

*2011 Coffeeville Reservoir Report*  
*Rivers and Reservoirs Monitoring Program*

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Field Operations Division  
Environmental Indicators Section  
Aquatic Assessment Unit  
July 2014

# **Rivers and Reservoirs Monitoring Program**

**2011**

## **Coffeeville Reservoir**

Tombigbee River Basin

**Alabama Department of Environmental Management  
Field Operations Division  
Environmental Indicators Section  
Aquatic Assessment Unit**

**July 2014**

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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 <i>a</i>	Chlorophyll <i>a</i>
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

Coffeeville Reservoir was constructed in the 1950s by the U.S. Army Corps of Engineers. Located near the town of Coffeeville in Clarke County, the 8,800 acre impoundment on the Tombigbee River system, extending from Coffeeville Dam, located three miles from the town of that name, to Demopolis Dam, 97 miles upstream.

The Alabama Department of Environmental Management (ADEM) monitored Coffeeville Reservoir as part of the 2011 assessment of the Escatawpa, Mobile and Tombigbee River 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, 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 2012 Monitoring Strategy (ADEM 2012).

Specific water quality criteria for nutrient management was implemented in 2005 at one location on Coffeeville Reservoir. This criterion represents the maximum growing season (April-October) mean chlorophyll *a* (chl *a*) concentration allowable, while still fully supporting the reservoir's Public Water Supply, Swimming and Fish and Wildlife (PWS/S/F&W) use classifications.

The purpose of this report is to summarize data collected at twelve stations in Coffeeville Reservoir during the 2011 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and 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 existing data and established criteria.

## METHODS

Sampling stations were determined using historical data and previous assessments ([Figs. 1a and 1b](#)). Specific location information is listed in [Table 1](#). Coffeerville was sampled in the dam forebay, mid and upper reservoir areas. Tributary embayment stations monitored include: Sucarnoochee Creek, Chickasaw Bogue Creek, Tuckabum Creek, Horse Creek, Wahalak Creek, Bashi Creek, Tallawampa Creek, Okatuppa Creek, and Turkey Creek.

Water quality assessments were conducted at monthly intervals May-October. Assessments scheduled in April were postponed due to devastating tornadoes that affected most of the basin, resulting in two water quality assessments conducted in May. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2011), Surface Water Quality Assurance Project Plan (ADEM 2008a) and Quality Management Plan (ADEM 2008b).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions at each site. For mainstem stations, monthly concentrations of these parameters were graphed with the closest available USGS flow data and ADEM's previously collected data to help interpret the 2011 results.



Figure 1a. Coffeeville Reservoir with 2011 upper sampling locations. A description of each

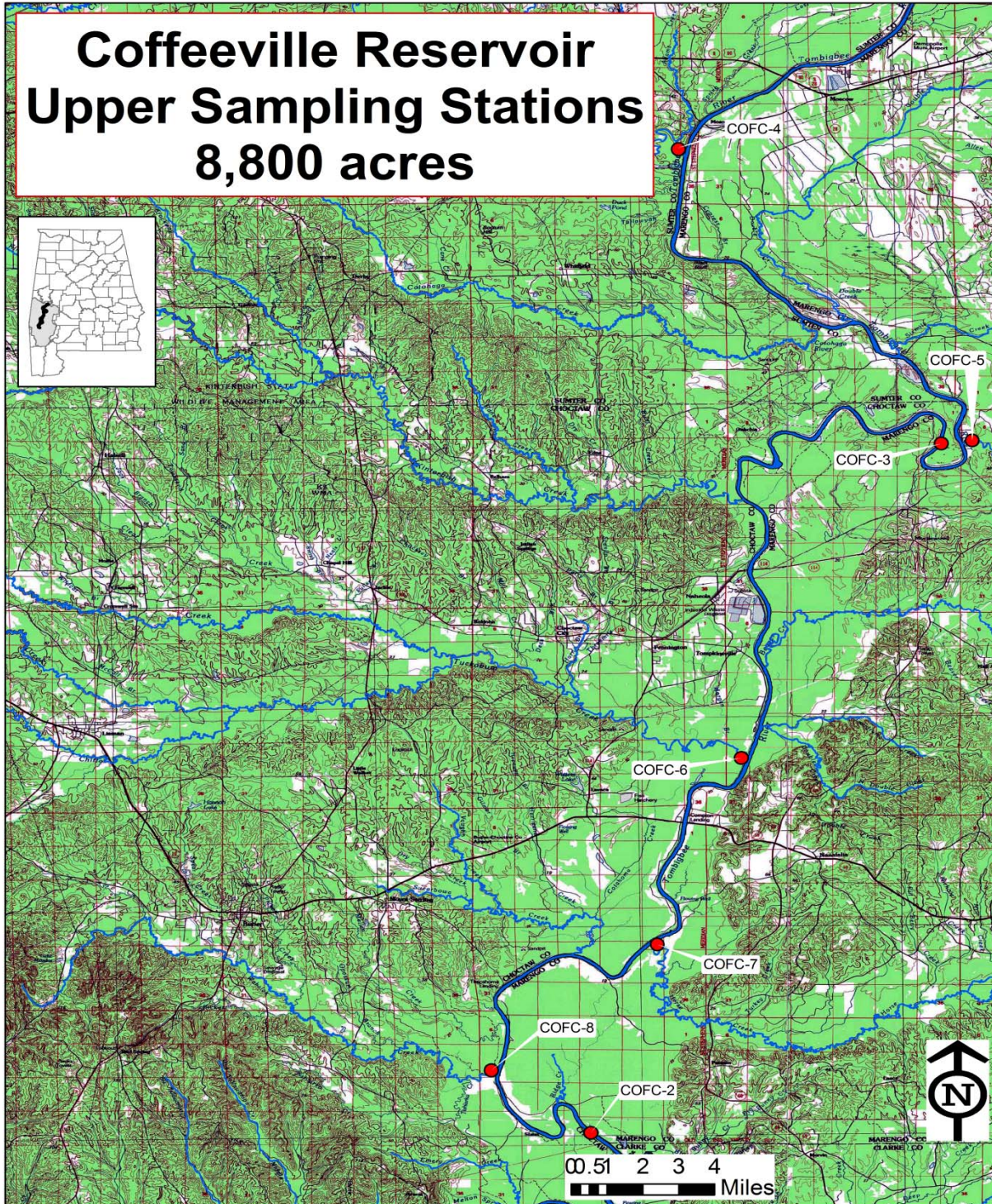
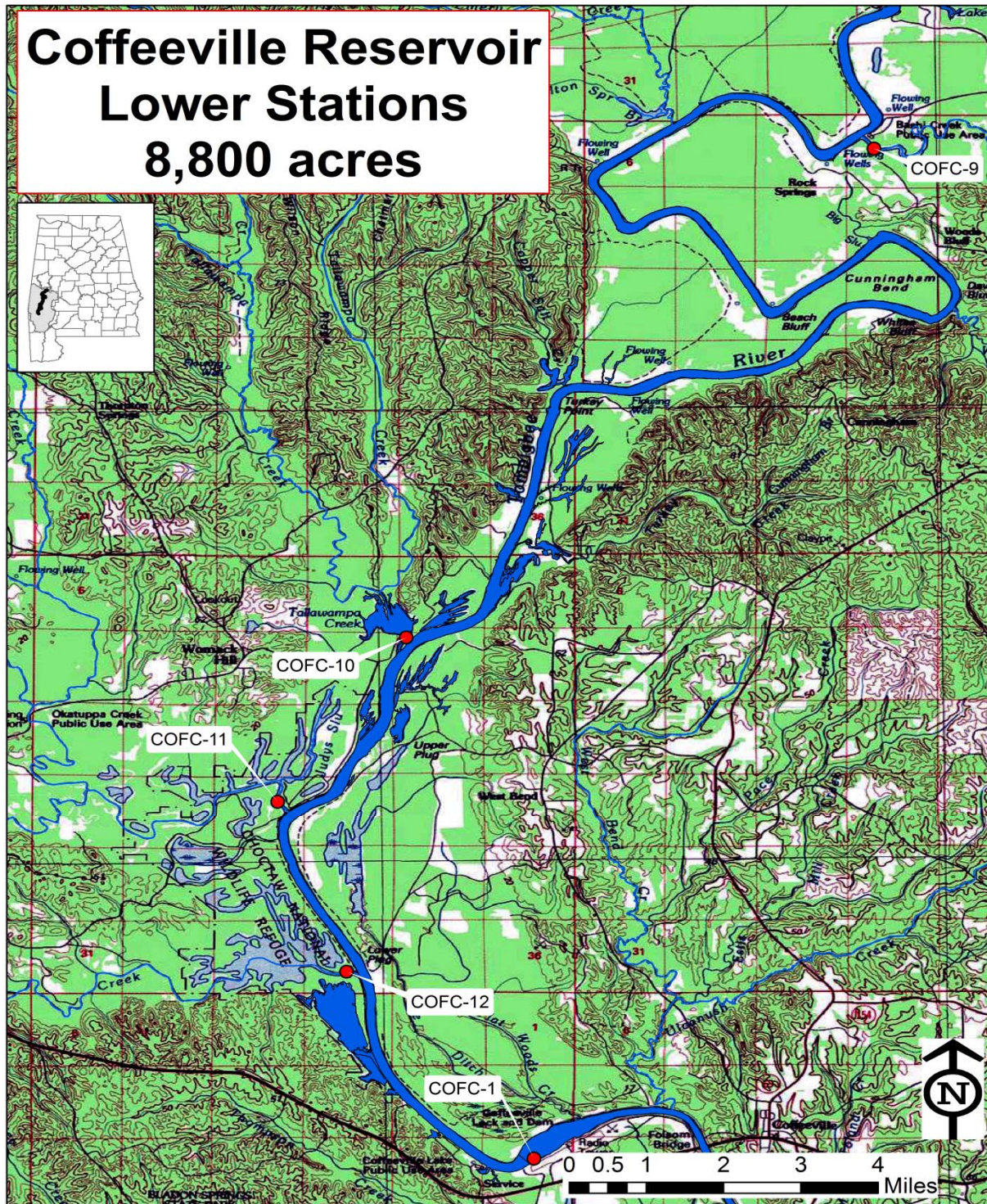




Figure 1b. Coffeeville Reservoir with 2011 lower sampling locations. A description of each



