

*2006 Aliceville Reservoir Report*  
*Rivers and Reservoirs Monitoring Program*

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Field Operations Division  
Environmental Indicators Section  
Aquatic Assessment Unit  
May 2011

# **Rivers and Reservoirs Monitoring Program**

**2006**

## **Aliceville Reservoir** Upper Tombigbee River Basin

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

**May 2011**

## Table of Contents

<b>LIST OF FIGURES .....</b>	<b>4</b>
<b>LIST OF TABLES .....</b>	<b>5</b>
<b>INTRODUCTION.....</b>	<b>6</b>
<b>METHODS .....</b>	<b>7</b>
<b>RESULTS .....</b>	<b>10</b>
<b>REFERENCES.....</b>	<b>20</b>
<b>APPENDIX.....</b>	<b>22</b>

**LIST OF FIGURES**

**Figure 1. Aliceville Reservoir with 2006 sampling locations..... 8**

**Figure 2. Mean total nitrogen (TN), mean total phosphorus (TP), mean chlorophyll *a* (chl *a*) and mean total suspended solids (TSS) measured at the three Aliceville Reservoir stations, April-October 2006 ..... 12**

**Figure 3. Monthly total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the upper station in Aliceville Reservoir, April-October 2006..... 13**

**Figure 4. Monthly total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of Coal Fire Creek, April-October 2006..... 14**

**Figure 5. Monthly total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the dam forebay station in Aliceville Reservoir, April-October 2006 ..... 15**

**Figure 6. Mean chlorophyll *a* concentrations of Aliceville Reservoir, 2001 through 2006..... 16**

**Figure 7. Monthly depth profiles of dissolved oxygen (DO) and temperature (Temp) in Aliceville Reservoir, June-September 2006..... 17**

**Figure 8. Monthly DO concentrations at 5 ft (1.5m) for Aliceville Reservoir stations collected April-October 2006 ..... 18**

**Figure 9. Monthly TSI values for Aliceville Reservoir stations using chlorophyll *a* concentrations and Carlson’s Trophic State Index calculation, April-October 2006 ..... 19**

**Figure 10. Trophic State Index values from critical period sampling (August sampling only) from 1985 to 2006..... 19**

**LIST OF TABLES**

**Table 1. Descriptions of the 2006 monitoring stations in Aliceville Reservoir..... 9**

**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..... 16**

**Appendix Table 1. Summary of water quality data collected April-October, 2006 ..... 23**

## INTRODUCTION

With the completion of the Tom Bevill Dam in 1980, Aliceville Reservoir joined the Tennessee-Tombigbee Waterway (Tenn-Tom) system that connects the Tennessee River with the Tombigbee River. Located in Pickens County, Aliceville Reservoir is the first Alabama reservoir on Tenn-Tom system. The 234-mile waterway flows south from Pickwick Lake on the Tennessee River, down through northeast Mississippi and west Alabama to connect with the established Warrior-Tombigbee navigation system at Demopolis, Alabama. After 12 years of construction, the waterway opened to commercial traffic in January 1985.

The Alabama Department of Environmental Management (ADEM) monitored Aliceville Reservoir as part of the 2006 assessment of the Escatawpa, Mobile, and Tombigbee 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, 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 2005 Monitoring Strategy.

Aliceville Reservoir was placed on Alabama's 1996 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its Swimming (S)/Fish & Wildlife (F&W) water use classifications. The reservoir was listed for impairments caused by organic enrichment/dissolved oxygen (OE/DO). A total maximum daily load (TMDL), developed to address this impairment, was approved by the US EPA in 2008.

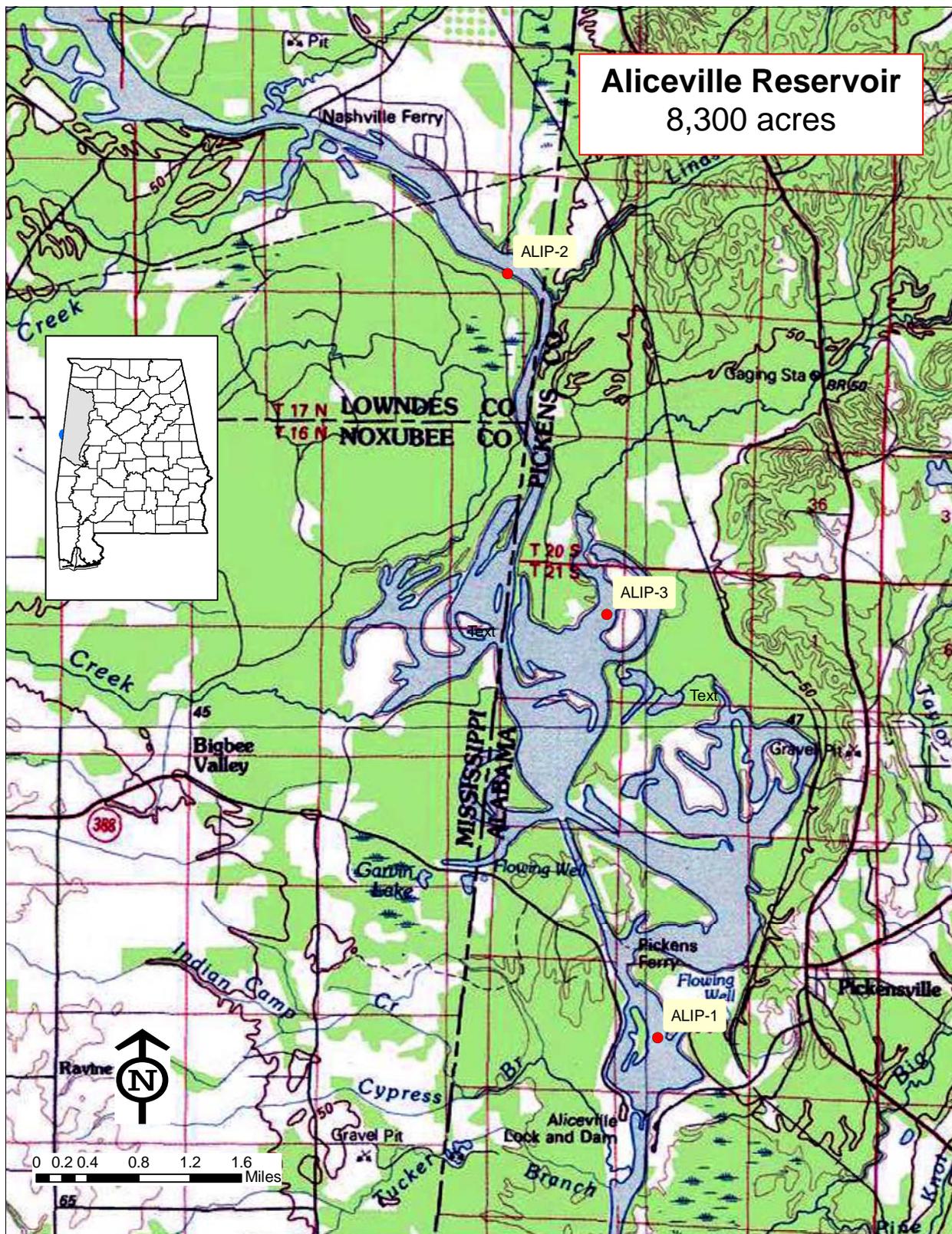
The purpose of this report is to summarize data collected at three stations in Aliceville Reservoir during the 2006 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic dataset. Monthly and mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (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 selected using historical data and previous assessments ([Fig. 1](#)). Specific location information is listed in [Table 1](#). Aliceville Reservoir was sampled in the dam forebay, the upper reservoir just upstream of the Lindsey Creek confluence near the state line, and in the Coal Fire Creek embayment.

