2010 Lay Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
January 2013

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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
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

Lay Reservoir was created with the completion of Lay Dam on the Coosa River in 1914. The reservoir encompasses approximately 12,000 acres and is located about 12 miles north/east of Clanton, AL. Lay Reservoir is situated between Logan Martin Reservoir and Mitchell Reservoir. In addition to power generation, Lay Reservoir provides recreational opportunities including boating, fishing and swimming.

Lay Reservoir was placed on Alabama's 1996 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its public water supply (PWS)/swimming (S)/fish & wildlife (F&W) water use classifications. The reservoir was listed for impairments caused by priority organics (PCBs), nutrients and organic enrichment/dissolved oxygen (OE/DO). A TMDL developed to address the nutrient and OE/DO impairment in Lay, as well as the entire Coosa River reservoir chain, was approved by the USEPA in 2008 (ADEM 2008c).

The Alabama Department of Environmental Management (ADEM) monitored Lay Reservoir as part of the 2010 assessment of the Alabama, Coosa and Tallapoosa River (ACT) 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 (now known as RRMP) Program was initiated by the Field Operations Division of the 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).

In 2010, the ADEM implemented specific water quality criteria for nutrient management at the lower and mid Lay Reservoir stations. These criteria represents the maximum growing season mean (April-October) chlorophyll *a* (chl *a*) concentration allowable while still fully supporting Lay Reservoir's PWS, S and F&W use classifications.

The purpose of this report is to summarize data collected at nine stations in Lay Reservoir during the 2010 growing season and to evaluate growing season trends in lake trophic status and nutrient concentrations using ADEM's fourteen-year dataset. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chl *a*; algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)] and trophic state [Carlson's trophic state index (TSI)] were compared to ADEM's historical data and established criteria.

METHODS

Sampling stations were selected using historical data and previous assessments (Fig. 1). Specific location information can be found in Table 1. Lay Reservoir was sampled in the dam forebay, mid reservoir, and upper reservoir. Tributary embayment stations monitored include: Waxahatchee, Peckerwood, Yellowleaf, Tallaseehatchee, Talladega and Kelly Creeks.

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 2010), 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. Monthly concentrations of these parameters were graphed with the closest available flow data and ADEM's previously collected data to help interpret the 2010 results.

Figure 1. Lay Reservoir with 2010 sampling locations.

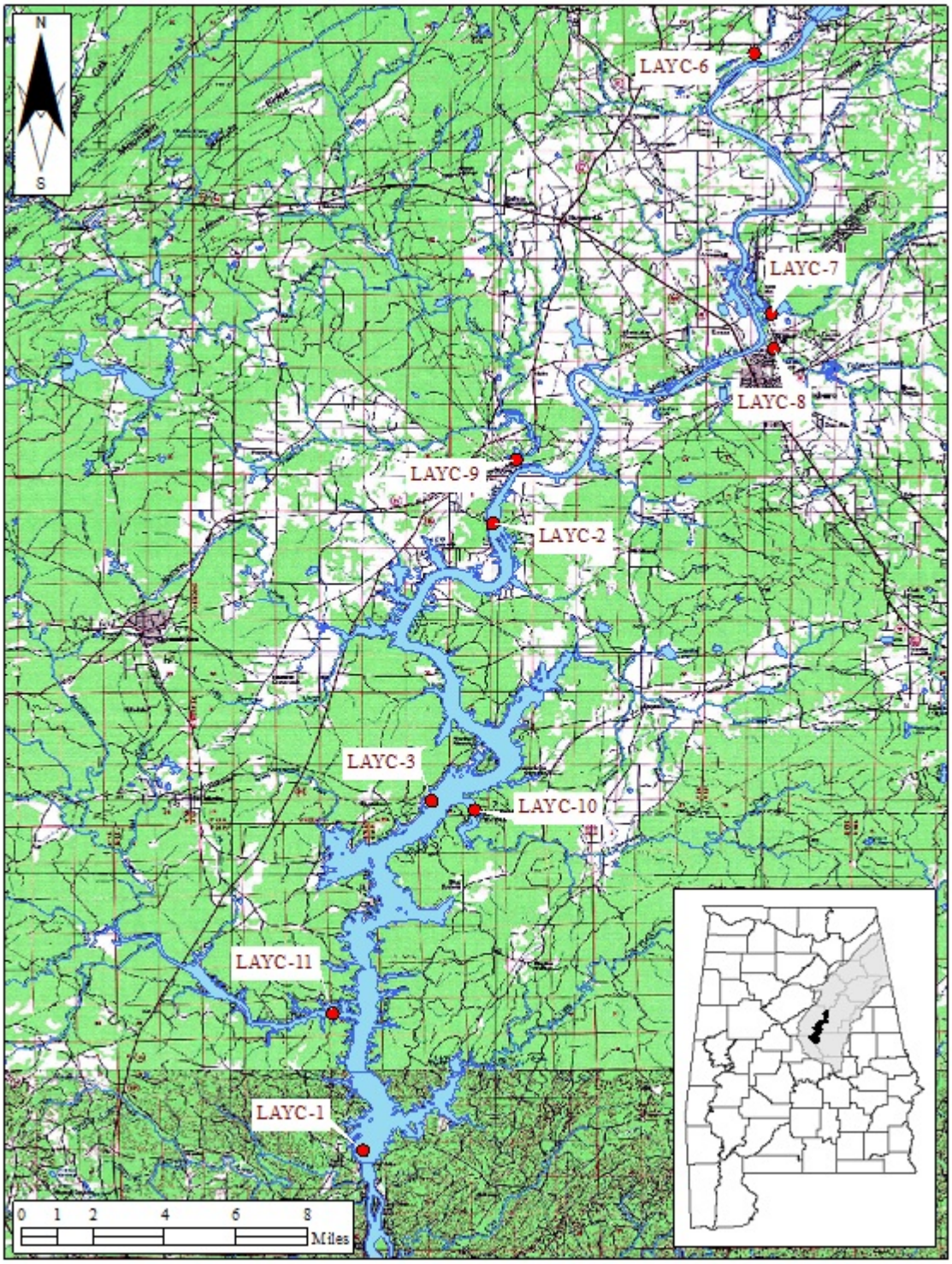


Table 1. Descriptions of the 2010 monitoring stations in Lay Reservoir.

HUC	County	Station Number	Report Designation	Waterbody	Station Description	Chl *a* Criteria	Latitude	Longitude
031501070503	Chilton	LAYC-1*	Lower	Coosa R	Deepest point, main river channel, dam forebay.	17 ug/L	32.9683	-86.5189
031501070304	Shelby	LAYC-2	Upper	Coosa R	Deepest point, main river channel, upstream of Bullock's Islands.		33.2217	-86.4665
031501070503	Shelby	LAYC-3*	Mid	Coosa R	Deepest point, main river channel, immediately downstream of Peckerwood Ck/Coosa River confluence.	17 ug/L	33.1097	-86.4912
031501060808	St Clair	LAYC-6	Kelly Ck	Kelly Ck	Deepest point, main creek channel, Kelly Ck embayment, approximately 0.5 miles upstream of lake confluence.		33.4115	-86.3606
031501060703	Talladega	LAYC-7	Talladega Ck	Talladega Ck	Deepest point, main creek channel, Talladega Ck embayment, immediately upstream of AL Hwy. 235 bridge.		33.3064	-86.3537
031501070106	Talladega	LAYC-8	Tallaseehatchee Ck	Tallaseehatchee Ck	Deepest point, main creek channel, Tallaseehatchee Ck embayment, immediately upstream of AL Hwy. 235 bridge.		33.2923	-86.3528
031501070205	Shelby	LAYC-9	Yellowleaf Ck	Yellowleaf Ck	Deepest point, main creek channel, Yellowleaf Ck embayment, upstream of Gaston Steam Plant discharge.		33.2476	-86.4570
031501070501	Talladega	LAYC-10	Peckerwood Ck	Peckerwood Ck	Deepest point, main creek channel, Peckerwood Ck embayment, approximately 0.5 miles upstream of lake confluence.		33.1058	-86.4738
031501070406	Shelby	LAYC-11	Waxahatchee Ck	Waxahatchee Ck	Deepest point, main creek channel, Waxahatchee Ck embayment, approximately 0.5 miles upstream of lake confluence.		33.0236	-86.5312

*Growing season mean chl *a* criteria implemented at this station in 2010.

RESULTS

Growing season mean graphs for TN, TP, chl *a* and TSS are provided in this section (Figs. 2 and 3). Monthly graphs for TN, TP, chl *a*, TSS, DO and TSI are also provided (Figs. 4-8 and 12). 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 9-11. Summary statistics of all data collected during 2010 are presented in Appendix Table 1. The table contains the minimum, maximum, median, mean and standard deviation of each parameter analyzed. Due to resource constraints AGPT samples were collected in one mainstem location in August. Results for TKN, TP and TN analyses in Lay Reservoir embayment stations did not meet laboratory QC requirements.

Stations with the highest concentrations of nutrients, chlorophyll and TSS are noted in the paragraphs to follow. Though stations with lowest concentrations may not always be mentioned, review of the graphs that follow will indicate these stations that may be potential candidates for reference waterbodies and watersheds.

