2014 West Point Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
March 2016

Rivers and Reservoirs Monitoring Program

2014

West Point Reservoir

Chattahoochee River Basin

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

March 2016

Table of Contents

LIST OF ACRONYMS

A&I	Agriculture and Industry water supply use classification
ADEM	Alabama Department of Environmental Management
AGPT	Algal Growth Potential Test
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

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

West Point Reservoir's (West Point) 25,900 acre water body was established in 1972 by U.S. Corp of Engineers (Corp) with the completion of West Point Dam on the Chattahoochee River system. The Corp maintains the dam for flood control, hydroelectric production, and recreation.

The Alabama Department of Environmental Management (ADEM) monitored West Point Reservoir as part of the 2014 assessment of the Chattahoochee and Perdido-Escambia 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 2012 Monitoring Strategy.

In 2001, the ADEM implemented a specific water quality criterion for nutrient management at one location on West Point at LaGrange, Georgia. Although this site is monitored by the Georgia Department Environmental Protection, the upper West Point Reservoir station has been monitored by ADEM since 1999, and is used by ADEM to verify compliance of the criteria. This criterion represents the maximum growing season mean (Apr-Oct) 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 three stations in West Point during the 2014 growing season and to evaluate growing season 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 historical data and established criteria.

METHODS

Sampling stations were selected using historical data and previous assessments (Fig. 1). Specific location information can be found in Table 1. West Point Reservoir was sampled in the dam forebay with additional stations in the Wehadkee Creek embayment and upper reservoir.

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 2014), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

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 U.S. Corps of Engineers flow data and ADEM's previously collected data to help interpret the 2014 results.

Figure 1. West Point Reservoir with 2014 sampling locations. A description of each sampling location is provided in Table 1.

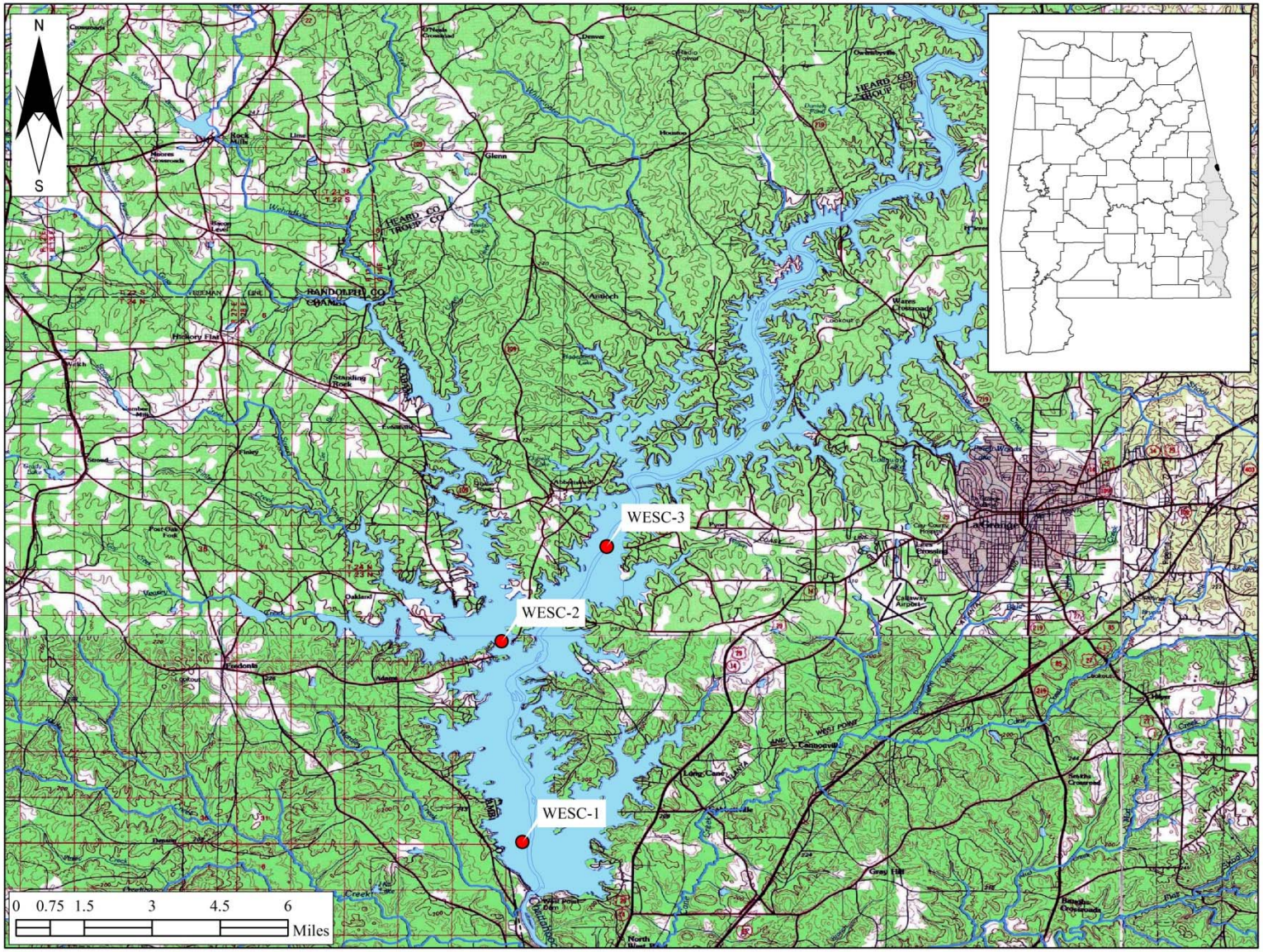


Table 1. Descriptions of the 2014 monitoring stations in West Point Reservoir.

HUC	County	Station Number	Report Designation	Waterbody Name	Station Description	Latitude	Longitude
West Point Reservoir							
031300020808	Chambers	WESC-1	Lower	Chattahoochee R.	Deepest point, main river channel, dam forebay.	32.93429	-85.19174
031300020806	Chambers	WESC-2	Wehadkee	Wehadkee Cr	Deepest point, main creek channel, immediately downstream of Wehadkee/Veasey/Stroud Creeks confluence.	32.99830	-85.19835
031300020807	Chambers	WESC-3	Upper	Chattahoochee R	Deepest point, main river channel, at GA Hwy. 109 bridge.	33.02865	-85.16483

RESULTS

Growing season mean graphs for TN, TP, chl *a*, and TSS are provided in this section (Figs. 2 and 3). Monthly graphs for TN, TP, chl *a*, TSS, DO, and TSI are also provided (Figs. 4-8 and 10), 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, DO, and conductivity appear in Fig. 9. Summary statistics of all data collected during 2014 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, chlorophyll, and TSS are noted in the paragraphs to follow. Though stations with lowest concentrations are not mentioned, review of the graphs that follow will indicate these stations that may be potential candidates for reference waterbodies and watersheds.