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 2007), Surface Water Quality Assurance Project Plan (ADEM 2005), and Quality Assurance Management Plan (ADEM 2003b)

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 USGS flow data and ADEM's previously collected data to help interpret the 2006 results.



**Figure 1.** Aliceville Reservoir with 2006 sampling locations. A description of each sampling location is provided in Table 1.

**Table 1.** Descriptions of the 2006 monitoring stations in Aliceville Reservoir.

Sub-watershed	County	Station Number	Report Designation	Waterbody Name	Station Description	Latitude	Longitude
<b>Aliceville Reservoir</b>							
<b>Upper Tombigbee (0315-0105)</b>							
0502	Pickens	ALIP-1	Lower	Tombigbee R	Lower reservoir. Deepest point, main river channel, dam forebay.	33.2191	-88.2861
0308	Pickens	ALIP-2	Upper	Tombigbee R	Upper reservoir. Deepest point, main river channel, immed. upstream of Lindsey Branch confluence.	33.3030	-88.3029
0203	Pickens	ALIP-3	Coal Fire	Coal Fire Cr	Deepest point, main creek channel, Coal Fire Creek embayment, approx. one mile upstream of confluence with Tombigbee River.	33.2669	-88.2936

## RESULTS

Summary statistics of all data collected during 2006 are presented in [Appendix Table 1](#). The table contains the min, max, median, mean, and standard deviation of each parameter analyzed.

Mean TN concentrations at mainstem stations were higher than the mean TN concentration of Coal Fire Creek ([Fig. 2](#)). Mean TN concentrations for all stations were higher in 2006 than in 2001 (ADEM 2003a). TN tended to increase monthly for the upper and lower stations, with the highest values recorded in September and October ([Fig. 3 & 5](#)). Monthly TN concentrations in Coal Fire Creek embayment were at historic highs June through October (n=4), with the highest monthly concentration of the season measured in July ([Fig. 4](#)).

Mean TP concentrations at both mainstem stations were higher than the mean TP concentration of Coal Fire ([Fig. 2](#)). Mean TP concentrations at all three stations were lower in 2006 than in 2001 (ADEM 2003a). At mainstems stations, monthly TP concentrations were highest during May and October, when flows were also highest. By contrast, Coal Fire Creek was relatively stable and below historic means for six of the seven sampling events ([Fig. 3, 4, & 5](#)).

Mainstem mean chl *a* concentrations were higher in 2006 than in 2001 ([Fig. 2](#), ADEM 2003a). The highest mean chl *a* concentration was in Coal Fire Creek in both 2001 and 2006 ([Fig. 2](#); ADEM 2003a). The monthly chl *a* concentration at Coal Fire Creek was highest in June (35 µg/l) and exceeded 20 µg/l in both April and September ([Fig. 4](#)). The highest concentrations in both mainstem stations occurred in May and September ([Fig. 3 & 5](#)). While the mean chl *a* has been generally increasing at the upper station, the lower station has decreased since 2003 ([Fig. 6](#)). Coal Fire Creek increased 2001-2004 then decreased in 2006 ([Fig. 6](#)).

The 2006 mean TSS concentrations were 14.1 mg/L and 14.9 mg/L at the upper and lower stations, respectively ([Fig. 2](#)). These values were lower and less variable than concentrations measured in 2001 (ADEM 2003a). Mean TSS concentration at Coal Fire Creek was also lower in 2006 than in 2001 ([Fig. 2](#), ADEM 2003a). Monthly TSS concentrations at all

