2005 Weiss Reservoir Report

Rivers and Reservoirs Monitoring Program

Alabama Department of Environmental Management

Field Operations Division
Environmental Indicators Section
Aquatic Assessment Unit
January 7, 2010

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INTRODUCTION

The Alabama Department of Environmental Management (ADEM) monitored Weiss 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.

Weiss 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, pH, and organic enrichment/dissolved oxygen (OE/DO). USEPA approved delisting Weiss for OE/DO and pH in the 2000 and 2004 §303(d) lists, respectively, based on intensive monitoring data. In 2004, USEPA approved two TMDLs for Weiss Reservoir, addressing PCB and nutrient impairments. After additional years of monitoring and with the development of the Coosa River TMDL, a revised Weiss Reservoir nutrient TMDL was approved by the USEPA in 2008.

Specific water quality criteria for nutrient management were implemented in 2001 at two locations on Weiss which has 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 designated uses.

The purpose of this report is to summarize data collected at ten stations in Weiss 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)) were compared to ADEM's historical data and established criteria.

METHODS

Sampling stations were determined using historical data and previous assessments [Fig. 1]. Specific location information can be found in Table 1. Weiss was sampled in the dam forebay, near the dam powerhouse, with additional stations added in the mid reservoir, and two in the upper reservoir (transition area). Since Weiss is the first reservoir of the Coosa R chain, a station was also established at the stateline to monitor incoming water quality. Tributary embayment stations were established in five of the larger embayments, with selection of embayments distributed throughout the range of watershed disturbance.

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).

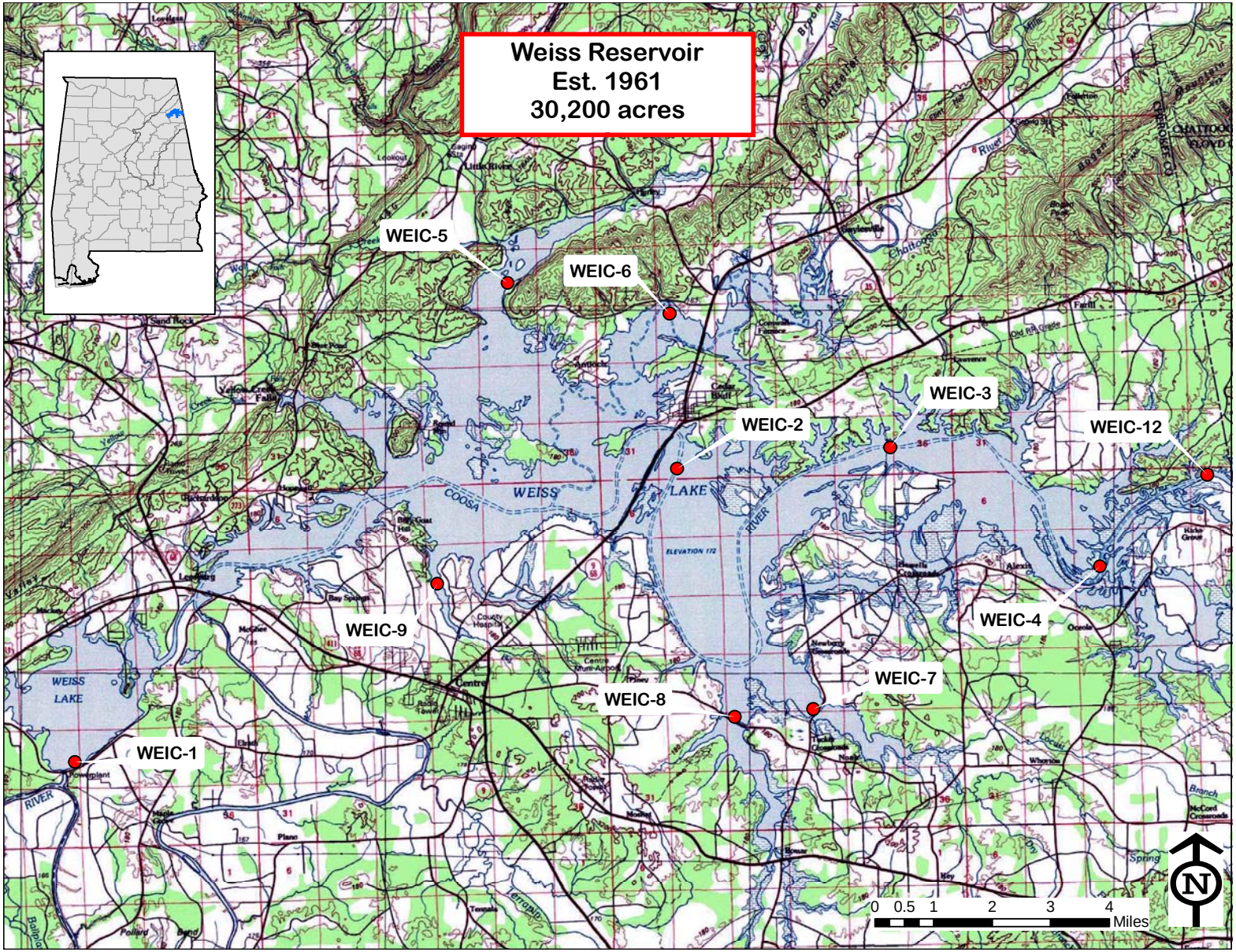


Figure 1. Weiss Reservoir with 2005 sampling locations. A description of each sampling location is provided in Table 1.

Table 1. Descriptions for the monitoring stations in 2005 for Weiss Reservoir.

Sub-watershed	County	Station Number	Report Designation	Waterbody Name	Station Description	Chl *a* Criteria	Latitude	Longitude
Weiss Reservoir								
Upper Coosa (0315-0105)								
1003	Cherokee	WEIC-1**	Lower	Coosa R	Lower reservoir. Deepest point, main river channel, power dam forebay.	20 ug/L	34.1348	-85.7911
1001	Cherokee	WEIC-2**	Mid	Coosa R	Mid reservoir. Deepest point, main river channel, immediately upstream of causeway at Cedar Bluff.	20 ug/L	34.2057	-85.6105
0107	Cherokee	WEIC-3	Upper	Coosa R	Upper reservoir. Deepest point, main river channel, at power line crossing upstream of Spring Creek.		34.2103	-85.5468
0206	Cherokee	WEIC-4	Near Stateline	Coosa R	Near stateline. Deepest point, main river channel, immediately upstream of the Mud Creek / Coosa River confluence.		34.1800	-85.4847
0807	Cherokee	WEIC-5	Little R	Little R	Deepest point, main river channel, Little River embayment, LRM 12.5		34.2525	-85.6603
0605	Cherokee	WEIC-6	Chattooga R	Chattooga R	Deepest point, main river channel, Chattooga River embayment, CRM 12.5		34.2443	-85.6120
0304	Cherokee	WEIC-7	Spring Cr	Spring Cr	Deepest point, main creek channel, Spring Creek embayment, downstream of Cherokee Co. Hwy. 31 bridge.		34.1457	-85.5708
0303	Cherokee	WEIC-8	Cowan Cr	Cowan Cr	Deepest point, main creek channel, Cowan Creek embayment, downstream of Cherokee Co. Hwy. 16 bridge.		34.1440	-85.5943
1001	Cherokee	WEIC-9	Big Nose Cr	Big Nose Cr	Deepest point, main creek channel, Big Nose Creek embayment, approximately 0.5 miles upstream of lake confluence.		34.1780	-85.6824
0206	Cherokee	WEIC-12	Stateline	Coosa R	Stateline. Deepest point, main river channel, Alabama/Georgia stateline.		34.2024	-85.4524

**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 TN concentration was highest at the upper mainstem station of the reservoir (Fig. 2). While monthly TN concentrations were relatively stable at the stateline and lower stations, the upper station tended to increase most months, reaching the highest monthly concentration in October (Fig. 3, 4, 5, &6).