In 2010 the highest mean growing season TN value calculated among Lay Reservoir mainstem stations was in the upper station while the lower and mid stations were similar (Fig. 2). Mean growing season TN values in the mainstem stations have shown an overall decline from 2000 through 2010. Historic high monthly TN concentrations were measured in the lower and upper stations in September (Fig. 4). Historic, or near historic, low TN concentrations were measured in the lower station in June, August and October, and the mid and upper stations in October.

In 2010 the highest mean growing season TP value among Lay Reservoir mainstem stations was in the upper station while the lowest value was in the lower station (Fig. 2). Mean growing season TP values in all Lay Reservoir mainstem stations during 2010 were the lowest since monitoring began and have declined overall at most locations in the years monitored. Monthly TP concentrations measured in all Lay Reservoir mainstem stations were at or below historic means most months monitored April-October, 2010 (Fig. 5). Historic low monthly TP

concentrations were measured during September in the lower station and during April, July and September in the mid and upper stations.

Specific water quality criteria for nutrient management have been established for the lower and mid stations on Lay Reservoir. The growing season mean chl *a* values calculated in the lower and mid stations in Lay Reservoir during 2010 were in compliance with the criteria limits (Fig. 3). In 2010 the highest mean growing season chl *a* value calculated among Lay Reservoir mainstem stations was in the mid station. The highest value calculated among tributary stations was in Tallaseehatchee Creek. Mean growing season chl *a* values in the lower, mid and upper mainstem stations and the Waxahatchee Creek, Peckerwood Creek and Yellowleaf Creek embayment stations were the lowest since monitoring began. Values in the Tallaseehatchee Creek embayment station were the highest since monitoring began and values in the Talledega Creek and Kelly Creek embayments were variable. Historic low monthly chl *a* concentrations were measured in the lower station during June, August and September (Fig. 6). Historic low concentrations were measured in the mid station during June, September and October and in the upper station during April, September and October.

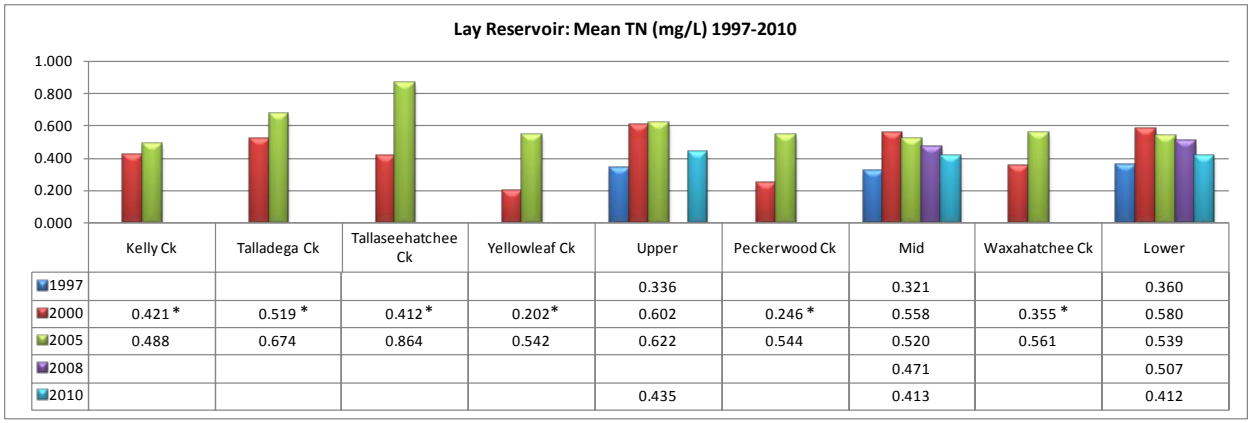
In 2010 the highest mean growing season TSS value calculated among Lay Reservoir mainstem stations was in the upper station and the lowest was in the mid station (Fig. 3). Mean growing season TSS values in all mainstem stations have varied since monitoring began. All values in tributary embayment stations were the lowest since monitoring began and have declined overall at most locations in the years monitored. Historic low monthly TSS concentrations were measured during October in the lower station, May and October in the mid station, and April, June, July and October in the upper station (Fig. 7). Historic high concentrations were measured in the lower and upper stations in May during a high flow period.

AGPT results for the lower Lay Reservoir station indicate it was nitrogen limited in 1997 and non-limiting in 2000 and 2005 (Table 2). The mid station has remained nitrogen limited all years monitored while the upper station has varied. AGPT results from August 2010 indicate the upper station exceeded 5 mg/L MSC, the value that Raschke et al. (1996) defined as protective of reservoir and lake systems.

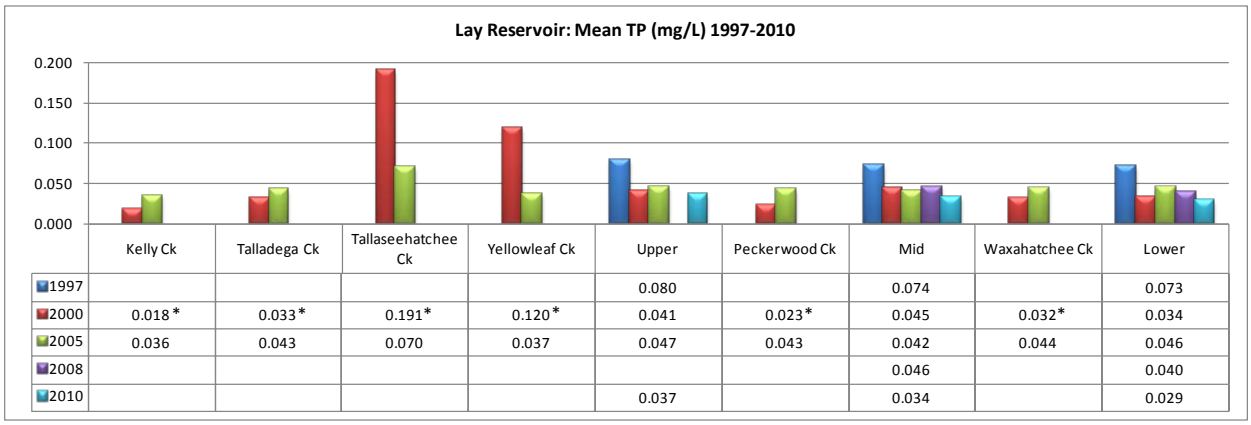
Dissolved oxygen (DO) concentrations were near or below the ADEM Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/L at 5.0 ft (1.5 m) in the lower Lay Reservoir station August-October, and the mid station in August (Fig. 8). DO concentrations were also near or below the ADEM Criteria value in Yellowleaf Creek in July and August. Based on monthly DO profiles, DO concentrations were near or below 5.0 mg/L in the entire water column in the lower station in June and August-October and in the mid and upper stations during August (Fig. 9).

TSI values were calculated using monthly chl *a* concentrations and Carlson's Trophic State Index. TSI values in the lower station were mesotrophic in April and eutrophic May through October (Fig. 12). The mid station was eutrophic April-October and the upper station was mesotrophic in April, oligotrophic in September, and eutrophic all other months monitored. Among the tributaries, Tallaseehatchee Creek had the highest TSI value reaching hypereutrophic conditions in June while Kelly Creek had the lowest, remaining oligotrophic all months except September.

Figure 2. Mean growing season TN and TP measured in Lay Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right.



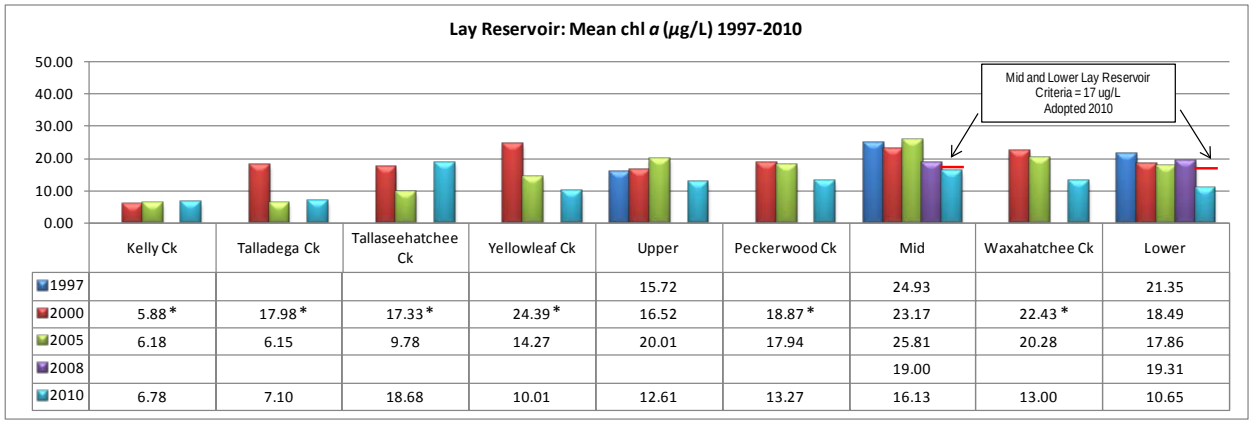
	Kelly Ck	Talladega Ck	Tallaseehatchee Ck	Yellowleaf Ck	Upper	Peckerwood Ck	Mid	Waxahatchee Ck	Lower
1997					0.336		0.321		0.360
2000	0.421 *	0.519 *	0.412 *	0.202 *	0.602	0.246 *	0.558	0.355 *	0.580
2005	0.488	0.674	0.864	0.542	0.622	0.544	0.520	0.561	0.539
2008							0.471		0.507
2010					0.435		0.413		0.412