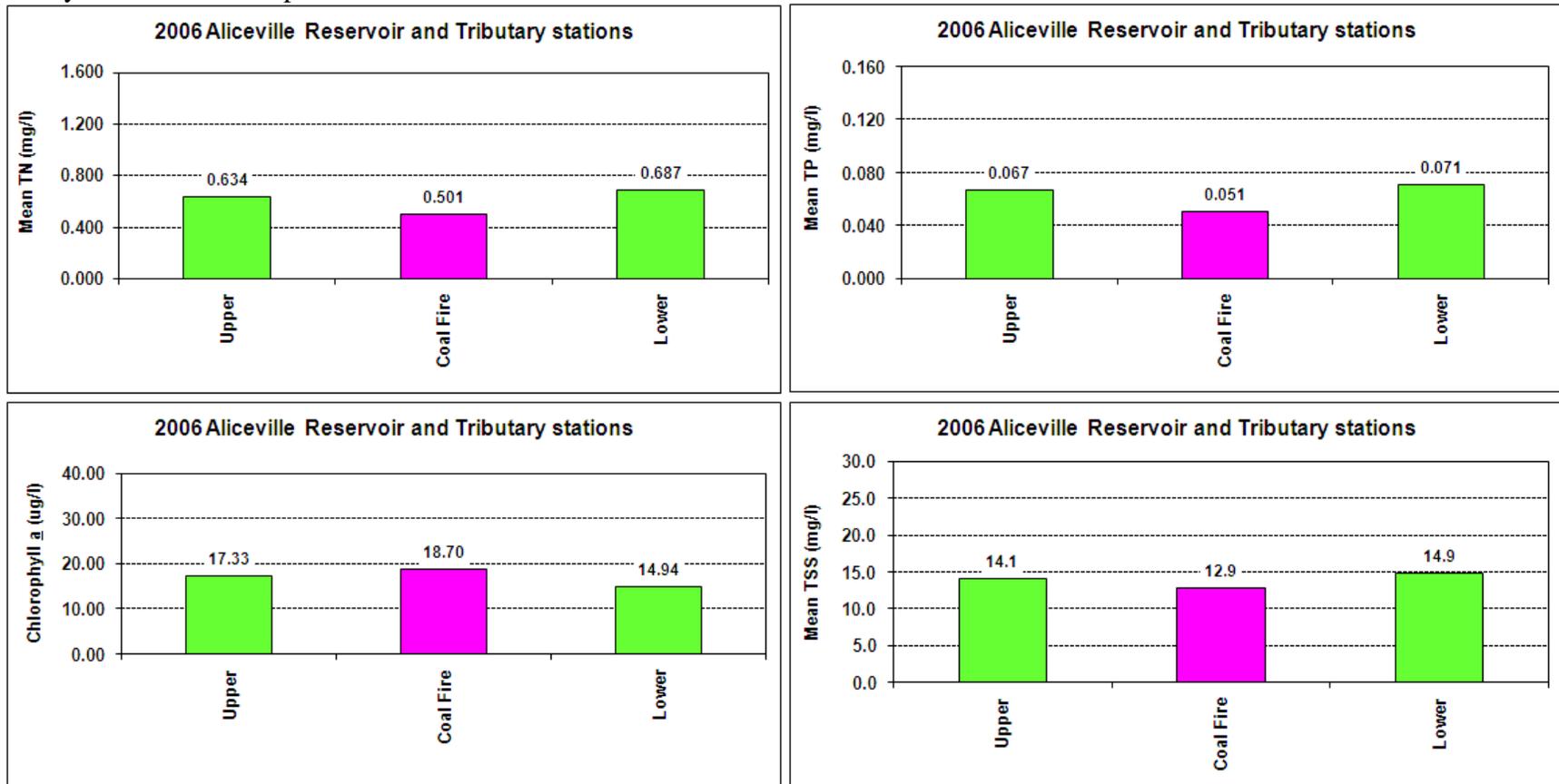
three reservoir stations were below historic mean values (n=4) April-September ([Fig. 3, 4, & 5](#)). In October, the upper and lower stations measured historically high concentrations while Coal Fire remained below historic means ([Fig. 3, 4, & 5](#)). Monthly TSS concentrations at the mainstem stations were higher during periods of higher discharge ([Fig. 3 & 5](#)).

AGPT results indicated the entire reservoir was nitrogen limited, similar to results obtained in 2001 ([Table 2](#)). The mean standing crop (MSC) value at the lower reservoir in 2006 was just above 5 mg/L, the value that Raschke et al. (1996) defined as protective of reservoir and lake systems.