**Table 1.** Descriptions of the 2011 monitoring stations in Coffeerville Reservoir.

Coffeerville Reservoir								
HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl <i>a</i> Criteria	Latitude	Longitude
31602010909	Choctaw	COFC-1*	Lower	Coffeerville Res	Lower reservoir. Deepest point, main river channel, dam forebay .	10 ug/L	31.7529	-88.13382
31602010905	Choctaw	COFC-2	Mid	Coffeerville Res	Mid reservoir. Deepest point, main river channel, approx. 1.5 miles upstream of Big Bunny Creek confluence.		31.99463	-88.07962
31602010408	Choctaw	COFC-3	Upper	Coffeerville Res	Upper reservoir. Deepest point, main river channel, approx. two miles downstream of Chickasaw Bogue Creek confluence.		32.29236	-87.93796
31602020703	Sumter	COFC-4	Sucarnoochee Cr	Sucarnoochee Cr	Deepest point, main creek channel, Sucarnoochee River embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		32.41956	-88.04436
31602010109	Marengo	COFC-5	Chikasaw Bogue Cr	Chikasaw Bogue Cr	Deepest point, main creek channel, Chickasaw Bogue Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		32.29369	-87.92542
31602010506	Choctaw	COFC-6	Tuckabum Cr	Tuckabum Cr	Deepest point, main creek channel, Tuckabum Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		32.1565	-88.01891
31602010604	Marengo	COFC-7	Horse Cr	Horse Cr	Deepest point, main creek channel, Horse Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		32.07607	-88.05283
31602010904	Choctaw	COFC-8	Wahalak Cr	Wahalak Cr	Deepest point, main creek channel, Wahalak Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		32.02165	-88.12001
31602010704	Clarke	COFC-9	Bashi Cr	Bashi Cr	Deepest point, main creek channel, Bashi Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		31.95441	-88.07008
31602010906	Choctaw	COFC-10	Tallawampa Cr	Tallawampa Cr	Deepest point, main creek channel, Tallawampa Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		31.85692	-88.15773
31602010807	Choctaw	COFC-11	Okatuppa Cr	Okatuppa Cr	Deepest point, main creek channel, Okatuppa Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		31.82423	-88.18183
31602010908	Choctaw	COFC-12	Turkey Cr	Turkey Cr	Deepest point, main creek channel, Turkey Creek embayment, approx. 0.5 miles upstream of confluence with Tombigbee River.		31.79016	-88.1689

\*Growing season mean chl *a* criterion established at this station in 2005



## RESULTS

Growing season mean graphs for TN, TP, chl *a* and TSS are provided in this section ([Figs. 2-5](#)). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided ([Figs 6-10, & 13](#)), with mean monthly discharge included as an indicator of flow and retention time in the months sampled. AGPT results appear in [Table 2](#). Depth profile graphs of temperature, conductivity and DO appear in [Figs. 11-12](#). Summary statistics of all data collected during 2011 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 be mentioned, review of the graphs will indicate stations that may be potential candidates for reference waterbodies and watersheds.

In 2011, the highest growing season mean TN was calculated for the Horse Cr station ([Fig. 2](#)). The mean TN concentrations at the Bashi Cr, mid, Horse Cr, and upper stations mean TN concentrations were higher in 2011 than in the previously measured. The mean TN concentration at lower and remaining tributary stations decreased from previous years. Highest monthly TN concentrations occurred during the first May sample for upper and mid mainstem stations ([Fig.6](#)). Historic high monthly TN concentrations occurred at the upper station in the first May sample and August, and the second May sample, along with July and September at the mid station. Monthly TN concentrations at the lower station were generally at or below historic means.

In 2011, the highest growing season means TP were calculated for the Sucarcoochee Cr and Horse Cr stations ([Fig. 3](#)). Both growing season mean TP concentrations were the highest calculated for these stations. The mean TP concentrations all other stations decreased from previous growing season means ([Fig. 3](#)). Highest monthly TP concentrations occurred at the first sampling event in May for all mainstem stations. All monthly TP concentrations at mainstem stations were at or below historic mean values ([Fig. 7](#)).

In 2011, the highest growing season mean chl *a* was calculated for the Chickasaw Bogue Cr station ([Fig. 4](#)). Mean chl *a* concentrations for Horse Cr and Chickasaw Bogue Cr increased from the previous growing season sampling seasons. All other station growing season mean chl *a* concentrations decreased, with the lower five tributaries showing a notable decrease from 2006. The mean chl *a* concentration in lower Coffeerville station was below the established criterion. Historic high values were observed during the second May sampling for upper and mid station, and June for the lower station ([Fig. 8](#)).

In 2011, the highest growing season mean TSS value was calculated for the Sucarnochee Cr station ([Fig. 5](#)). All other stations TSS mean values were lower in 2011 than in the previous sampling year. Monthly TSS concentrations at the mainstem stations were below historic means, reaching historic lows in most months ([Fig. 9](#)).

AGPT results for the upper, mid, and lower stations indicated nitrogen-limited conditions in 2011, similar to 2006 ([Table 2](#)). In 2011, the msc at the lower station was above 5.0 mg/L, the value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

Dissolved oxygen concentrations at Horse Cr and Wahalak Cr were below the ADEM criterion of 5.0 mg/L at 5.0 ft (1.5m) April-October and April, July-October, respectively (ADEM Admin. Code R. 335-6-10-.09) ([Fig. 10](#)). Concentrations were also below the criterion at Bashi Cr in the first May sample, June, and September, and Tukabum Cr in June and August. One additional violation was measured in the Tallawampa Cr station in July. Dissolved oxygen concentrations at all mainstem Coffeerville stations met the dissolved oxygen criterion, April-October. Profiles of the lower and mid mainstem stations were mixed throughout the sampling season. Highest temperatures were reached in July-August ([Figs. 11-12](#)).

TSI values were calculated using monthly chl *a* concentrations and Carlson's Trophic State Index. The mainstem stations were eutrophic May and June. The lower station was mesotrophic July, August and October, while the upper station was mesotrophic in September and the mid was mesotrophic in October. Although the embayment stations were generally mesotrophic to eutrophic, Wahalak Cr, Sucarnochee Cr, Bashi Cr, and Okatuupa Cr were Oligotrophic during some months ([Fig. 13](#)).

Figure 2. Mean growing season TN measured in Coffeerville Reservoir, May-October, 2001-2011. Stations are illustrated from upstream to downstream as the graph is read from left to right.

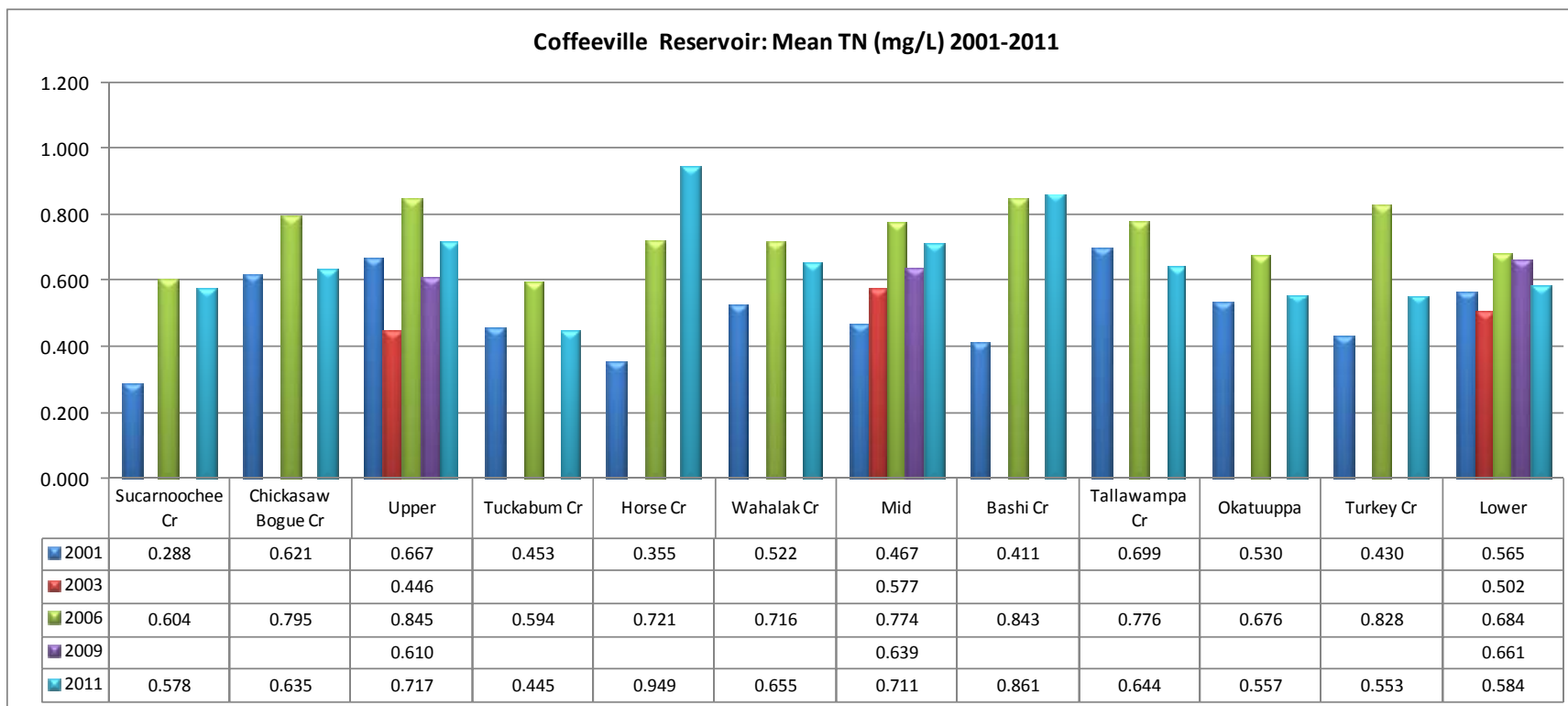


Figure 3. Mean growing season TP measured in Coffeeville Reservoir, May-October, 2001-2011. Stations are illustrated from upstream to downstream as the graph is read from left to right.