As in previous years, the highest mainstem growing season mean TN in 2014 was observed in the upper station (Fig. 2). Monthly TN concentrations were highest in September in the upper station and in October in the Wehadkee and lower stations (Fig. 4). Monthly TN concentrations were near or below historic means throughout the reservoir April-July.

The growing season mean TP concentrations in all West Point Reservoir monitoring locations are similar and have declined steadily since 2004 (Fig. 2). Monthly TP concentrations at all stations were generally at or below historic means (Fig. 5).

Mean growing season chl *a* concentrations during 2014 in all West Point Reservoir stations were the lowest calculated since sampling began and well below the criteria established upstream of the upper station (Fig. 3). Monthly chl *a* concentrations were at or below historic means all months monitored with no clear trend (Fig. 6). Historic lows were measured in the lower station during June, July, and September and in the upper and Wehadkee Ck stations during April, and June through September.

Growing season mean TSS concentrations in all West Point Reservoir stations declined overall 2004 through 2012 then increased in 2014 (Fig. 3). With the exception of the lower station

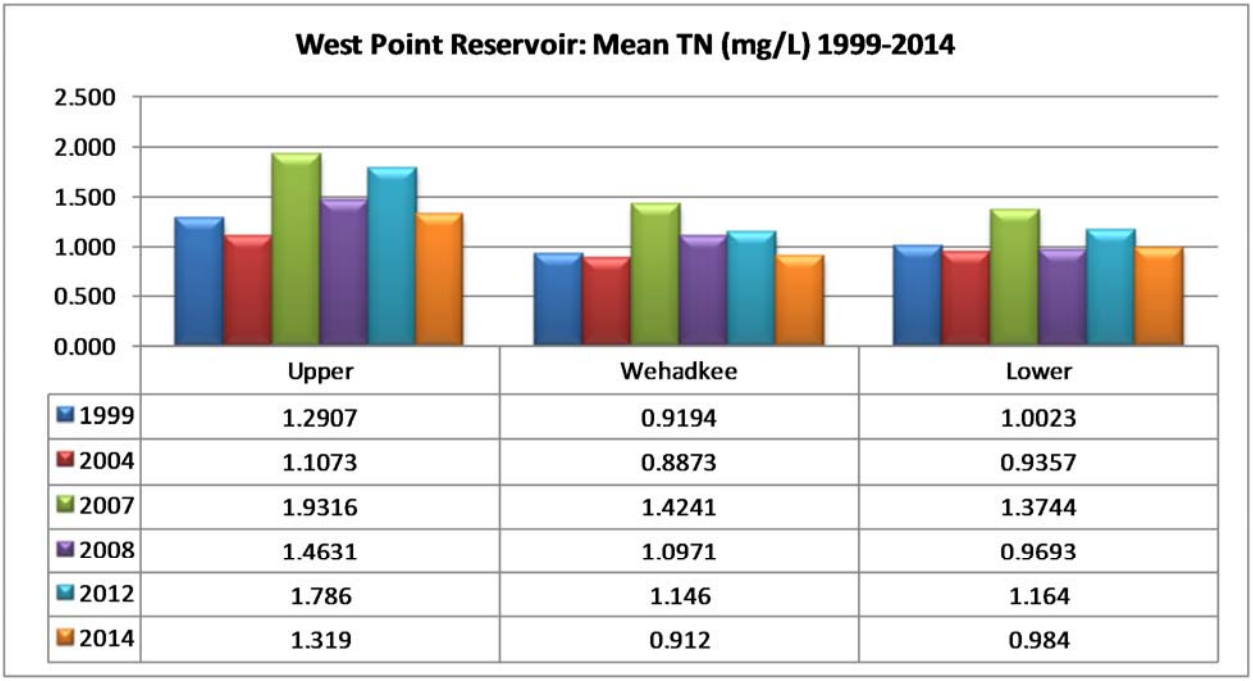
in August, all monthly concentrations were near or below historic means April through October (Fig. 7).

AGPT results show all stations have remained phosphorus limited since 1999 (Table 2). Mean standing crop (MSC) values in the lower and Wehadkee Ck stations were below 5 mg/L, the value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems (Table 2); however the upper station exceeded this limit for the first time since monitoring began in 1999.

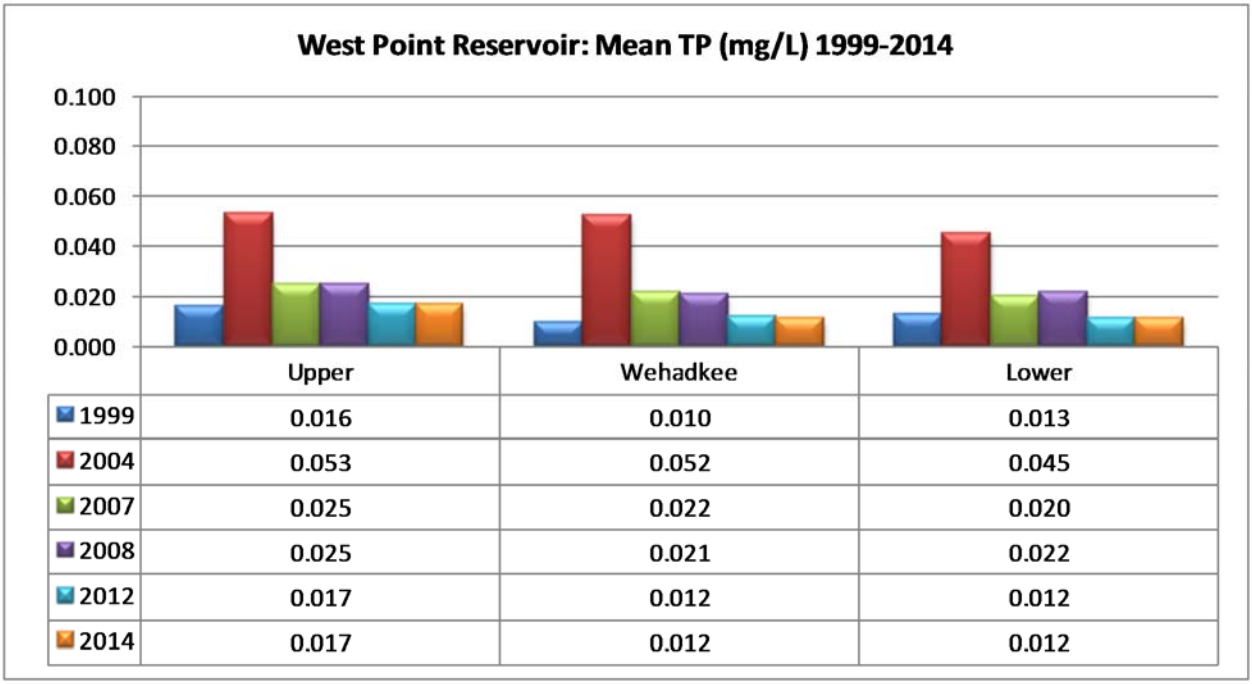
Dissolved oxygen concentrations in the Wehadkee Ck station did not meet the ADEM Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) in September (Fig. 8). All other DO concentrations met the 5.0 mg/L criteria, though concentrations declined overall during the growing season and were below 6.0 mg/L in the lower and upper stations in September. Based on monthly DO profiles, the lower station was stratified in most months (Fig. 9). From June through September conditions were essentially deoxygenated in the lower half of the water column. Highest temperatures were recorded in June (Fig. 9).