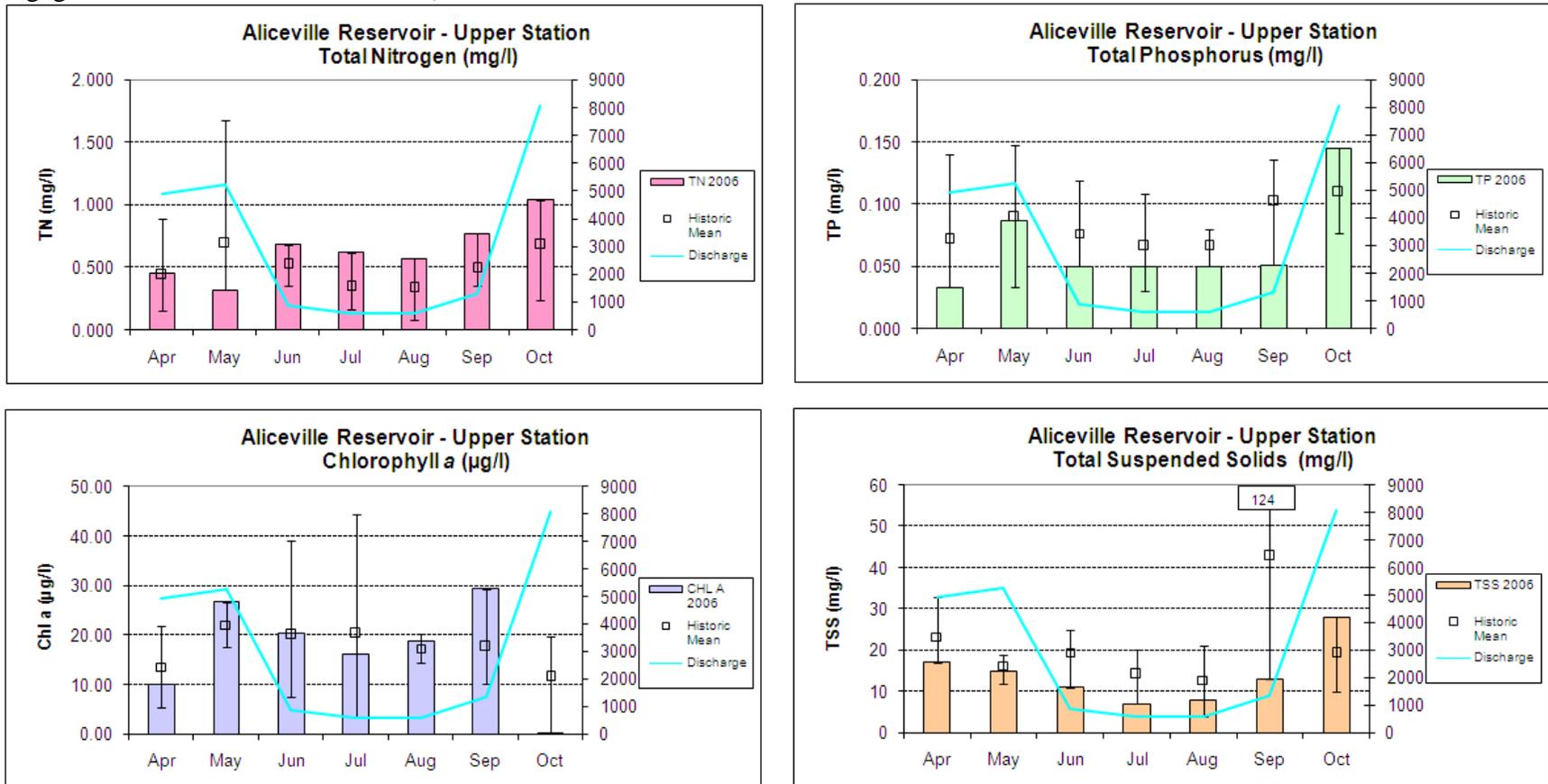
Profiles of dissolved oxygen concentrations indicate the water column was well mixed at all stations, June through September ([Fig. 7](#)). Coal Fire Creek was deoxygenated near the bottom when water temperatures were greatest ([Fig. 7](#)). While water temperatures were at or above 30°C June-August, the entire water column was at least five and half degrees colder in September at all stations ([Fig. 7](#)). Dissolved oxygen concentrations in the upper reservoir and Coal Fire Creek stations met the ADEM Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5 ft (1.5 m) though the concentration at the upper station in July was near the limit ([Fig. 8](#)). Dissolved oxygen concentrations at the lower station were less than the ADEM criteria in July and August, and just above 5.0 mg/L in June ([Fig. 8](#)).

Monthly TSI was calculated using Carlson's Trophic State Index. TSI values were generally eutrophic, with the exception of the lower station in July, and Coal Fire Creek and the upper station in October ([Fig.9](#)). August TSI values calculated from data collected at Aliceville stations, 1985-2006, are presented in [Fig. 10](#). For each station, August TSI values were eutrophic throughout the entire historic record (1985-2006).

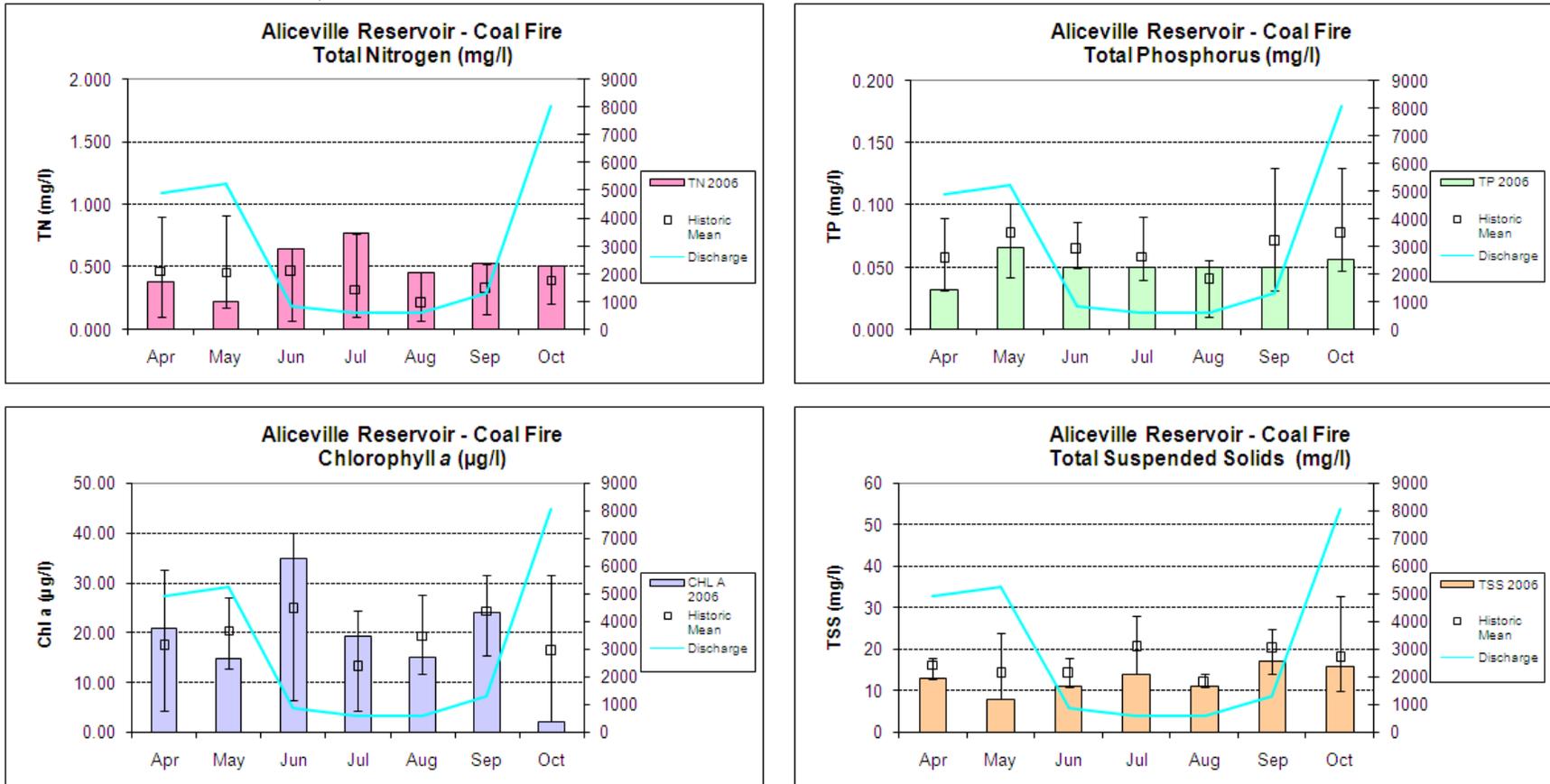
**Figure 2.** Mean total nitrogen (TN), mean total phosphorus (TP), mean chlorophyll *a* (chl *a*) and mean total suspended solids (TSS) measured at the three Aliceville Reservoir stations, April-October 2006. Bar graphs consist of multiple stations, illustrated from upstream to downstream as the graph is read from left to right. The green bars represent the mainstem stations and the tributary embayment station is in pink.