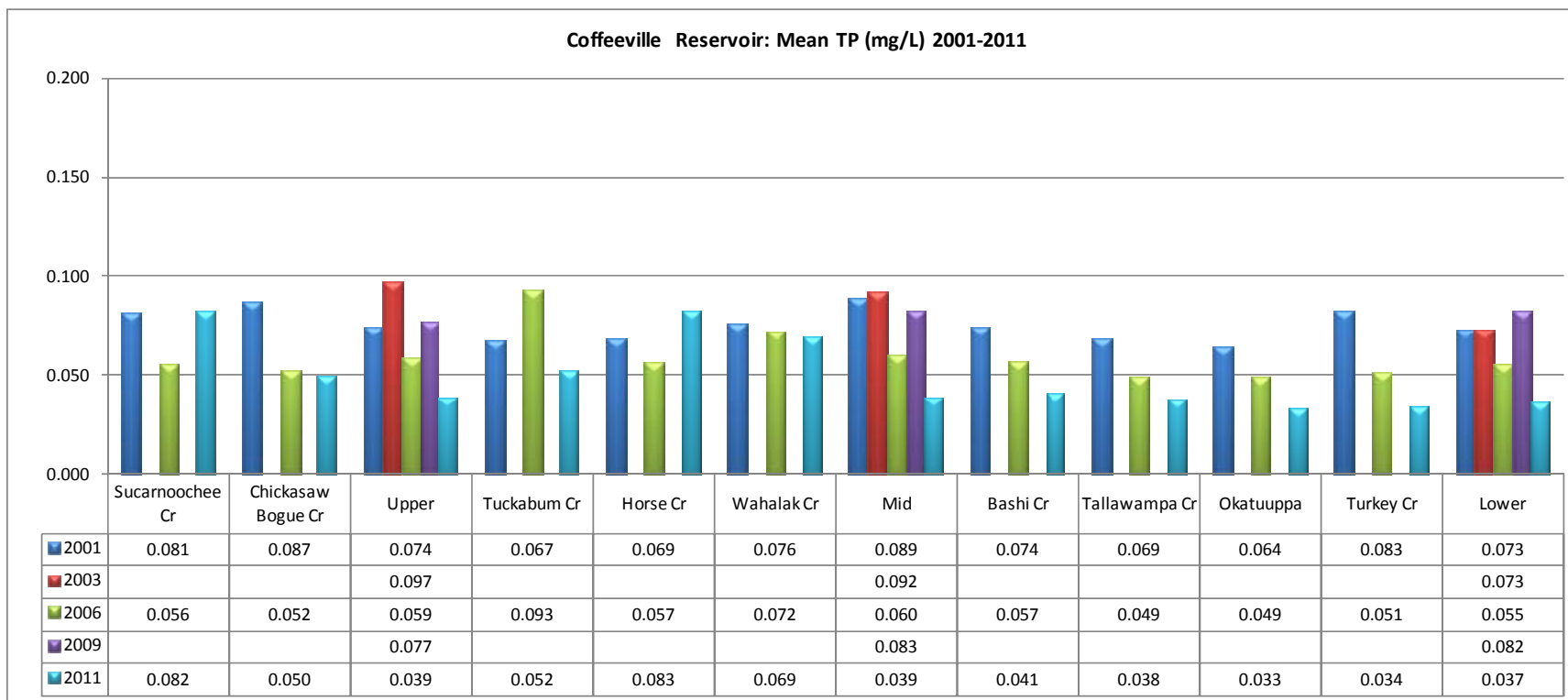


Figure 4. Mean growing season chl *a* measured in Coffeeville Reservoir, May-October, 2001-2011. Stations are illustrated from upstream to downstream as the graph is read from left to right.

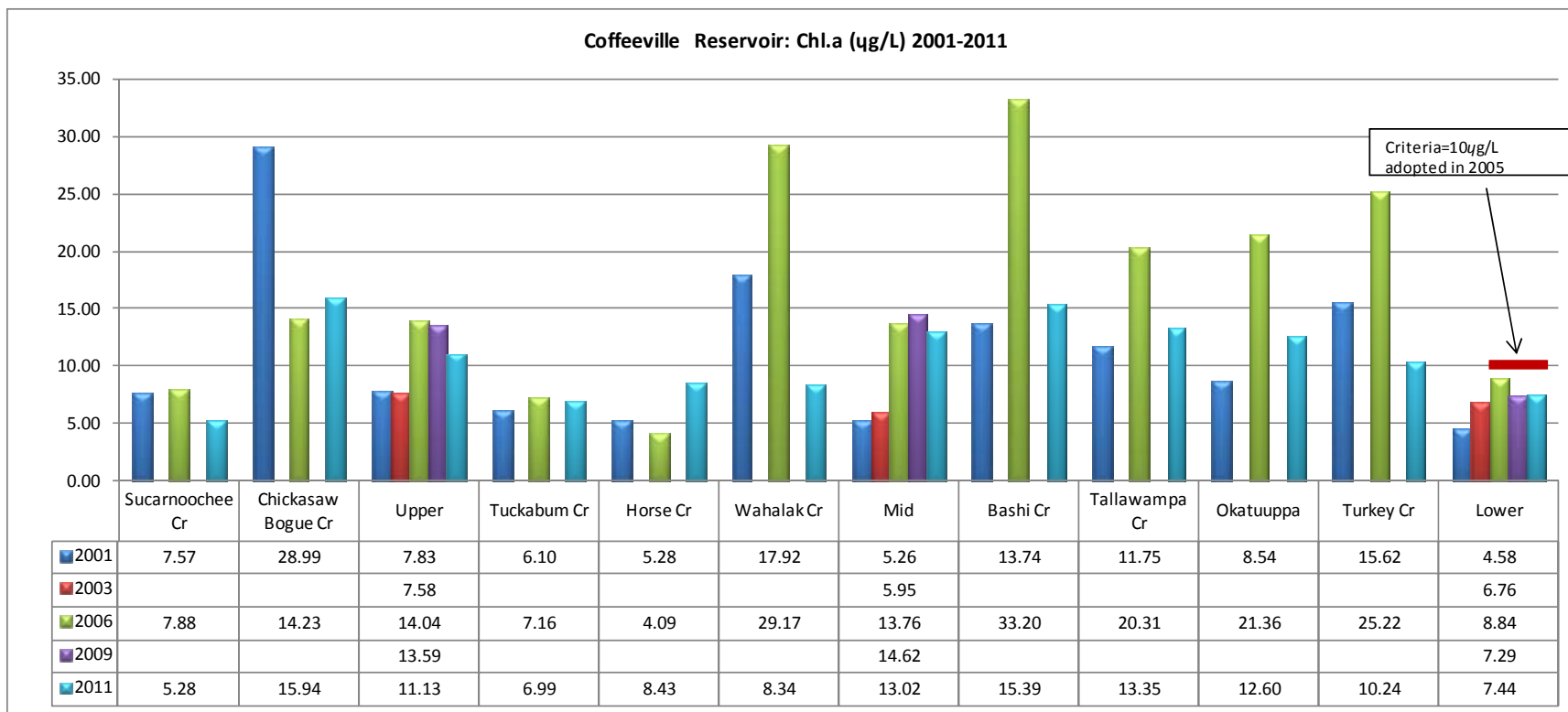




Figure 5. Mean growing season TSS measured in Coffeerville Reservoir, May-October, 2001-2011. Stations are illustrated from upstream to downstream as the graph is read from left to right.

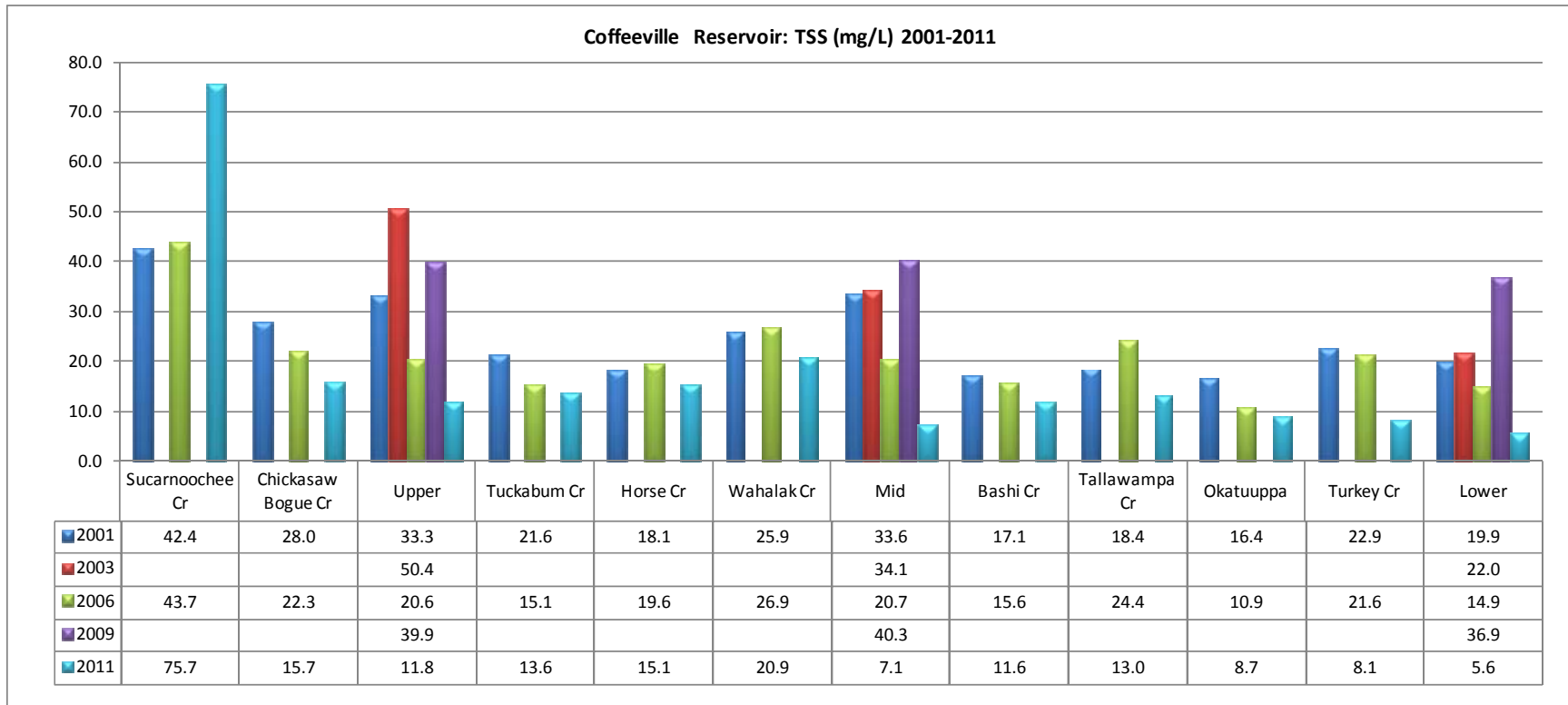


Figure 6. Monthly TN concentrations measured at upper, mid, and lower station in Coffeerville Reservoir, May-October 2011 vs. average monthly discharge. Monthly discharge acquired from USGS Tombigbee R gauge 02469761 at Coffeerville Reservoir Dam. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