Mean TP concentrations ranged from 0.046 mg/l to 0.116 mg/l in Weiss Reservoir with the highest mean TP concentrations occurring at the stateline station (Fig. 2). TP concentrations over 0.025 mg/l can indicate eutrophic conditions within a lake or reservoir. Monthly TP concentrations were below historic means at all mainstem stations in June and October (Fig. 3, 4, 5, &6). By contrast, the monthly TP concentrations were unusually high at the stateline station in September and at the upper station in July. The September TP concentration at the stateline station was close to three times higher than any other month (Fig. 3) and the highest of any historic concentration measured at this station since sampling began. The July TP concentration at the upper station was the highest recorded of any station, for any month, on the Coosa River (Fig.4). Although the sample batch for both stations passed all QA/QC requirements in the laboratory, both stations were determined to be statistical outliers from the entire historic dataset and excluded from any calculations. Although there was a high discharge in July, no other environmental conditions were noted in the reservoir that would cause such an increase in concentration from one month to the next.

The highest mean chl *a* concentrations were found in the tributaries in the middle of the reservoir. The mean chl *a* concentration at the mid station was more than double the concentration at the upper station (Fig. 2). The monthly chl *a* concentrations at the mid and lower mainstem stations were >20 ug/l from June-October, indicating eutrophic conditions for most of the growing season (Fig. 3, 4, 5, &6). The mid station measured 51.4 ug/l in September, the highest concentration measured in Weiss Reservoir during 2005. Specific water quality

criteria for nutrient management have been established on Weiss at the lower and mid reservoir. These criteria were exceeded at both stations during 2005 (Fig. 7).

Mean TSS was highest at the upper and mid stations (Fig. 2). TSS concentrations in May at all four mainstem stations were the highest concentrations of the year and of the entire historic dataset (Fig. 3, 4, 5, &6).

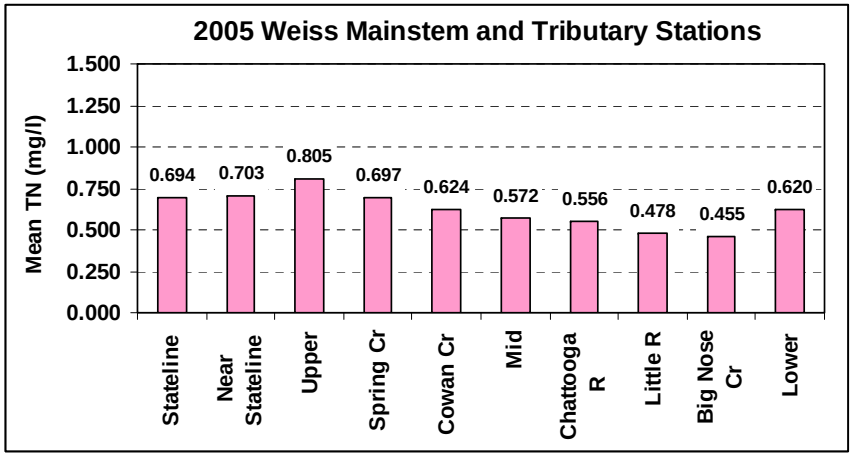
AGPT results indicated the entire reservoir was nitrogen limited, corroborating results obtained in 2000 (Table 2). Mean standing crop (MSC) values ranged from 4.73 mg/l at the lower station to 39.38 mg/l at the stateline, with concentrations steadily decreasing from the riverine sections of the reservoir upstream to the more lacustrine areas downstream. Raschke et al. (1996) defined 5 mg/l MSC as protective of reservoir and lake systems and 20 mg/l MSC as protective of flowing streams and rivers.

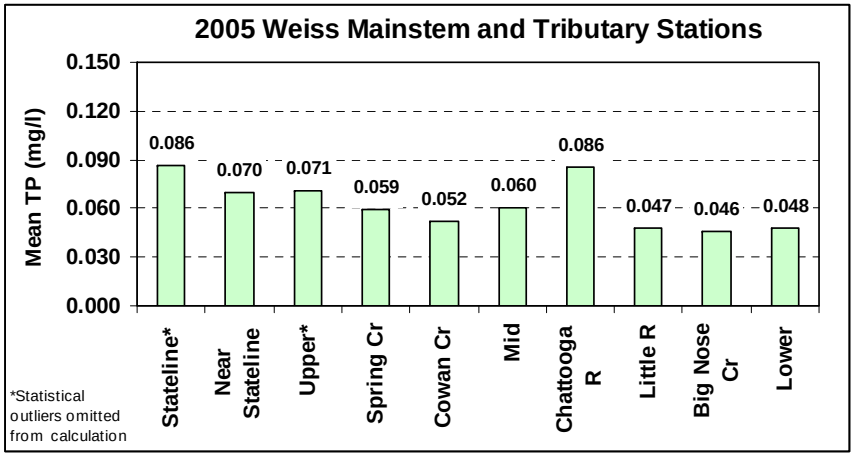
The dissolved oxygen concentration in Spring Creek was <5.0 mg/l at a depth of 5.0 feet during July (Fig. 9). All other measurements of dissolved oxygen concentrations were above the ADEM Criteria (ADEM Admin. Code R. 335-6-10-.09) limit of 5.0 mg/l (Fig. 8 & 9). Dissolved oxygen profiles of the mainstem stations show the reservoir to be stratified at the mid and lower stations during June-September (Fig. 8), while the upper two stations remained well mixed throughout the sampling period. Warmest water temperatures in the upper half of the reservoir were reached in September while the lower portions reached their warmest water temperatures in July.

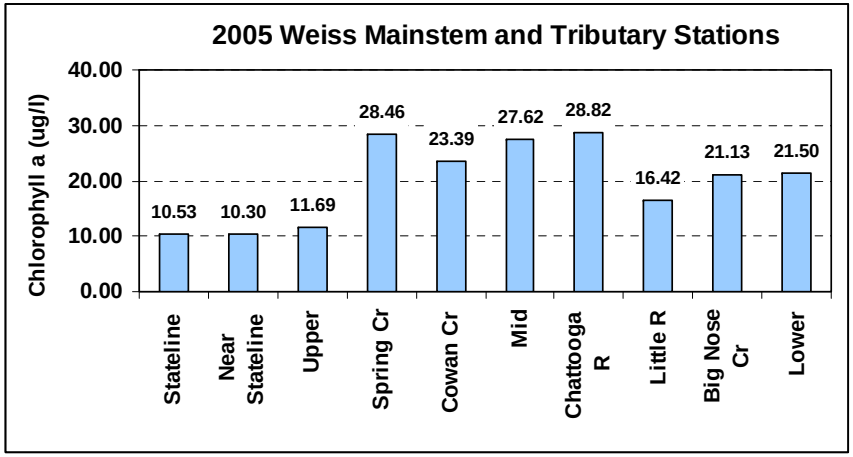
Carlson's TSI was calculated from the corrected chl *a* concentrations. TSI values for all of the embayment stations were eutrophic June-October, and highly eutrophic in the mid and lower stations (Fig.10).

