

2005 Mitchell Reservoir Report
Rivers and Reservoirs Monitoring Program



Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
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Rivers and Reservoirs Monitoring Program

2005

Mitchell Reservoir Coosa River Basin

**Alabama Department of Environmental Management
Field Operations Division
Environmental Indicators Section
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INTRODUCTION

The Alabama Department of Environmental Management (ADEM) monitored Mitchell 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 condition, identify trends in water quality conditions, and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria.

Mitchell 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 nutrients. A [TMDL](#) developed to address the nutrient impairment was approved by the USEPA in 2008.

The purpose of this report is to summarize data collected at four stations in Mitchell Reservoir during the 2005 growing season and to evaluate trends in mean lake trophic status and nutrient concentrations using ADEM's 20 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)) are compared to ADEM's historical data.

METHODS

Sampling stations were determined using historical data and previous assessments ([Fig. 1; Table 1](#)). Mitchell Reservoir was sampled in the dam forebay with an additional station added in the transitional area of the upper reservoir. Two stations were established in Hatchet and Walnut Creek embayments.

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 \(QMP\)](#).

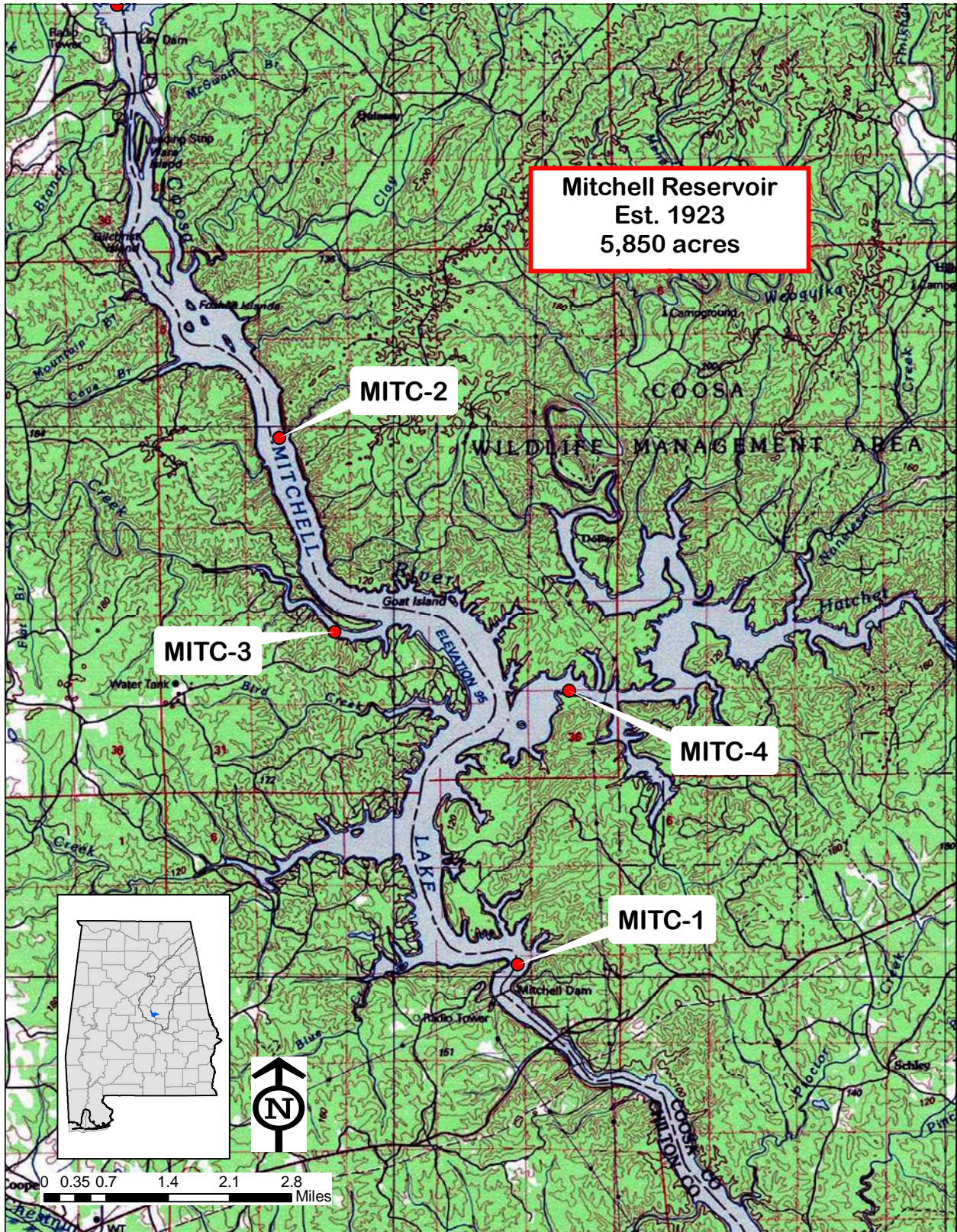


Figure 1. Mitchell Reservoir with 2005 sampling locations. A description of each sampling location is provided in Table 1.

