2005 R.L .Harris Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
July, 2010

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July 22, 2010
Revised March 23, 2011

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INTRODUCTION

R. L. Harris dam was completed in 1983 by Alabama Power Company for hydropower generation. Harris Reservoir, also known as Lake Wedowee, encompasses 10,660 acres and has approximately 271 miles of shoreline in Clay and Randolph Counties.

The Alabama Department of Environmental Management (ADEM) monitored Harris Reservoir as part of the 2005 assessment of the Alabama, Coosa, and Tallapoosa (ACT) River basins under the Rivers and Reservoirs Monitoring Program (RRMP). Implemented in 1990, the objectives of this program were 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.

Specific water quality criteria for nutrient management were implemented in 2001 at two locations on Harris which have been monitored by ADEM since the mid-80's (Table 1). These criteria represent the maximum growing season mean (Apr-Oct) chlorophyll *a* concentration allowable while still fully supporting the reservoir's Swimming and Fish and Wildlife (S/F&W) use classifications.

The purpose of this report is to summarize data collected at six stations in Harris Reservoir during the 2005 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's historic year 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

Specific location information is provided in Table 1. Tallapoosa River was sampled in the upper reservoir, the mid reservoir just upstream of its confluence with the Little Tallapoosa River, and just upstream of the dam forebay. Little Tallapoosa River was also monitored at one location. Mad Indian Creek upstream of the mid reservoir location and Wedowee Creek, a tributary of Little Tallapoosa, were also sampled (Fig. 1).

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 (SOP), Surface Water Quality Assurance Project Plan (QAPP), and Quality Management Plan (QMP).

Mean annual TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions at each station. For Tallapoosa and Little Tallapoosa River 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 2005 results.

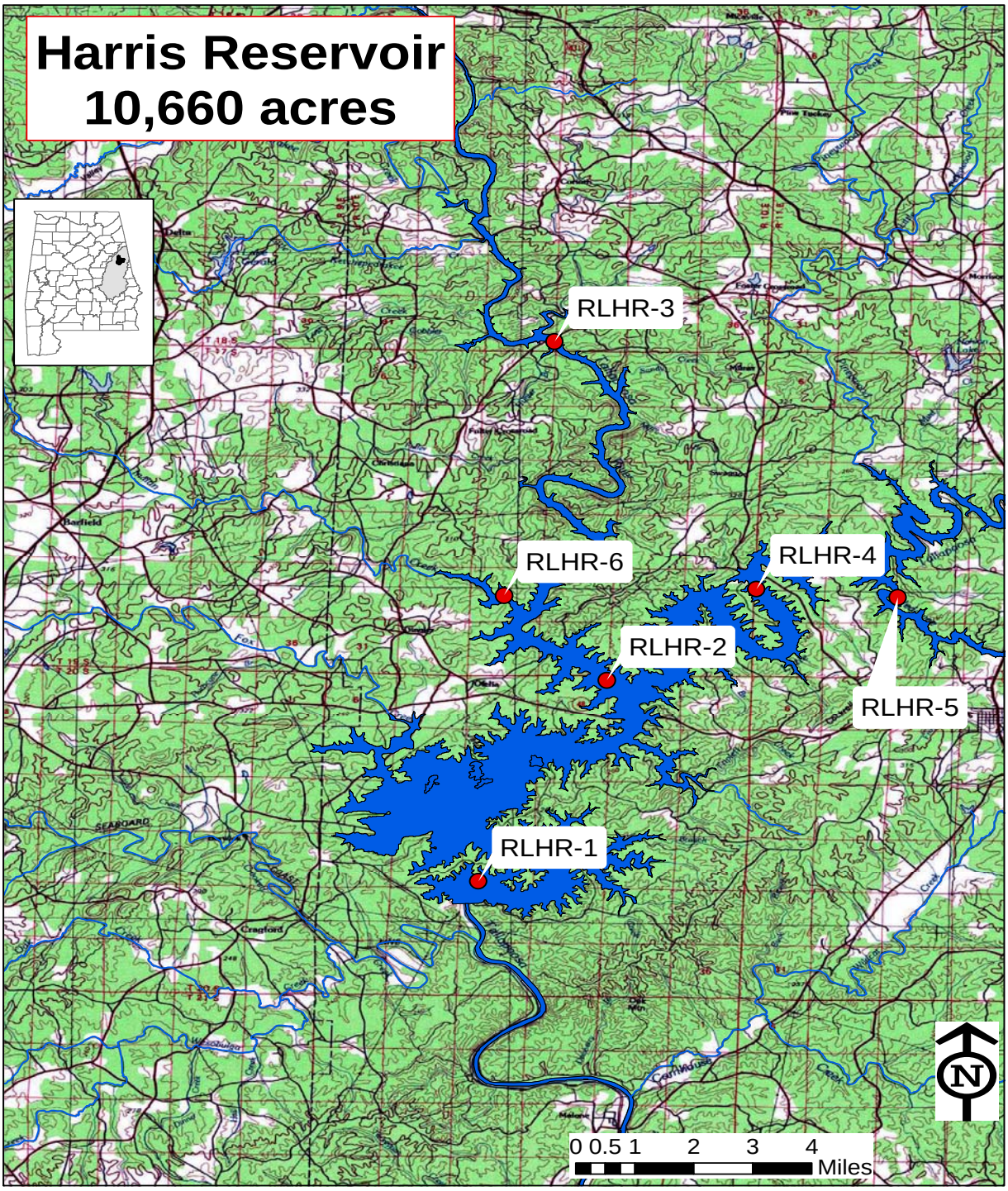


Figure 1. Harris Reservoir with 2005 sampling locations. A description of each sampling location is provided in Table 1.

Table 1. Description of each 2005 monitoring station located in Harris Reservoir.

Station	Report Designation	12 digit HUC	County	Waterbody	Station Description	Latitude	Longitude
RLHR-1**	Lower	0315-0109-0105	Randolph	Tallapoosa R	Lower reservoir. Deepest point, main river channel, dam forebay.	33.2641	-85.6127
RLHR-2**	Mid	0315-0108-1006	Randolph	Tallapoosa R	Mid reservoir. Deepest point, main river channel, immediately upstream of Tallapoosa River/Little Tallapoosa River confluence.	33.3184	-85.5811
RLHR-3	Upper	0315-0108-1006	Randolph	Tallapoosa R	Upper reservoir. Deepest point, main river channel, immediately downstream of Randolph Co. Hwy 82 bridge.	33.4100	-85.5939
RLHR-4	L Tallapoosa	0315-0108-0906	Randolph	Little Tallapoosa R	Deepest point, Little Tallapoosa River channel, immediately downstream of Randolph Co. Hwy 29.	33.3431	-85.5444
RLHR-5	Wedowee	0315-0108-0904	Randolph	Wedowee Cr	Deepest point, main creek channel, Wedowee Creek embayment, approximately 0.5 miles upstream of lake confluence.	33.3408	-85.5097
RLHR-6	Mad Indian	0315-0108-1005	Randolph	Mad Indian Cr	Deepest point, main creek channel, Mad Indian Creek embayment, approximately 0.5 miles upstream of lake confluence.	33.3414	-85.6064

**Growing season mean chl *a* criteria implemented at this station in 2001

RESULTS

Summary statistics of all data collected during 2005 are presented in Appendix Table 1. The table contains the min, max, median, average, and standard deviation of each parameter analyzed. Mean concentrations of TN, TP, chl *a*, and TSS are presented in Fig. 2. Monthly concentrations of these parameters are also presented for the upper (Fig. 3), mid (Fig. 4), L. Tallapoosa (Fig. 5), and lower (Fig. 6) stations. Fig. 7 compares the mean concentrations of chl *a* at each mainstem station, 1997-2005.

