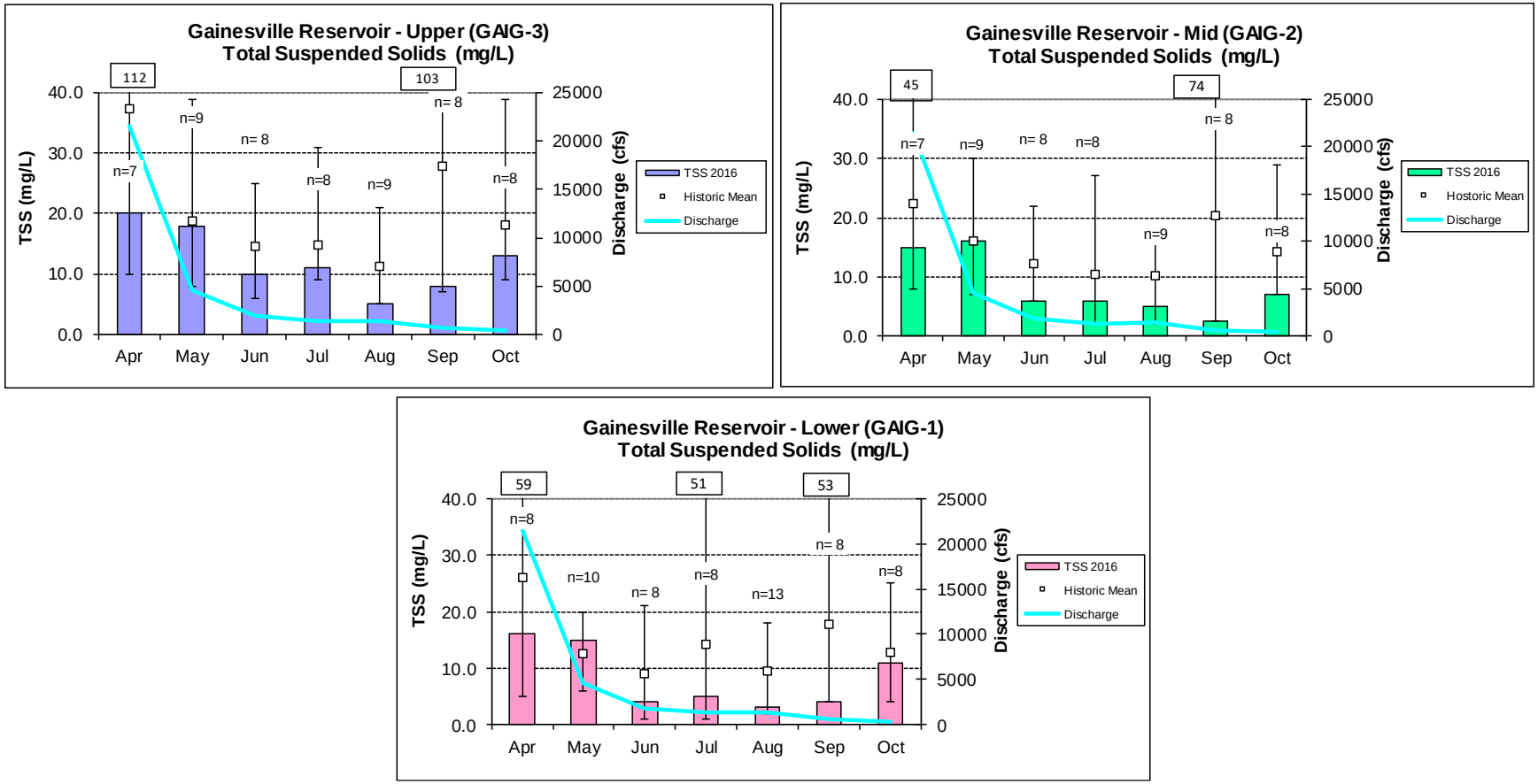
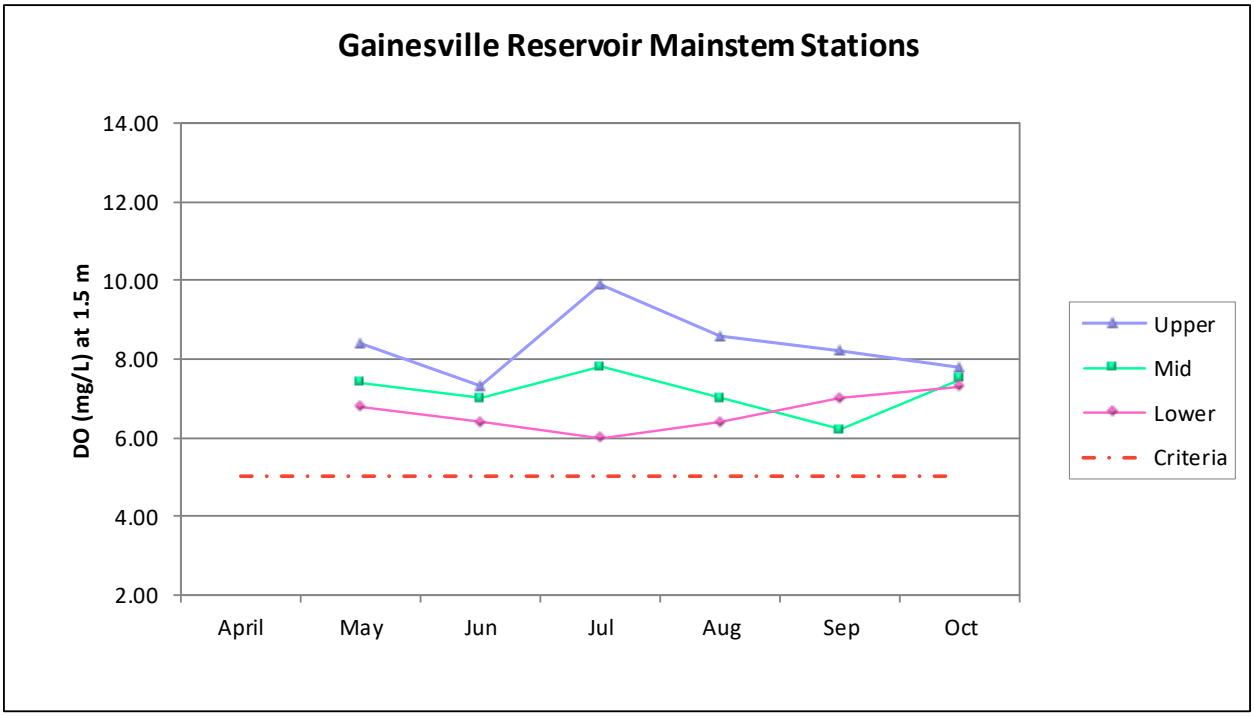