August TSI values calculated from data collected at mainstem stations, 1985-2005, are presented in Fig. 11. August TSI values at the mid and lower mainstem stations were highly eutrophic and consistent throughout the entire historic record (1985-2005).

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







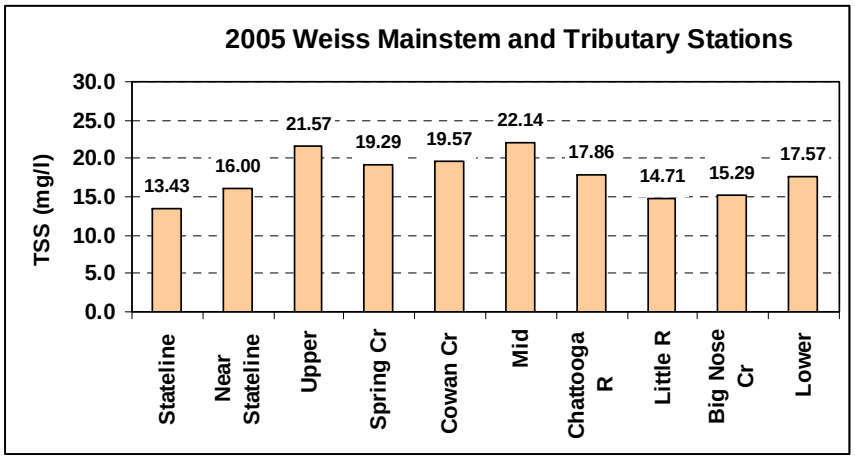
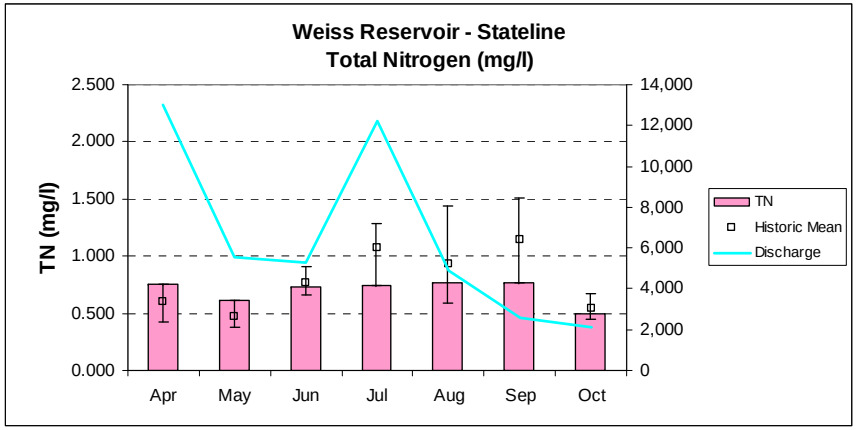
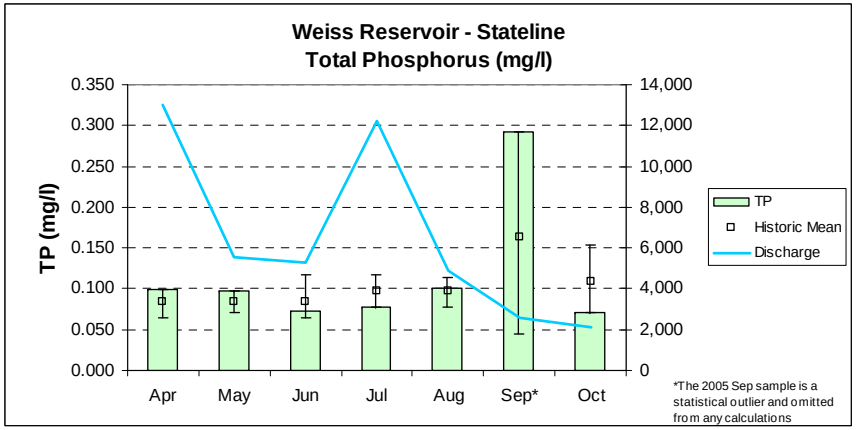
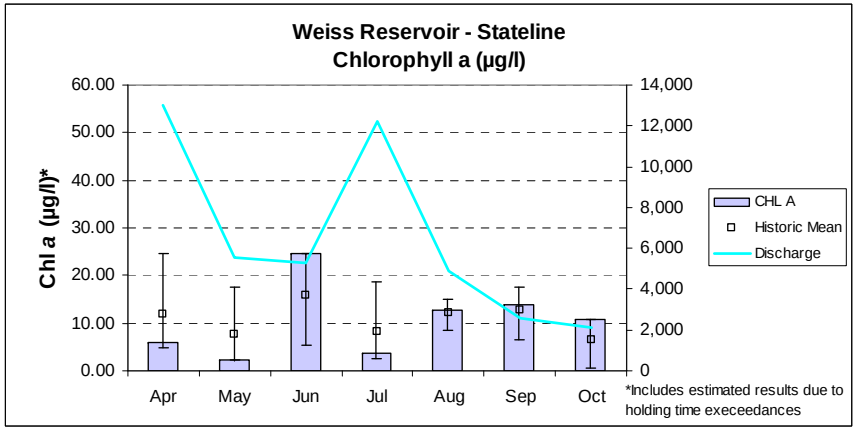


Figure 3. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl *a*) and total suspended solids (TSS) of the stateline station in Weiss Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the Stateline station. The historic mean and min/max range are also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