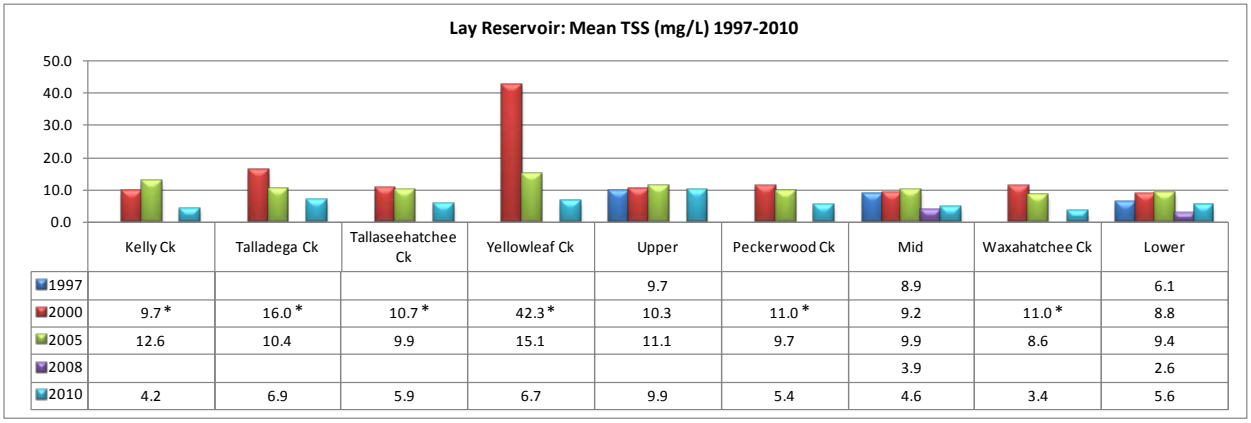
	Kelly Ck	Talladega Ck	Tallaseehatchee Ck	Yellowleaf Ck	Upper	Peckerwood Ck	Mid	Waxahatchee Ck	Lower
1997					0.080		0.074		0.073
2000	0.018 *	0.033 *	0.191 *	0.120 *	0.041	0.023 *	0.045	0.032 *	0.034
2005	0.036	0.043	0.070	0.037	0.047	0.043	0.042	0.044	0.046
2008							0.046		0.040
2010					0.037		0.034		0.029

* Mean of April/June/August only.

Figure 3. Mean growing season chl *a* and TSS measured in Lay Reservoir, April-October, 1997-2010. Stations are illustrated from upstream to downstream as the graph is read from left to right. Chl *a* criteria applies to the growing season means of the lower and mid stations.



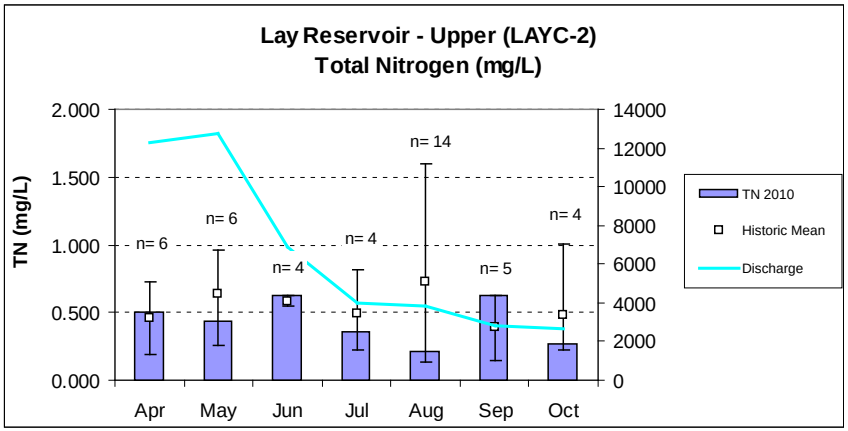
	Kelly Ck	Talladega Ck	Tallaseehatchee Ck	Yellowleaf Ck	Upper	Peckerwood Ck	Mid	Waxahatchee Ck	Lower
1997					15.72		24.93		21.35
2000	5.88 *	17.98 *	17.33 *	24.39 *	16.52	18.87 *	23.17	22.43 *	18.49
2005	6.18	6.15	9.78	14.27	20.01	17.94	25.81	20.28	17.86
2008							19.00		19.31
2010	6.78	7.10	18.68	10.01	12.61	13.27	16.13	13.00	10.65

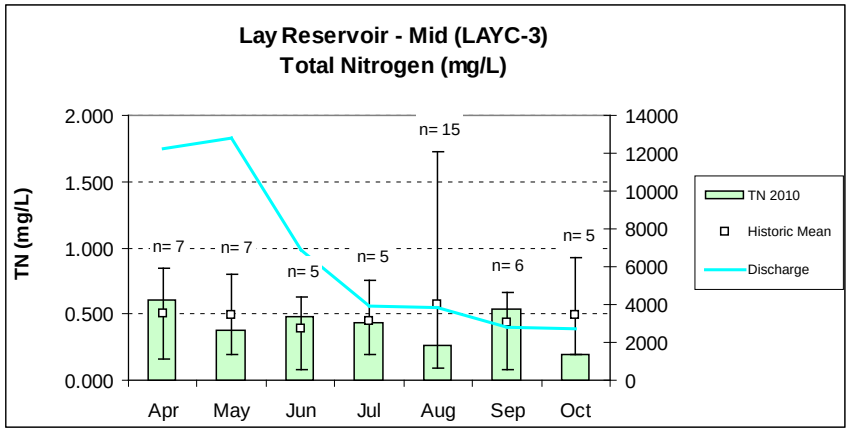


	Kelly Ck	Talladega Ck	Tallaseehatchee Ck	Yellowleaf Ck	Upper	Peckerwood Ck	Mid	Waxahatchee Ck	Lower
1997					9.7		8.9		6.1
2000	9.7 *	16.0 *	10.7 *	42.3 *	10.3	11.0 *	9.2	11.0 *	8.8
2005	12.6	10.4	9.9	15.1	11.1	9.7	9.9	8.6	9.4
2008							3.9		2.6
2010	4.2	6.9	5.9	6.7	9.9	5.4	4.6	3.4	5.6

* Mean of April/June/August only.

Figure 4. Monthly TN concentrations measured in Lay Reservoir, April-October 2010 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





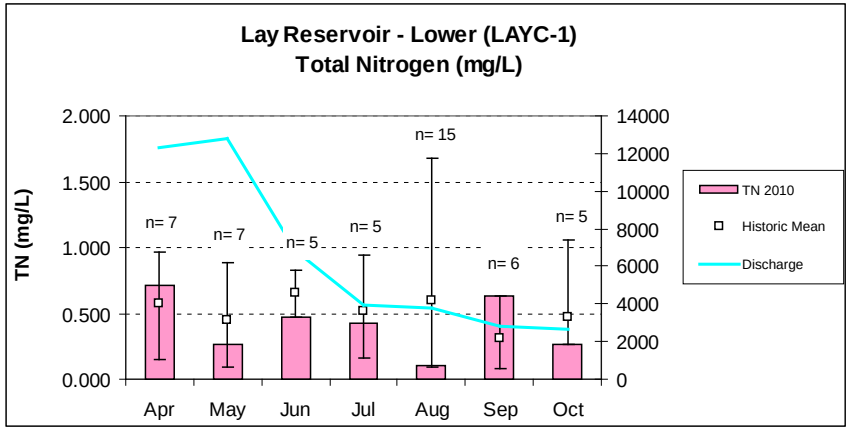


Figure 5. Monthly TP concentrations measured in Lay Reservoir, April-October 2010 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.