Table 2. Algal growth potential test results, Gainesville Reservoir, 2001-2016, (expressed as mean Maximum Standing Crop (MSC) dry weights of Selenastrum capricornutum in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers (Raschke and Schultz 1987).

Station	Upper		Mid		Lower	
	MSC	Limiting Nutrient	MSC	Limiting Nutrient	MSC	Limiting Nutrient
2001	2.30	Nitrogen	0.72	Nitrogen	3.56	Nitrogen
2006	1.55	Nitrogen	1.41	Nitrogen	1.63	Nitrogen
2011	1.14	Nitrogen	1.41	Nitrogen	2.39	Nitrogen
2016	3.33	Nitrogen	*	*	5.43	Nitrogen

*AGPT not collected at this station

Figure 10. Monthly DO concentrations at 1.5 m (5 ft) for Gainesville Reservoir stations collected April-October, 2016. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2019).



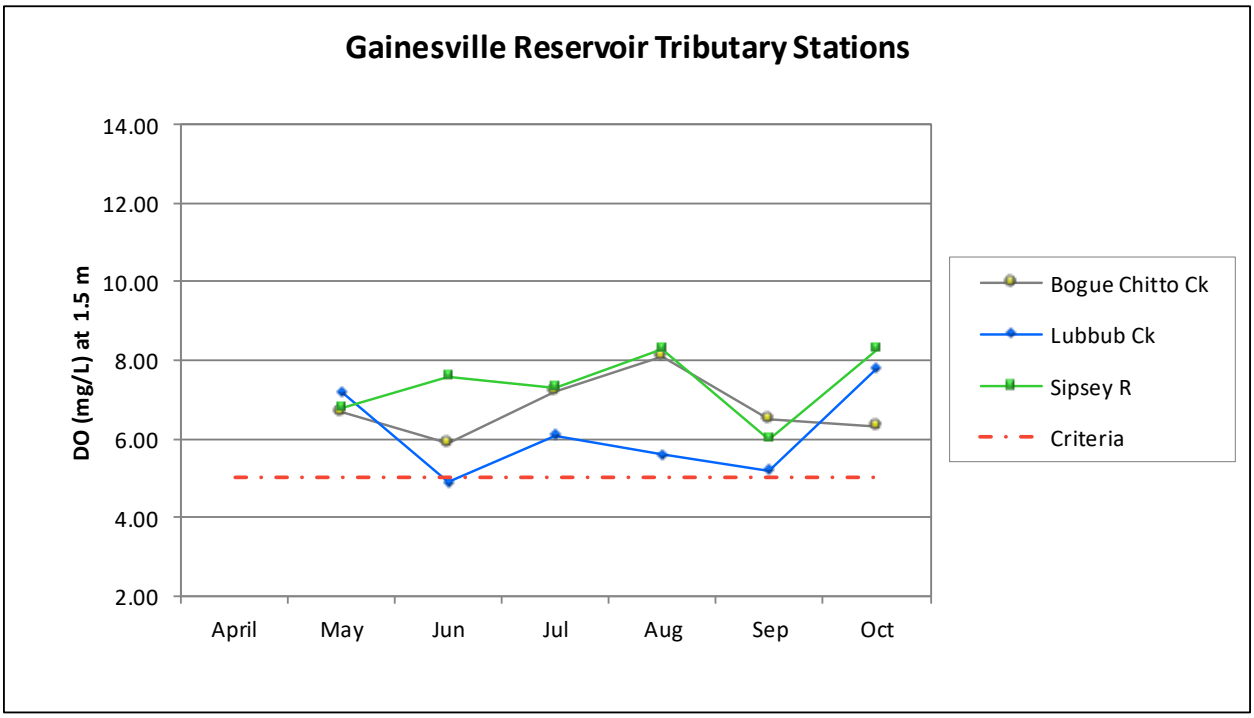


Figure 11. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Gainesville Reservoir station, April-October, 2016.

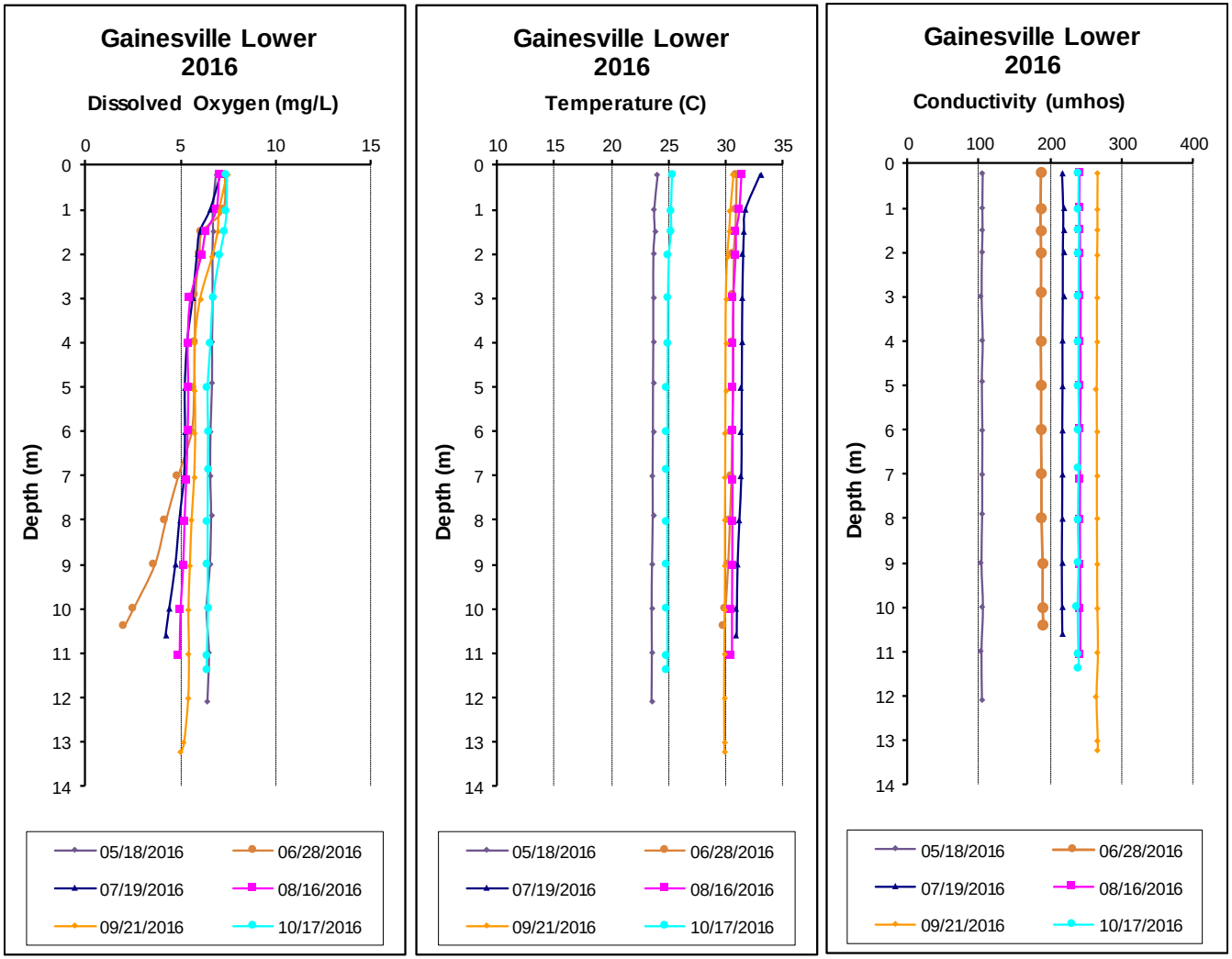


Figure 12. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the mid Gainesville Reservoir station, April-October, 2016.