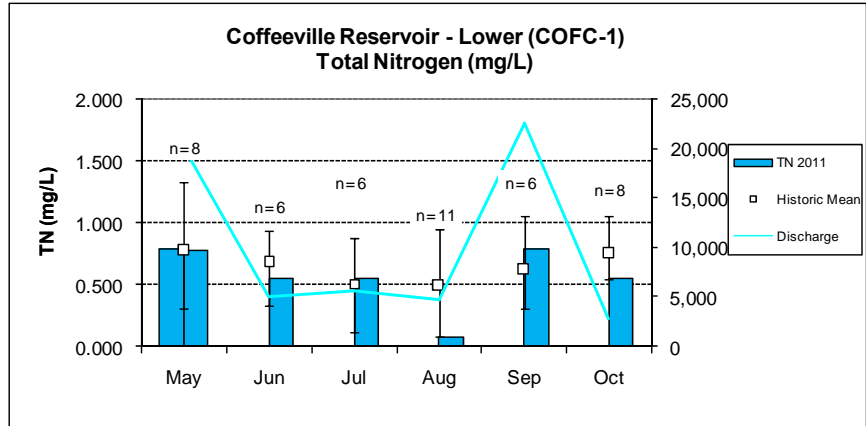
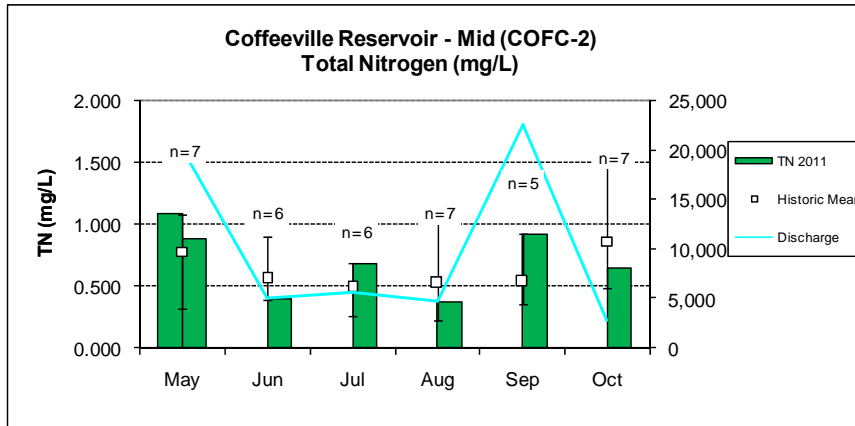
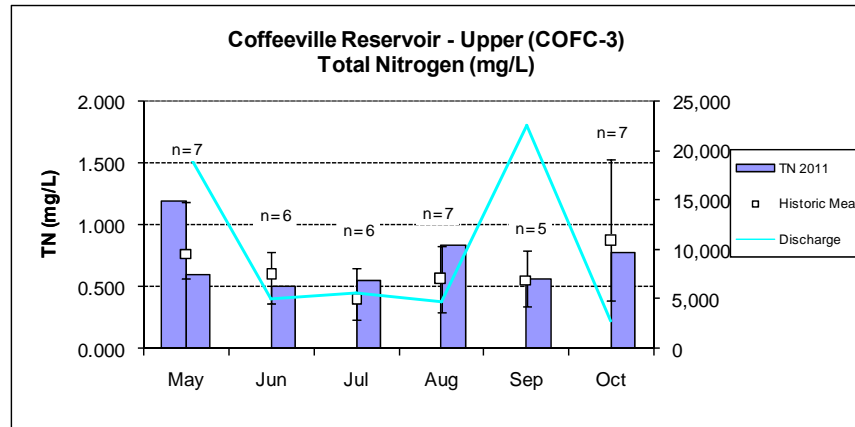


Figure 7. Monthly TP concentrations measured at upper, mid, and lower station in Coffeeville Reservoir, May-October 2011 vs. average monthly discharge. Monthly discharge acquired from USGS Tombigbee R gauge 02469761 at Coffeeville Reservoir Dam. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

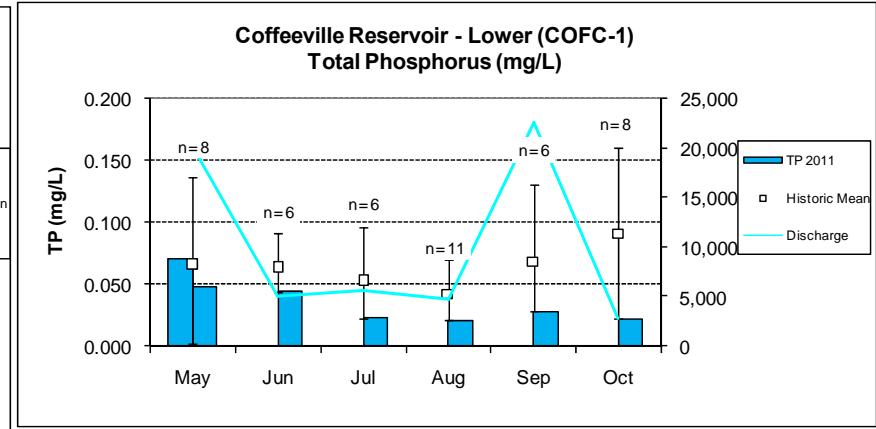
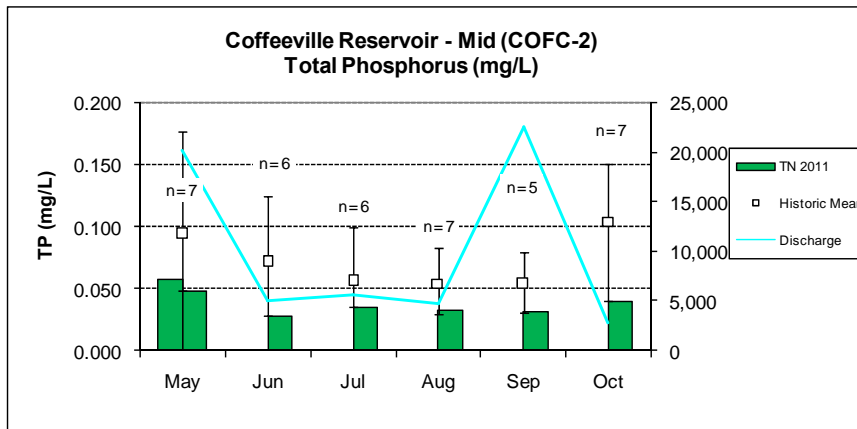
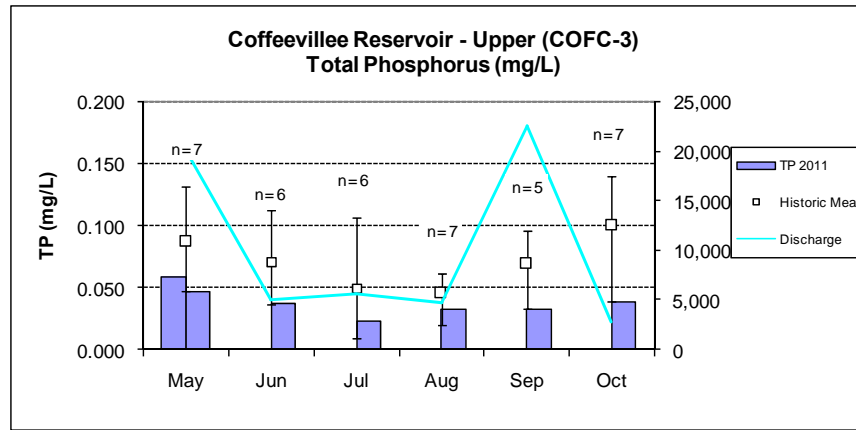


Figure 8. Monthly chl *a* concentrations measured at upper, mid, and lower station in Coffeerville Reservoir, May-October 2011 vs. average monthly discharge. Monthly discharge acquired from USGS Tombigbee R gauge 02469761 at Coffeerville Reservoir Dam. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

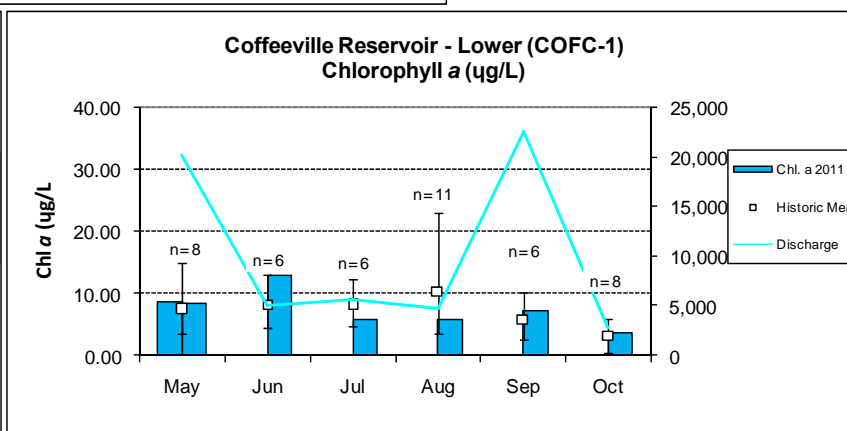
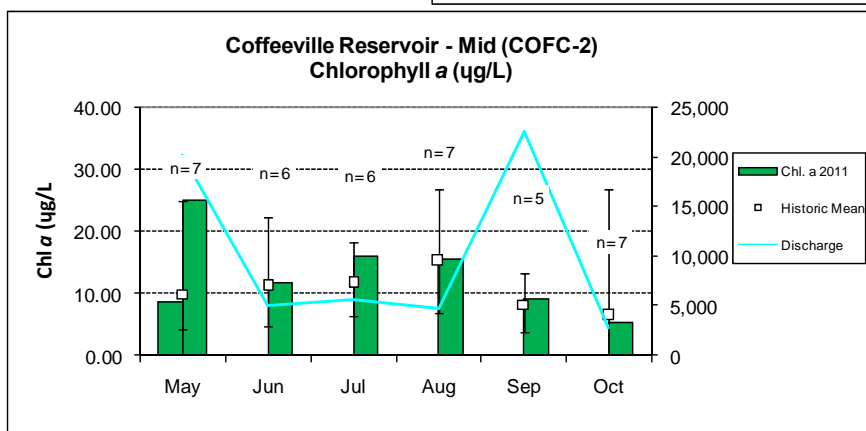
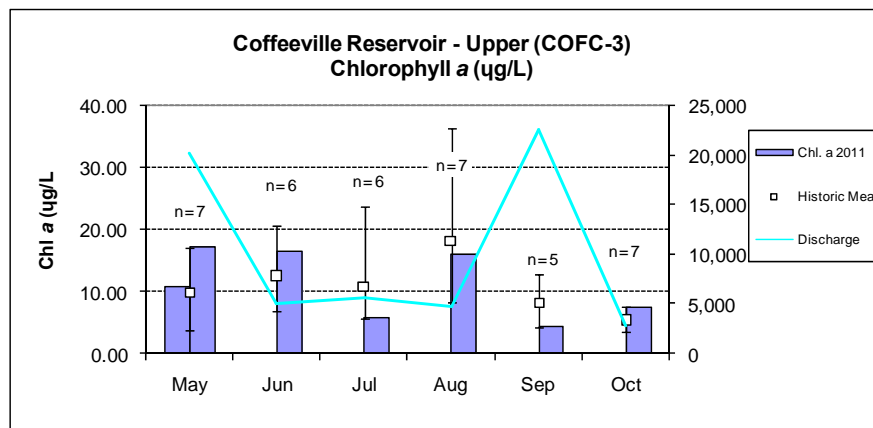


Figure 9. Monthly TSS concentrations measured at upper, mid, and lower station in Coffeerville Reservoir, May-October 2011 vs. average monthly discharge. Monthly discharge acquired from USGS Tombigbee R gauge 02469761 at Coffeerville Reservoir Dam. Each bar graph depicts monthly changes in each station. The historic mean (1992-2011) and min/max ranges are also displayed for comparison. The “n” value equals the number of datapoints included in the monthly historic calculations.