Monthly TSI values were calculated using chl *a* concentrations and Carlson's Trophic State Index. TSI values calculated for the lower station ranged from eutrophic in April to oligotrophic in July and September while the upper station varied between mesotrophic and eutrophic throughout the sample season (Fig. 10). The Wehadkee Ck station was mostly mesotrophic.

Figure 2. Growing season mean TN and TP concentrations measured in West Point Reservoir, April-October 1999-2014. Bar graphs consist of the Wehadkee Creek and upper and lower mainstem stations, illustrated from upstream to downstream as the graph is read from left to right.

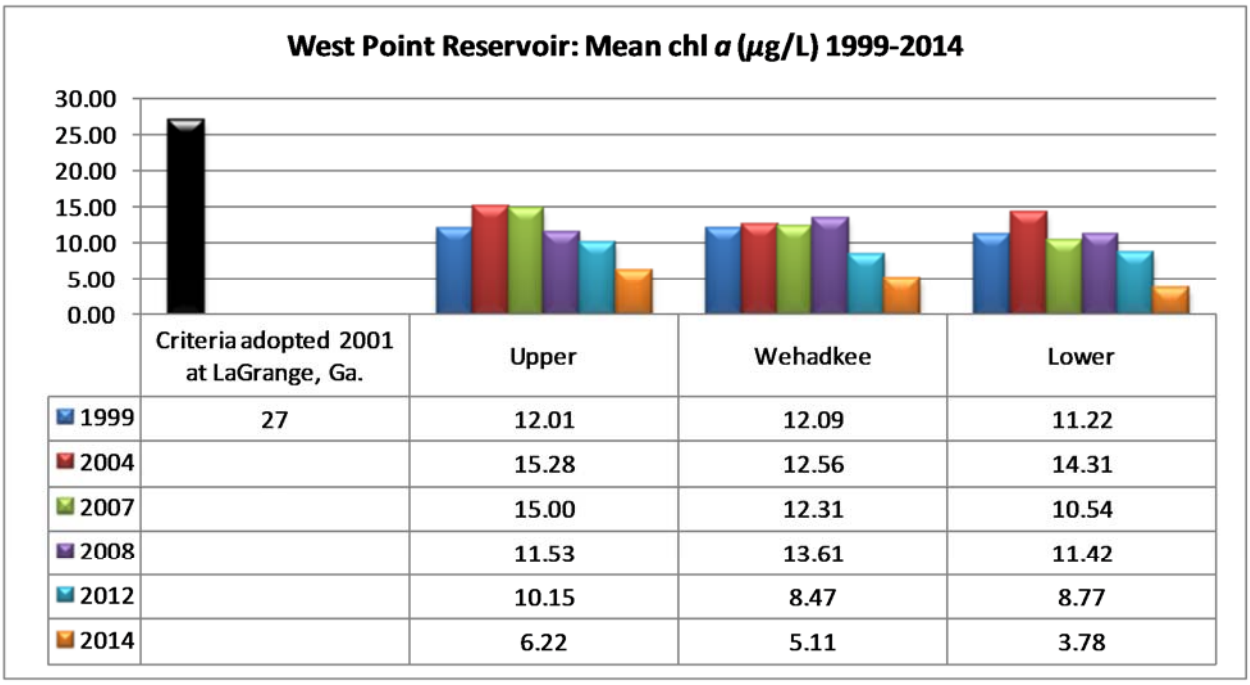


	Upper	Wehadkee	Lower
1999	1.2907	0.9194	1.0023
2004	1.1073	0.8873	0.9357
2007	1.9316	1.4241	1.3744
2008	1.4631	1.0971	0.9693
2012	1.786	1.146	1.164
2014	1.319	0.912	0.984

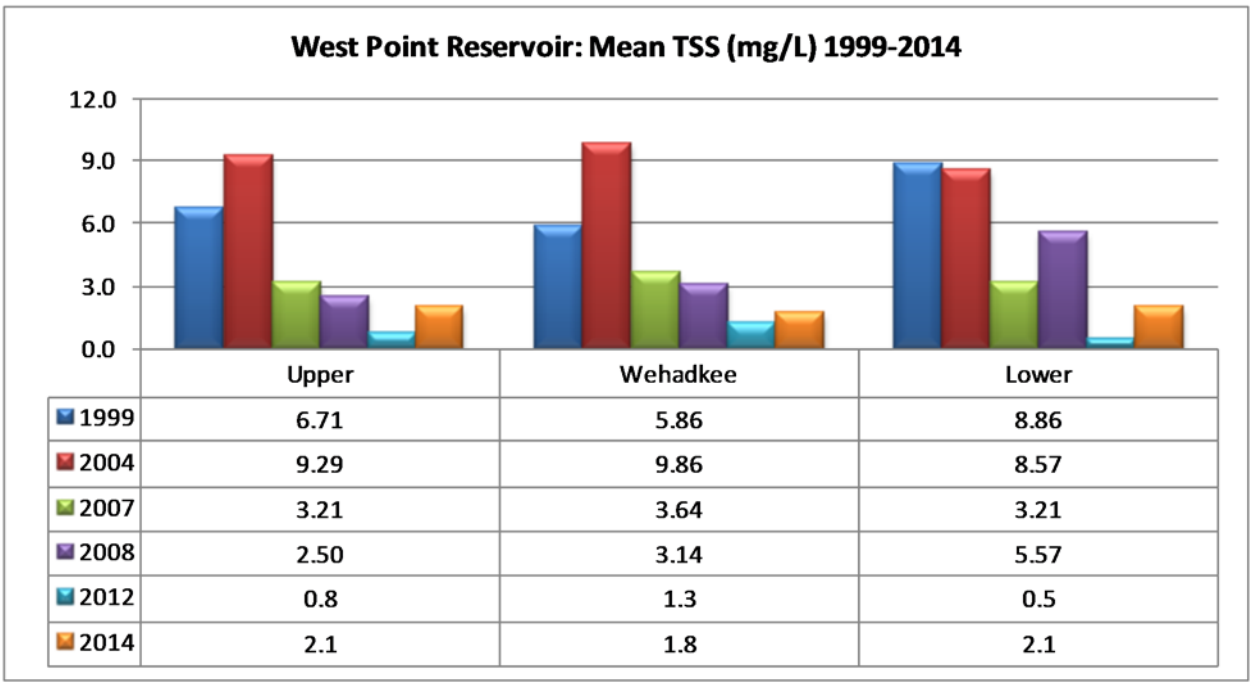


	Upper	Wehadkee	Lower
1999	0.016	0.010	0.013
2004	0.053	0.052	0.045
2007	0.025	0.022	0.020
2008	0.025	0.021	0.022
2012	0.017	0.012	0.012
2014	0.017	0.012	0.012