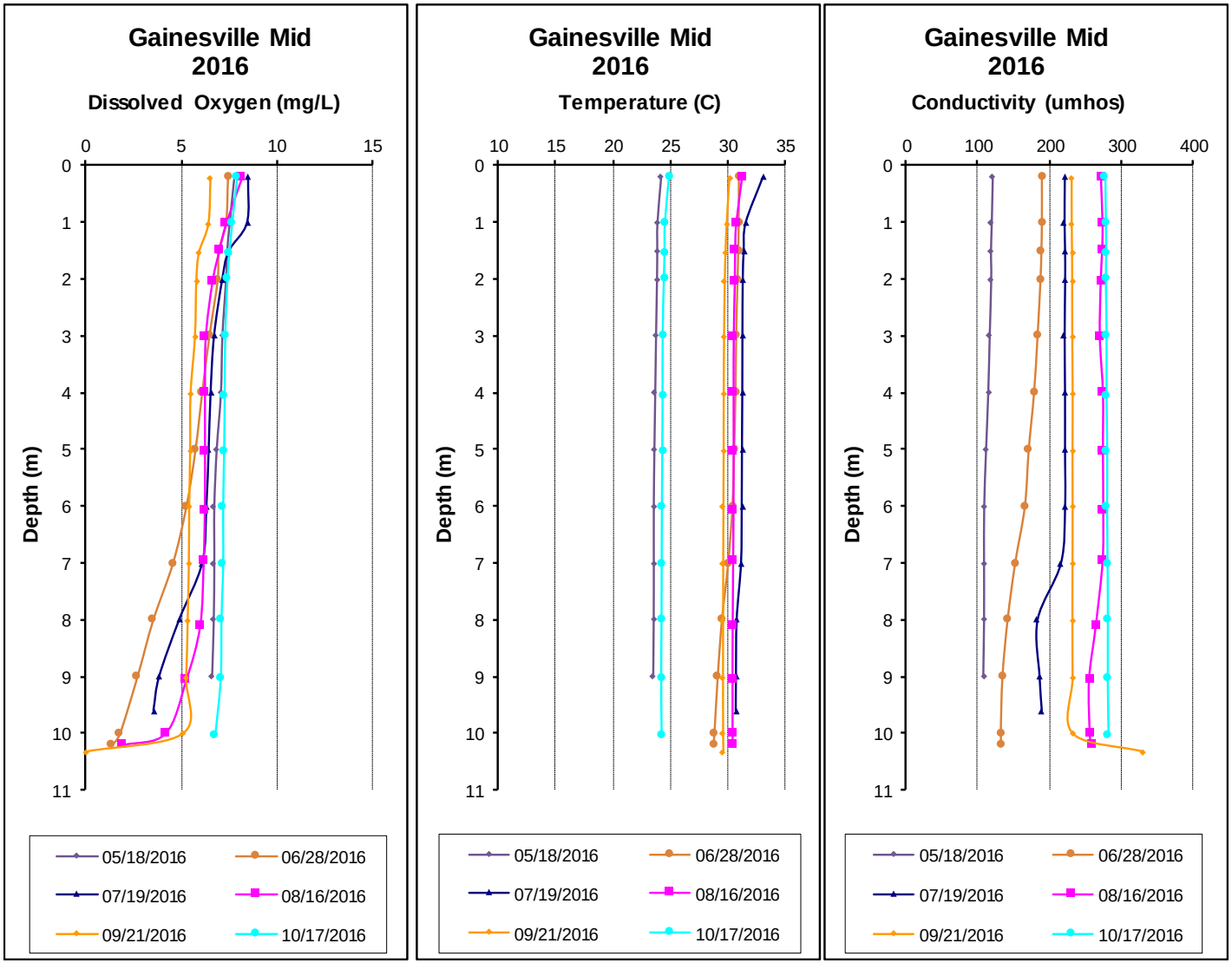


Figure 13. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the upper Gainesville Reservoir station, April-October, 2016.