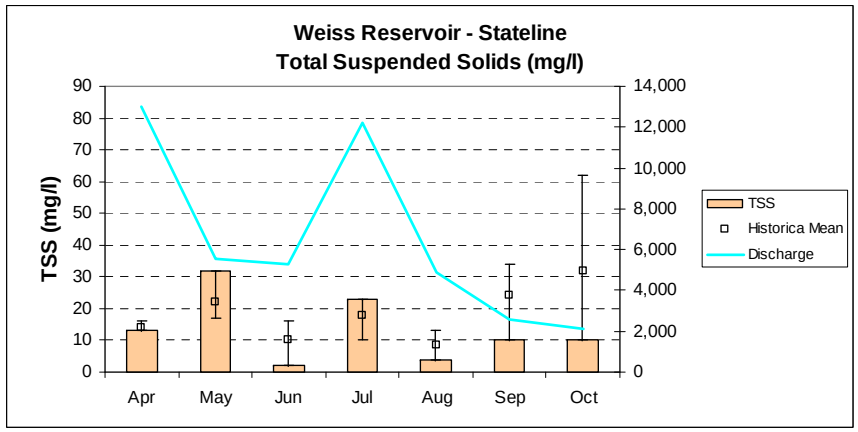
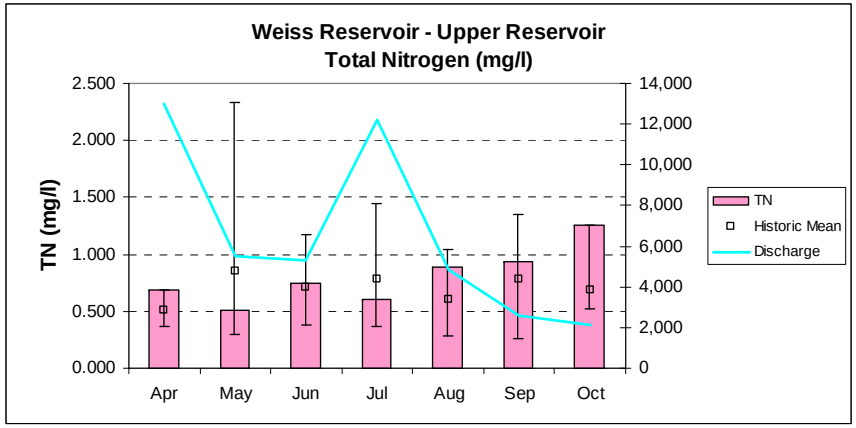
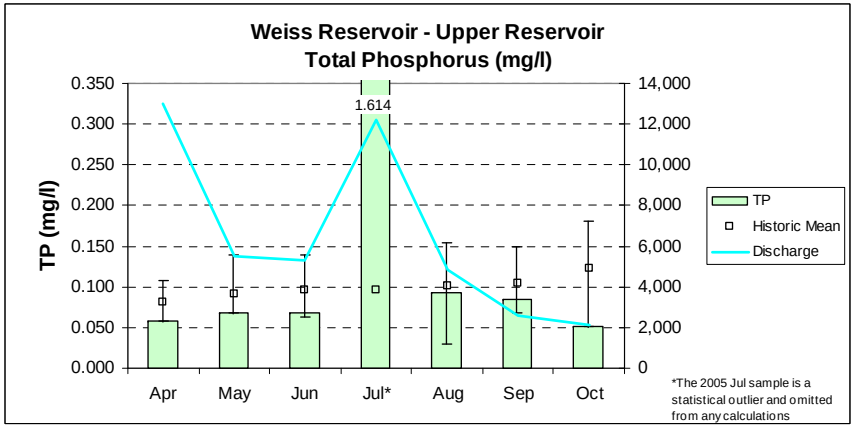
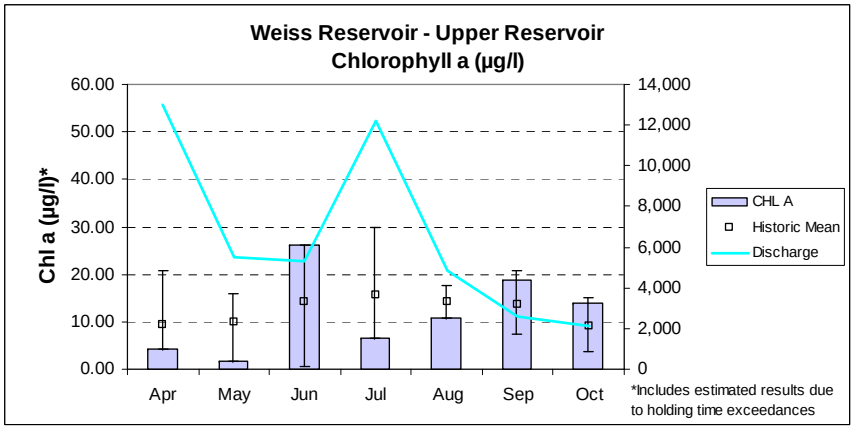


Figure 4. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl *a*) and total suspended solids (TSS) of the upper station in Weiss Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the upper station. The historic mean and min/max range are also displayed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







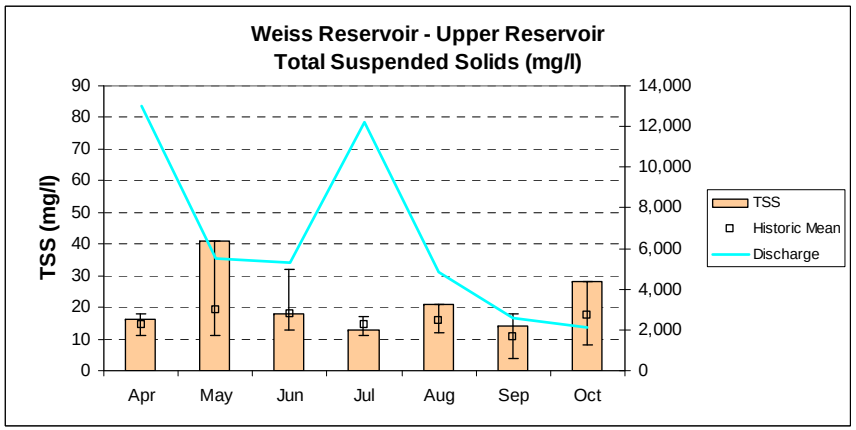
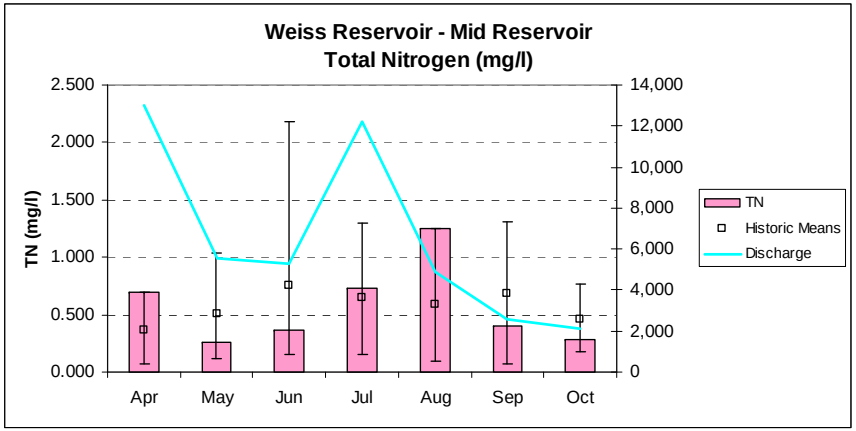
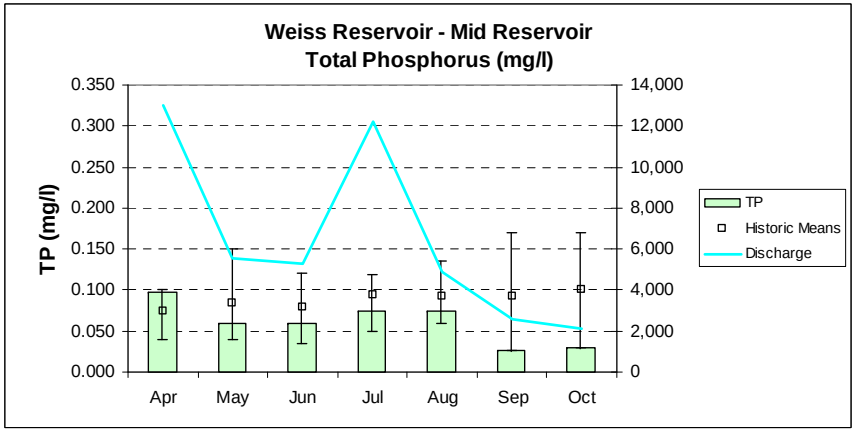
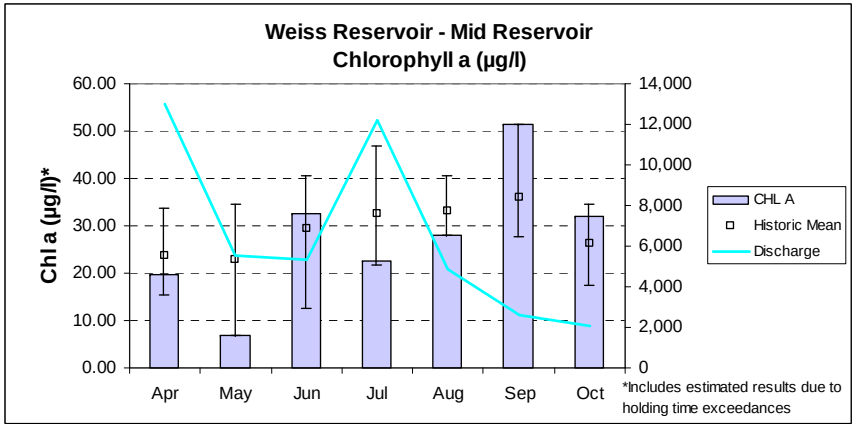