Table 1. Descriptions for the monitoring stations in 2005 for Mitchell Reservoir. Stations are listed from upstream to downstream.

Mitchell Reservoir							
Sub-watershed	County	Station Number	Report Designation	Waterbody Name	Station Description	Latitude	Longitude
Lower Coosa (0315-0107)							
0601	Coosa	MITC-1**	Lower	Coosa R	Lower reservoir. Deepest point, main river channel, dam forebay .	32.8106	-86.4420
0601	Coosa	MITC-2	Upper	Coosa R	Upper reservoir. Deepest point, main river channel, downstream of Foshee Islands.	32.8972	-86.4877
0603	Chilton	MITC-3	Walnut Cr	Walnut Cr	Deepest point, main creek channel, Walnut Creek embayment, approximately 0.5 miles upstream of lake confluence.	32.8653	-86.4771
0807	Coosa	MITC-4	Hatchet Cr	Hatchet Cr	Deepest point, main creek channel, Hatchet Creek embayment, approximately 0.5 miles upstream of lake confluence.	32.8555	-86.4317

**Growing season mean Chl a criteria will be established at this station in 2010

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 TN concentrations were similar across the entire reservoir with values ranging from 0.369 mg/L to 0.516 mg/L ([Fig. 2](#)). Monthly TN concentrations were lowest in May ([Fig. 3 & 4](#)).

Mean TP concentrations in Mitchell ranged from 0.044 to 0.049 mg/l, indicating eutrophic conditions throughout the reservoir ([Fig. 2](#)). The lowest monthly TP concentrations occurred in August and October for all mainstem stations ([Fig. 3 & 4](#)).

Mean chl *a* concentrations ranged from 15.83 in the upper reservoir to 18.44 at the Hatchet Cr station ([Fig. 2](#)). Lowest monthly concentrations occurred in May for both mainstem stations; highest chl *a* concentrations were measured in Jun at the upper station and Jul at the lower station ([Fig. 3 & 4](#)). The ADEM monitored growing season mean chl *a* concentrations at mainstem reservoir stations in 1997, 2000, 2004, and 2005 ([Fig. 5](#)). Mean chl *a* was lowest in 2005 at the upper station and lowest in 1997 at the lower station.

Mean TSS concentrations were higher in the upper portion of the reservoir and decreased downstream ([Fig. 2](#)). Highest monthly TSS concentrations in the mainstem stations occurred in July during highest flows ([Fig. 3 & 4](#)).

Algal growth potential testing (AGPT) results showed Lay to be nitrogen limited at both mainstem stations ([Table 2](#)). The upper station had an MSC of 8.21 mg/L, above the 5 mg/l MSC Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

Dissolved oxygen concentrations were above the ADEM Water Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/l for all ([Fig. 6 & 7](#)). The lower station was super saturated through the first 2 meters of the water column, Jun-Sep ([Fig. 6](#)). Mitchell tributaries remained well oxygenated throughout the sampling season ([Fig. 7](#)). Warmest water temperatures occurred in August.

August TSI values calculated from data collected at mainstem stations, 1985-2005, are presented in [Fig. 9](#). August TSI at the upper and lower stations remained stable in the mid-eutrophic range.

Figure 2. Mean total nitrogen (TN), mean total phosphorus (TP), mean chlorophyll a (Chl *a*) and mean total suspended solids (TSS) of all stations in Mitchell Reservoir, April-October 2005. Bar graphs consist of multiple stations, illustrated from upstream to downstream as the graph is read from left to right.