Mainstem Stations: The highest mean TN and TP concentrations were measured at the upper station during both 2000 and 2005 (Fig. 2; ADEM 2003). Comparison of mean 2000 and 2005 TN and TP data collected at the L. Tallapoosa station indicate higher concentrations in 2005. Comparison of mean chl *a* data collected 1997-2005 indicate variable concentrations at mainstem stations, but the 2005 concentrations were among the highest measured at all four locations (Fig. 7). Mean TSS varied little among stations and showed similar concentrations between the 2000 and 2005 (Fig. 2; ADEM 2003). The 2005 AGPT results indicated phosphorus limited conditions at the upper, L. Tallapoosa, and lower stations (Table 2). By contrast, the 2001 results showed the upper station to be nitrogen limited, while algal growth at the lower and L. Tallapoosa stations to be neither nitrogen nor phosphorus limited. The mid station was limited by both nitrogen and phosphorus concentrations in 2001 and 2005.

Dissolved oxygen was stratified at the mid, lower, and L Tallapoosa stations while the upper station was a little more mixed during June-September (Fig. 8). Monthly TSI values, calculated using chl *a* concentrations and the Carlson's Trophic State Index, indicated eutrophic conditions at each mainstem station (Fig. 9). Based on August data collected since 1985, the mid and lower stations ranged from mesotrophic to eutrophic, while the L. Tallapoosa and upper stations have been consistently eutrophic (Fig. 10).

Tributary Stations: Of the two tributary stations, mean TN, TP, chl *a*, and TSS concentrations were highest at Wedowee (Fig. 2). Mean concentrations of each of these parameters increased from 2000 to 2005 at this location (ADEM 2003). Comparison of mean TN and chl a data collected in 2000 and 2005 at Mad Indian indicated lower concentrations of these parameters in 2005 (Fig. 2; ADEM 2003). Dissolved oxygen concentrations were > 5.0 mg/l at 5 ft. in Wedowee and Mad Indian Creek during the entire sampling period (Fig. 9).

Monthly TSI values, calculated using chl *a* concentrations and the Carlson's Trophic State Index, indicated eutrophic conditions at both tributary stations (Fig. 10).

Figure 2. Mean total nitrogen (TN), mean total phosphorus (TP), mean chlorophyll *a* (Chl *a*) and mean total suspended solids (TSS) measured throughout Harris Reservoir, April-October 2005. Bar graphs consist of multiple stations, illustrated from upstream to downstream as the graph is read from left to right. The blue bars represent the mainstem stations; tributary stations are green.

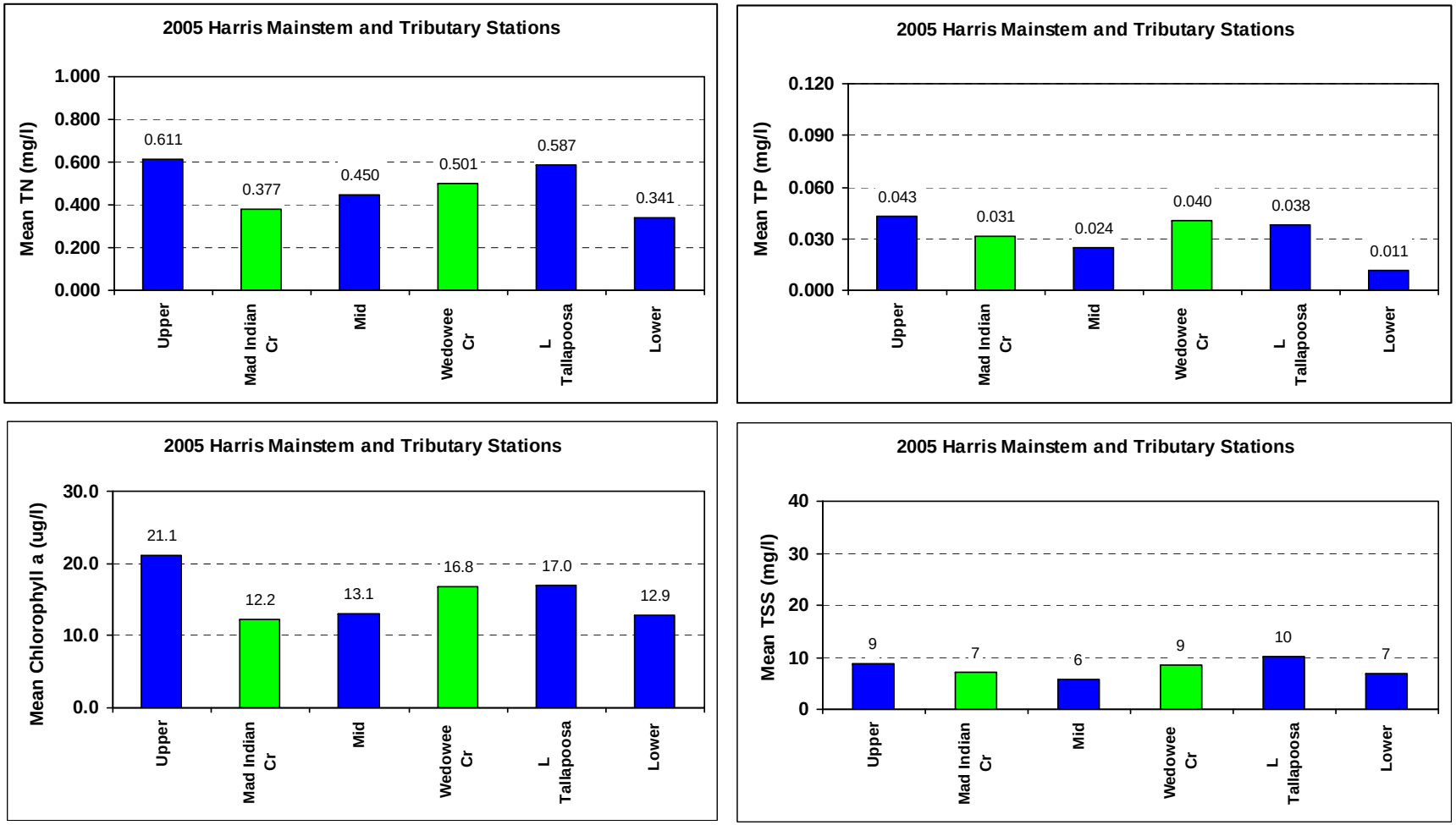
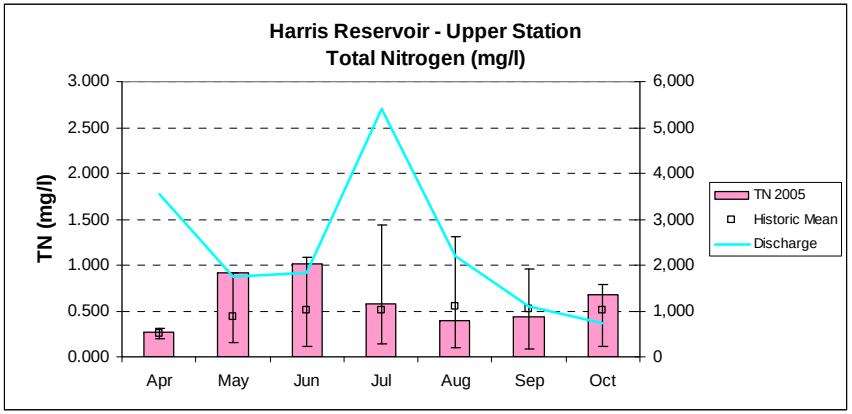
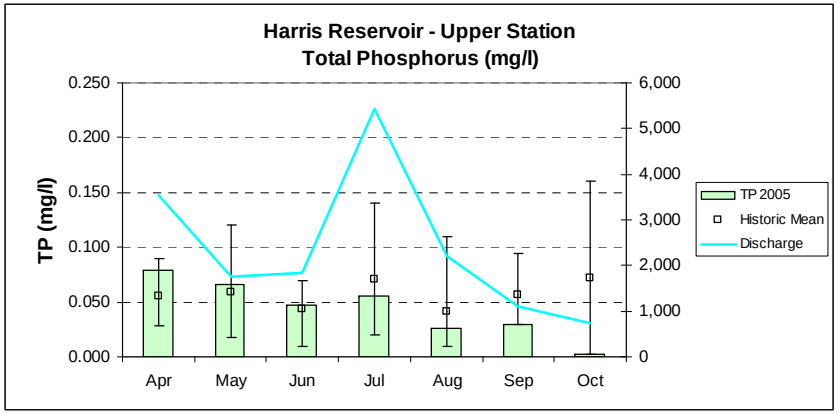
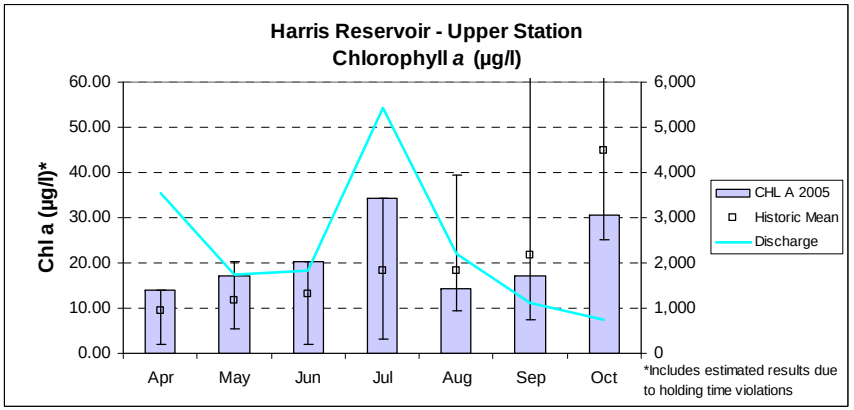