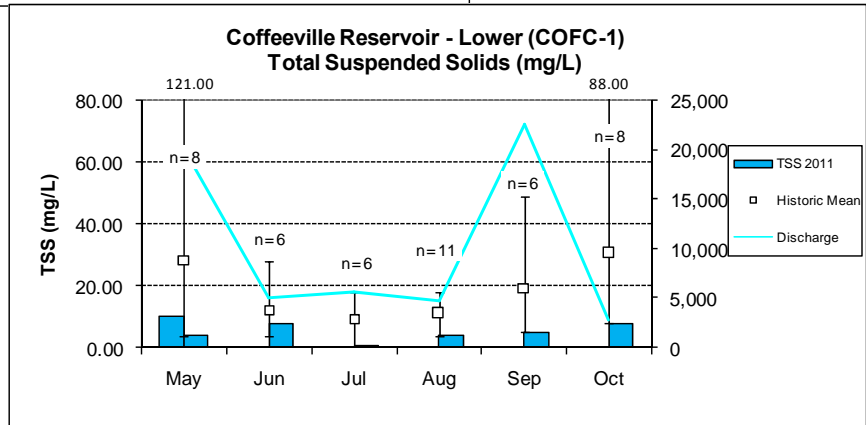
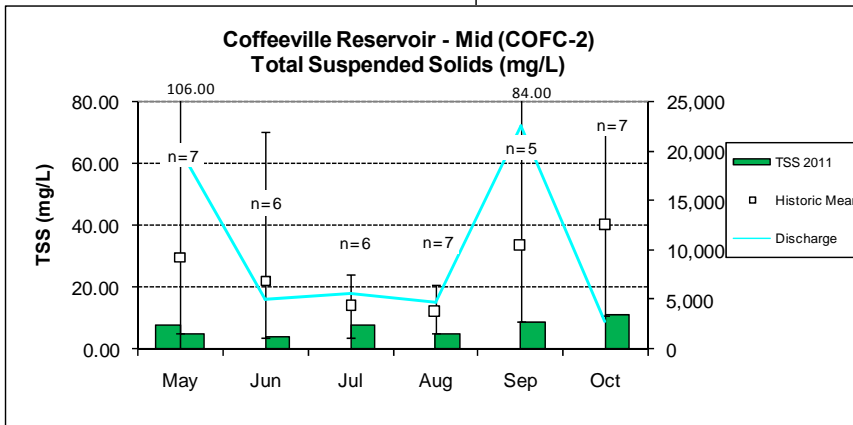
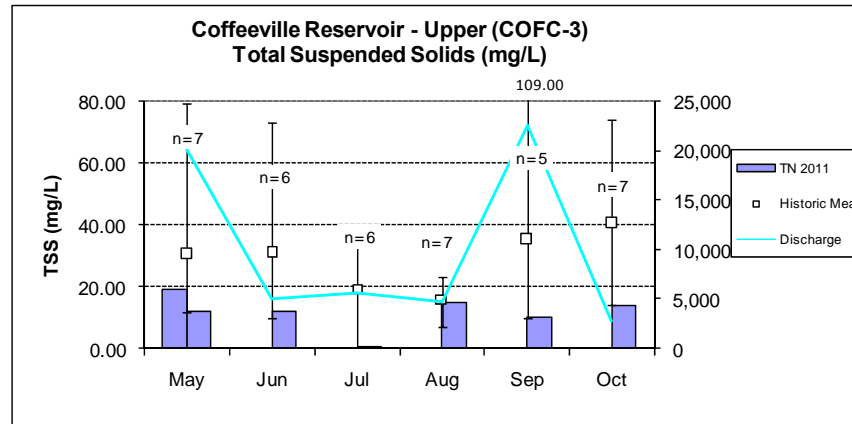


Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/l are considered to be protective in reservoirs and lakes; MSC values below 20 mg/L are considered protective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

Station	2001	2001	2006	2006	2011	2011
	Control mean MSC	Limiting Nutrient	Control mean MSC	Limiting Nutrient	Control mean MSC	Limiting Nutrient
Upper	7.63	Phosphorus	5.16	Nitrogen	4.13	Nitrogen
Mid	7.63	Nitrogen	7.17	Nitrogen	4.45	Nitrogen
Lower	13.58	Nitrogen	4.19	Nitrogen	7.98	Nitrogen

Figure 10. Monthly DO concentrations at 1.5 m (5 ft) for Coffeeville Reservoir stations collected May-October 2011. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2010).

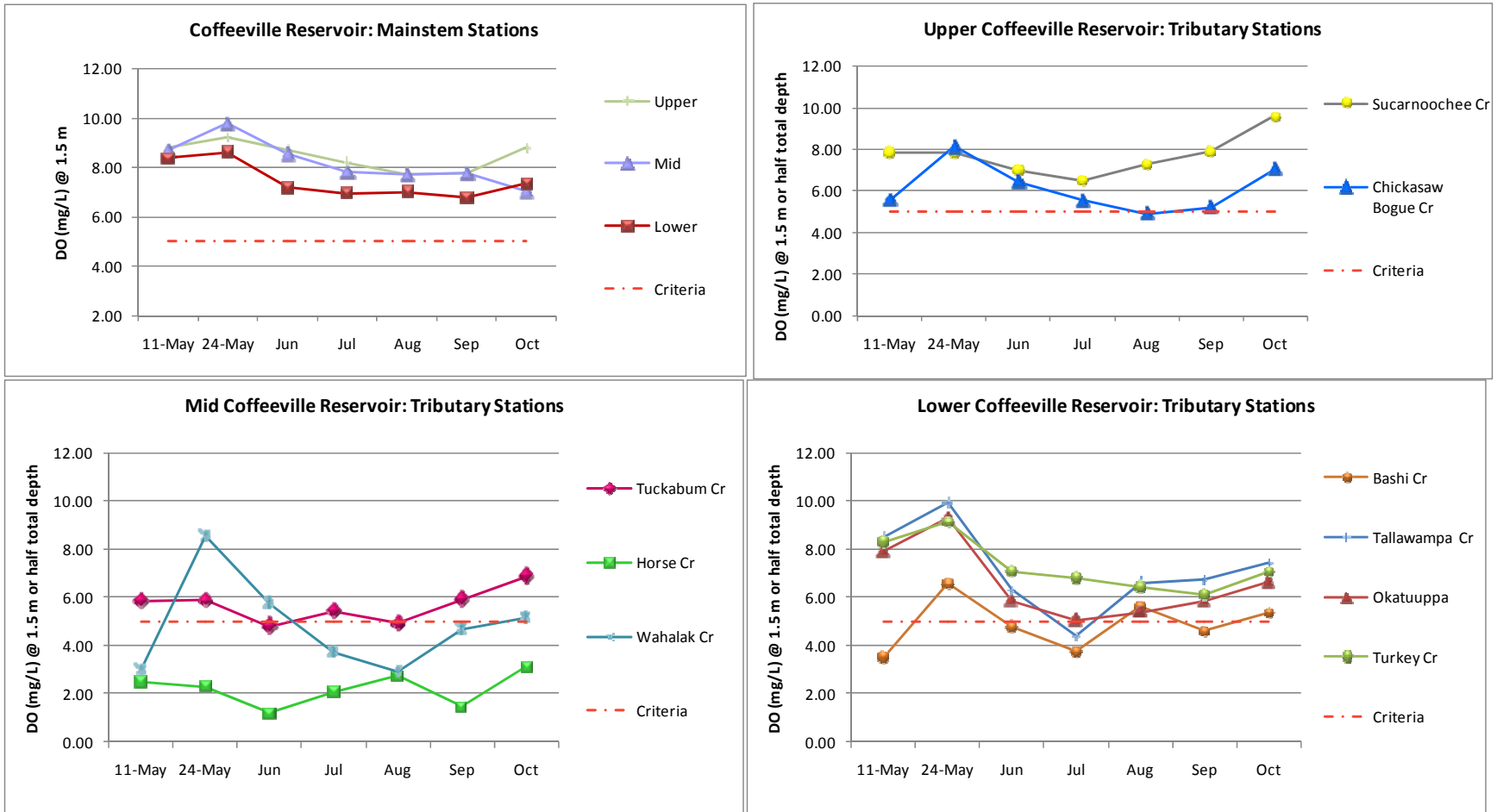


Figure 11. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the mid Coffeeville Reservoir station, May-October 2011.