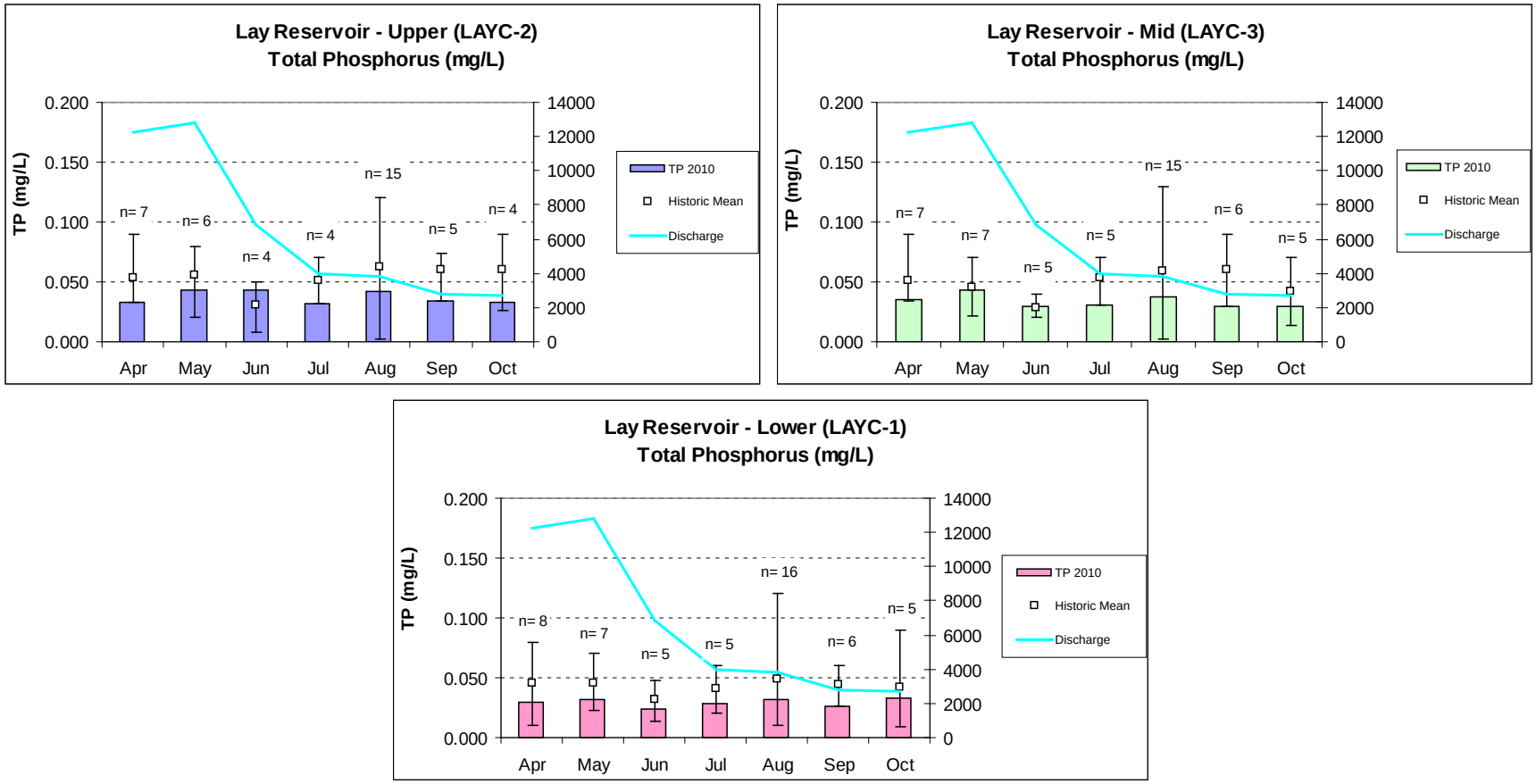
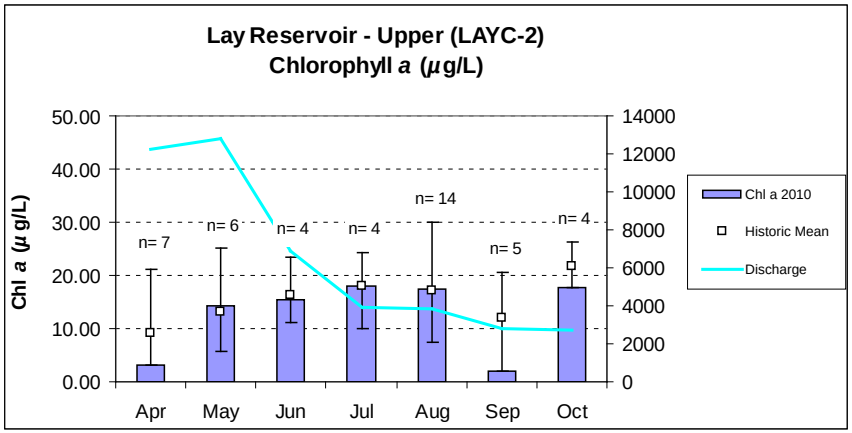
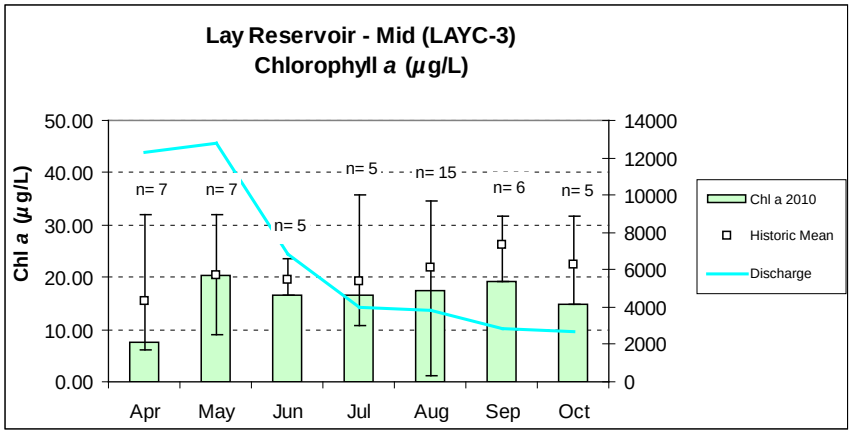


Figure 6. Monthly chl *a* concentrations measured in Lay Reservoir, April-October 2010 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





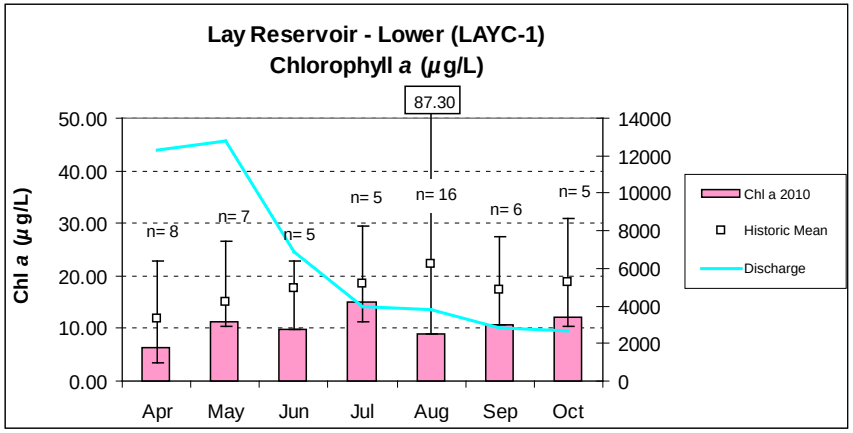
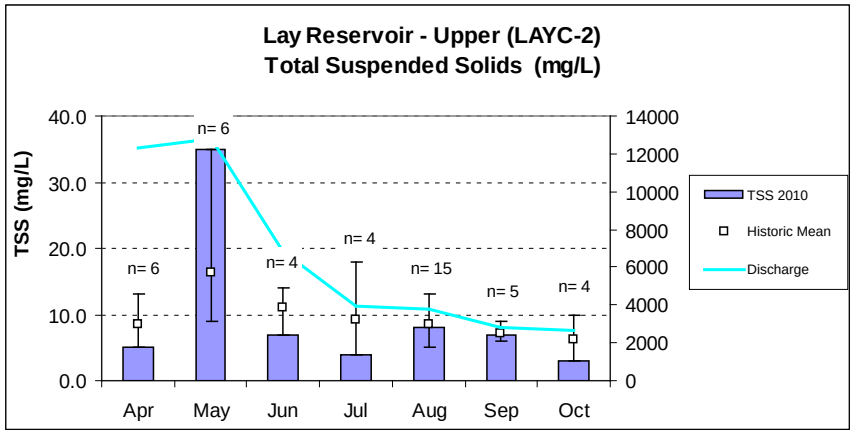
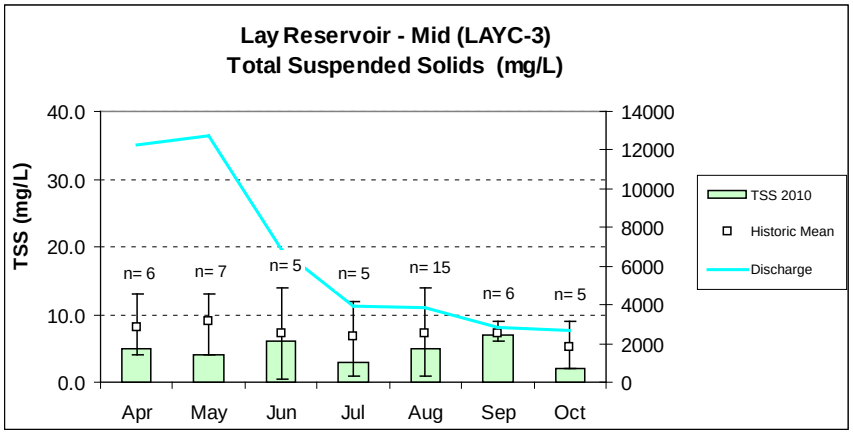


Figure 7. Monthly TSS concentrations measured in Lay Reservoir, April-October 2010 vs. average monthly discharge. Discharge provided by APCO. Each bar graph depicts monthly changes in each station. The historic mean (1990-2010) and min/max range are also displayed for comparison. The "n" value equals the number of datapoints included in the monthly historic calculations.