Figure 3. Total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the upper station in Harris Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the Stateline station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (R.L. Harris Dam discharge data).







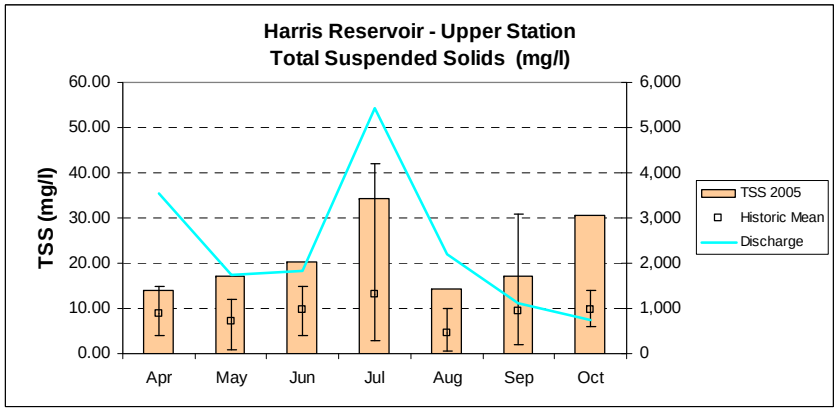


Figure 4. Total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the mid station in Harris Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the upper station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (R.L. Harris Dam discharge data).