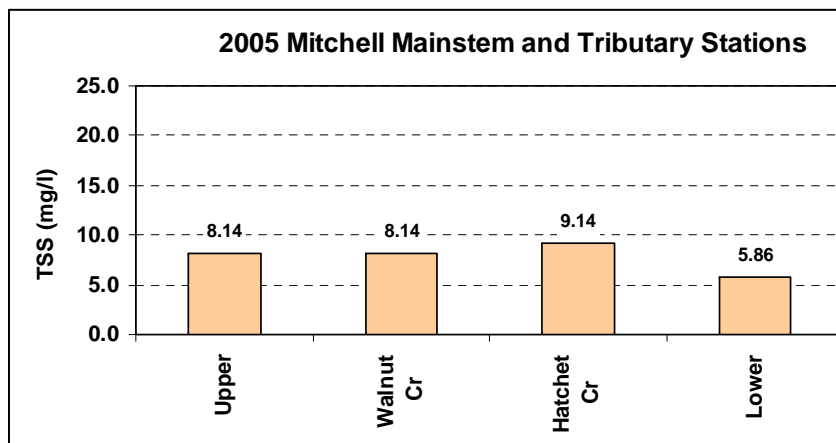
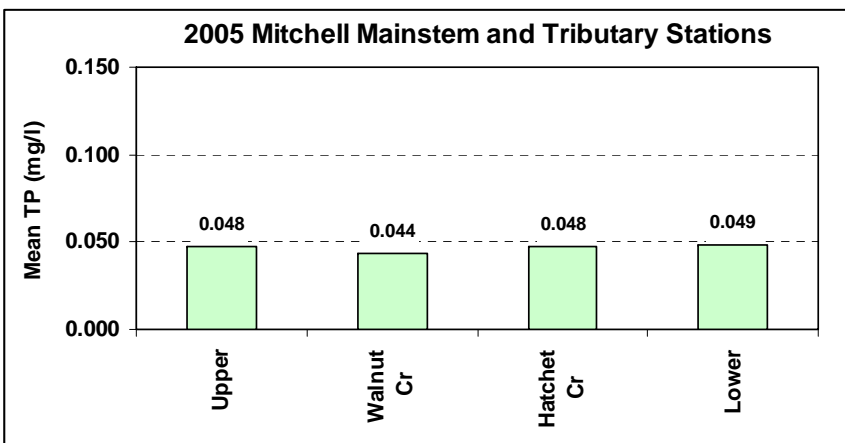
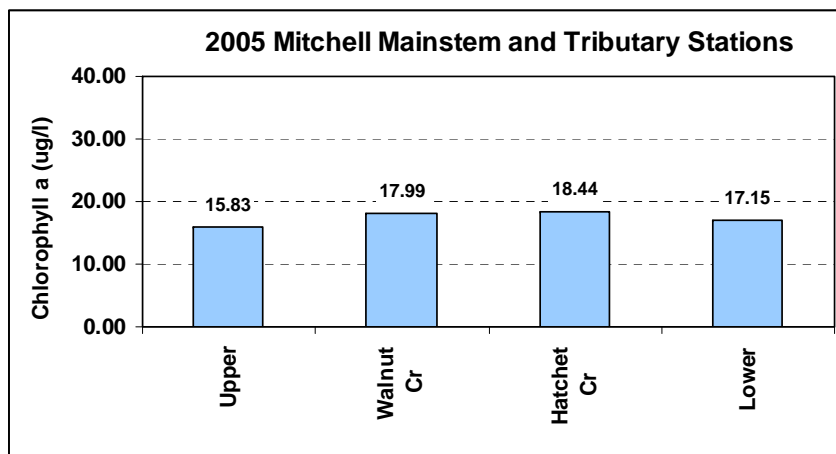
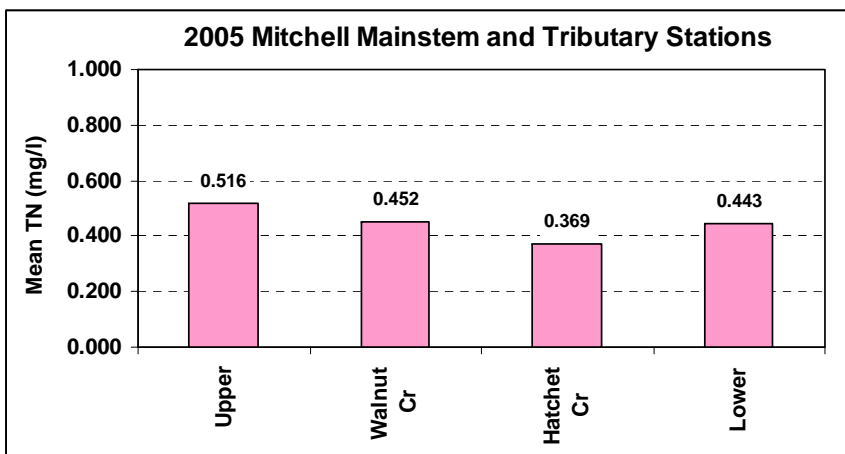


Figure 3. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl a) and total suspended solids (TSS) of the upper station in Mitchell Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the upper station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (Coosa River near Rome, GA).