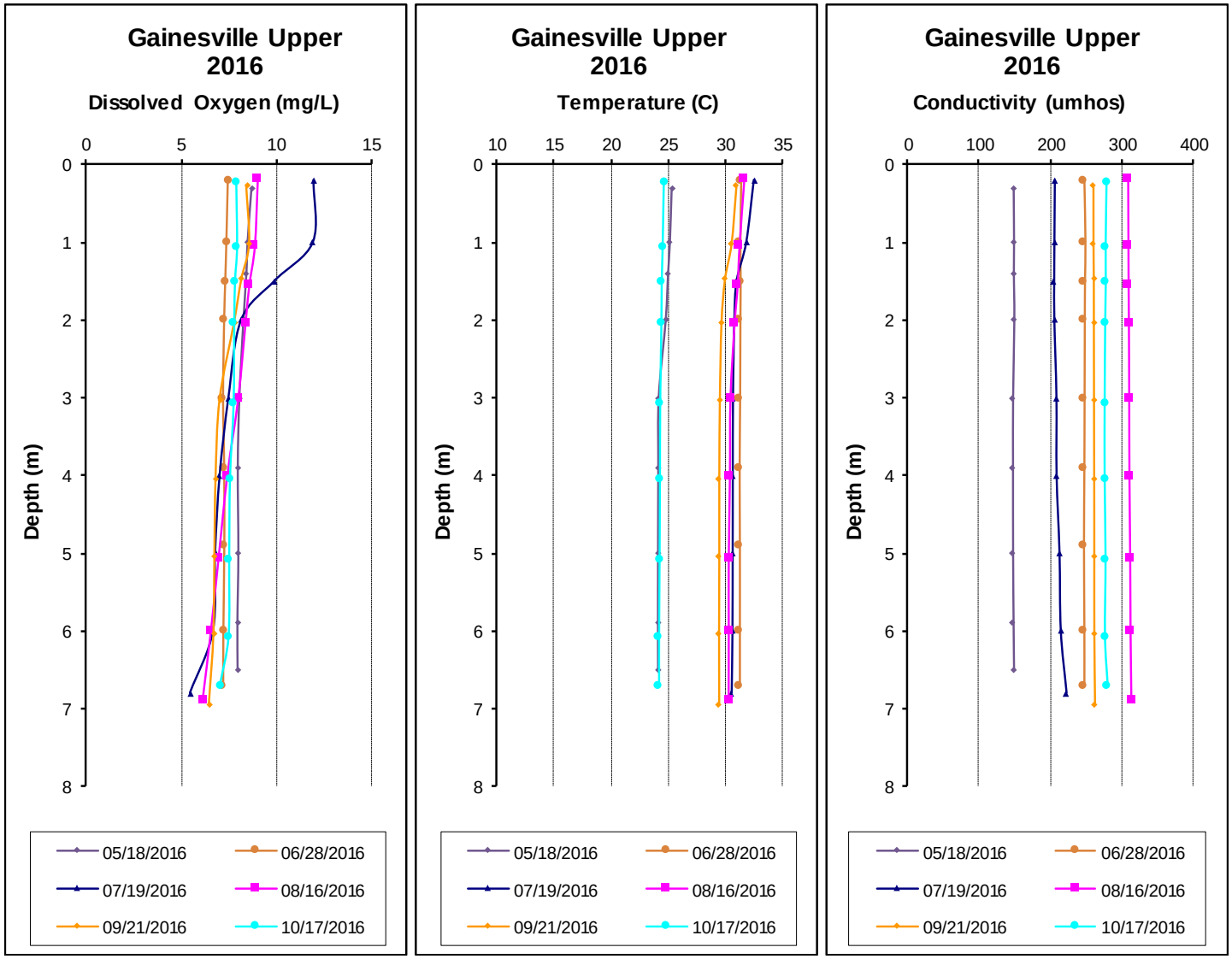
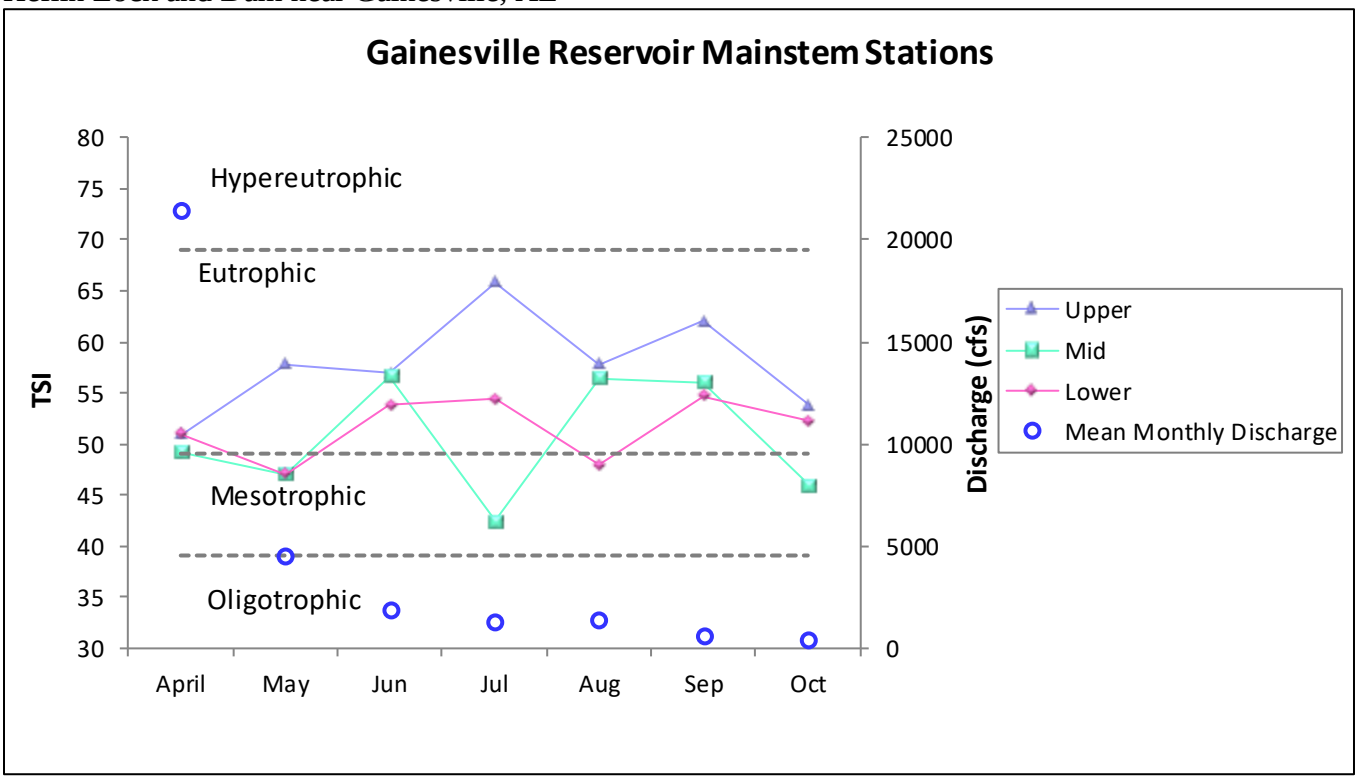