Figure 3. Growing season mean chl *a* and TSS concentrations measured in West Point Reservoir, April-October 1999-2014. Bar graphs consist of the Wehadkee Creek and upper and lower mainstem stations, illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria at LaGrange, GA is used as a comparison for compliance at downstream locations.



	Criteria adopted 2001 at LaGrange, Ga.	Upper	Wehadkee	Lower
1999	27	12.01	12.09	11.22
2004		15.28	12.56	14.31
2007		15.00	12.31	10.54
2008		11.53	13.61	11.42
2012		10.15	8.47	8.77
2014		6.22	5.11	3.78



	Upper	Wehadkee	Lower
1999	6.71	5.86	8.86
2004	9.29	9.86	8.57
2007	3.21	3.64	3.21
2008	2.50	3.14	5.57
2012	0.8	1.3	0.5
2014	2.1	1.8	2.1

Figure 4. Monthly TN concentrations of the mainstem stations in West Point Reservoir, April-October 2014. Each bar graph depicts monthly changes in each station. The historic mean (1990-2014) and min/max range are also displayed for comparison. The "n" value equals the number of data points included in the monthly historic calculations. TN was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).

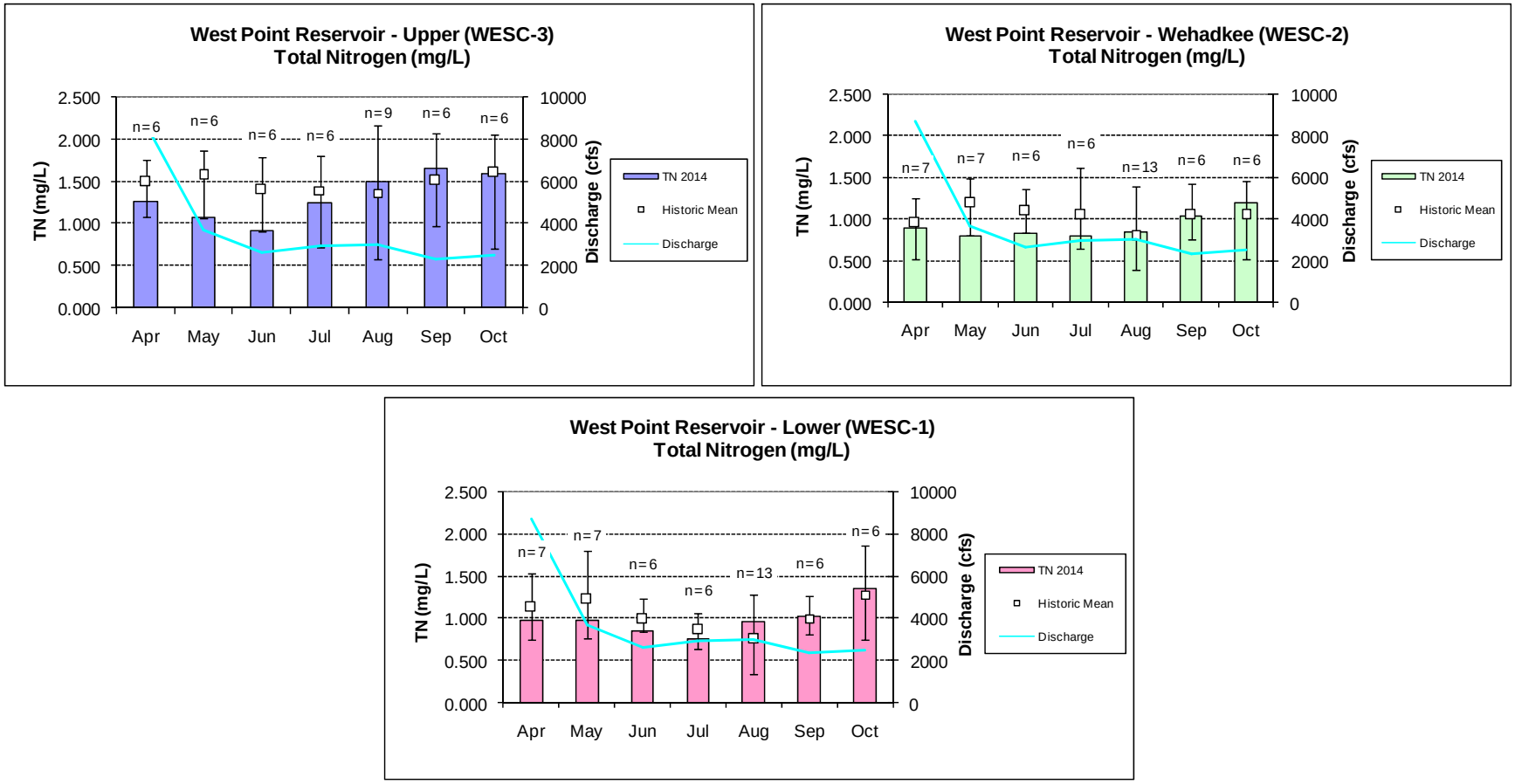


Figure 5. Monthly TP concentrations of the mainstem stations in West Point Reservoir, April-October 2014. Each bar graph depicts monthly changes in each station. The historic mean (1990-2014) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. TP was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).