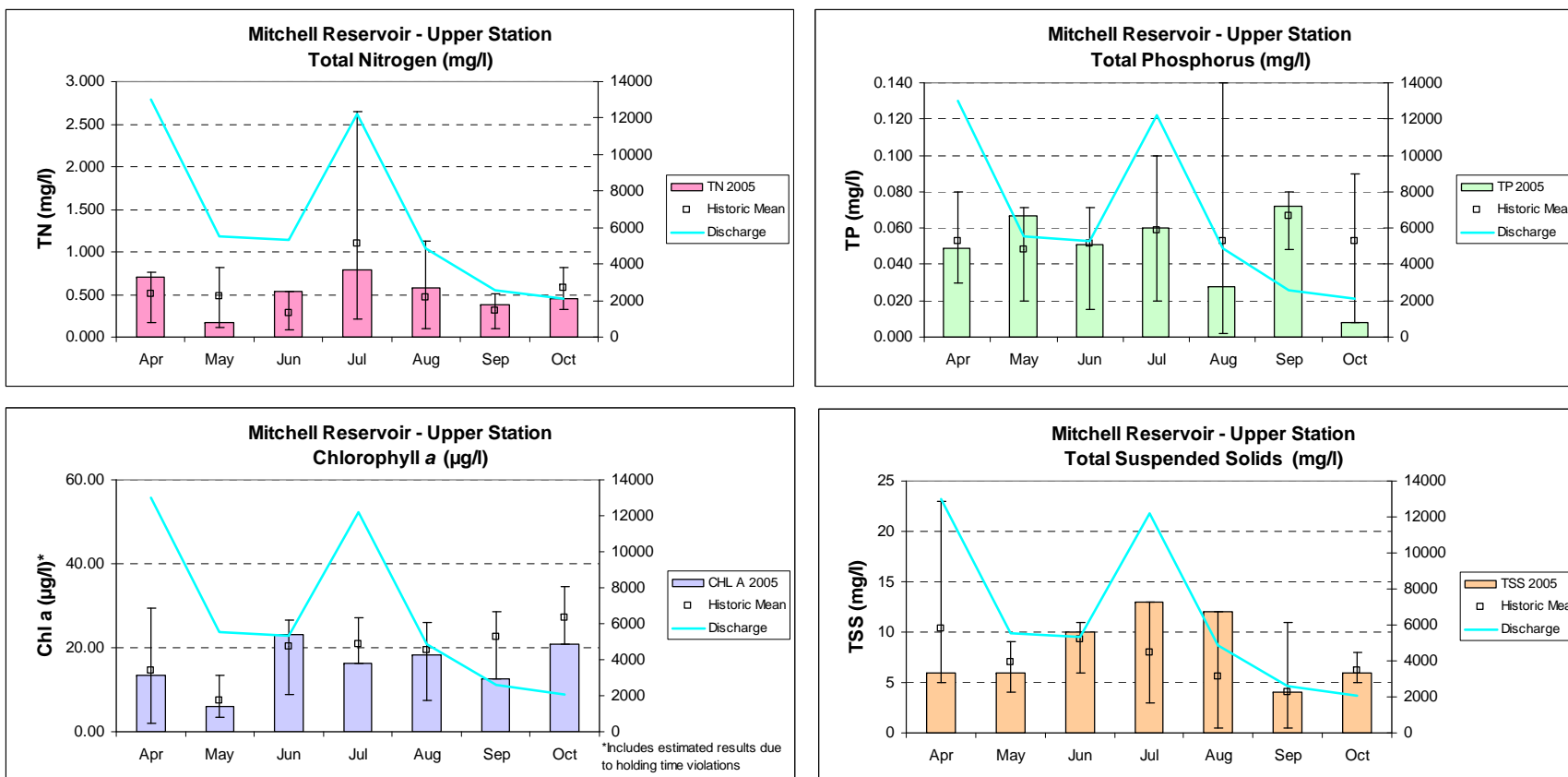


Figure 4. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl a) and total suspended solids (TSS) of the lower station in Mitchell Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the lower station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (Coosa River near Rome, GA).