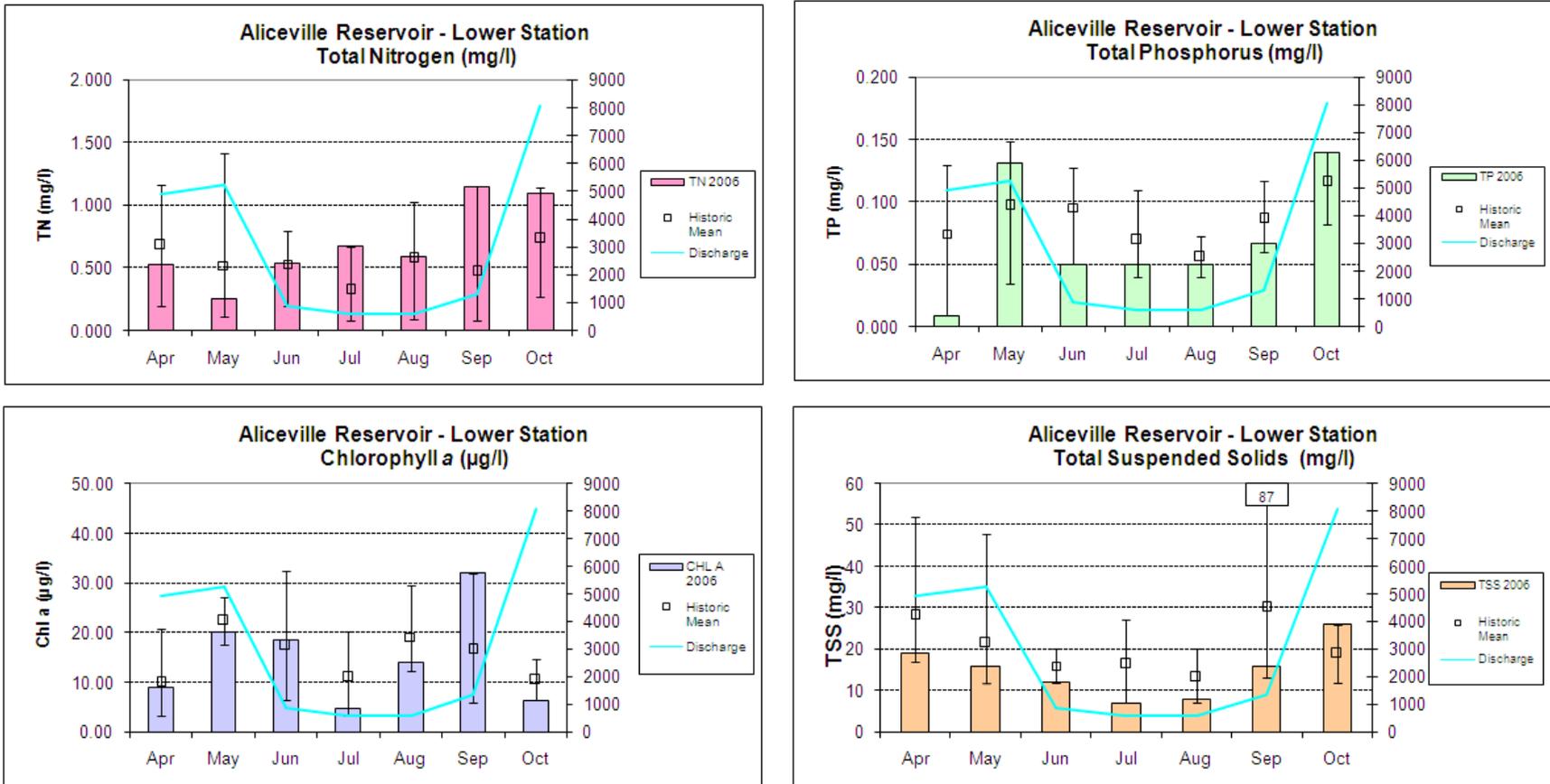
**Figure 3.** Monthly total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the upper station in Aliceville Reservoir, April-October 2006. Each bar graph depicts monthly changes in the variables at the upper station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS were plotted vs. discharge (USGS Tombigbee R gage at Stennis Lock and Dam, MS)