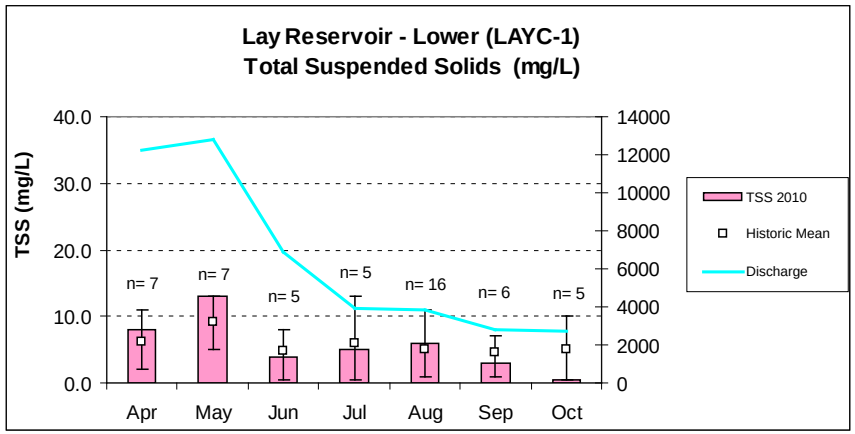
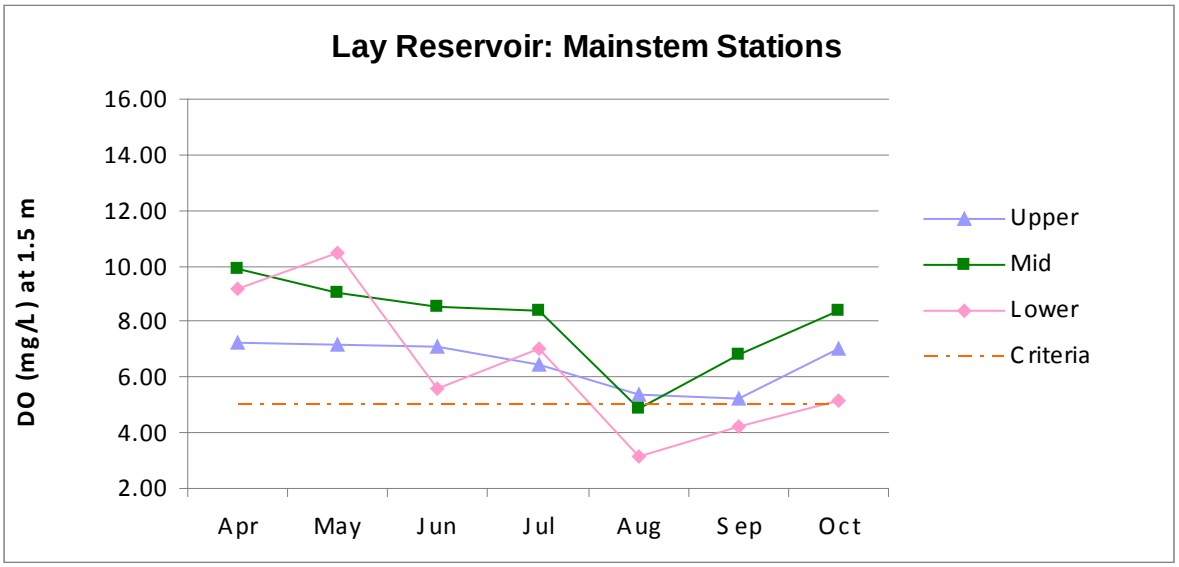


Table 2. Algal growth potential test results, Lay Reservoir, 1997-2010 (expressed as mean Maximum Standing Crop (MSC) dry weights of Selenastrum capricornutum in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes; values below 20 mg/L MSC 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
August 1997	10.48	Co-limiting	2.21	Nitrogen	6.8	Nitrogen
August 2000	3.04	Co-limiting	5.55	Nitrogen	2.67	Non-limiting
August 2005	10.35	Nitrogen	3.72	Nitrogen	3.31	Non-limiting
August 2010	9.71	Phosphorus	-	-	-	-

Figure 8. Monthly DO concentrations at 1.5 m (5 ft) for Lay Reservoir stations collected April-October 2010. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth (ADEM 2005).



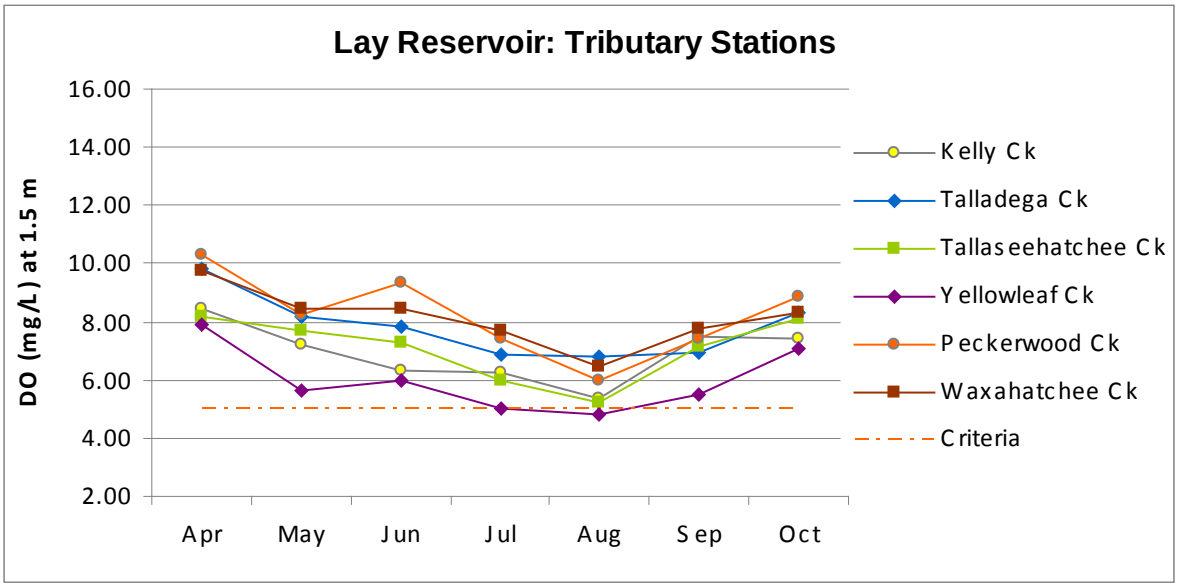


Figure 9. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the lower Lay Reservoir station, April-October 2010.

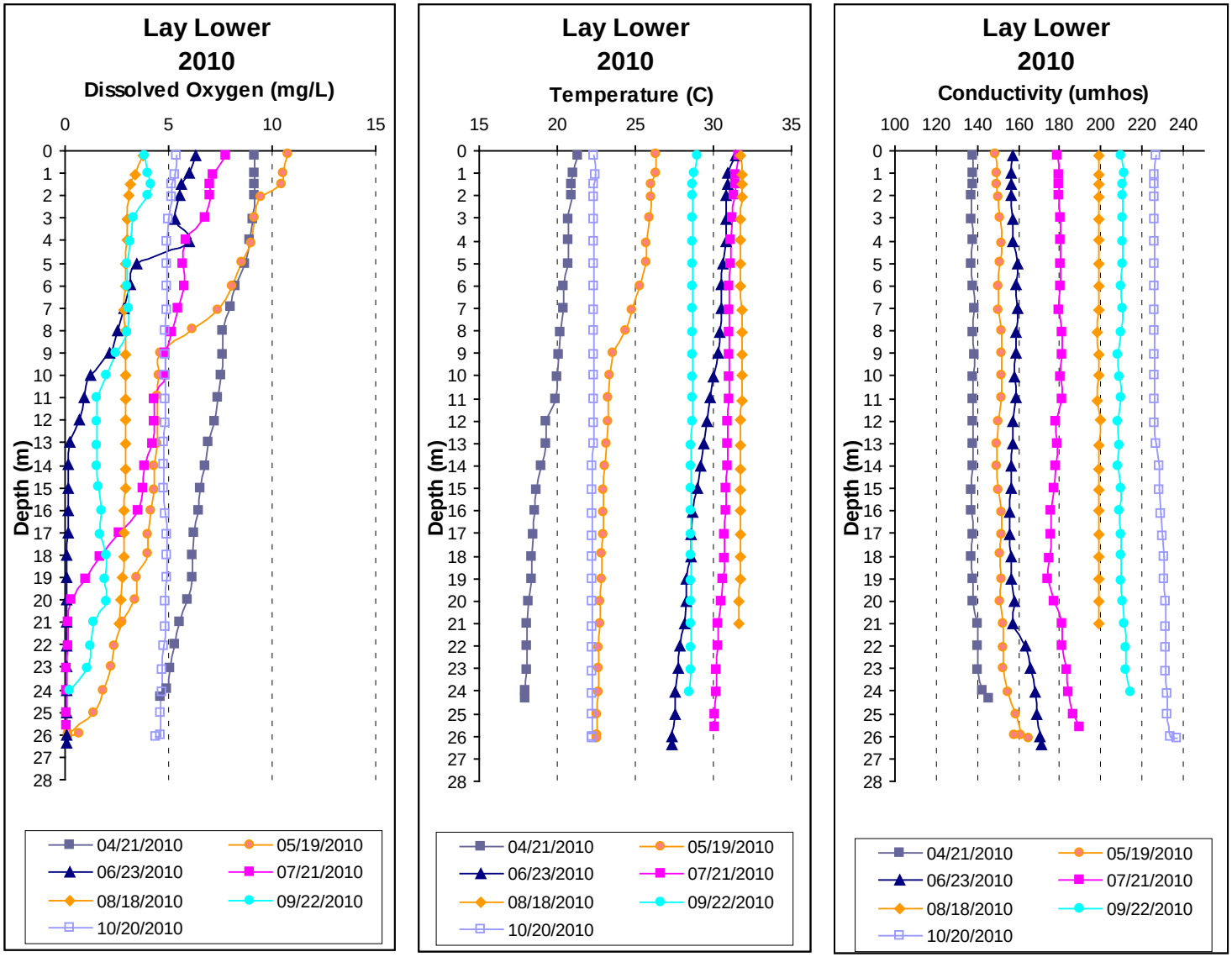


Figure 10. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the mid Lay Reservoir station, April-October 2010.