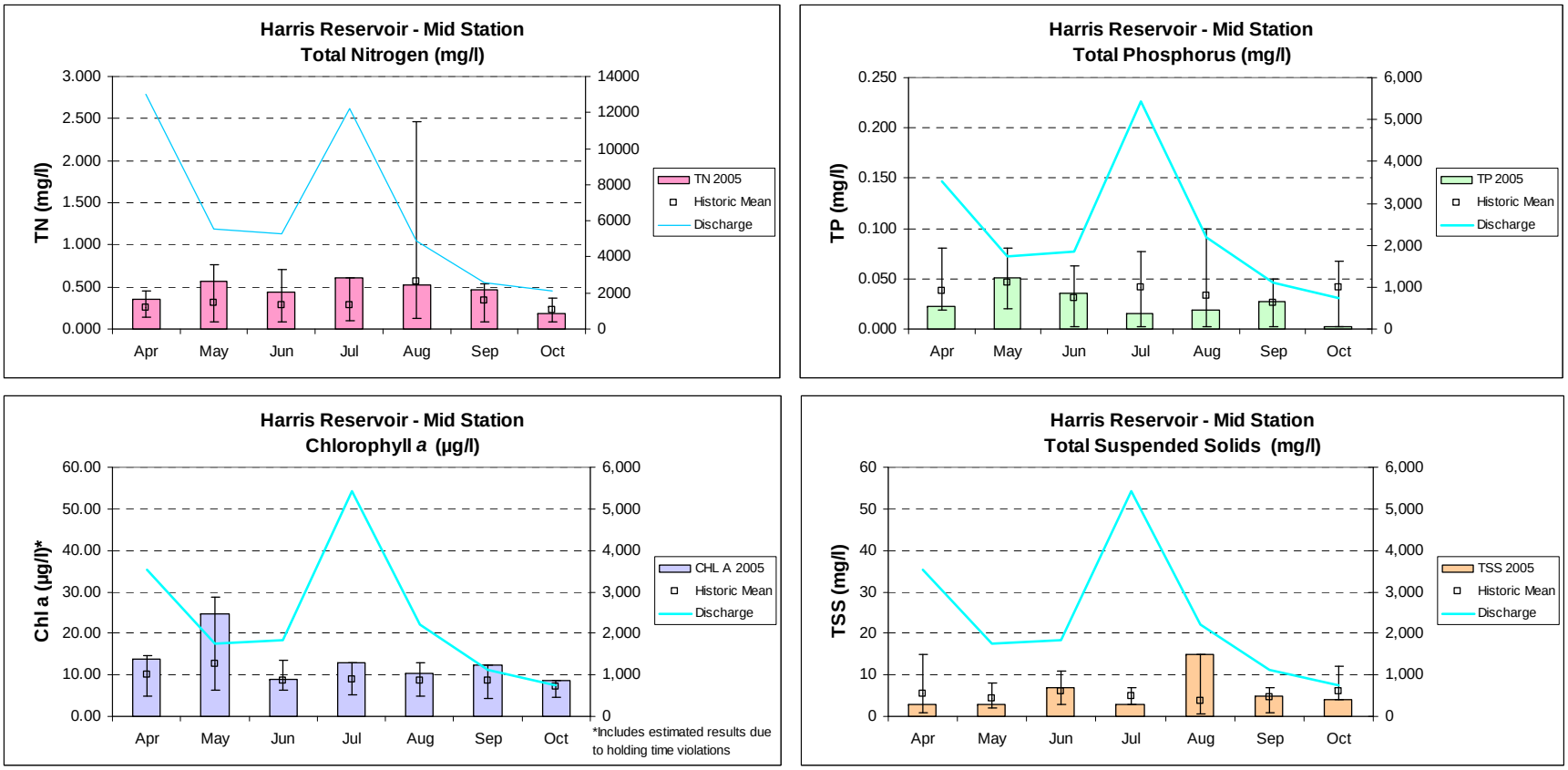
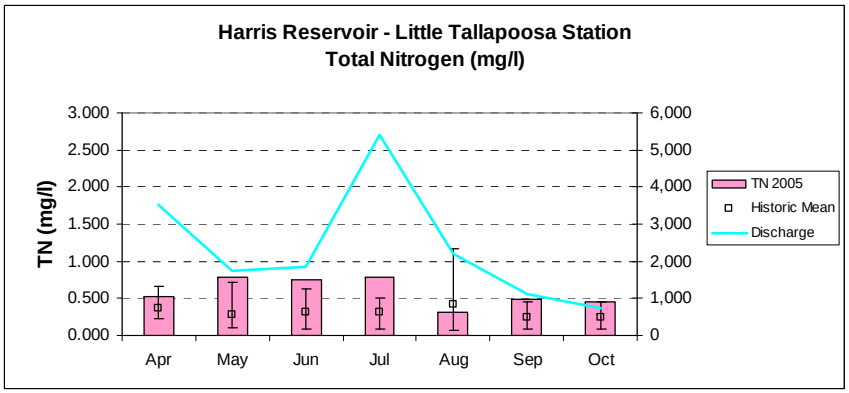
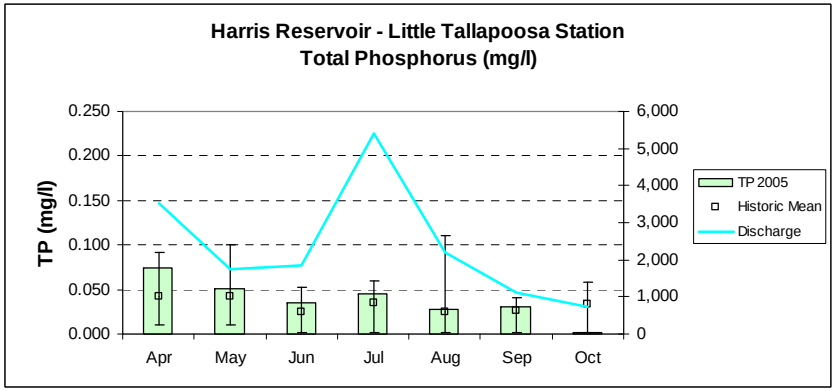
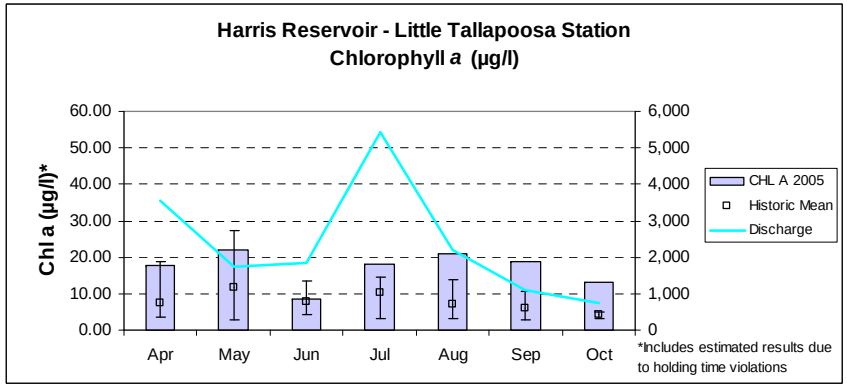


Figure 5. Total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of L. Tallapoosa station in Harris Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the mid-reservoir station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (R.L. Harris Dam discharge data).