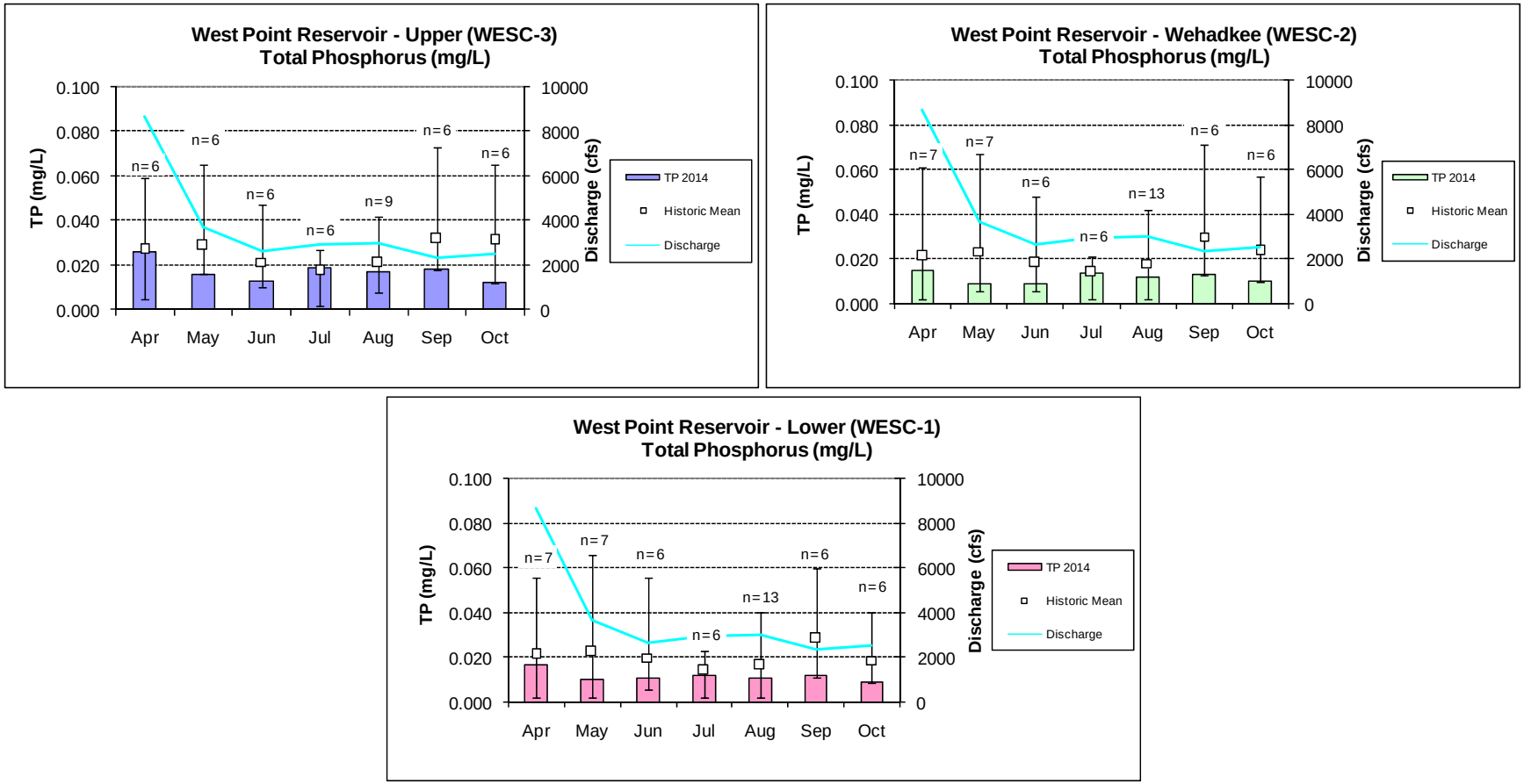


Figure 6. Monthly chl *a* concentrations of the mainstem stations in West Point Reservoir, April-October 2014. Each bar graph depicts monthly changes in each station. The historic mean (1990 -2014) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. Chl *a* was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).

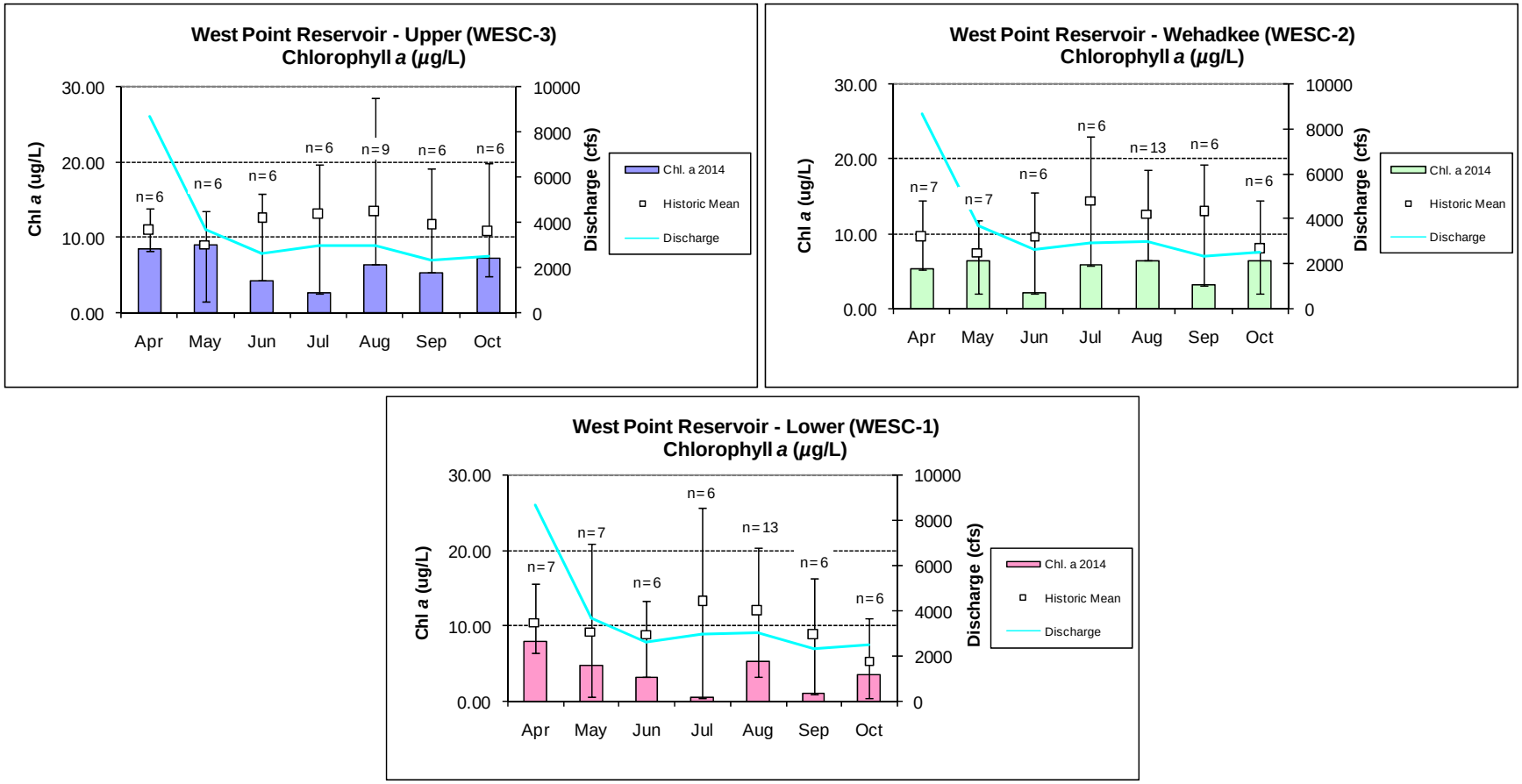


Figure 7. Monthly TSS concentrations of the mainstem stations in West Point Reservoir, April-October 2014. Each bar graph depicts monthly changes in each station. The historic mean (1990-2014) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations. TSS was plotted vs. the closest discharge (West Point Dam, information provided by U.S. Corp of Engineers).