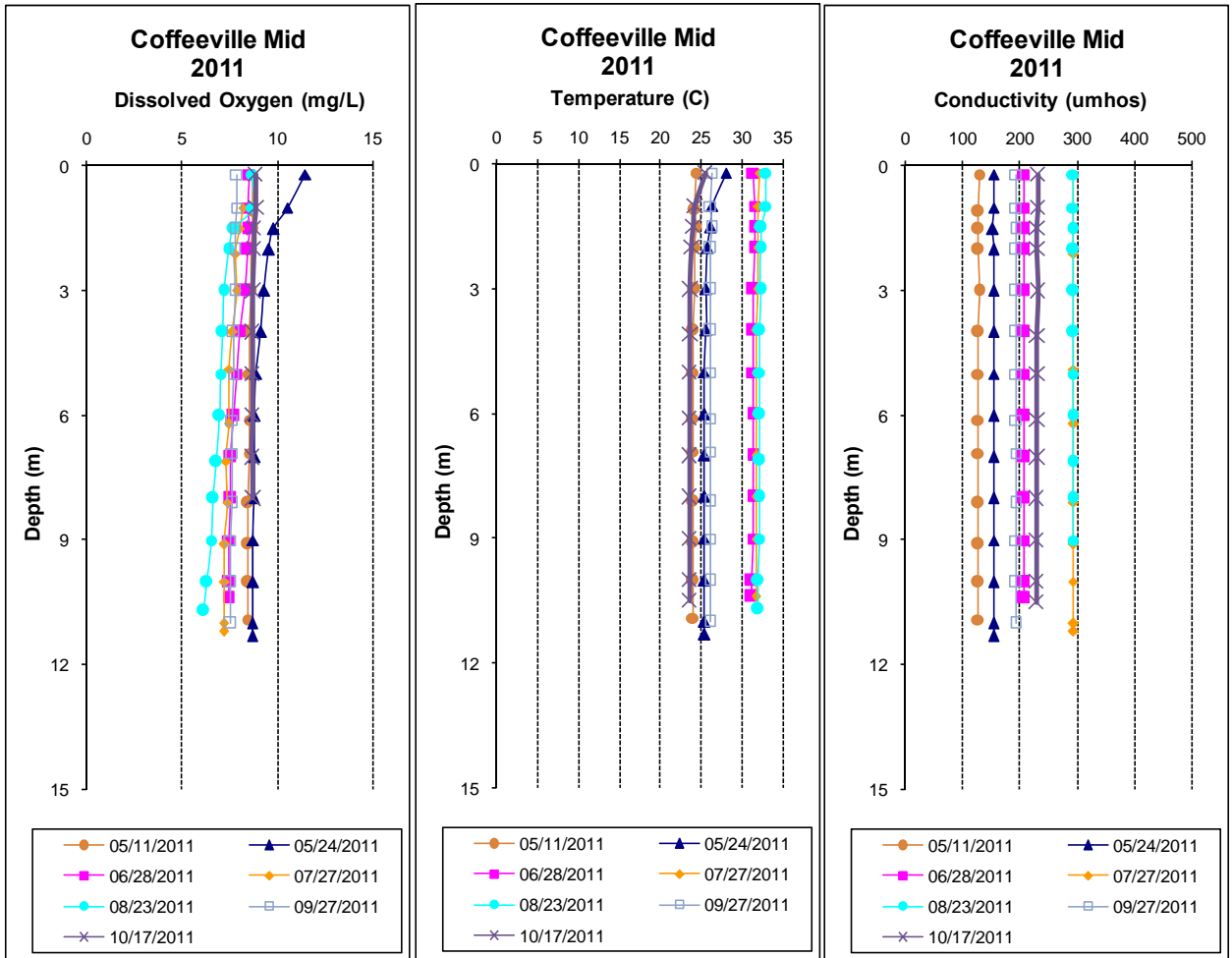




Figure 12. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the lower Coffeeville Reservoir station, May-October 2011.

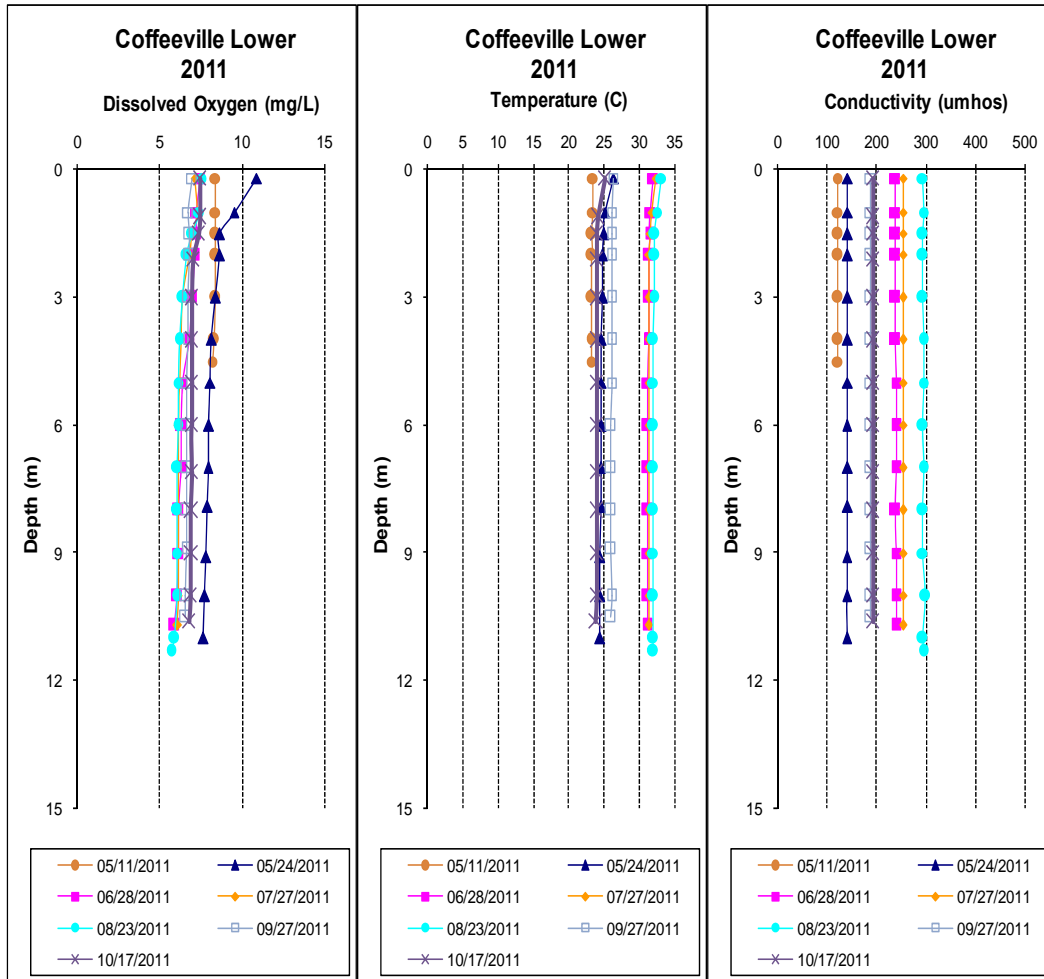
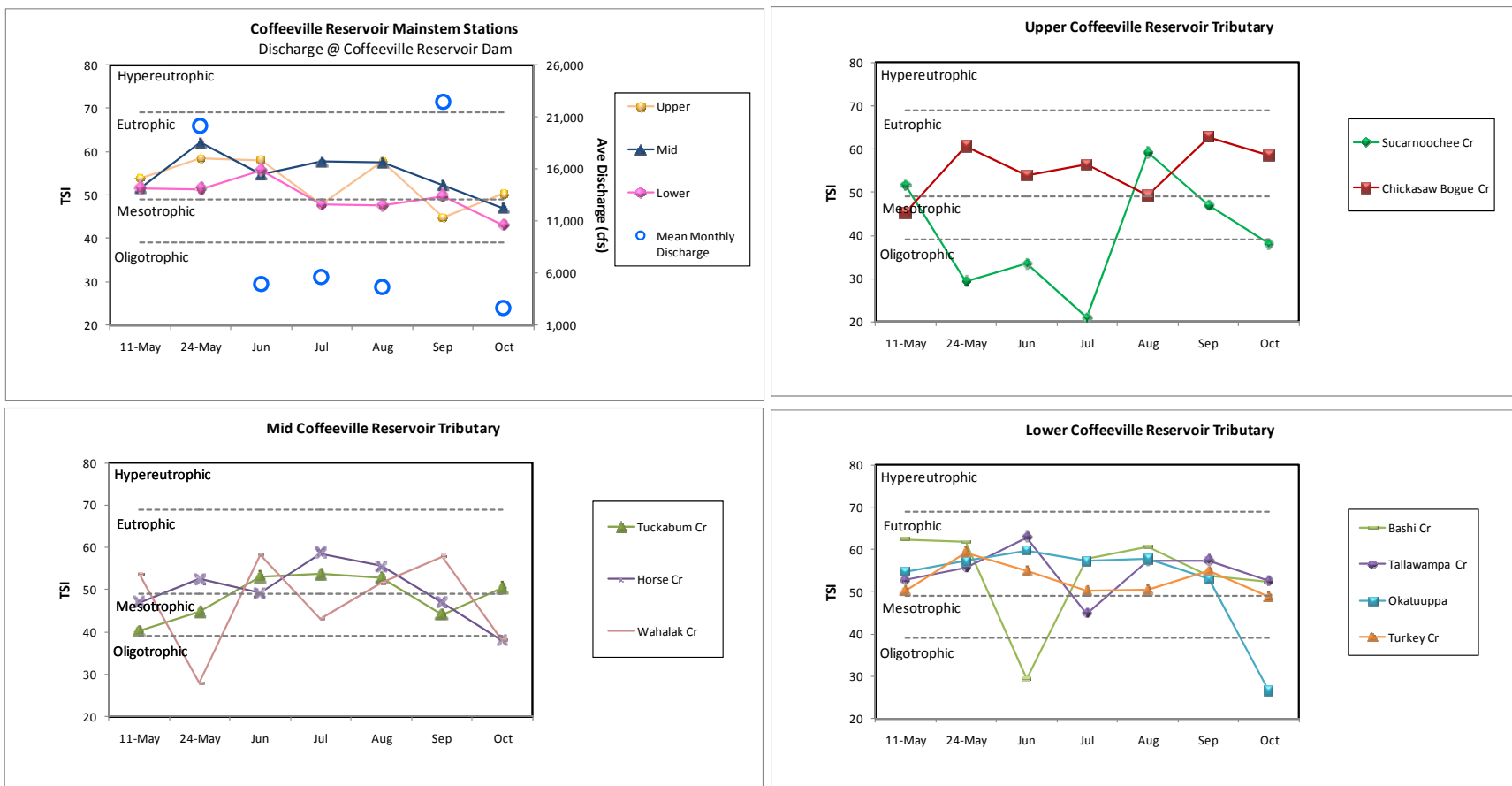


Figure 13. Monthly TSI values calculated for mainstem and tributary Coffeeville Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. Monthly discharge acquired from USGS Tombigbee R gauge station 02469761 at Coffeeville Dam.