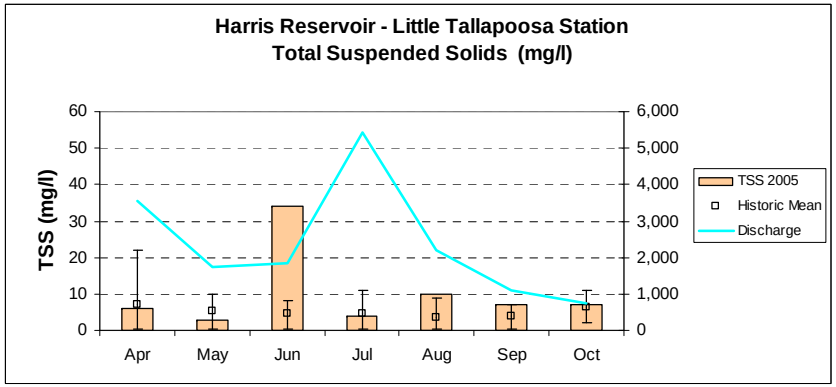
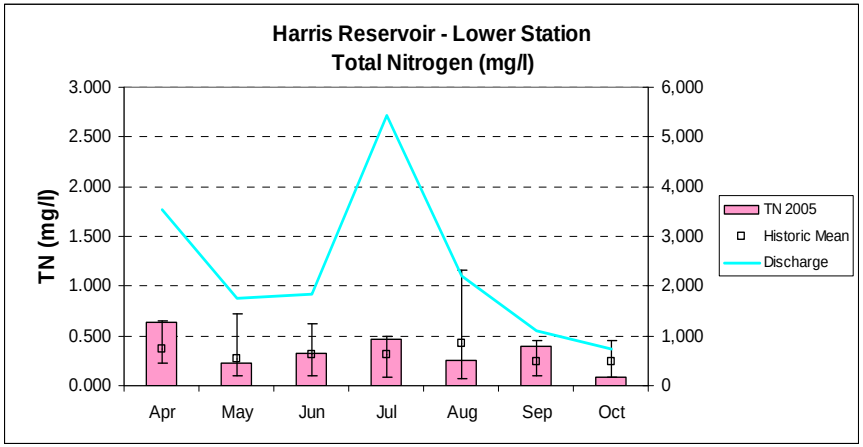
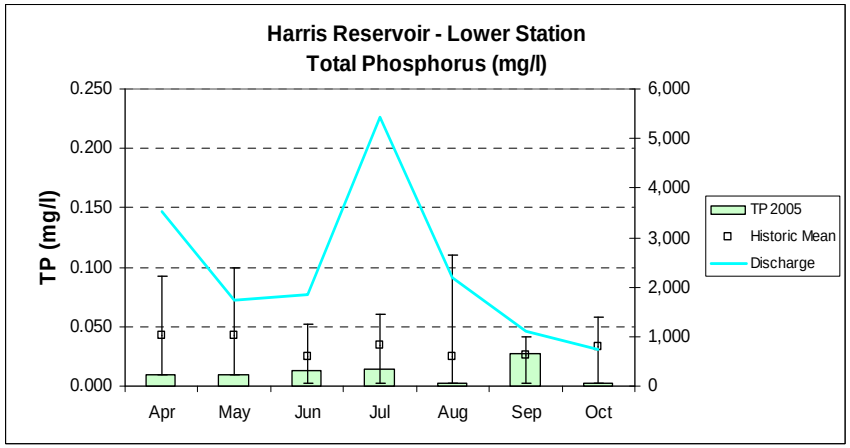
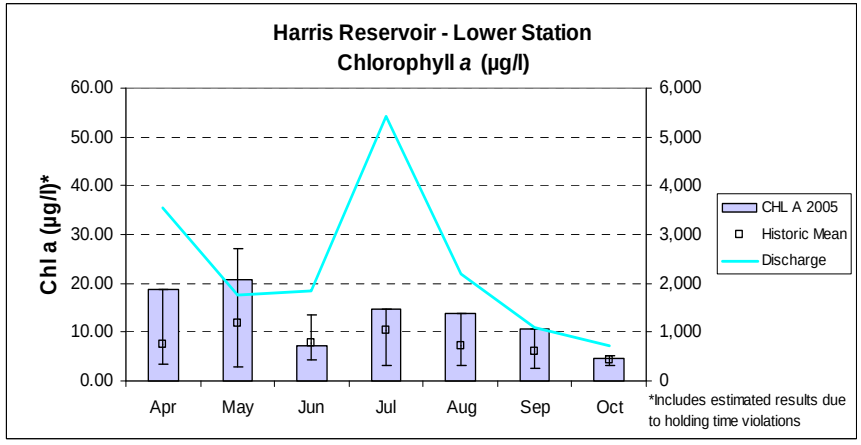


Figure 6. Total nitrogen (TN), total phosphorus (TP), chlorophyll *a* (chl *a*) and total suspended solids (TSS) of the dam forebay station in Harris Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the lower reservoir station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (R.L. Harris Dam discharge data).







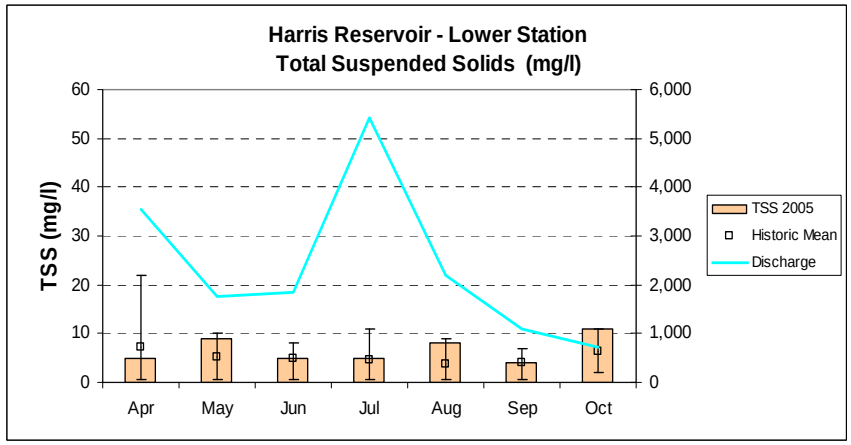
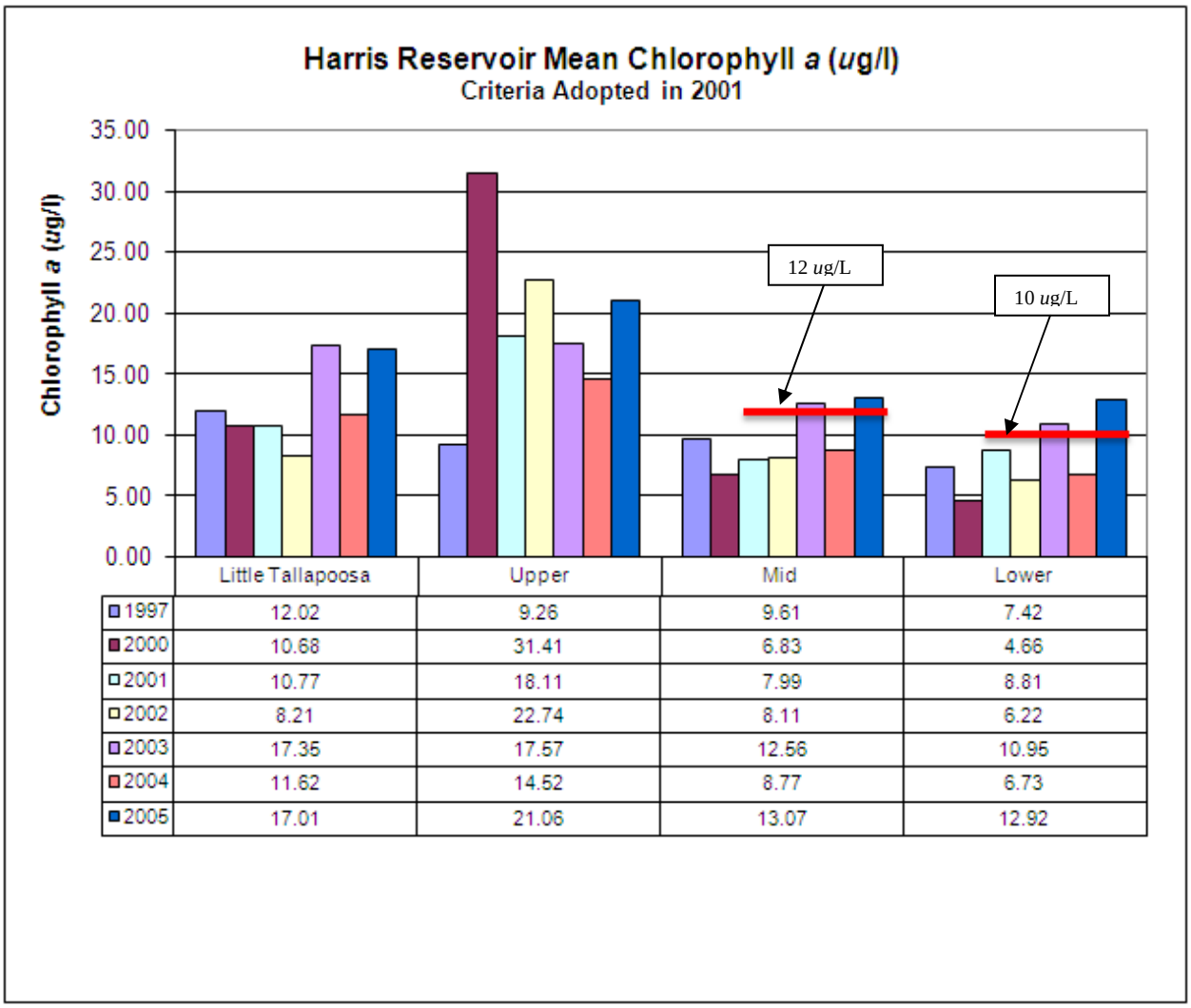


Figure 7. Mean chlorophyll *a* concentrations of mainstem Harris Reservoir, 1997 through 2005. Chlorophyll *a* criteria applies to the growing season mean of the mid and lower stations only beginning in 2001.