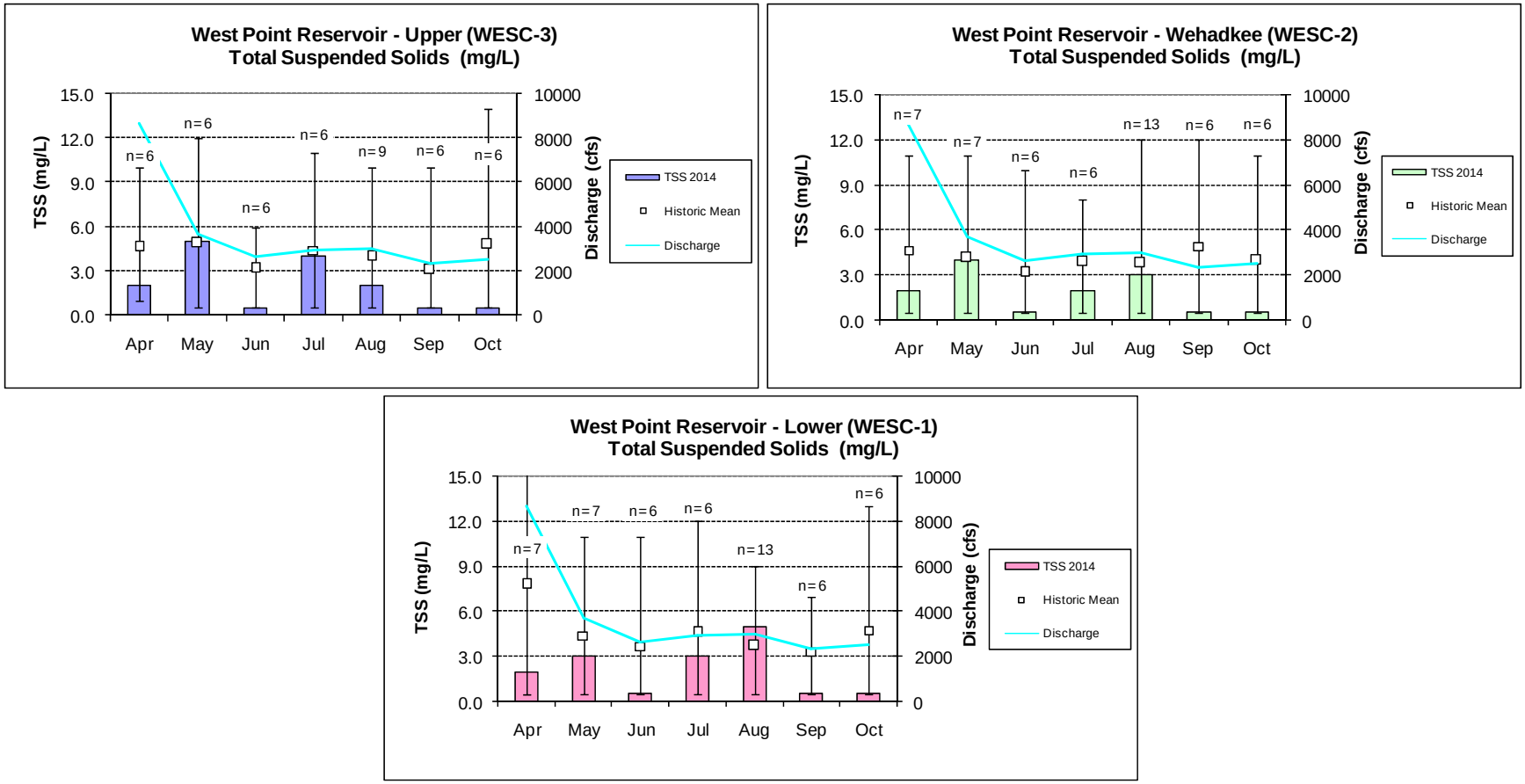


Table 2. Algal growth potential test results, West Point Reservoir, 1999-2014, (expressed as mean Maximum Standing Crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC are considered protective of flowing streams and rivers (Raschke and Schultz 1987).

Station	Upper		Wehadkee		Lower	
	MSC	Limiting Nutrient	MSC	Limiting Nutrient	MSC	Limiting Nutrient
June 1999	3.87	Phosphorus	1.74	Phosphorus	1.78	Phosphorus
July 1999	1.68	Phosphorus	1.33	Phosphorus	1.57	Phosphorus
August 1999	1.74	Phosphorus	1.24	Phosphorus	1.11	Phosphorus
August 2004	2.65	Phosphorus	2.25	Phosphorus	2.38	Phosphorus
August 2008	3.69	Phosphorus	---	---	2.84	Phosphorus
August 2014	6.94	Phosphorus	3.00	Phosphorus	3.00	Phosphorus

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for West Point Reservoir stations collected April-October 2014. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2010).