Figure 5. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl *a*) and total suspended solids (TSS) of the mid station in Weiss Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the mid-reservoir station. The historic mean and min/max range are also displayed for comparison. Nutrients and TSS are plotted vs. discharge (USGS Coosa R gauge near Rome, GA).







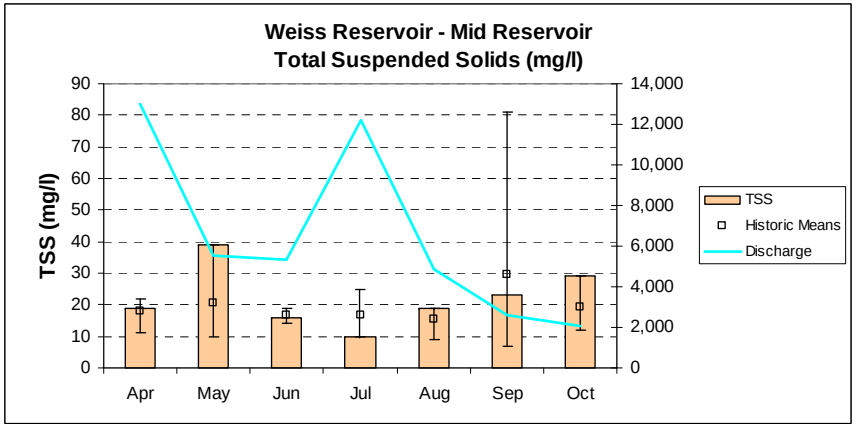
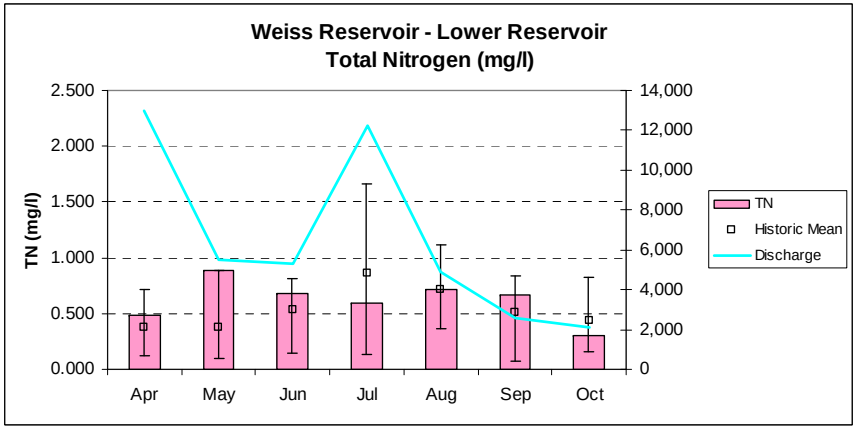
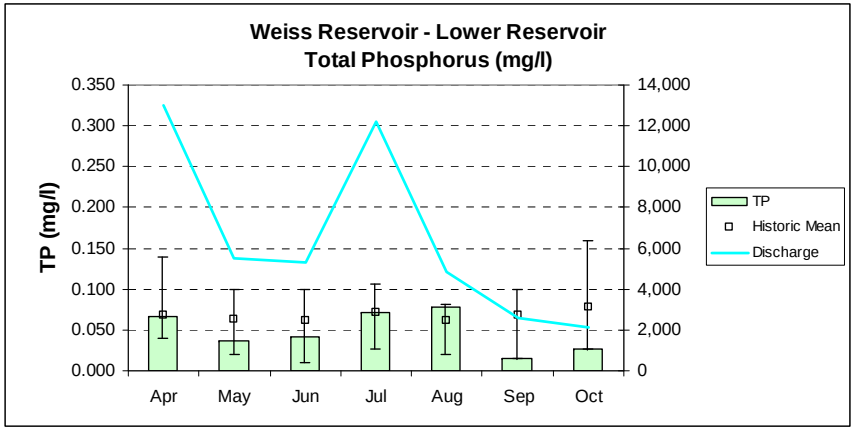
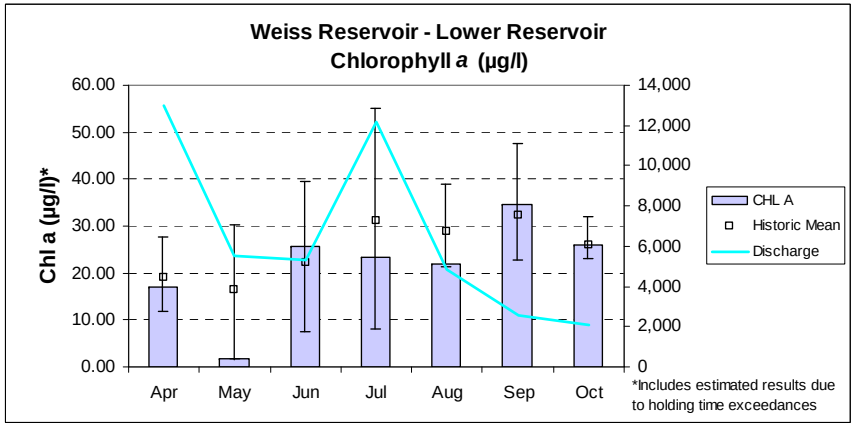


Figure 6. Total nitrogen (TN), total phosphorus (TP), chlorophyll a (Chl *a*) and total suspended solids (TSS) of the dam forebay station in Weiss Reservoir, April-October 2005. Each bar graph depicts monthly changes in the variables at the lower reservoir station. The historic mean and min/max range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