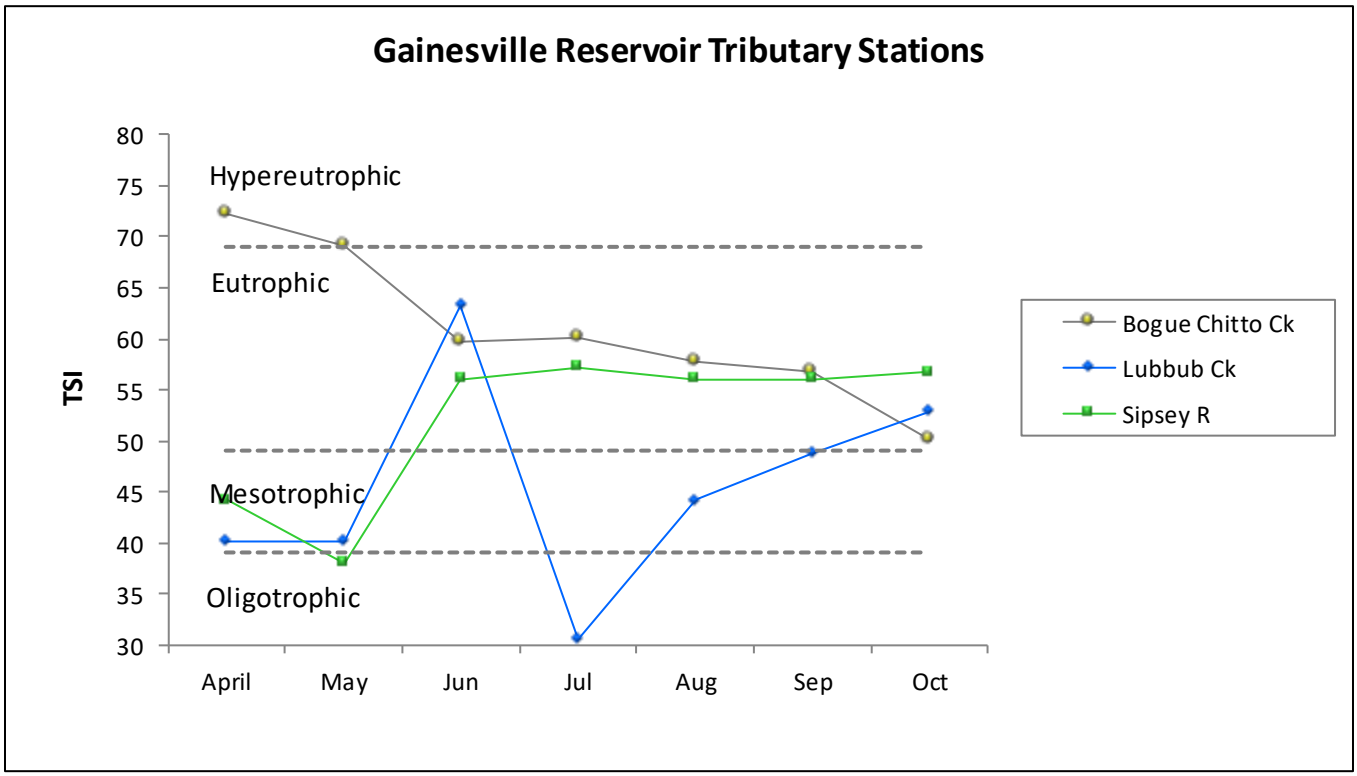