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## APPENDIX

**Appendix Table 1.** Summary of water quality data collected April-October, 2011. Minimum (Min) and maximum (Max) values calculated using minimum detection limits when results were less than this value. Median, mean, and standard deviation (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

COFC-1	<b>Physical</b>							
	Turbidity (NTU)	8	5.4	30.7	11.1	12.8	8.0	
	Total Dissolved Solids (mg/L)	7	<	1.0	186.0	112.0	103.2	59.4
	Total Suspended Solids (mg/L) <sup>1</sup>	7	<	1.0	10.0	5.0	5.6	3.2
	Hardness (mg/L)	4	40.7	81.1	55.0	58.0	17.1	
	Alkalinity (mg/L)	7	36.1	61.8	42.3	46.1	9.1	
	Photic Zone (m)	7	1.38	4.29	2.67	2.77	0.97	
	Secchi (m)	7	0.38	1.67	0.84	0.94	0.41	
	Bottom Depth (m)	8	4.90	11.30	10.55	9.21	2.77	
	<b>Chemical</b>							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.028	0.378	0.154	0.193	0.136	
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.107	0.632	0.412	0.392	0.209
	Total Nitrogen (mg/L)	7	<	0.082	0.790	0.554	0.584	0.251
	Dissolved Reactive Phosphorus (mg/L) <sup>1</sup>	7	0.004	0.014	0.006	0.008	0.005	
	Total Phosphorus (mg/L)	7	0.021	0.071	0.028	0.037	0.019	
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.1	0.4
	Chlorides (mg/L)	7	4.7	24.4	11.8	13.4	7.1	
	<b>Biological</b>							
Chlorophyll a (ug/L)	7	3.56	12.98	7.12	7.44	2.99		
E. coli (mpn/100mL) <sup>1</sup>	3	<	1	8	2	4	4	
COFC-2	<b>Physical</b>							
	Turbidity (NTU)	7	7.3	26.0	13.3	14.4	6.2	
	Total Dissolved Solids (mg/L)	7	88.0	194.0	118.0	133.7	39.4	
	Total Suspended Solids (mg/L)	7	4.0	11.0	8.0	7.1	2.5	
	Hardness (mg/L)	4	40.9	83.3	56.6	59.4	17.9	
	Alkalinity (mg/L)	7	38.1	63.9	42.7	47.3	9.4	
	Photic Zone (m)	7	1.42	2.57	2.15	2.06	0.41	
	Secchi (m)	7	0.61	1.20	0.72	0.79	0.21	
	Bottom Depth (m)	7	10.00	11.30	10.90	10.86	0.34	
	<b>Chemical</b>							
	Ammonia Nitrogen (mg/L) <sup>1</sup>	7	<	0.005	0.367	0.002	0.057	0.137
	Nitrate+Nitrite Nitrogen (mg/L) <sup>1</sup>	7	0.009	0.355	0.126	0.170	0.144	
	Total Kjeldahl Nitrogen (mg/L)	7	0.300	0.839	0.569	0.542	0.217	
	Total Nitrogen (mg/L) <sup>1</sup>	7	0.376	1.079	0.683	0.711	0.267	
	Dissolved Reactive Phosphorus (mg/L) <sup>1</sup>	7	0.004	0.019	0.006	0.009	0.006	
	Total Phosphorus (mg/L)	7	0.028	0.057	0.035	0.039	0.010	
	CBOD-5 (mg/L)	7	<	2.0	2.1	1.0	1.2	0.4
	Chlorides (mg/L)	7	5.9	27.5	14.2	14.6	7.9	
	<b>Biological</b>							
Chlorophyll a (ug/L)	7	5.34	24.92	11.75	13.02	6.49		
E. coli (mpn/100mL) <sup>1</sup>	3	<	1	10	4	5	4	

Station	Parameter	N	Min	Max	Med	Mean	SD
COFC-3	<b>Physical</b>						
	Turbidity (NTU)	8	8.5	29.6	18.2	17.6	6.4
	Total Dissolved Solids (mg/L) <sup>1</sup>	7	76.0	134.0	104.0	104.3	19.8
	Total Suspended Solids (mg/L) <sup>1</sup>	7	< 1.0	19.0	12.0	11.8	5.7
	Hardness (mg/L)	4	39.9	89.2	55.8	60.2	21.0
	Alkalinity (mg/L)	7	35.2	63.3	41.9	45.9	10.1
	Photic Zone (m)	7	1.80	3.37	2.35	2.38	0.59
	Secchi (m)	7	0.60	0.96	0.69	0.72	0.12
	Bottom Depth (m)	8	5.90	8.20	7.30	7.14	0.96
	<b>Chemical</b>						
	Ammonia Nitrogen (mg/L)	7	< 0.005	0.025	0.002	0.006	0.008
	Nitrate+Nitrite Nitrogen (mg/L) <sup>1</sup>	7	0.003	0.354	0.147	0.156	0.138
	Total Kjeldahl Nitrogen (mg/L)	7	0.212	0.981	0.479	0.561	0.258
	Total Nitrogen (mg/L) <sup>1</sup>	7	0.507	1.186	0.601	0.717	0.240
	Dissolved Reactive Phosphorus (mg/L) <sup>1</sup>	7	< 0.004	0.010	0.006	0.007	0.002
	Total Phosphorus (mg/L)	7	0.023	0.059	0.037	0.039	0.012
	CBOD-5 (mg/L)	7	< 2.0	2.5	1.0	1.2	0.6
	Chlorides (mg/L)	7	5.9	21.9	11.2	13.0	5.8
	<b>Biological</b>						
	Chlorophyll a (ug/L)	7	4.27	17.09	10.68	11.13	5.44
E. coli (mpn/100mL) <sup>1</sup>	3	5	8	7	7	1	
COFC-4	<b>Physical</b>						
	Turbidity (NTU)	7	15.0	115.0	45.2	51.1	33.2
	Total Dissolved Solids (mg/L)	7	66.0	180.0	92.0	102.9	37.9
	Total Suspended Solids (mg/L)	7	24.0	254.0	42.0	75.7	82.4
	Hardness (mg/L)	4	33.2	115.0	39.6	56.8	39.0
	Alkalinity (mg/L)	7	26.5	107.0	34.0	44.3	28.0
	Photic Zone (m)	7	0.20	1.00	0.40	0.47	0.25
	Secchi (m)	7	0.20	0.50	0.40	0.38	0.09
	Bottom Depth (m)	7	0.00	1.00	0.40	0.47	0.25
	<b>Chemical</b>						
	Ammonia Nitrogen (mg/L)	7	< 0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L) <sup>1</sup>	7	< 0.002	0.148	0.081	0.081	0.050
	Total Kjeldahl Nitrogen (mg/L) <sup>1</sup>	7	0.087	1.110	0.513	0.497	0.340
	Total Nitrogen (mg/L) <sup>1</sup>	7	< 0.130	1.180	0.600	0.578	0.358
	Dissolved Reactive Phosphorus (mg/L)	7	0.010	0.016	0.014	0.014	0.002
	Total Phosphorus (mg/L)	7	0.041	0.164	0.078	0.082	0.040
	CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7	3.9	11.5	5.7	6.2	2.6
	<b>Biological</b>						
	Chlorophyll a (ug/L)	7	< 0.10	18.69	2.14	5.28	6.61
E. coli (mpn/100mL) <sup>1</sup>	3	44	687	199	310	335	

Station	Parameter	N	Min	Max	Med	Mean	SD	
COFC-5	<b>Physical</b>							
	Turbidity (NTU)	7	13.2	39.3	22.8	24.5	8.5	
	Total Dissolved Solids (mg/L)	7	<	1.0	176.0	152.0	128.6	60.8
	Total Suspended Solids (mg/L)	7	<	1.0	25.0	18.0	15.4	8.6
	Hardness (mg/L)	4		46.8	119.0	109.5	96.2	33.3
	Alkalinity (mg/L)	7		36.4	121.0	105.0	97.8	28.4
	Photic Zone (m)	7		1.41	2.70	1.64	1.80	0.48
	Secchi (m)	7		0.33	0.70	0.48	0.47	0.12
	Bottom Depth (m)	7		1.00	3.30	2.10	2.20	0.62
	<b>Chemical</b>							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.002	0.008	0.002	0.003	0.002
	Total Kjeldahl Nitrogen (mg/L)	7		0.347	0.937	0.811	0.673	0.264
	Total Nitrogen (mg/L)	7	<	0.349	0.939	0.813	0.675	0.263
	Dissolved Reactive Phosphorus (mg/L)	7		0.004	0.016	0.007	0.008	0.004
	Total Phosphorus (mg/L)	7		0.039	0.062	0.051	0.051	0.010
	CBOD-5 (mg/L)	7	<	2.0	2.2	1.0	1.3	0.6
	Chlorides (mg/L)	7		6.0	13.3	9.0	8.1	2.4
	<b>Biological</b>							
	Chlorophyll a (ug/L)	7		4.45	26.70	13.88	14.41	7.96
	E. coli (col/100mL) <sup>J</sup>	3		9	44	29	27	18
COFC-6	<b>Physical</b>							
	Turbidity (NTU)	7		12.0	29.6	18.1	19.7	6.2
	Total Dissolved Solids (mg/L)	7		92.0	144.0	104.0	111.7	19.4
	Total Suspended Solids (mg/L) <sup>J</sup>	7		6.0	26.0	14.0	13.6	6.8
	Hardness (mg/L)	4		23.5	40.5	27.1	29.6	7.8
	Alkalinity (mg/L)	7		26.5	51.5	47.5	43.0	9.2
	Photic Zone (m)	7		1.19	1.73	1.63	1.53	0.22
	Secchi (m)	7		0.45	0.87	0.67	0.67	0.14
	Bottom Depth (m)	7		1.90	2.10	1.80	1.80	0.18
	<b>Chemical</b>							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.065	0.002	0.012	0.024
	Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7		0.016	0.044	0.031	0.031	0.008
	Total Kjeldahl Nitrogen (mg/L) <sup>J</sup>	7		0.147	0.837	0.387	0.414	0.248
	Total Nitrogen (mg/L) <sup>J</sup>	7		0.178	0.871	0.418	0.445	0.253
	Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7		0.008	0.012	0.009	0.009	0.002
	Total Phosphorus (mg/L)	7		0.037	0.067	0.048	0.052	0.012
	CBOD-5 (mg/L)	7	<	2.0	2.5	1.0	1.4	0.7
	Chlorides (mg/L)	7		4.2	9.5	7.4	7.0	2.0
	<b>Biological</b>							
	Chlorophyll a (ug/L)	7		2.67	10.68	7.63	6.99	3.30
	E. coli (mpn/100mL)	3		19	194	32	82	97