	Little Tallapoosa	Upper	Mid	Lower
1997	12.02	9.26	9.61	7.42
2000	10.68	31.41	6.83	4.66
2001	10.77	18.11	7.99	8.81
2002	8.21	22.74	8.11	6.22
2003	17.35	17.57	12.56	10.95
2004	11.62	14.52	8.77	6.73
2005	17.01	21.06	13.07	12.92

Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) or 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 (Raschke and Schultz 1987); MSC values below 20 mg/l MSC are considered protective of flowing streams and rivers (Raschke et al. 1996).

Station	2000 Control mean MSC	2000 Limiting Nutrient	2005 Control mean MSC	2005 Limiting Nutrient
Upper	3.62	Nitrogen	7.46	Phosphorus
L. Tallapoosa	1.97	None	5.46	Phosphorus
Mid	1.59	Co-limiting	2.90	Co-limiting
Lower	1.74	None	2.91	Phosphorus

Figure 8. Depth profiles of dissolved oxygen (DO) and temperature (Temp) in Harris Reservoir, June-September 2005. Although profiles were meaured 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.

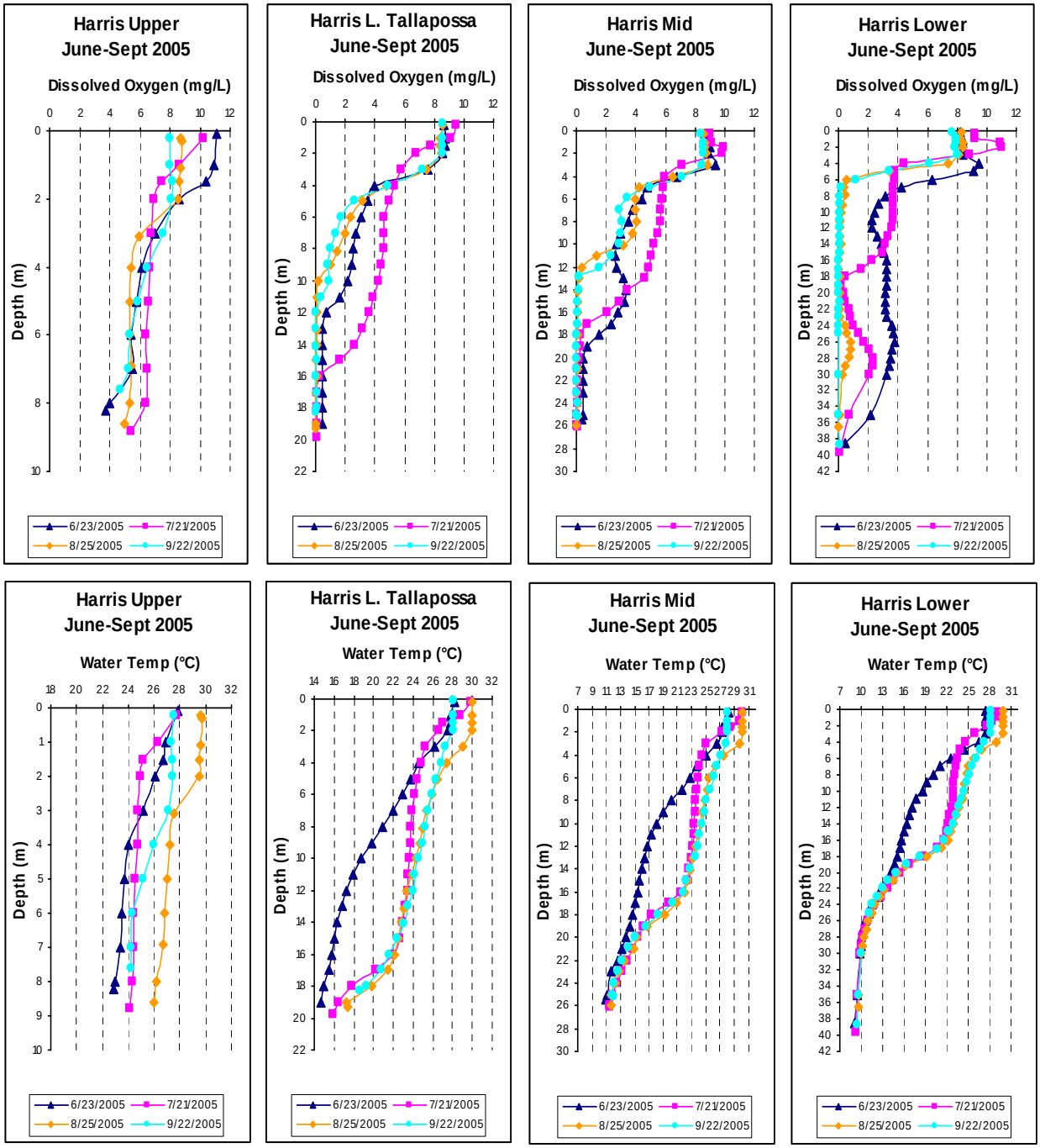


Figure 9. DO concentrations at 5 ft (1.5m) for Harris Reservoir tributaries collected April-October 2005. For tributary embayments, which are typically not as deep as mainstem stations and usually maintain a mixed water column throughout the season, profiles were collected but only the monthly DO concentrations at a depth of 5ft (1.5m) are graphed. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/l at this depth (ADEM 2005).