Figure 14. Monthly TSI values calculated for mainstem and tributary Gainesville Reservoir stations, April-October, 2016, using chl *a* concentrations and Carlson's Trophic State Index calculation. Mean monthly discharge measured at USGS gage 02447025, Tombigbee River at Heflin Lock and Dam near Gainesville, AL





REFERENCES

ADEM. 2017. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama Rev 1.3. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 2/6/2017

ADEM. 2017 (as amended). Standard operating procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2017 (draft). State of Alabama Water Quality Monitoring Strategy January 2017. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 108 pp.

ADEM. 2018. Quality Management Plan (QMP) for the Alabama Department of Environmental Management (ADEM) Rev 5, Montgomery, AL. 72 pp.

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2019. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2019. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.

Carlson, R.E. 1977. A trophic state index. Limnology and Oceanography. 22(2):361-369.

Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. Journal of Water Pollution Control Federation 59(4):222-227.

APPENDIX

Appendix Table 1. Summary of Gainesville 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.

	Parameter	N	Min	Max	Med	Mean	SD
GAIG-1	**Physical**						
	Turbidity (NTU)	7	6.8	33.5	8.1	13.6	10.7
	Total Dissolved Solids (mg/L)[J]	7	72.0	174.6	117.0	127.7	43.5
	Total Suspended Solids (mg/L)[J]	7	3.0	16.0	5.0	8.3	5.6
	Hardness (mg/L)	4	64.8	82.8	79.1	76.4	8.3
	Alkalinity (mg/L)	7	33.3	49.5	46.3	43.1	6.9
	Photic Zone (m)	7	1.30	5.02	3.19	3.08	1.34
	Secchi (m)	7	0.43	1.39	1.04	1.02	0.34
	Bottom Depth (m)	7	10.6	13.2	11.0	11.6	1.1
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.007	0.070	0.004	0.022	0.032
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	< 0.002	0.188	0.004	0.048	0.077
	Total Kjeldahl Nitrogen (mg/L)[J]	7	0.131	0.790	0.530	0.504	0.206
	Total Nitrogen (mg/L)[J]	7	< 0.133	0.915	0.596	0.552	0.248
	Dis Reactive Phosphorus (mg/L)[J]	7	< 0.002	0.014	0.004	0.006	0.005
	Total Phosphorus (mg/L)	7	0.014	0.057	0.021	0.030	0.016
	CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7	4.4	43.2	29.1	25.5	14.8
	Biological						
	Chlorophyll a (mg/m³)	7	5.34	11.70	9.08	8.86	2.57
	E. coli (MPN/DL)[J]	4	1	2	1	1	1
GAIG-2	**Physical**						
	Turbidity (NTU)	7	6.6	34.5	7.6	14.3	12.0
	Total Dissolved Solids (mg/L)	7	71.0	201.3	116.0	129.9	54.4
	Total Suspended Solids (mg/L)	7	2.6	16.0	6.0	8.2	5.2
	Hardness (mg/L)	4	66.1	88.9	74.5	76.0	9.7
	Alkalinity (mg/L)	7	35.0	48.3	46.1	43.1	5.5
	Photic Zone (m)	7	1.15	3.42	3.06	2.64	0.92
	Secchi (m)	7	0.44	1.39	1.21	1.05	0.36
	Bottom Depth (m)	7	9.0	10.3	10.0	9.8	0.5
	Chemical						
	Ammonia Nitrogen (mg/L)	7	< 0.007	0.070	0.004	0.022	0.031
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	< 0.002	0.161	0.011	0.048	0.071
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.037	0.755	0.318	0.366	0.245
	Total Nitrogen (mg/L)[J]	7	< 0.024	0.756	0.331	0.414	0.279
	Dis Reactive Phosphorus (mg/L)[J]	7	< 0.003	0.015	0.003	0.006	0.005
	Total Phosphorus (mg/L)	7	0.017	0.059	0.019	0.029	0.018
	CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7	4.7	45.4	29.7	27.2	16.0
	Biological						
	Chlorophyll a (mg/m³)	7	3.34	14.20	6.68	8.82	4.82
	E. coli (MPN/DL)[J]	4	1	2	2	2	1