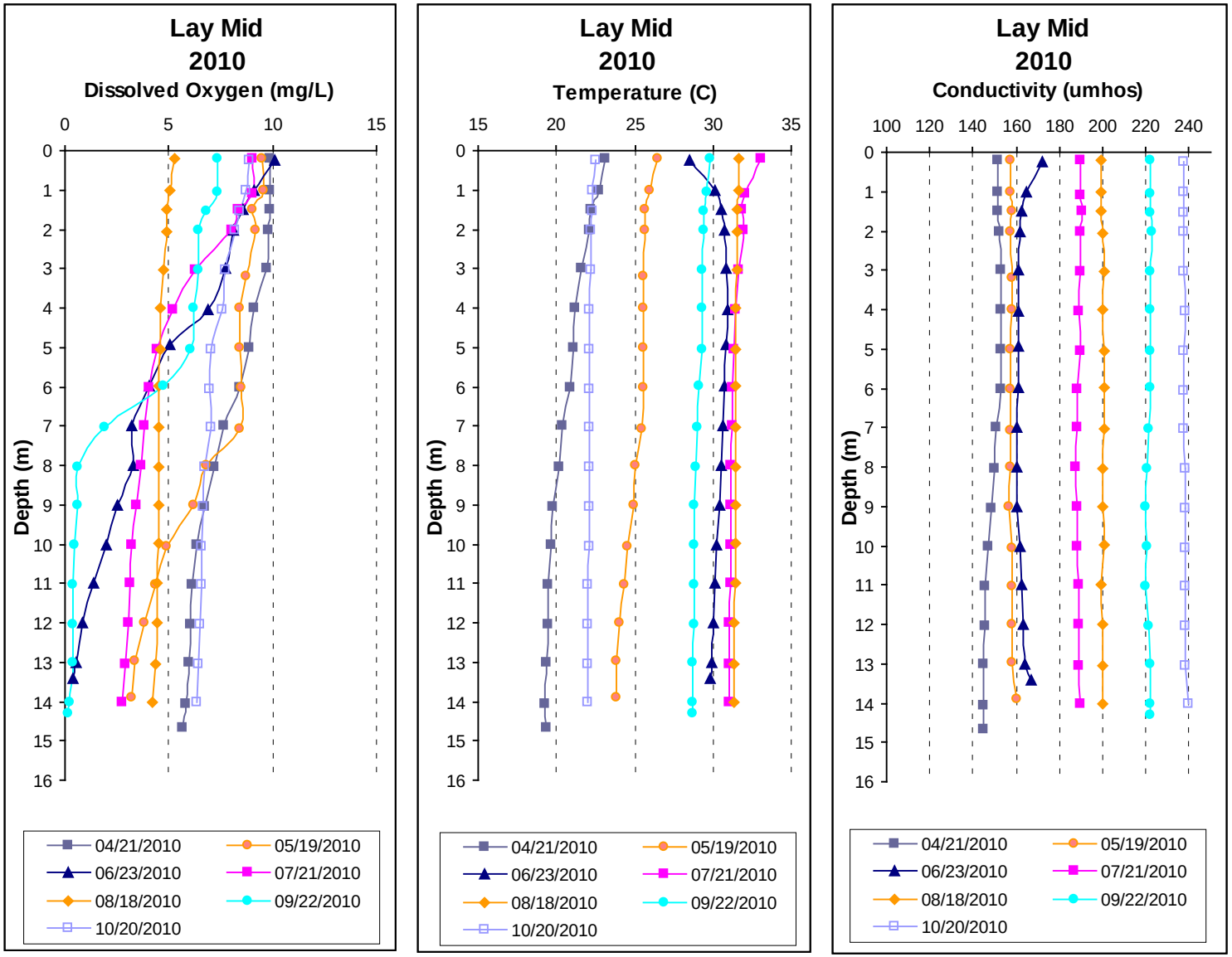


Figure 11. Monthly depth profiles of dissolved oxygen (mg/L), temperature (C), and conductivity (umhos) in the upper Lay Reservoir station, April-October 2010.