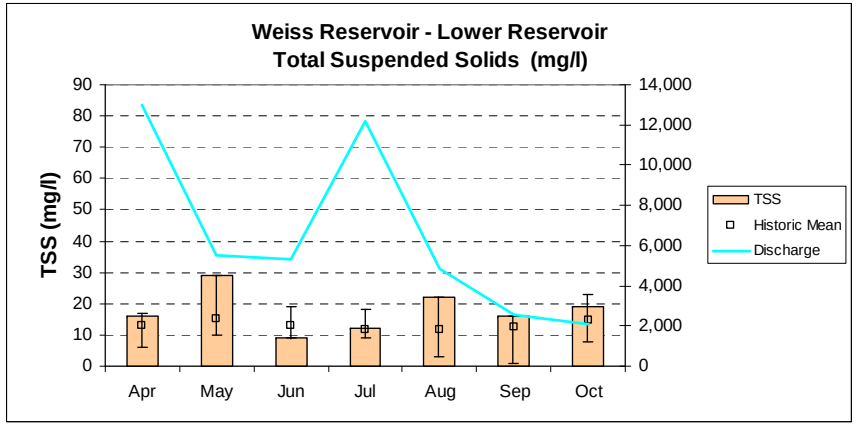
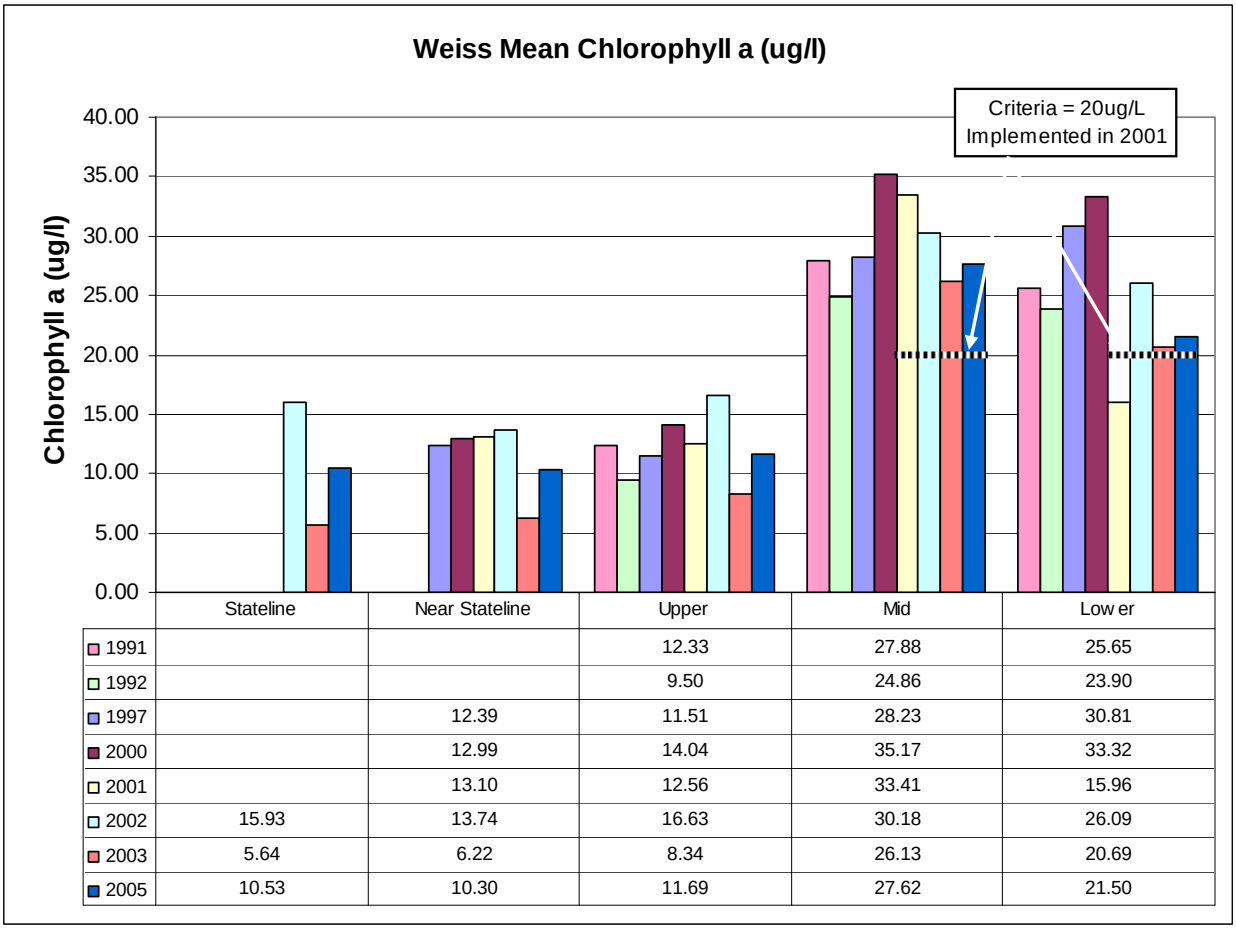


Figure 7. Mean chlorophyll a concentrations of mainstem Weiss Reservoir, 1991 through 2005. Chlorophyll *a* criteria applies to the growing season mean of the mid and lower stations only.



	Stateline	Near Stateline	Upper	Mid	Lower
1991			12.33	27.88	25.65
1992			9.50	24.86	23.90
1997		12.39	11.51	28.23	30.81
2000		12.99	14.04	35.17	33.32
2001		13.10	12.56	33.41	15.96
2002	15.93	13.74	16.63	30.18	26.09
2003	5.64	6.22	8.34	26.13	20.69
2005	10.53	10.30	11.69	27.62	21.50

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; MSC values below 20 mg/l MSC are considered protective of flowing streams and rivers. (Raschke and Schultz 1987).

Station	2000 Control mean MSC	2000 Limiting Nutrient	2005 Control mean MSC	2005 Limiting Nutrient
Stateline			39.38	Nitrogen
Near Stateline	21.20	Nitrogen	24.34	Nitrogen
Upper	28.32	Nitrogen	18.20	Nitrogen
Mid	5.59	Nitrogen	5.69	Nitrogen
Lower	8.35	Nitrogen	4.73	Nitrogen

Figure 8. Depth profiles of dissolved oxygen (DO) and temperature (Temp) in Weiss 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.