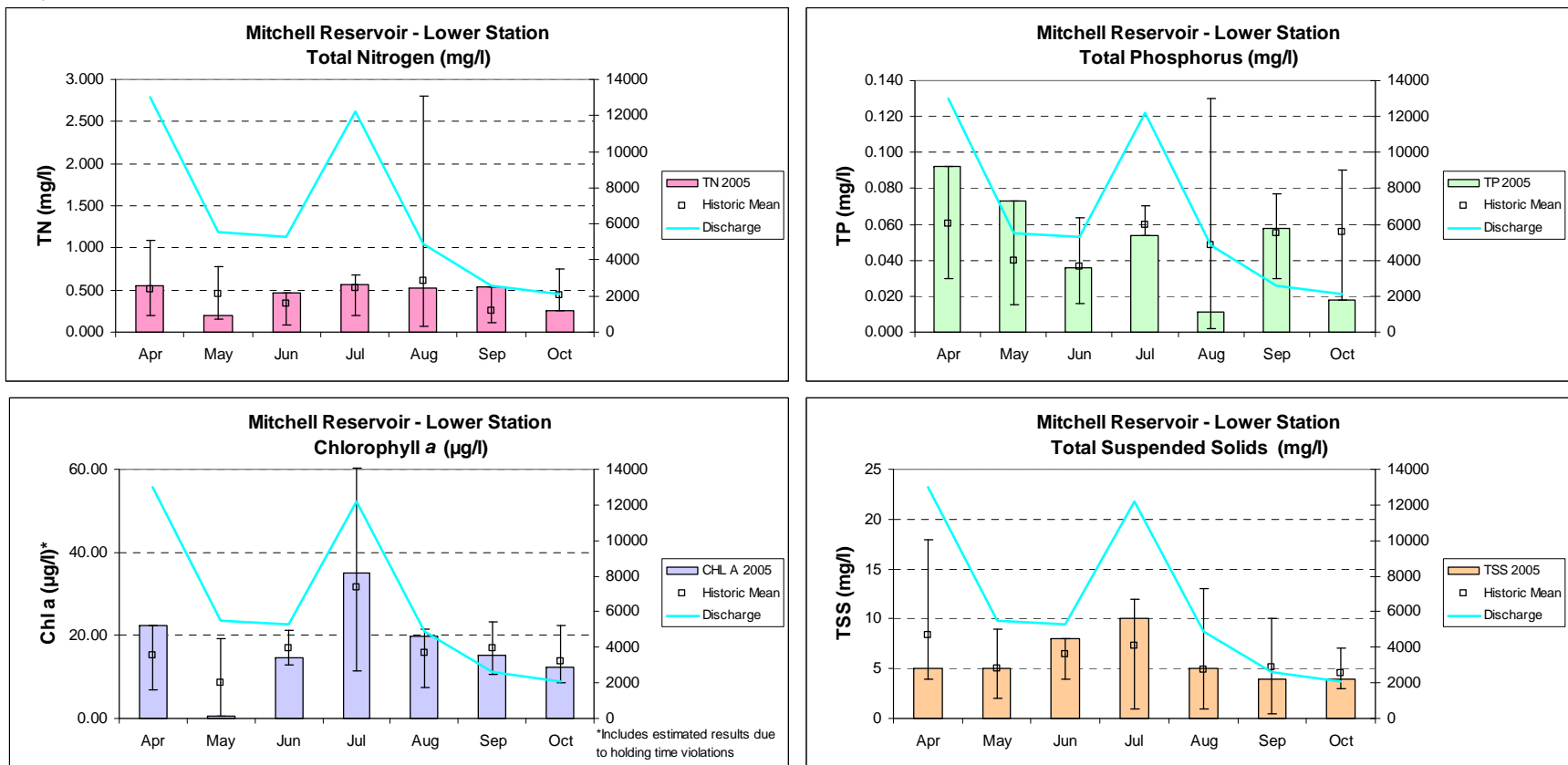


Figure 5. Growing season mean chlorophyll a concentrations of mainstem Mitchell Reservoir, 1997 through 2005.

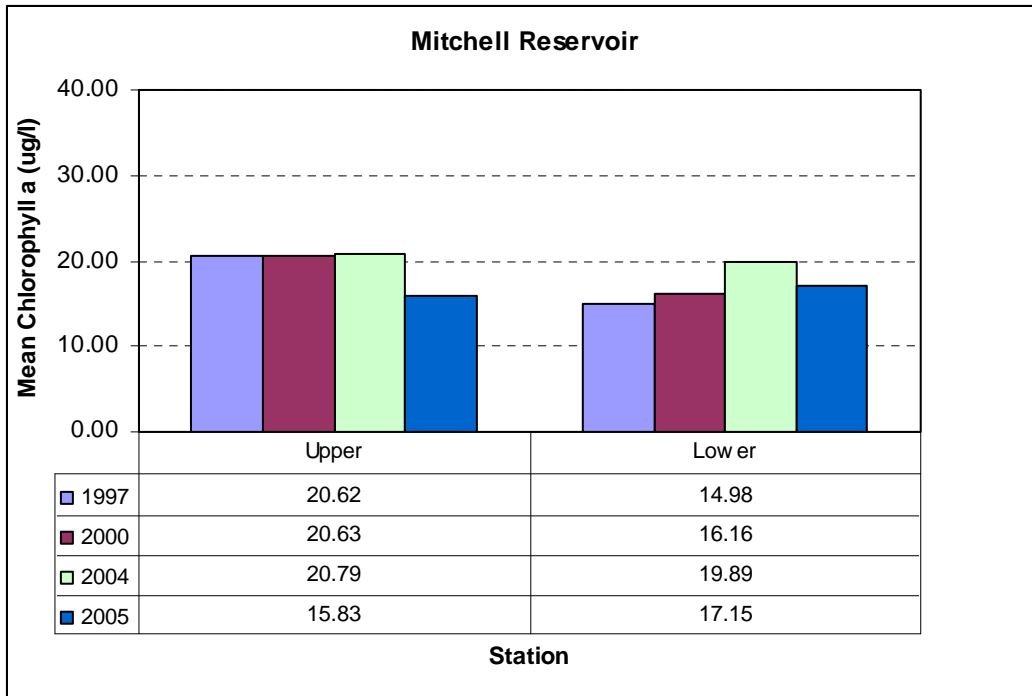


Table 2. Algal growth potential test results (expressed as mean Maximum Standing Crop (MSC) or dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status from 2000 and 2005. Mean standing crop (MSC) values below 5 mg/l are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Station	2000 Control mean MSC	2000 Limiting Nutrient	2005 Control mean MSC	2005 Limiting Nutrient
Upper	4.17	Non Limiting	8.38	Nitrogen
Lower	2.01	Non Limiting	2.12	Nitrogen

Figure 6. Depth profiles of dissolved oxygen (DO) and temperature (Temp) in Mitchell Reservoir, June-September 2005. 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 ft (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.