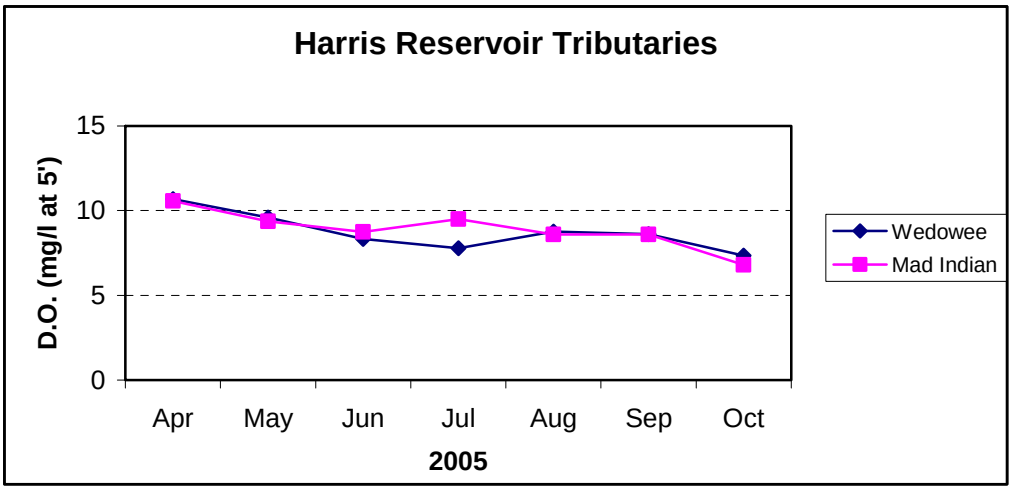
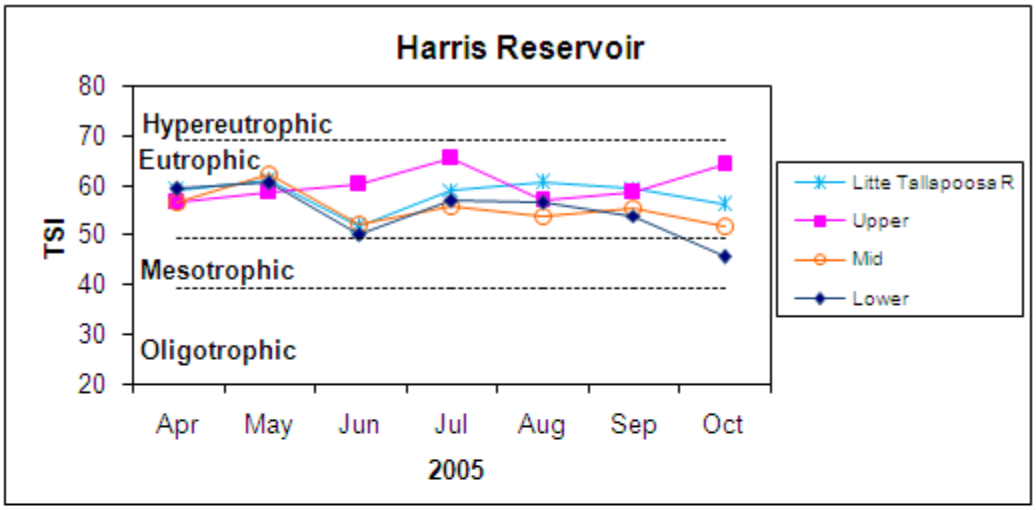


Figure 10. Monthly TSI values for mainstem and tributary stations using chlorophyll a concentrations and the Carlson's Trophic State Index calculation, April-October 2005.



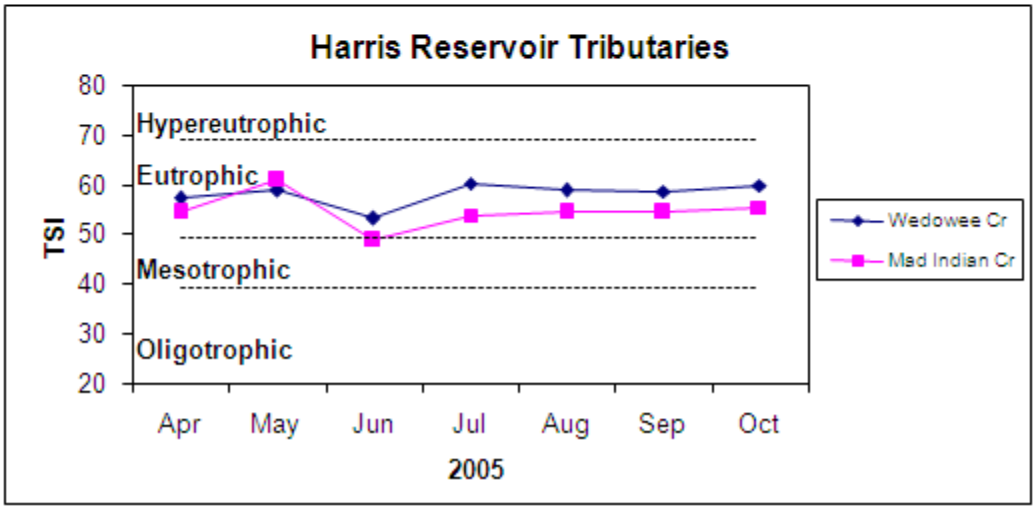
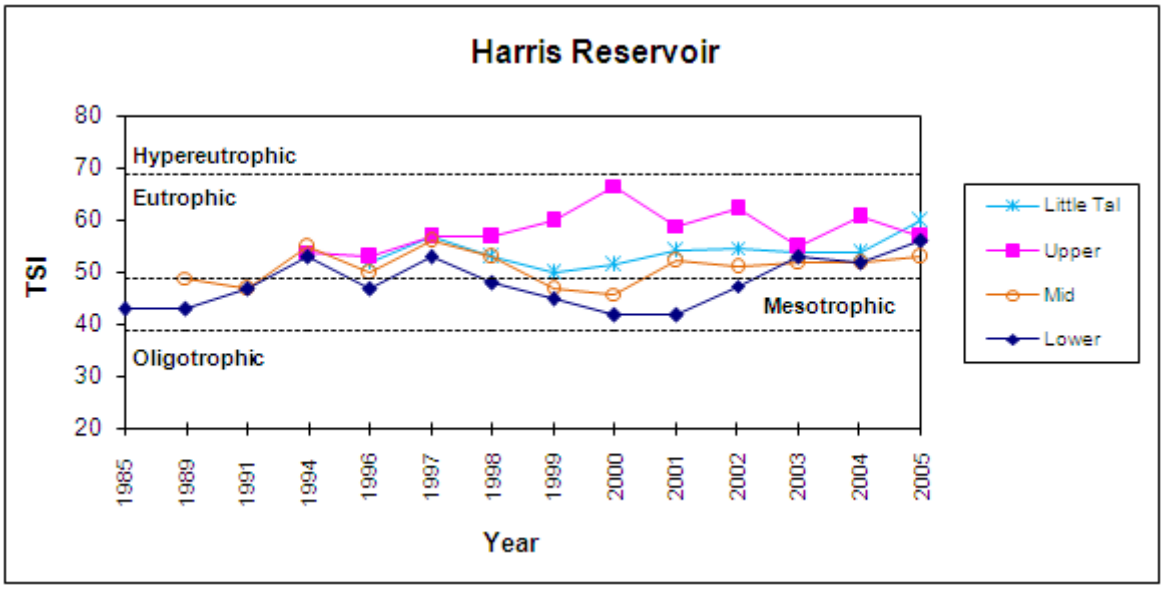


Figure 11. Trophic State Index values from critical period sampling (August sampling only) from 1985 to 2005.