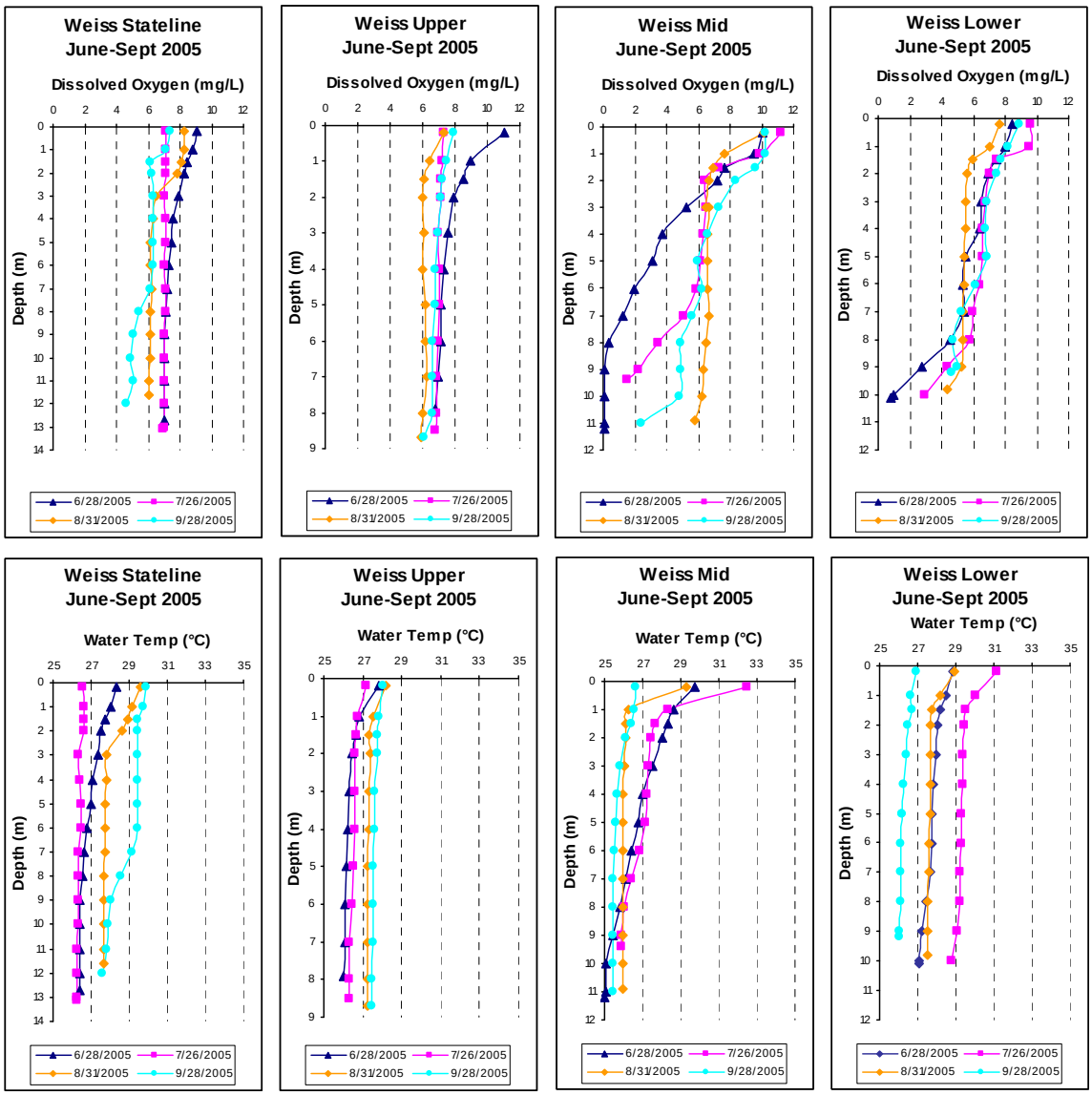


Figure 9. DO concentrations at 5 ft (1.5m) for Weiss Reservoir tributaries collected April-October 2005. For tributary embayments, which are typically not as deep as mainstem stations and usually maintain a mixed water column throughout the season, profiles were collected but only the monthly DO concentrations 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).

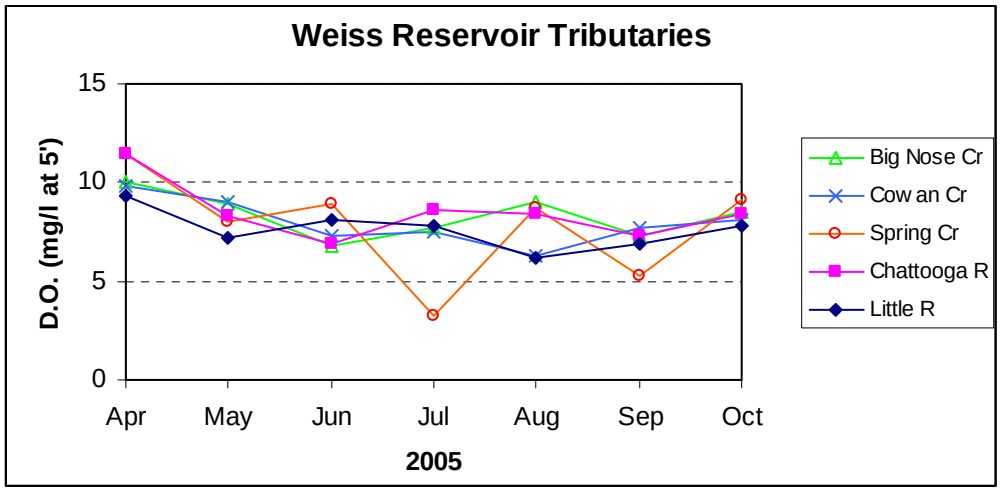
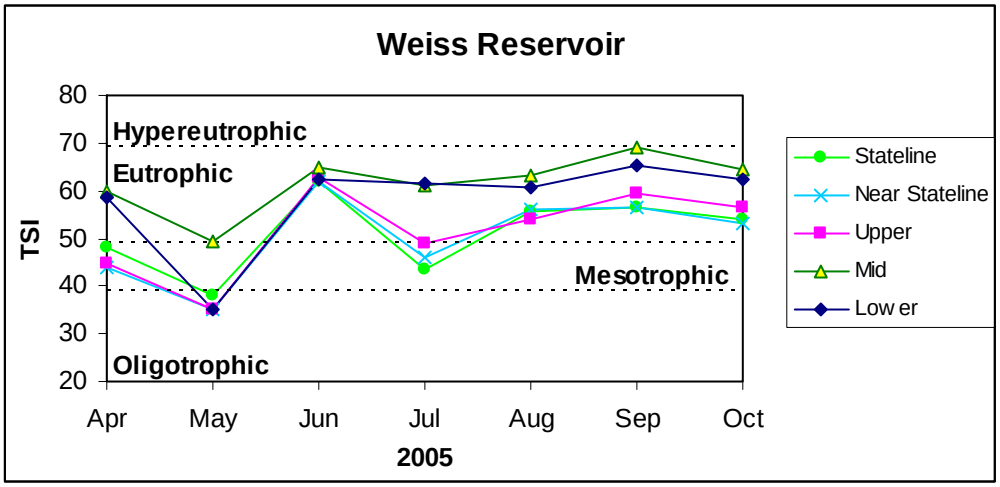


Figure 10. Monthly TSI values for mainstem and tributary stations using chlorophyll a concentrations and the Carlson's Trophic State Index calculation, April-October 2005.