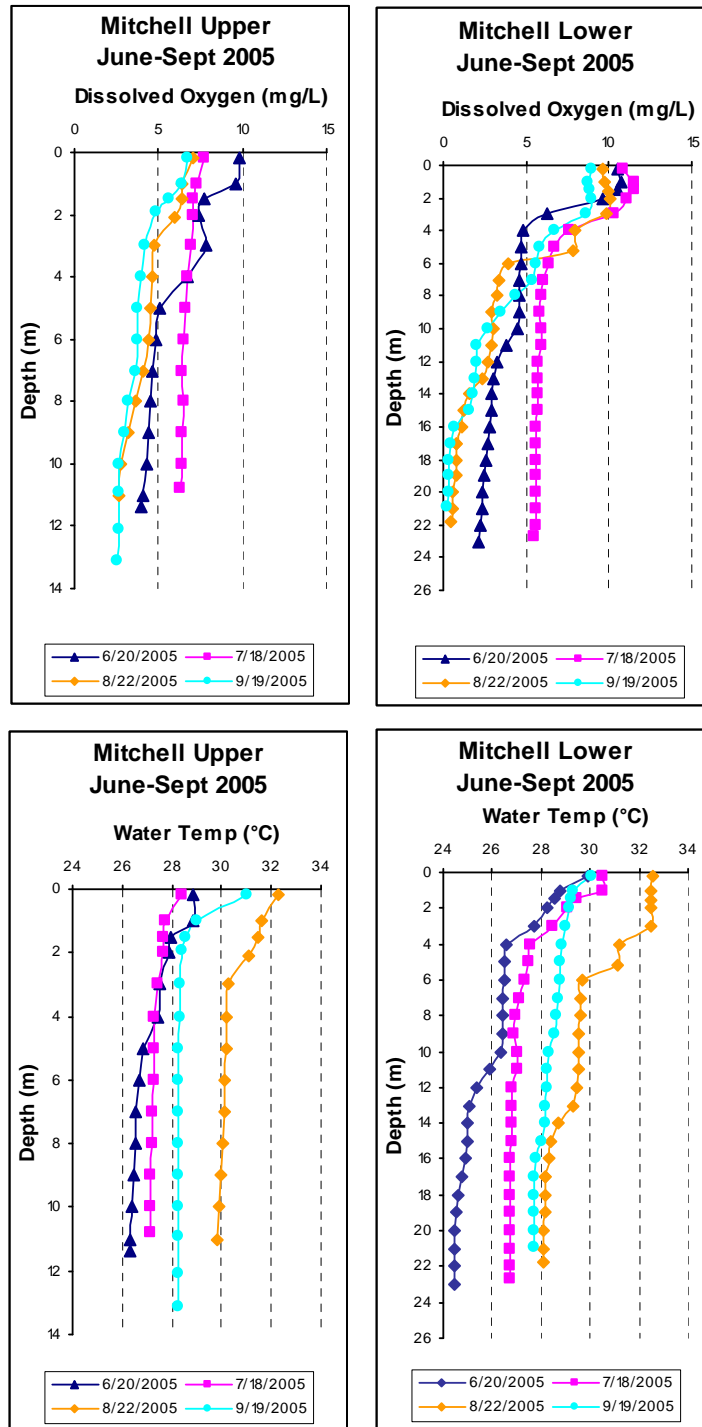


Figure 7. DO concentrations at 5 ft. for Mitchell Reservoir collected April-October 2005. For tributary embayments, which are typically not as deep as mainstem stations and usually maintain a mixed water column throughout the season, profiles were collected but only the monthly DO concentration at a 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).