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APPENDIX

Appendix Table 1. Summary of water quality data collected April-October, 2005. Minimum (Min) and maximum (Max) values calculated using minimum detection limits (MDL) when results were less than this value. Median (Med), average (Ave), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

Station	Parameter	N	Min	Max	Median	Avg	SD
RLHR-1	Alkalinity (mg/L)	7	8.2	24.1	10.3	12.0	5.5
	Hardness (mg/L)	4	8.6	12.4	10.8	10.6	1.9
	Total Dissolved Solids (mg/L)	7	26.0	51.0	42.0	39.9	9.8
	Total Suspended Solids (mg/L)	7	4.0	11.0	5.0	6.7	2.6
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.021	0.008	0.009	0.005
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.169	0.043	0.056	0.054
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.461	0.291	0.285	0.133
	Total Nitrogen (mg/L)	7	< 0.080	0.630	0.330	0.341	0.177
	Total Phosphorus (mg/L)	7	< 0.004	0.027	0.010	0.011	0.008
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.009	0.002	0.004	0.003
	Chlorophyll a (mg/L)[J]	7	4.63	20.83	13.88	12.92	5.87
	Turbidity (NTU)	7	2	5	3	3	1
	Secchi (m)	7	1.24	2.92	2.21	2.17	0.67
	Fecal Coliform (col/100 mL)	1	---	---	---	1	---
RLHR-2	Alkalinity (mg/L)	7	9.5	29.6	11.1	13.6	7.2
	Hardness (mg/L)	4	9.7	13.0	11.6	11.5	1.5
	Total Dissolved Solids (mg/L)	7	29.0	73.0	40.0	43.1	15.8
	Total Suspended Solids (mg/L)	7	3.0	15.0	4.0	5.7	4.3
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.043	0.008	0.013	0.013
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.311	0.074	0.090	0.108
	Total Kjeldahl Nitrogen (mg/L)	7	0.184	0.586	0.355	0.360	0.159
	Total Nitrogen (mg/L)	7	0.190	0.610	0.460	0.450	0.144
	Total Phosphorus (mg/L)	7	< 0.004	0.051	0.022	0.024	0.016
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.015	0.002	0.006	0.005
	Chlorophyll a (mg/L)[J]	7	8.54	24.56	12.46	13.07	5.46
	Turbidity (NTU)	7	3	6	3	4	1
	Secchi (m)	7	1.11	2.13	2.04	1.86	0.36
	Fecal Coliform (col/100 mL)	1	---	---	---	1	---
RLHR-3	Alkalinity (mg/L)	7	11.4	29.3	13.1	15.0	6.4
	Hardness (mg/L)	4	10.4	14.1	13.7	13.0	1.7
	Total Dissolved Solids (mg/L)	7	31.0	66.0	53.0	51.0	11.1
	Total Suspended Solids (mg/L)	7	5.0	18.0	8.0	8.9	4.4
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.016	0.008	0.009	0.003
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.203	0.137	0.127	0.076
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.902	0.443	0.485	0.265
	Total Nitrogen (mg/L)	7	0.270	1.020	0.580	0.611	0.277
	Total Phosphorus (mg/L)	7	< 0.004	0.079	0.047	0.043	0.026
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.024	0.009	0.010	0.008
	Chlorophyll a (mg/L)[J]	7	13.88	34.18	17.09	21.06	8.04
	Turbidity (NTU)	7	5	26	9	11	7
	Secchi (m)	7	0.60	1.51	1.28	1.14	0.34
	Fecal Coliform (col/100 mL)	1	---	---	---	11	---

Station	Parameter	N		Min	Max	Median	Avg	SD
RLHR-4	Alkalinity (mg/L)	7		8.9	26.9	11.4	13.4	6.2
	Hardness (mg/L)	4		10.4	13.0	11.5	11.6	1.2
	Total Dissolved Solids (mg/L)	7		26.0	208.0	40.0	74.0	70.3
	Total Suspended Solids (mg/L)	7		3.0	34.0	7.0	10.1	10.8
	Ammonia Nitrogen (mg/L)	7	<	0.015	0.050	0.008	0.016	0.016
	Nitrate+Nitrite Nitrogen (mg/L)	7		0.035	0.317	0.113	0.143	0.092
	Total Kjeldahl Nitrogen (mg/L)	7		0.172	0.702	0.455	0.444	0.210
	Total Nitrogen (mg/L)	7		0.320	0.780	0.530	0.587	0.183
	Total Phosphorus (mg/L)	7	<	0.004	0.074	0.035	0.038	0.022
	Dissolved Reactive Phosphorus (mg/L)	7	<	0.004	0.014	0.007	0.008	0.006
	Chlorophyll a (mg/L)[J]	7		8.54	21.89	18.16	17.01	4.66
	Turbidity (NTU)	7		2	6	4	4	1
	Secchi (m)	7		1.21	2.05	1.72	1.68	0.29
	Fecal Coliform (col/100 mL)	1		---	---	---	1	---
RLHR-5	Alkalinity (mg/L)	7		7.6	23.9	10.2	12.1	5.6
	Hardness (mg/L)	5		8.0	12.2	10.4	10.1	1.7
	Total Dissolved Solids (mg/L)	7		26.0	77.0	43.0	43.7	17.2
	Total Suspended Solids (mg/L)	7		2.0	16.0	7.0	8.6	5.7
	Ammonia Nitrogen (mg/L)	7	<	0.015	0.021	0.008	0.012	0.006
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.003	0.251	0.060	0.092	0.092
	Total Kjeldahl Nitrogen (mg/L)	7		0.236	0.772	0.383	0.410	0.184
	Total Nitrogen (mg/L)	7		0.240	0.830	0.490	0.501	0.195
	Total Phosphorus (mg/L)	7	<	0.004	0.073	0.034	0.040	0.025
	Dissolved Reactive Phosphorus (mg/L)	7	<	0.004	0.013	0.002	0.005	0.004
	Chlorophyll a (mg/L)[J]	7		9.97	20.49	17.62	16.84	3.52
	Turbidity (NTU)	7		3	6	4	4	1
	Secchi (m)	7		1.22	1.92	1.58	1.58	0.23
	Fecal Coliform (col/100 mL)	1		---	---	---	20	---
RLHR-6	Alkalinity (mg/L)	7		8.1	28.2	10.8	12.9	7.0
	Hardness (mg/L)	4		8.7	13.4	10.7	10.9	2.1
	Total Dissolved Solids (mg/L)	7		17.0	65.0	50.0	44.7	16.7
	Total Suspended Solids (mg/L)	7		3.0	14.0	5.0	7.1	4.8
	Ammonia Nitrogen (mg/L)	7	<	0.015	0.038	0.008	0.015	0.013
	Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.003	0.160	0.059	0.069	0.056
	Total Kjeldahl Nitrogen (mg/L)	7	<	0.150	0.611	0.281	0.307	0.174
	Total Nitrogen (mg/L)	7		0.200	0.670	0.360	0.377	0.148
	Total Phosphorus (mg/L)	7	<	0.004	0.082	0.023	0.031	0.027
	Dissolved Reactive Phosphorus (mg/L)	7	<	0.004	0.012	0.002	0.005	0.004
	Chlorophyll a (mg/L)[J]	7		6.41	21.89	11.21	12.18	4.70
	Turbidity (NTU)	7		3	9	5	6	2
	Secchi (m)	7		1.33	2.10	1.92	1.86	0.26
	Fecal Coliform (col/100 mL)	1		---	---	---	23	---

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