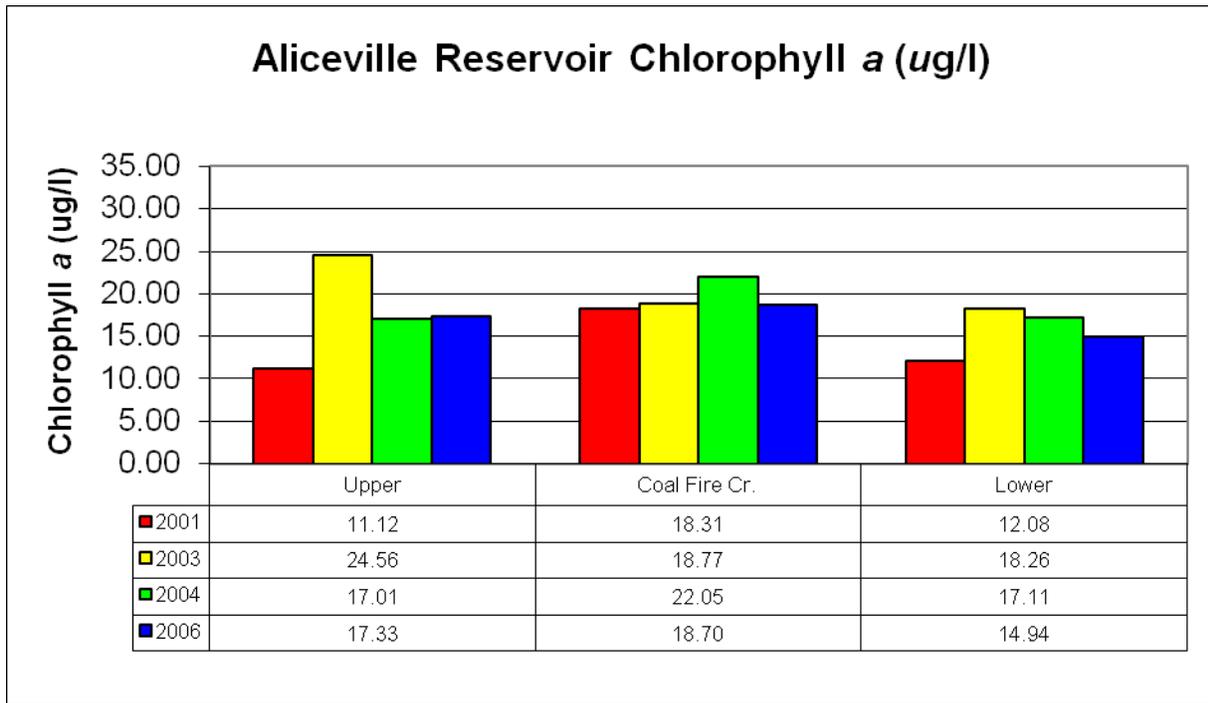
**Figure 4.** Monthly total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of Coal Fire Creek, April-October 2006. Each bar graph depicts monthly changes in the variables at the mid-reservoir station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS were plotted vs. discharge (USGS Tombigbee R gage at Stennis Lock and Dam, MS)



**Figure 5.** Monthly total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the dam forebay station in Aliceville Reservoir, April-October 2006. Each bar graph depicts monthly changes in the variables at the lower reservoir station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS were plotted vs. discharge (USGS Tombigbee R gage at Stennis Lock and Dam, MS)