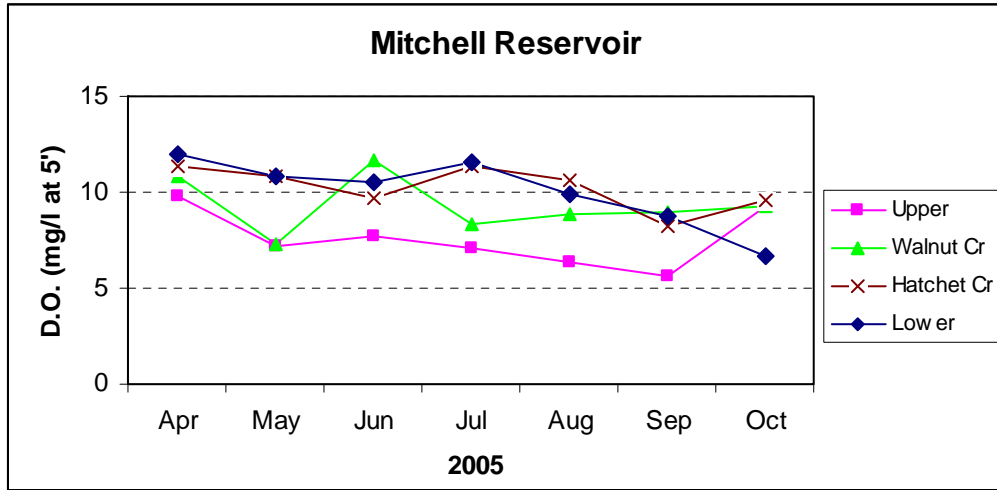


Figure 8. Monthly TSI values for mainstem and tributary stations using chlorophyll a concentrations and the Carlson's Trophic State Index calculation, April-October 2005.

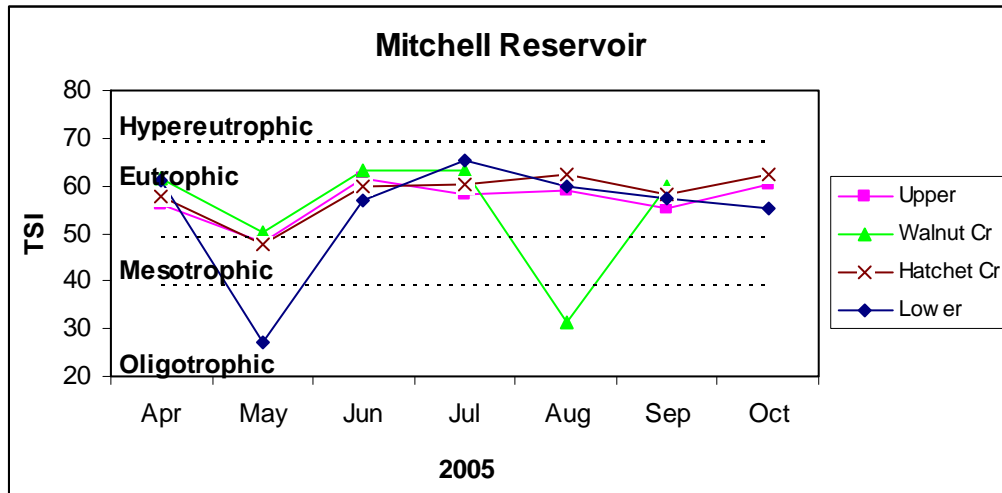
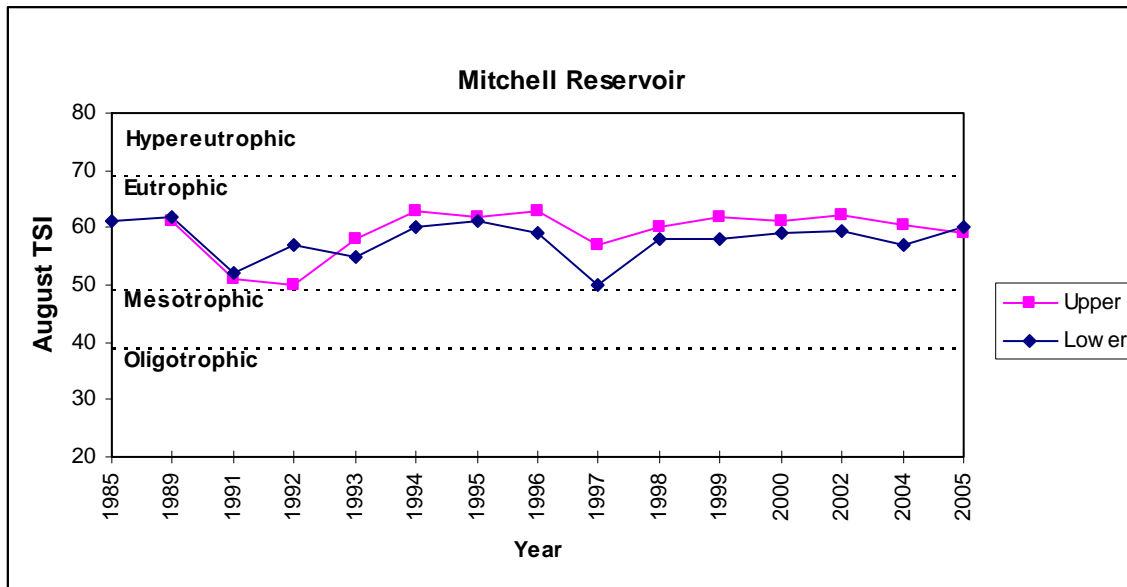


Figure 9. Trophic State Index values from critical period sampling (August sampling only) from 1985 to 2005.