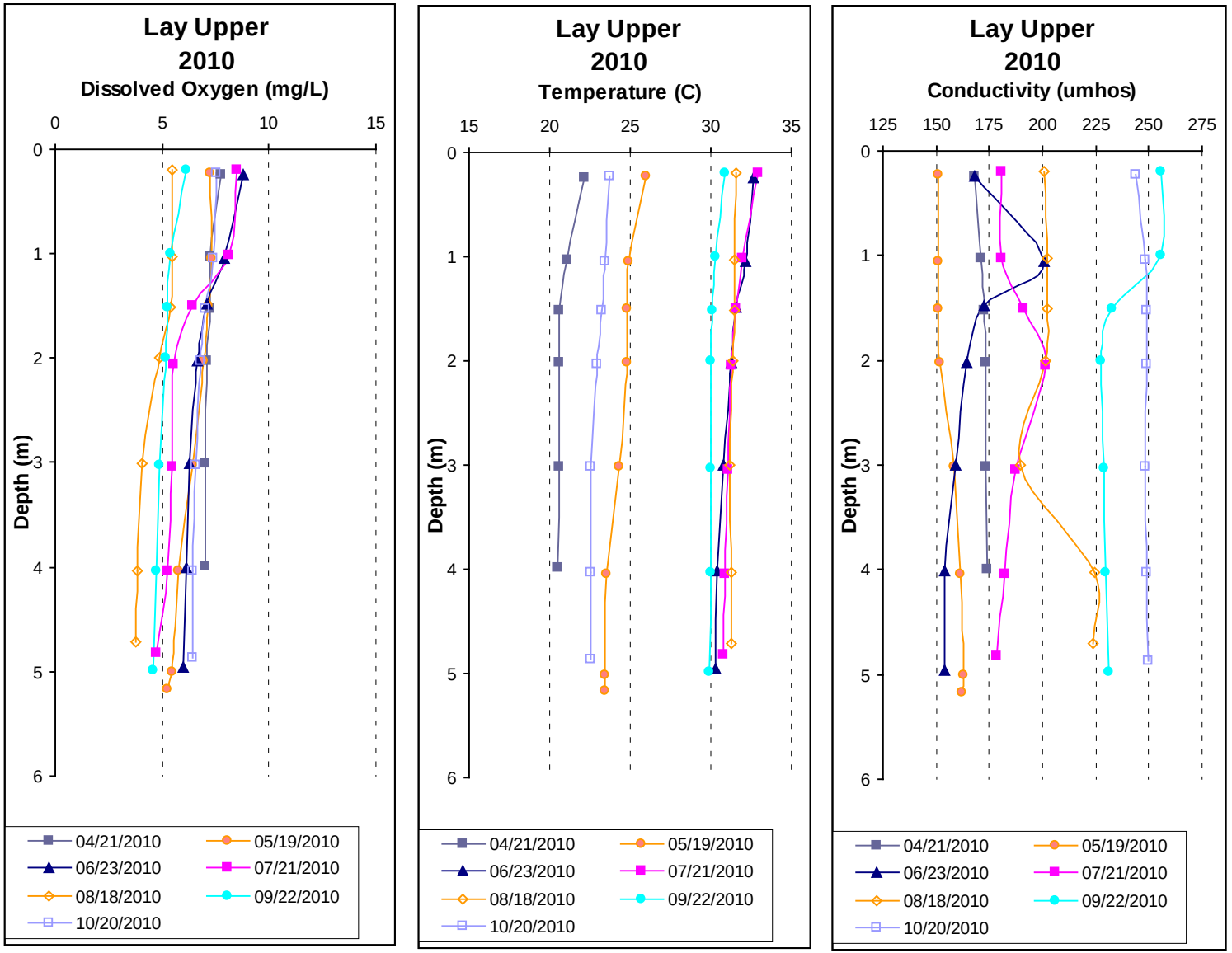
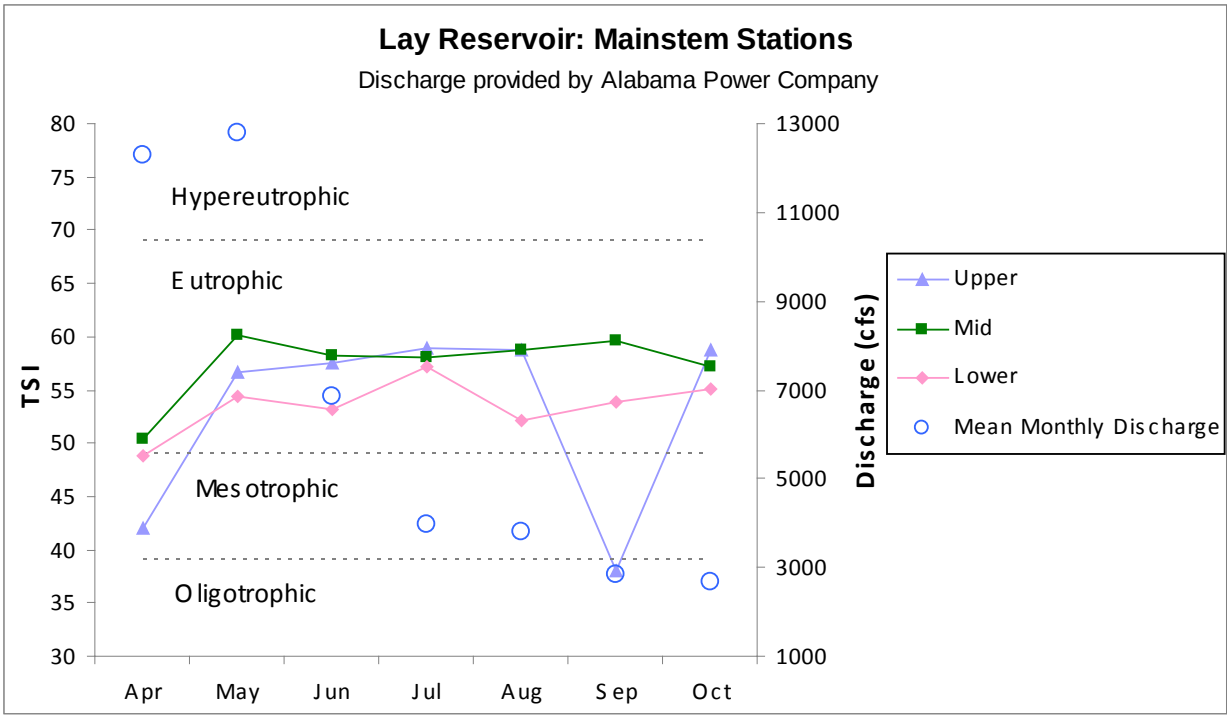
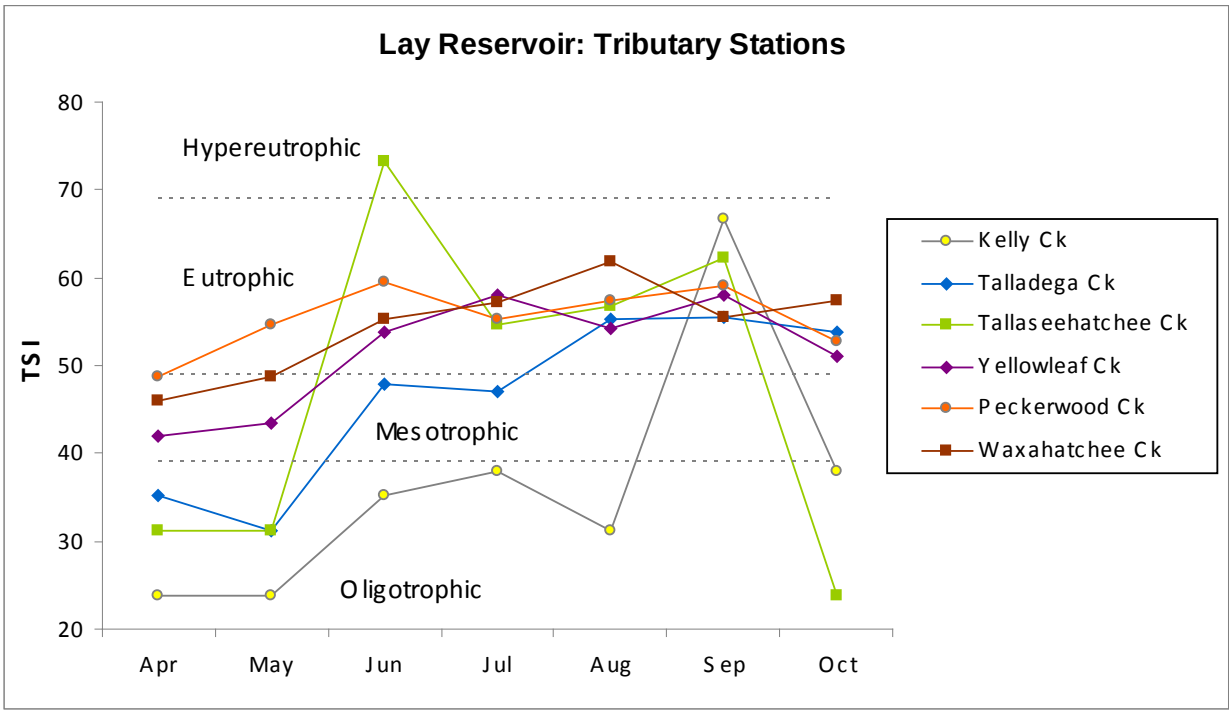


Figure 12. Monthly TSI values calculated for mainstem and tributary Lay Reservoir stations using chl *a* concentrations and Carlson's Trophic State Index calculation. Monthly discharge provided by APCO.





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APPENDIX

Appendix Table 1. Summary of Lay Reservoir water quality data collected April-October, 2010. 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
LAYC-1	**Physical**							
	Turbidity (NTU)	7		2.4	5.0	3.1	3.5	1.1
	Total Dissolved Solids (mg/L)[J]	7		58.0	136.0	102.0	101.1	25.8
	Total Suspended Solids (mg/L)[J]	7	<	1.0	13.0	5.0	5.6	4.0
	Hardness (mg/L)	4		56.6	78.4	65.6	66.5	10.5
	Alkalinity (mg/L)	7		55.4	87.9	70.9	71.7	12.3
	Photic Zone (m)	7		3.08	5.28	4.55	4.43	0.72
	Secchi (m)	7		1.07	2.14	1.80	1.75	0.36
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.003	0.098	0.033	0.040	0.034
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.080	0.617	0.426	0.372	0.206
	Total Nitrogen (mg/L)[J]	7	<	0.103	0.715	0.428	0.412	0.217
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.004	0.010	0.006	0.006	0.003
	Total Phosphorus (mg/L)	7		0.024	0.033	0.030	0.029	0.003
	CBOD-5 (mg/L)	7	<	2.0	3.2	1.0	1.3	0.8
	Chlorides (mg/L)	7		3.6	8.8	4.9	5.6	1.9
	Biological							
	Chlorophyll a (ug/L)	7		6.41	14.95	10.68	10.65	2.66
	E. coli (mpn/100mL)[J]	3		1	1	1	1	0
LAYC-2	**Physical**							
	Turbidity (NTU)	7		3.8	8.5	5.5	5.6	1.5
	Total Dissolved Solids (mg/L)[J]	7		76.0	152.0	112.0	113.1	30.1
	Total Suspended Solids (mg/L)	7		3.0	35.0	7.0	9.9	11.2
	Hardness (mg/L)	4		64.6	83.0	72.2	73.0	8.6
	Alkalinity (mg/L)	7		60.8	102.0	75.6	79.0	15.9
	Photic Zone (m)	7		2.55	4.10	3.31	3.31	0.50
	Secchi (m)	7		1.13	1.66	1.22	1.32	0.22
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.021	0.048	0.010	0.016	0.014
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.056	0.213	0.124	0.134	0.062
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.080	0.549	0.293	0.301	0.177
	Total Nitrogen (mg/L)	7	<	0.217	0.630	0.436	0.435	0.163
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.006	0.016	0.010	0.010	0.003
	Total Phosphorus (mg/L)	7		0.032	0.043	0.034	0.037	0.005
	CBOD-5 (mg/L)	7	<	2.0	2.6	1.0	1.4	0.7
	Chlorides (mg/L)	7		4.4	11.1	5.1	6.5	2.6
	Biological							
	Chlorophyll a (ug/L)	7		2.14	18.05	15.49	12.61	6.93
	E. coli (mpn/100mL)[J]	3		1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Mean	SD
LAYC-3	**Physical**							
	Turbidity (NTU)	7		4.1	7.7	6.1	5.9	1.4
	Total Dissolved Solids (mg/L)[J]	7		74.0	144.0	112.0	113.4	28.5
	Total Suspended Solids (mg/L)	7		2.0	7.0	5.0	4.6	1.7
	Hardness (mg/L)	4		60.4	81.2	67.6	69.2	10.2
	Alkalinity (mg/L)	7		61.9	90.5	76.1	75.0	11.9
	Photic Zone (m)	7		2.80	3.88	3.58	3.43	0.38
	Secchi (m)	7		0.93	1.54	1.23	1.25	0.20
	Chemical							
	Ammonia Nitrogen (mg/L)	7	<	0.021	0.021	0.010	0.010	0.000
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.002	0.117	0.002	0.034	0.046
	Total Kjeldahl Nitrogen (mg/L)	7		0.196	0.533	0.428	0.379	0.140
	Total Nitrogen (mg/L)	7	<	0.197	0.610	0.430	0.413	0.146
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.007	0.004	0.004	0.002
	Total Phosphorus (mg/L)	7		0.029	0.043	0.031	0.034	0.005
	CBOD-5 (mg/L)	7	<	2.0	3.2	1.0	1.5	0.8
	Chlorides (mg/L)	7		4.1	9.9	5.4	6.1	2.2
	Biological							
	Chlorophyll a (ug/L)	7		7.48	20.47	16.66	16.13	4.22
	E. coli (mpn/100mL)[J]	3		1	1	1	1	0
LAYC-6	**Physical**							
	Turbidity (NTU)	7		2.2	22.3	4.9	8.0	7.0
	Total Dissolved Solids (mg/L)	7		63.0	164.0	89.0	97.3	32.1
	Total Suspended Solids (mg/L)	7	<	0.3	10.0	4.0	4.2	3.3
	Hardness (mg/L)	4		47.8	61.2	53.2	53.9	5.5
	Alkalinity (mg/L)	7		33.8	71.9	46.2	49.6	15.0
	Photic Zone (m)	7		1.63	3.10	2.40	2.38	0.45
	Secchi (m)	7		0.68	2.54	1.83	1.61	0.78
	Chemical							
	Ammonia Nitrogen (mg/L)[J B]	1					0.500	
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.007	0.263	0.152	0.138	0.085
	Total Kjeldahl Nitrogen (mg/L)[B]							
	Total Nitrogen (mg/L)[B]							
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.004	0.002	0.002	0.001
	Total Phosphorus (mg/L)[B]							
	CBOD-5 (mg/L)[J]	7	<	1.0	1.3	0.5	0.6	0.3
	Chlorides (mg/L)	7		2.1	19.5	11.9	10.9	6.6
	Biological							
	Chlorophyll a (ug/L)	7	<	1.00	39.50	1.60	6.78	14.44
	E. coli (mpn/100mL)	2		14	60	37	37	33