Station	Parameter	N	Min	Max	Med	Mean	SD	
COFC-7	<b>Physical</b>							
	Turbidity (NTU)	7	19.8	42.2	30.0	29.3	8.0	
	Total Dissolved Solids (mg/L) <sup>J</sup>	7	66.0	156.0	110.0	107.6	37.4	
	Total Suspended Solids (mg/L)	7	11.0	22.0	14.0	15.1	3.9	
	Hardness (mg/L)	4	28.1	39.4	33.6	33.6	4.6	
	Alkalinity (mg/L)	7	17.3	46.4	38.3	35.6	9.1	
	Photic Zone (m)	7	0.80	1.10	1.00	0.97	0.14	
	Secchi (m)	7	0.31	0.73	0.51	0.51	0.16	
	Bottom Depth (m)	8	0.90	1.10	1.05	0.98	0.16	
	<b>Chemical</b>							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.205	0.090	0.091	0.068
	Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7		0.010	0.098	0.042	0.046	0.029
	Total Kjeldahl Nitrogen (mg/L)	7		0.230	2.500	0.716	0.902	0.742
	Total Nitrogen (mg/L) <sup>J</sup>	7		0.282	2.528	0.809	0.949	0.737
	Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7		0.007	0.010	0.009	0.009	0.001
	Total Phosphorus (mg/L)	7		0.064	0.102	0.092	0.083	0.018
	CBOD-5 (mg/L)	7	<	2.0	2.1	1.0	1.2	0.4
	Chlorides (mg/L)	7		4.4	10.9	6.1	7.4	2.5
	<b>Biological</b>							
	Chlorophyll a (ug/L)	7		2.14	17.36	6.68	8.43	5.19
	E. coli (mpn/100mL)	3		50	122	57	76	40
COFC-8	<b>Physical</b>							
	Turbidity (NTU)	7	12.0	58.5	24.2	29.1	15.5	
	Total Dissolved Solids (mg/L)	7	92.0	182.0	132.0	126.6	30.5	
	Total Suspended Solids (mg/L) <sup>J</sup>	7	6.0	23.0	18.0	16.4	5.6	
	Hardness (mg/L)	4	43.2	60.2	47.6	49.7	7.3	
	Alkalinity (mg/L)	7	23.0	58.5	54.5	48.2	13.2	
	Photic Zone (m)	7	0.40	1.10	0.80	0.79	0.21	
	Secchi (m)	7	0.24	0.80	0.52	0.50	0.21	
	Bottom Depth (m)	7	0.00	1.30	0.80	0.84	0.29	
	<b>Chemical</b>							
	Ammonia Nitrogen (mg/L)	7	<	0.005	0.248	0.004	0.058	0.090
	Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7		0.009	0.197	0.061	0.086	0.067
	Total Kjeldahl Nitrogen (mg/L)	7		0.323	0.920	0.524	0.541	0.200
	Total Nitrogen (mg/L)	7		0.332	0.981	0.627	0.627	0.227
	Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7		0.004	0.013	0.009	0.009	0.004
	Total Phosphorus (mg/L)	7		0.028	0.103	0.073	0.069	0.022
	CBOD-5 (mg/L)	7	<	2.0	2.3	1.0	1.2	0.5
	Chlorides (mg/L)	7		3.7	12.7	8.4	8.9	3.3
	<b>Biological</b>							
	Chlorophyll a (ug/L)	7		0.76	16.69	8.54	8.34	6.49
	E. coli (col/100mL)	7		3	613	30	120	220

Station	Parameter	N	Min	Max	Med	Mean	SD
COFC-9	<b>Physical</b>						
	Turbidity (NTU)	7	12.7	25.5	15.3	16.9	4.5
	Total Dissolved Solids (mg/L)	7	32.0	170.0	128.0	118.0	47.7
	Total Suspended Solids (mg/L)	7	7.0	14.0	12.0	11.6	2.4
	Hardness (mg/L)	4	47.0	71.0	55.2	57.1	10.6
	Alkalinity (mg/L)	7	40.5	61.4	46.3	48.9	7.9
	Photic Zone (m)	7	1.23	2.18	1.76	1.78	0.31
	Secchi (m)	7	0.54	0.81	0.65	0.65	0.11
	Bottom Depth (m)	7	2.90	3.00	3.00	2.96	0.11
	<b>Chemical</b>						
	Ammonia Nitrogen (mg/L)	7	< 0.005	0.022	0.002	0.005	0.007
	Nitrate+Nitrite Nitrogen (mg/L) <sup>1</sup>	7	0.008	0.262	0.078	0.117	0.111
	Total Kjeldahl Nitrogen (mg/L)	7	0.312	1.790	0.593	0.745	0.516
	Total Nitrogen (mg/L) <sup>1</sup>	7	0.502	1.995	0.609	0.861	0.528
	Dissolved Reactive Phosphorus (mg/L) <sup>1</sup>	7	0.004	0.011	0.006	0.007	0.003
	Total Phosphorus (mg/L)	7	0.024	0.065	0.034	0.041	0.016
	CBOD-5 (mg/L)	7	< 2.0	3.0	1.0	1.3	0.8
	Chlorides (mg/L)	7	6.3	19.2	14.5	13.0	5.2
	<b>Biological</b>						
	Chlorophyll a (ug/L)	7	0.89	25.63	16.02	15.39	9.01
	E. coli (mpn/100mL) <sup>1</sup>	3	3	11	6	7	3
COFC-10	<b>Physical</b>						
	Turbidity (NTU)	7	13.0	29.0	16.7	18.8	5.4
	Total Dissolved Solids (mg/L)	7	78.0	174.0	130.0	123.4	40.2
	Total Suspended Solids (mg/L)	7	8.0	19.0	13.0	13.0	3.5
	Hardness (mg/L)	4	40.7	73.4	51.9	54.5	14.1
	Alkalinity (mg/L)	7	36.0	57.4	41.5	45.1	7.7
	Photic Zone (m)	7	1.37	2.21	1.77	1.78	0.28
	Secchi (m)	7	0.49	0.90	0.68	0.67	0.14
	Bottom Depth (m)	7	3.00	4.20	3.90	3.89	0.28
	<b>Chemical</b>						
	Ammonia Nitrogen (mg/L)	7	< 0.005	0.216	0.002	0.033	0.081
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.002	0.256	0.129	0.120	0.086
	Total Kjeldahl Nitrogen (mg/L)	7	0.153	1.120	0.537	0.524	0.338
	Total Nitrogen (mg/L)	7	< 0.217	1.268	0.595	0.644	0.340
	Dissolved Reactive Phosphorus (mg/L) <sup>1</sup>	7	0.004	0.010	0.005	0.006	0.002
	Total Phosphorus (mg/L)	7	0.021	0.061	0.037	0.038	0.014
	CBOD-5 (mg/L)	7	< 2.0	2.6	1.0	1.2	0.6
	Chlorides (mg/L)	7	5.0	20.5	12.0	12.6	5.8
	<b>Biological</b>						
	Chlorophyll a (ug/L)	7	4.27	26.70	12.97	13.35	7.05
	E. coli (mpn/100mL) <sup>1</sup>	3	2	58	18	26	29

Station	Parameter	N	Min	Max	Med	Mean	SD
COFC-11	<b>Physical</b>						
	Turbidity (NTU)	7	9.2	23.9	14.4	14.7	4.6
	Total Dissolved Solids (mg/L)	7 <	1.0	144.0	110.0	98.1	47.0
	Total Suspended Solids (mg/L)	7	6.0	11.0	9.0	8.7	1.7
	Hardness (mg/L)	4	42.4	74.9	55.4	57.0	13.6
	Alkalinity (mg/L)	7	37.6	56.8	42.7	45.3	7.2
	Photic Zone (m)	7	1.53	2.57	1.98	2.05	0.33
	Secchi (m)	7	0.57	1.22	0.73	0.81	0.23
	Bottom Depth (m)	7	4.90	5.80	5.50	5.29	0.47
	<b>Chemical</b>						
	Ammonia Nitrogen (mg/L)	7 <	0.005	0.007	0.002	0.003	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7 <	0.002	0.188	0.135	0.107	0.072
	Total Kjeldahl Nitrogen (mg/L)	7	0.210	0.710	0.491	0.450	0.178
	Total Nitrogen (mg/L)	7 <	0.211	0.749	0.658	0.557	0.216
	Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	0.003	0.012	0.006	0.007	0.003
	Total Phosphorus (mg/L)	7	0.019	0.056	0.029	0.033	0.014
	CBOD-5 (mg/L)	7 <	2.0	2.3	1.0	1.2	0.5
	Chlorides (mg/L)	7	5.0	18.1	9.6	10.2	4.6
	<b>Biological</b>						
	Chlorophyll a (ug/L)	7	0.67	19.36	15.13	12.60	6.06
E. coli (mpn/100mL) <sup>J</sup>	3	2	23	21	15	12	
COFC-12	<b>Physical</b>						
	Turbidity (NTU)	7	7.8	27.5	14.9	14.7	6.5
	Total Dissolved Solids (mg/L) <sup>J</sup>	7	80.0	186.0	120.0	123.1	38.2
	Total Suspended Solids (mg/L) <sup>J</sup>	7	5.0	13.0	7.0	8.1	3.1
	Hardness (mg/L)	4	41.8	83.5	53.4	58.0	18.1
	Alkalinity (mg/L)	7	36.5	61.8	43.8	46.6	8.9
	Photic Zone (m)	7	1.59	3.04	2.10	2.18	0.55
	Secchi (m)	7	0.52	1.27	0.74	0.82	0.27
	Bottom Depth (m)	7	4.00	4.90	4.50	4.51	0.24
	<b>Chemical</b>						
	Ammonia Nitrogen (mg/L)	7 <	0.005	0.035	0.002	0.007	0.012
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.033	0.339	0.156	0.177	0.118
	Total Kjeldahl Nitrogen (mg/L)	7	0.246	0.699	0.342	0.376	0.169
	Total Nitrogen (mg/L)	7	0.279	0.855	0.646	0.553	0.231
	Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	0.003	0.012	0.007	0.008	0.004
	Total Phosphorus (mg/L)	7	0.023	0.051	0.028	0.034	0.012
	CBOD-5 (mg/L)	7 <	2.0	3.3	1.0	1.3	0.9
	Chlorides (mg/L)	7	4.9	23.1	11.7	13.4	7.0
	<b>Biological</b>						
	Chlorophyll a (ug/L)	7	6.41	18.69	7.57	10.24	4.37
E. coli (mpn/100mL) <sup>J</sup>	3	1	26	2	10	14	

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