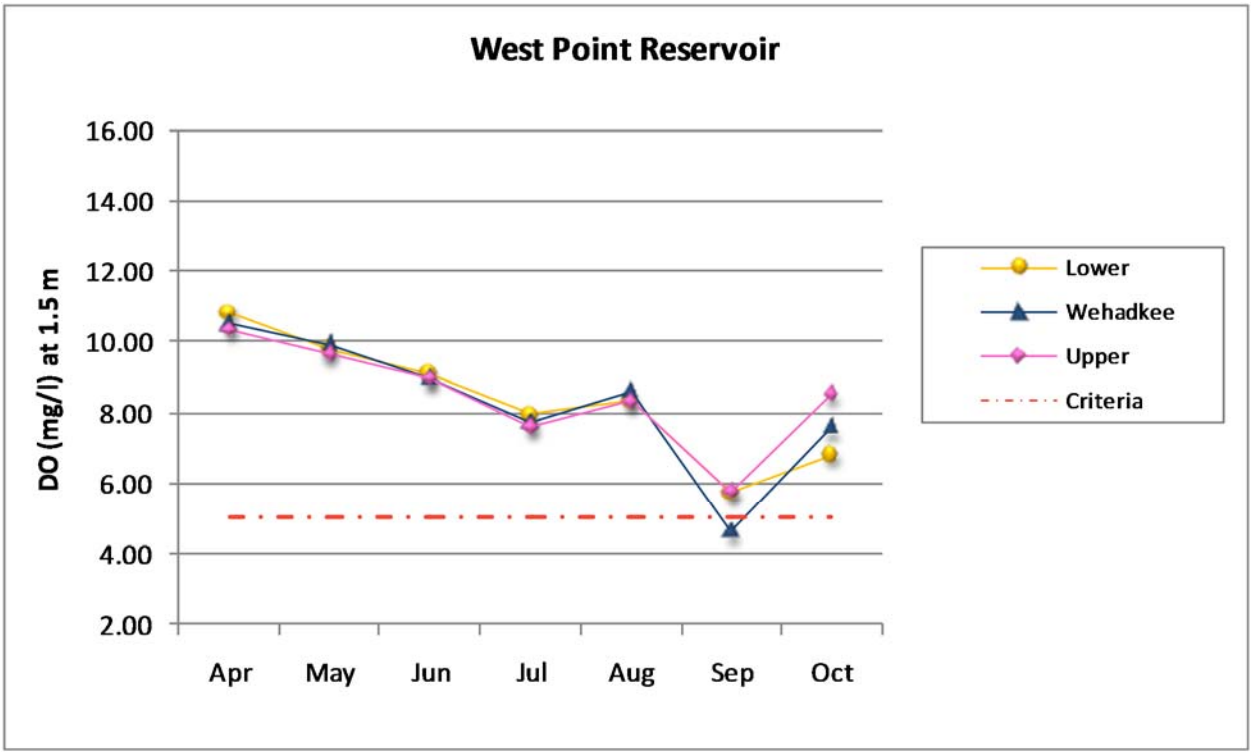


Figure 9. Monthly depth profiles of dissolved oxygen, temperature, and conductivity in the lower West Point Reservoir station, April-October 2014.

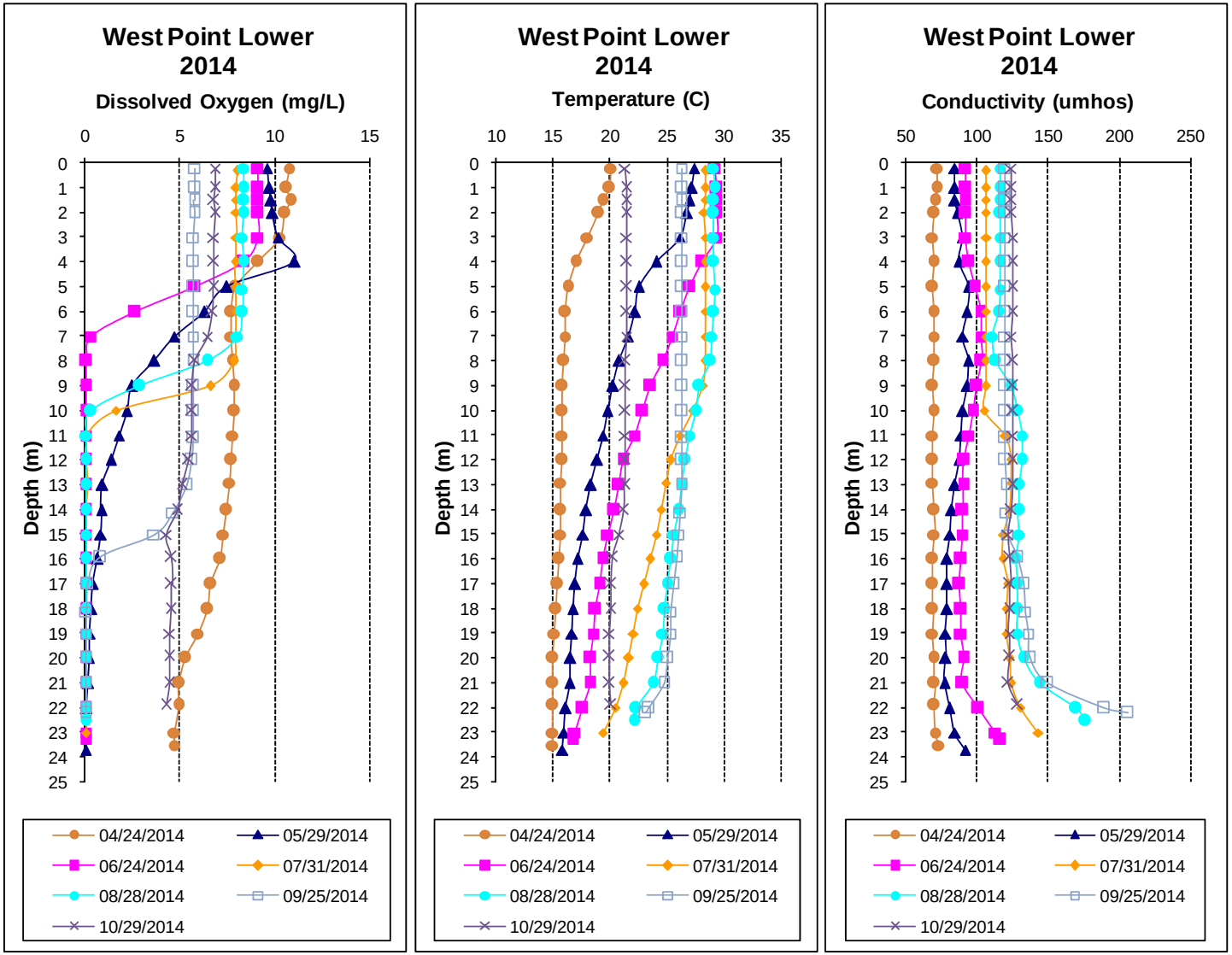
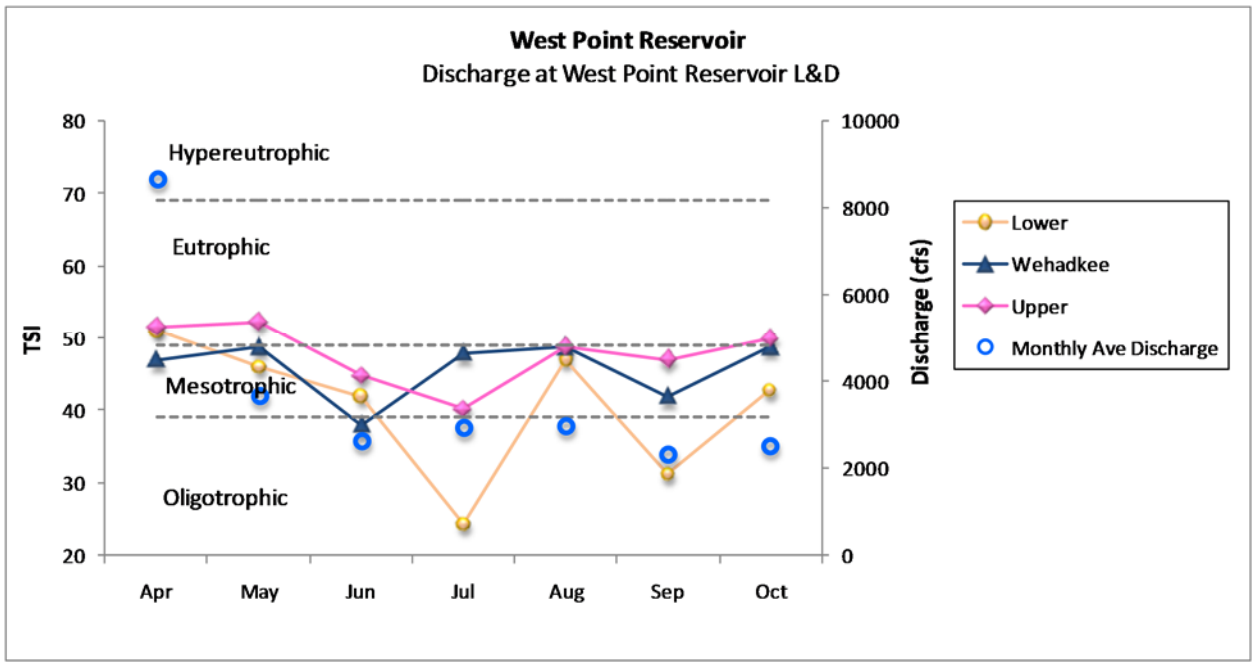