**Figure 6.** Mean chlorophyll *a* concentrations of Aliceville Reservoir, 2001 through 2006.

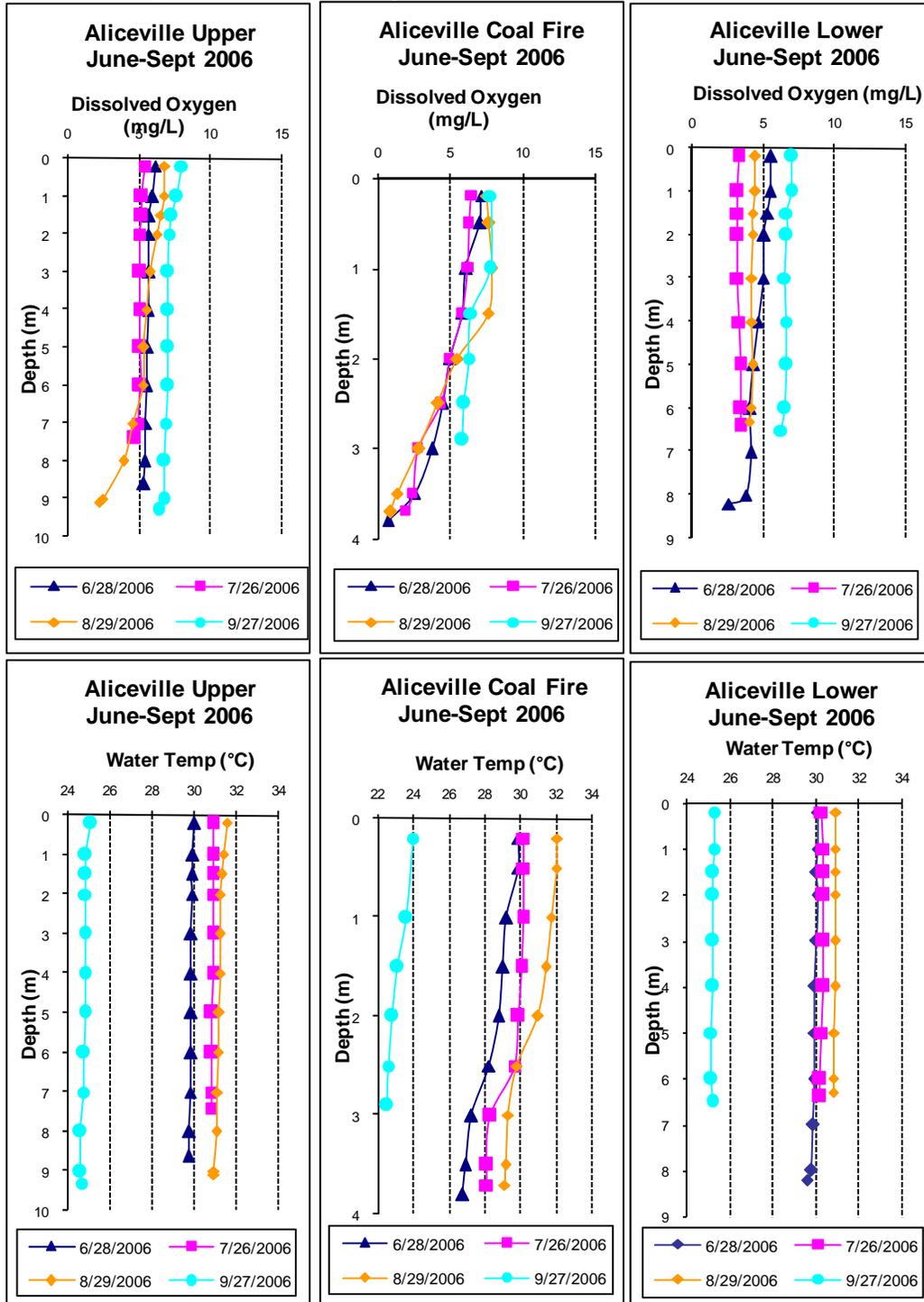


**Table 2.** Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. Mean standing crop (MSC) values below 5 mg/l are considered to be protective in reservoirs and lakes; MSC values below 20 mg/l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

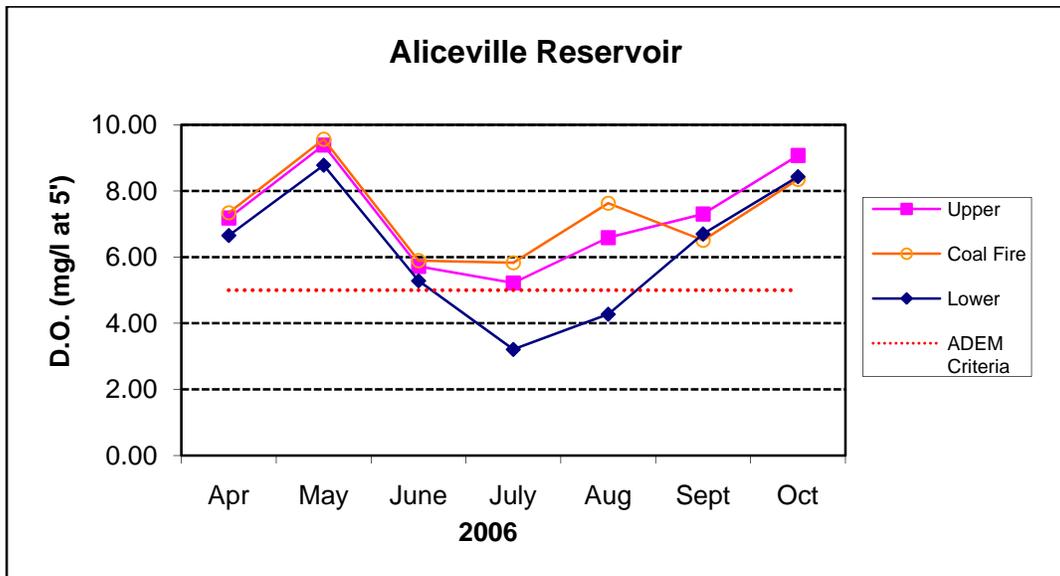
Station	2001 Control mean MSC	2001 Limiting Nutrient	2006 Control mean MSC	2006 Limiting Nutrient
Upper	4.88	Nitrogen	4.61	Nitrogen
Coal Fire Cr.	*		3.72	Nitrogen
Lower	1.79	Nitrogen	5.14	Nitrogen

\* Coal Fire Creek Station was not sampled for AGPT in 2001.

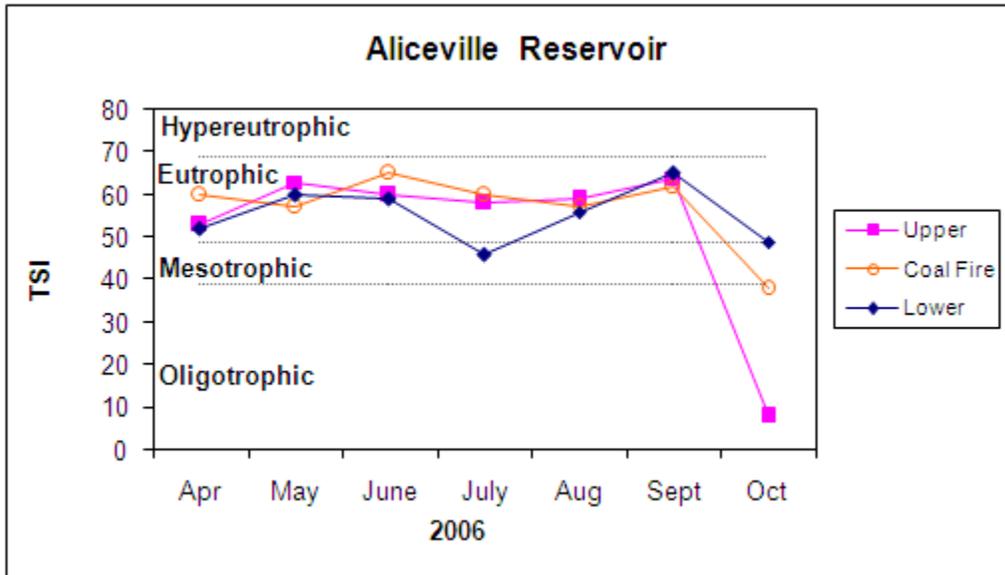
**Figure 7.** Monthly depth profiles of dissolved oxygen (DO) and temperature (Temp) in Aliceville Reservoir, June-September 2006. Although profiles were measured April-October, these select months were chosen as they represent the warmest water temperatures and most stratified dissolved oxygen concentrations. ADEM Water Quality Criteria pertaining to non-wadeable river and reservoir waters require a DO concentration of 5.0 mg/l at 5.0ft (1.5m) (ADEM Admin. Code R. 335-6-10-.09). Under extreme natural conditions such as drought, the DO concentration may be as low as 4.0 mg/l.