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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
MITC-1	Alkalinity (mg/L)	7	42.5	61.9	52.7	52.8	6.3
	Hardness (mg/L)	4	46.3	62.4	50.7	52.5	7.1
	Total Dissolved Solids (mg/L)	7	49.0	96.0	72.0	72.0	18.1
	Total Suspended Solids (mg/L)	7	4.0	10.0	5.0	5.9	2.3
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.072	0.032	0.034	0.028
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.145	0.002	0.027	0.053
	Total Kjeldahl Nitrogen (mg/L)	7	0.194	0.555	0.450	0.415	0.141
	Total Nitrogen (mg/L)	7	0.200	0.570	0.520	0.443	0.153
	Total Phosphorus (mg/L)	7	0.011	0.092	0.054	0.049	0.029
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.009	0.006	0.006	0.002
	Chlorophyll a (mg/L) ^j	7	0.71	34.89	15.22	17.15	10.44
	Turbidity (NTU)	7	1.68	7.33	3.28	3.86	2.03
	Secchi (m)	7	0.91	1.75	1.33	1.38	0.29
	Fecal Coliform (col/100 mL)	1	---	---	---	< 1	---
MITC-2	Alkalinity (mg/L)	7	45.7	64.9	52.3	55.0	7.7
	Hardness (mg/L)	4	50.5	67.2	54.7	56.8	7.4
	Total Dissolved Solids (mg/L)	7	30.0	107.0	96.0	82.3	27.8
	Total Suspended Solids (mg/L)	7	4.0	13.0	6.0	8.1	3.5
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.026	0.008	0.010	0.007
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.246	0.093	0.095	0.084
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.651	0.453	0.410	0.181
	Total Nitrogen (mg/L)	7	0.100	0.790	0.530	0.504	0.227
	Total Phosphorus (mg/L)	7	0.008	0.072	0.051	0.048	0.023
	Dissolved Reactive Phosphorus (mg/L)	7	0.006	0.023	0.010	0.012	0.007
	Chlorophyll a (mg/L) ^j	7	6.05	23.14	16.38	15.83	5.74
	Turbidity (NTU)	7	3.49	10.3	4.93	5.41	2.41
	Secchi (m)	7	0.93	1.42	1.09	1.12	0.18
	Fecal Coliform (col/100 mL) ^j	1	---	---	---	4	---
MITC-3	Alkalinity (mg/L)	7	41.1	77.1	51.7	54.8	12.3
	Hardness (mg/L)	4	49.4	65.5	53.2	55.3	7.0
	Total Dissolved Solids (mg/L)	7	30.0	102.0	76.0	75.0	25.1
	Total Suspended Solids (mg/L)	7	4.0	13.0	8.0	8.1	2.7
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.283	0.008	0.053	0.103
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.157	0.022	0.046	0.058
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.690	0.425	0.395	0.185
	Total Nitrogen (mg/L)	7	0.130	0.770	0.430	0.440	0.202
	Total Phosphorus (mg/L)	7	< 0.004	0.075	0.049	0.044	0.028
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.010	0.005	0.005	0.003
	Chlorophyll a (mg/L) ^j	6	1.07	28.12	21.59	17.99	11.25
	Turbidity (NTU)	7	2.31	6.93	4.31	4.28	1.60
	Secchi (m)	7	0.95	1.49	1.24	1.20	0.18
	Fecal Coliform (col/100 mL)	1	---	---	---	< 1	---

Station	Parameter	N	Min	Max	Median	Avg	SD
MITC-4	Alkalinity (mg/L)	7	12.6	68.7	49.1	44.7	19.5
	Hardness (mg/L)	4	24.4	59.8	47.2	44.6	15.3
	Total Dissolved Solids (mg/L)	7	44.0	105.0	76.0	78.4	20.4
	Total Suspended Solids (mg/L)	7	6.0	16.0	8.0	9.1	3.3
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.061	0.017	0.027	0.022
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.061	0.002	0.013	0.022
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.580	0.372	0.345	0.179
	Total Nitrogen (mg/L)	7	0.080	0.600	0.370	0.359	0.177
	Total Phosphorus (mg/L)	7	< 0.004	0.084	0.049	0.048	0.030
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.013	0.009	0.007	0.005
	Chlorophyll a (mg/L)J	7	5.70	25.63	19.58	18.44	6.77
	Turbidity (NTU)	7	2.21	5.14	3.33	3.29	0.93
	Secchi (m)	7	1.08	1.56	1.45	1.42	0.16
	Fecal Coliform (col/100 mL)	1	---	---	---	< 1	---

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