Station	Parameter	N		Min	Max	Med	Mean	SD
GAIG-3	**Physical**							
	Turbidity (NTU)	7		8.3	36.7	11.4	16.5	10.9
	Total Dissolved Solids (mg/L)	7		82.0	234.6	133.0	149.9	61.4
	Total Suspended Solids (mg/L)[J]	7		5.0	20.0	11.0	12.1	5.3
	Hardness (mg/L)	4		71.3	100.0	82.4	84.0	12.1
	Alkalinity (mg/L)	7		37.0	50.2	47.3	44.6	5.0
	Photic Zone (m)	7		1.11	3.12	2.58	2.32	0.75
	Secchi (m)	7		0.47	1.21	0.93	0.86	0.24
	Bottom Depth (m)	7		6.5	7.1	6.8	6.8	0.2
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.060	0.004	0.017	0.021
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.274	0.002	0.078	0.107
	Total Kjeldahl Nitrogen (mg/L)	7		0.281	0.860	0.481	0.537	0.222
	Total Nitrogen (mg/L)[J]	7	<	0.282	0.982	0.482	0.616	0.303
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.016	0.004	0.007	0.005
	Total Phosphorus (mg/L)	7		0.018	0.059	0.024	0.031	0.016
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		6.0	54.8	35.5	32.2	18.1
	Biological							
	Chlorophyll a (mg/m³)	7		8.01	36.50	16.00	18.09	9.65
	E. coli (MPN/DL)[J]	4		1	33	10	13	15
GAIG-4	**Physical**							
	Turbidity (NTU)	7		11.2	38.1	18.8	21.6	10.0
	Total Dissolved Solids (mg/L)	7		109.0	207.0	170.0	161.8	42.4
	Total Suspended Solids (mg/L)[J]	7		10.0	33.0	17.0	18.0	7.9
	Hardness (mg/L)	4		79.3	113.0	89.8	93.0	14.6
	Alkalinity (mg/L)[J]	7		45.0	123.0	56.0	64.0	26.5
	Photic Zone (m)	7		1.17	2.75	2.12	2.03	0.64
	Secchi (m)	7		0.42	1.06	0.73	0.76	0.23
	Bottom Depth (m)	7		3.0	3.3	3.1	3.1	0.1
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.070	0.004	0.016	0.024
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.002	1.290	0.379	0.406	0.442
	Total Kjeldahl Nitrogen (mg/L)	7		0.191	1.300	0.835	0.751	0.417
	Total Nitrogen (mg/L)	7	<	0.192	2.125	1.069	1.157	0.746
	Dis Reactive Phosphorus (mg/L)[J]	7		0.003	0.012	0.006	0.006	0.003
	Total Phosphorus (mg/L)	7		0.023	0.052	0.032	0.035	0.012
	CBOD-5 (mg/L)	7	<	2.0	4.0	1.0	1.4	1.1
	Chlorides (mg/L)	7		14.7	48.4	34.9	33.3	12.9
	Biological							
	Chlorophyll a (mg/m³)	7		7.34	69.40	19.60	28.26	22.77
	E. coli (MPN/DL)[J]	4		4	66	17	26	27

	Parameter	N		Min	Max	Med	Mean	SD
GAIG-5	**Physical**							
	Turbidity (NTU)	7		14.5	32.4	18.3	19.9	6.2
	Total Dissolved Solids (mg/L)	7		2.0	54.0	44.0	36.4	17.5
	Total Suspended Solids (mg/L)	7		6.0	21.0	11.0	11.6	4.6
	Hardness (mg/L)	4		8.8	15.0	12.7	12.3	2.9
	Alkalinity (mg/L)	7		5.3	16.7	12.2	11.8	4.2
	Photic Zone (m)	7		1.21	175.00	1.50	26.23	65.60
	Secchi (m)	7		0.49	0.91	0.78	0.74	0.15
	Bottom Depth (m)	7		2.1	2.2	2.2	2.2	0.0
	Chemical							
	Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.043	0.018	0.020	0.017
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.002	0.201	0.108	0.097	0.068
	Total Kjeldahl Nitrogen (mg/L)	7		0.363	1.340	0.770	0.785	0.384
	Total Nitrogen (mg/L)	7	<	0.480	1.391	0.878	0.882	0.356
	Dis Reactive Phosphorus (mg/L)[J]	7		0.004	0.007	0.005	0.005	0.001
	Total Phosphorus (mg/L)	7		0.031	0.051	0.041	0.042	0.009
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		2.1	4.2	2.9	3.0	0.8
	Biological							
	Chlorophyll a (mg/m³)	7	<	0.10	28.00	4.00	7.66	9.50
	E. coli (MPN/DL)[J]	4		33	86	52	56	22
GAIG-6	**Physical**							
	Turbidity (NTU)	7		6.5	20.4	9.3	10.7	4.9
	Total Dissolved Solids (mg/L)	7		40.0	176.0	86.0	90.9	49.8
	Total Suspended Solids (mg/L)	7		4.0	13.0	6.0	7.3	3.6
	Hardness (mg/L)	4		43.9	67.7	54.0	54.9	11.5
	Alkalinity (mg/L)	7		13.2	48.0	31.7	32.8	11.4
	Photic Zone (m)	7		1.73	3.39	2.73	2.66	0.63
	Secchi (m)	7		0.73	1.70	1.15	1.19	0.29
	Bottom Depth (m)	7		8.0	8.7	8.4	8.4	0.3
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.007	0.033	0.004	0.010	0.011
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.002	0.079	0.006	0.022	0.030
	Total Kjeldahl Nitrogen (mg/L)[J]	7		0.113	0.828	0.400	0.441	0.233
	Total Nitrogen (mg/L)[J]	7	<	0.114	0.829	0.403	0.463	0.238
	Dis Reactive Phosphorus (mg/L)[J]	7	<	0.002	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L)	7		0.015	0.030	0.018	0.021	0.006
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		1.6	44.0	13.5	16.5	15.8
	Biological							
	Chlorophyll a (mg/m³)	7		2.14	15.10	13.40	10.83	5.37
	E. coli (MPN/DL)[J]	4		1	3	2	2	0

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