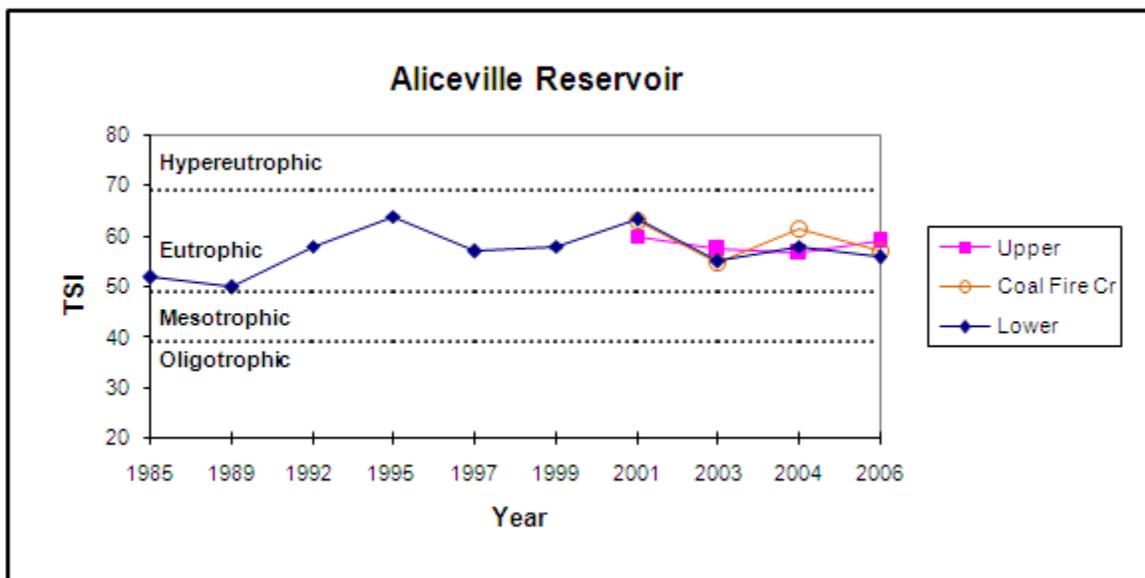
**Figure 8.** Monthly DO concentrations at 5 ft (1.5m) for Aliceville Reservoir stations collected April-October 2006. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/l at this depth (ADEM 2005).



**Figure 9.** Monthly TSI values for Aliceville Reservoir stations using chlorophyll *a* concentrations and Carlson's Trophic State Index calculation, April-October 2006.



**Figure 10.** Trophic State Index values from critical period sampling (August sampling only) from 1985 to 2006.



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## APPENDIX

**Appendix Table 1.** Summary of water quality data collected April-October, 2006. Minimum (Min) and maximum (Max) values calculated using minimum detection limits (MDL) 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.

Station	Parameter	N	Min	Max	Median	Mean	SD
ALIP-1	Alkalinity (mg/L)	7	31.9	73.2	44.7	46.3	14.0
	Total Dissolved Solids (mg/L)	7	70.0	295.0	159.0	152.4	75.8
	Total Suspended Solids (mg/L)	7	7.0	26.0	16.0	14.9	6.6
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.064	0.008	0.019	0.021
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.342	0.006	0.092	0.147
	Total Kjeldahl Nitrogen (mg/L)	7	0.246	0.824	0.585	0.596	0.198
	Total Nitrogen (mg/L)	7	0.250	1.150	0.590	0.689	0.322
	Total Phosphorus (mg/L)	7	0.009	0.140	0.050	0.071	0.048
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.052	0.006	0.016	0.021
	Chlorophyll a (mg/L)	7	4.81	32.04	13.90	14.94	9.52
	Turbidity (NTU)	7	7	32	10	14	9
	Secchi (m)	7	0.43	0.93	0.72	0.68	0.18
	Fecal Coliform (col/100 mL) <sup>J</sup>	1	---	---	---	9	---
ALIP-2	Alkalinity (mg/L)	7	31.6	51.5	48.3	44.5	8.4
	Total Dissolved Solids (mg/L)	7	73.0	219.0	119.0	143.0	51.8
	Total Suspended Solids (mg/L)	7	7.0	28.0	13.0	14.1	7.1
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.065	0.008	0.016	0.022
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.257	0.013	0.051	0.092
	Total Kjeldahl Nitrogen (mg/L)	7	0.303	0.787	0.604	0.583	0.175
	Total Nitrogen (mg/L)	7	0.320	1.040	0.620	0.636	0.232
	Total Phosphorus (mg/L)	7	0.033	0.145	0.050	0.067	0.038
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.056	0.007	0.015	0.019
	Chlorophyll a (mg/L)	7	< 0.10	29.37	18.90	17.33	9.99
	Turbidity (NTU)	7	6	32	12	14	9
	Secchi (m)	7	0.42	1.20	0.70	0.73	0.25
	Fecal Coliform (col/100 mL) <sup>J</sup>	1	---	---	---	1	---
ALIP-3	Alkalinity (mg/L)	7	1.0	44.4	38.5	32.8	15.4
	Total Dissolved Solids (mg/L)	7	59.0	248.0	125.0	123.7	67.5
	Total Suspended Solids (mg/L)	7	8.0	17.0	13.0	12.9	3.1
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.044	0.008	0.013	0.014
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.079	0.029	0.031	0.030
	Total Kjeldahl Nitrogen (mg/L)	7	0.194	0.765	0.450	0.470	0.188
	Total Nitrogen (mg/L)	7	0.220	0.770	0.510	0.503	0.178
	Total Phosphorus (mg/L)	7	0.032	0.100	0.050	0.051	0.010
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.008	0.002	0.003	0.003
	Chlorophyll a (mg/L)	7	2.14	35.00	19.20	18.70	10.02
	Turbidity (NTU)	7	8	16	14	13	3
	Secchi (m)	6	0.60	1.03	0.69	0.67	0.34
	Fecal Coliform (col/100 mL)	1	---	---	---	50	---

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