Figure 10. Monthly TSI values, April-October 2014, calculated for mainstem and tributary West Point Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. Monthly discharge acquired from USACE at West Point Lock and Dam.



REFERENCES

ADEM. 2014. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2013. Quality Management Plan (QMP) for the Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.

ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.

ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp. http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. 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). 2010. 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 West Point Reservoir water quality data collected April-October, 2014. 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	Mean	SD
WESC-1	Physical							
	Turbidity (NTU)	7		1.5	7.2	2.6	2.9	1.9
	Total Dissolved Solids (mg/L)	7		31.0	87.0	74.0	66.6	19.5
	Total Suspended Solids (mg/L)	7	<	1.0	5.0	2.0	2.1	1.7
	Hardness (mg/L)	4		17.0	29.2	24.4	23.7	5.0
	Alkalinity (mg/L)	7		16.2	28.4	27.2	25.0	4.3
	Photic Zone (m)	7		3.39	8.45	6.69	6.65	1.82
	Secchi (m)	7		1.42	3.12	2.08	2.23	0.59
	Bottom Depth (m)	7		21.90	23.70	23.00	22.87	0.68
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.006	0.011	0.003	0.005	0.003
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.482	1.021	0.555	0.615	0.187
	Total Kjeldahl Nitrogen (mg/L)	7		0.203	0.484	0.412	0.369	0.105
	Total Nitrogen (mg/L)	7		0.755	1.358	0.972	0.984	0.188
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.007	0.004	0.004	0.002
	Total Phosphorus (mg/L)[J]	7		0.009	0.017	0.011	0.012	0.003
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		5.6	12.4	9.6	9.2	2.4
	Biological							
	Chlorophyll a (ug/L)	7		0.53	8.01	3.47	3.78	2.57
	E. coli (col/100mL)	3	<	1	1	1	1	0
WESC-2	Physical							
	Turbidity (NTU)	7		2.1	5.7	2.6	3.1	1.3
	Total Dissolved Solids (mg/L)	7		39.0	81.0	53.0	57.6	14.4
	Total Suspended Solids (mg/L)	7	<	1.0	4.0	2.0	1.8	1.4
	Hardness (mg/L)	4		16.9	27.5	23.6	22.9	4.4
	Alkalinity (mg/L)	7		16.4	29.3	27.0	25.4	4.5
	Photic Zone (m)	7		3.15	7.49	6.36	5.92	1.67
	Secchi (m)	7		1.26	2.68	2.17	2.05	0.50
	Bottom Depth (m)	7		14.00	18.30	17.20	16.69	1.34
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.006	0.118	0.003	0.020	0.043
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.443	0.903	0.551	0.567	0.162
	Total Kjeldahl Nitrogen (mg/L)	7		0.223	0.597	0.285	0.345	0.138
	Total Nitrogen (mg/L)	7		0.791	1.188	0.848	0.912	0.148
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.004	0.003	0.003	0.001
	Total Phosphorus (mg/L)[J]	7		0.009	0.015	0.012	0.012	0.002
	CBOD-5 (mg/L)	7	<	2.0	2.1	1.0	1.2	0.4
	Chlorides (mg/L)	7		5.1	11.8	10.1	9.0	2.2
	Biological							
	Chlorophyll a (ug/L)	7		2.14	6.41	5.87	5.11	1.74
	E. coli (col/100mL)	3	<	1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Mean	SD
WESC-3	Physical							
	Turbidity (NTU)	7		1.9	7.4	2.8	3.4	2.0
	Total Dissolved Solids (mg/L)	7		8.0	107.0	81.0	64.1	34.8
	Total Suspended Solids (mg/L)	7	<	1.0	5.0	2.0	2.1	1.8
	Hardness (mg/L)	4		20.5	29.3	26.3	25.6	3.7
	Alkalinity (mg/L)	7		18.5	29.7	28.2	26.7	3.8
	Photic Zone (m)	7		3.22	7.34	5.82	5.45	1.59
	Secchi (m)	7		1.13	2.56	2.07	1.89	0.54
	Bottom Depth (m)	7		15.00	17.10	17.00	16.53	0.79
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.006	0.024	0.003	0.007	0.008
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.601	1.306	0.929	0.908	0.227
	Total Kjeldahl Nitrogen (mg/L)[J]	7		0.148	0.668	0.297	0.411	0.202
	Total Nitrogen (mg/L)[J]	7		0.910	1.648	1.269	1.319	0.274
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.005	0.003	0.003	0.001
	Total Phosphorus (mg/L)	7		0.012	0.026	0.017	0.017	0.005
	CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0	0.0
	Chlorides (mg/L)	7		6.4	13.4	11.5	10.4	2.5
	Biological							
	Chlorophyll a (ug/L)	7		2.67	9.08	6.41	6.22	2.30
	E. coli (col/100mL)	3	<	1	1	1	1	0

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