Station	Parameter	N		Min	Max	Med	Mean	SD
LAYC-7	Physical							
	Turbidity (NTU)	7		6.5	10.7	7.2	8.0	1.4
	Total Dissolved Solids (mg/L)	7		101.0	141.0	115.0	117.0	13.5
	Total Suspended Solids (mg/L)	7		5.0	8.0	7.0	6.9	1.1
	Hardness (mg/L)	4		87.8	108.0	97.2	97.6	8.8
	Alkalinity (mg/L)	7		67.2	99.5	80.6	79.6	10.9
	Photic Zone (m)	7		3.30	4.07	3.56	3.58	0.25
	Secchi (m)	7		1.19	1.45	1.20	1.27	0.12
	Chemical							
	Ammonia Nitrogen (mg/L)[J B]	1					0.500	
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.305	0.457	0.375	0.374	0.057
	Total Kjeldahl Nitrogen (mg/L)[B]							
	Total Nitrogen (mg/L)[B]							
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.005	0.014	0.008	0.008	0.003
	Total Phosphorus (mg/L)[B]							
	CBOD-5 (mg/L)[J]	7	<	1.0	1.0	0.5	0.5	0.0
	Chlorides (mg/L)	7		11.7	23.6	17.2	16.8	3.6
	Biological							
	Chlorophyll a (ug/L)	7		1.07	12.80	5.87	7.10	4.89
	E. coli (mpn/100mL)	2		5	17	11	11	8
LAYC-8	Physical							
	Turbidity (NTU)	7		4.7	8.1	6.0	6.0	1.2
	Total Dissolved Solids (mg/L)	7		101.0	143.0	120.0	120.1	13.2
	Total Suspended Solids (mg/L)	7		5.0	9.0	5.0	5.9	1.6
	Hardness (mg/L)	4		79.9	103.0	89.8	90.6	10.9
	Alkalinity (mg/L)	7		60.3	102.6	82.6	83.4	17.1
	Photic Zone (m)	7		3.33	4.67	3.58	3.79	0.53
	Secchi (m)	7		1.06	1.56	1.35	1.33	0.16
	Chemical							
	Ammonia Nitrogen (mg/L)[J B]	1					0.500	
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7		0.179	0.631	0.348	0.378	0.176
	Total Kjeldahl Nitrogen (mg/L)[B]							
	Total Nitrogen (mg/L)[B]							
	Dissolved Reactive Phosphorus (mg/L)[J]	7		0.005	1.150	0.008	0.174	0.430
	Total Phosphorus (mg/L)[B]							
	CBOD-5 (mg/L)[J]	7	<	1.0	1.7	1.0	1.0	0.5
	Chlorides (mg/L)	7		3.4	41.8	13.7	15.7	14.0
	Biological							
	Chlorophyll a (ug/L)	7	<	1.00	76.90	11.70	18.68	27.23
	E. coli (mpn/100mL)	2		1	3	2	2	2

Station	Parameter	N		Min	Max	Med	Mean	SD
LAYC-9	**Physical**							
	Turbidity (NTU)	7		5.9	10.8	7.1	7.8	2.0
	Total Dissolved Solids (mg/L)	7		84.0	149.0	99.0	106.0	24.8
	Total Suspended Solids (mg/L)	7		5.0	8.0	7.0	6.7	1.2
	Hardness (mg/L)	4		58.0	81.8	67.2	68.6	10.0
	Alkalinity (mg/L)	7		43.4	76.1	58.2	60.6	11.6
	Photic Zone (m)	7		1.00	3.54	2.52	2.53	0.85
	Secchi (m)	7		0.91	1.22	1.02	1.04	0.12
	Chemical							
	Ammonia Nitrogen (mg/L)[J B]	1					0.500	
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7		0.017	0.127	0.066	0.071	0.036
	Total Kjeldahl Nitrogen (mg/L)[B]							
	Total Nitrogen (mg/L)[B]							
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.003	0.002	0.002	0.000
	Total Phosphorus (mg/L)[B]							
	CBOD-5 (mg/L)[J]	7	<	1.0	1.7	1.0	0.9	0.4
	Chlorides (mg/L)	7		2.5	26.4	11.4	12.8	9.2
	Biological							
	Chlorophyll a (ug/L)	7		3.20	16.60	10.70	10.01	5.45
	E. coli (mpn/100mL)	2		10	35	22	22	18
LAYC-10	**Physical**							
	Turbidity (NTU)	7		3.6	9.2	4.4	5.4	2.1
	Total Dissolved Solids (mg/L)	7		82.0	202.0	116.0	122.7	39.5
	Total Suspended Solids (mg/L)	7		3.0	8.0	5.0	5.4	1.5
	Hardness (mg/L)	4		57.1	84.6	72.8	71.8	12.7
	Alkalinity (mg/L)	7		33.8	74.8	50.8	54.0	14.3
	Photic Zone (m)	7		2.53	4.00	3.37	3.39	0.46
	Secchi (m)	7		1.00	1.57	1.35	1.31	0.21
	Chemical							
	Ammonia Nitrogen (mg/L)[J B]	1					0.500	
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.007	0.027	0.004	0.008	0.009
	Total Kjeldahl Nitrogen (mg/L)[B]							
	Total Nitrogen (mg/L)[B]							
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.003	0.002	0.002	0.000
	Total Phosphorus (mg/L)[B]							
	CBOD-5 (mg/L)[J]	7	<	1.0	1.8	1.2	1.2	0.5
	Chlorides (mg/L)	7		13.1	30.5	26.2	23.3	7.7
	Biological							
	Chlorophyll a (ug/L)	7		6.41	19.20	12.30	13.27	4.62
	E. coli (mpn/100mL)	2	<	1	1	1	1	0

Station	Parameter	N		Min	Max	Med	Mean	SD
LAYC-11	**Physical**							
	Turbidity (NTU)	7		2.6	4.3	3.6	3.5	0.6
	Total Dissolved Solids (mg/L)	7		82.0	198.0	118.0	122.3	38.1
	Total Suspended Solids (mg/L)	7		1.0	5.0	4.0	3.4	1.7
	Hardness (mg/L)	4		58.9	79.2	70.2	69.6	9.8
	Alkalinity (mg/L)	7		34.8	72.1	55.9	54.1	11.4
	Photic Zone (m)	7		2.76	4.62	3.76	3.84	0.61
	Secchi (m)	7		1.00	2.22	1.31	1.47	0.52
	Chemical							
	Ammonia Nitrogen (mg/L)[J B]	1					0.500	
	Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.007	0.086	0.016	0.025	0.029
	Total Kjeldahl Nitrogen (mg/L)[B]							
	Total Nitrogen (mg/L)[B]							
	Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.003	0.003	0.002	0.002	0.000
	Total Phosphorus (mg/L)[B]							
	CBOD-5 (mg/L)[J]	7	<	1.0	1.4	1.2	0.9	0.4
	Chlorides (mg/L)	7		5.3	38.2	23.4	23.4	10.7
	Biological							
	Chlorophyll a (ug/L)	7		4.81	24.00	12.80	13.00	6.35
	E. coli (mpn/100mL)	2	<	1	2	1	1	1

J=one or more of the values provided are estimated.
B=Samples did not meet ADEM's laboratory QC requirements.
< = Actual value is less than the detection limit.