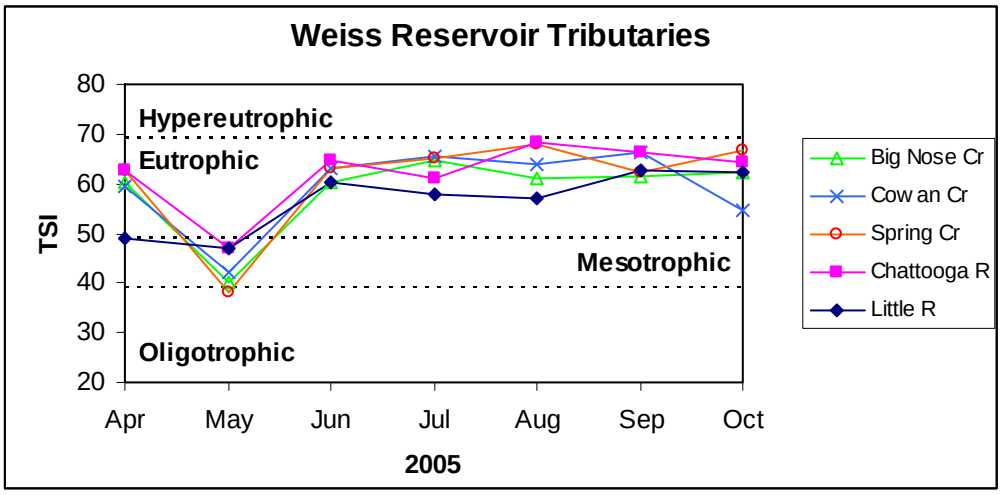
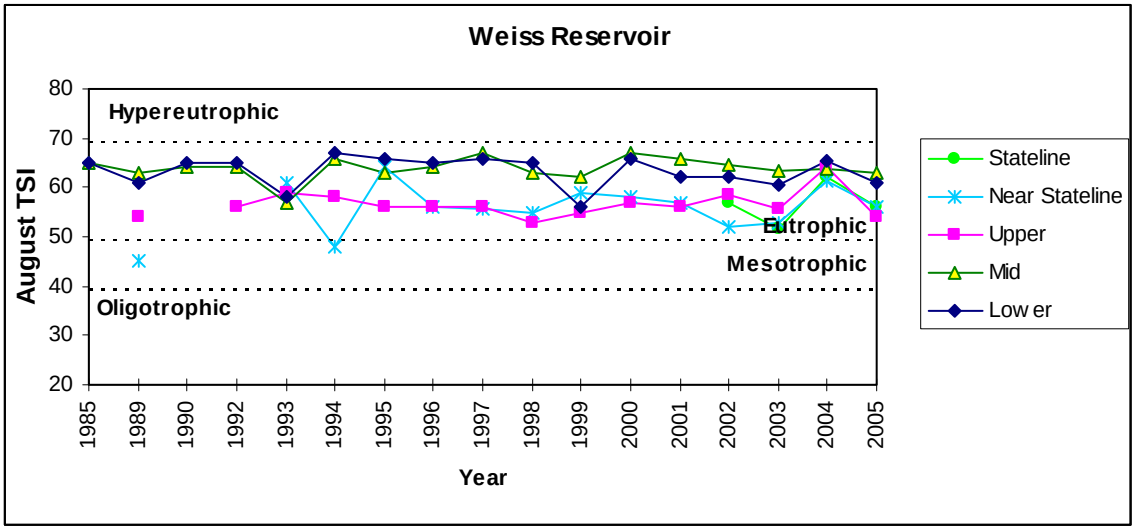


Figure 11. Trophic State Index values from critical period sampling (August sampling only) from 1985 to 2005.



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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
WEIC-1	Alkalinity (mg/L)	7	40.9	61.7	52.2	51.1	8.0
	Hardness (mg/L)	4	39.5	63.9	54.9	53.3	10.2
	Total Dissolved Solids (mg/L)	7	43.0	165.0	100.0	101.9	38.4
	Total Suspended Solids (mg/L)	7	9.0	29.0	16.0	17.6	6.6
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.113	0.008	0.023	0.040
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.115	0.028	0.050	0.051
	Total Kjeldahl Nitrogen (mg/L)	7	0.297	0.884	0.581	0.569	0.194
	Total Nitrogen (mg/L)	7	0.300	0.890	0.670	0.621	0.186
	Total Phosphorus (mg/L)	7	0.015	0.078	0.041	0.048	0.024
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.017	0.002	0.006	0.007
	Chlorophyll a (mg/L)[J]	7	1.60	34.71	23.50	21.50	10.26
	Turbidity (NTU)	7	8	16	11	11	3
	Secchi (m)	7	0.63	1.22	0.90	0.90	0.20
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	4	---
WEIC-2	Alkalinity (mg/L)	7	35.7	61.5	53.4	51.4	8.2
	Hardness (mg/L)	4	45.5	63.7	58.0	56.3	7.7
	Total Dissolved Solids (mg/L)	7	57.0	162.0	98.0	102.7	37.1
	Total Suspended Solids (mg/L)	7	10.0	39.0	19.0	22.1	9.5
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.048	0.008	0.018	0.018
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.337	0.097	0.128	0.123
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	1.006	0.363	0.433	0.302
	Total Nitrogen (mg/L)	7	0.190	1.260	0.400	0.563	0.369
	Total Phosphorus (mg/L)	7	0.026	0.098	0.060	0.060	0.025
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.033	0.015	0.016	0.013
	Chlorophyll a (mg/L)[J]	7	6.94	51.40	28.04	27.62	13.71
	Turbidity (NTU)	7	13	27	17	18	4
	Secchi (m)	6	0.45	0.73	0.63	0.54	0.26
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	< 1	---
WEIC-3	Alkalinity (mg/L)	7	32.1	53.9	49.3	48.0	7.3
	Hardness (mg/L)	4	51.8	55.4	53.7	53.7	1.8
	Total Dissolved Solids (mg/L)	7	78.0	154.0	98.0	106.3	26.3
	Total Suspended Solids (mg/L)	7	13.0	41.0	18.0	21.6	9.9
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.044	0.008	0.021	0.018
	Nitrate+Nitrite Nitrogen (mg/L)	7	0.303	1.068	0.376	0.471	0.270
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.554	0.302	0.323	0.183
	Total Nitrogen (mg/L)	7	0.440	1.250	0.750	0.796	0.262
	Total Phosphorus (mg/L)*	6	0.052	0.093	0.068	0.071	0.016
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.064	0.022	0.024	0.020
	Chlorophyll a (mg/L)J	7	1.60	26.17	10.68	11.69	8.66
	Turbidity (NTU)	7	14	20	16	16	2
	Secchi (m)	7	0.53	0.82	0.71	0.68	0.09
	Fecal Coliform (col/100 mL)	1	---	---	---	4	---

Station	Parameter	N	Min	Max	Median	Avg	SD
WEIC-4	Alkalinity (mg/L)	7	31.7	57.5	52.4	49.9	8.4
	Hardness (mg/L)	4	50.0	58.8	55.3	54.9	4.2
	Total Dissolved Solids (mg/L)	7	51.0	151.0	95.0	94.7	31.1
	Total Suspended Solids (mg/L)	7	3.0	34.0	16.0	16.0	9.5
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.060	0.008	0.017	0.020
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.560	0.375	0.355	0.180
	Total Kjeldahl Nitrogen (mg/L)	7	0.208	0.599	0.315	0.348	0.146
	Total Nitrogen (mg/L)	7	0.260	1.100	0.770	0.704	0.256
	Total Phosphorus (mg/L)	7	< 0.041	0.102	0.070	0.070	0.020
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.062	0.037	0.034	0.023
	Chlorophyll a (mg/L)[J]	7	1.60	24.56	10.01	10.30	7.87
	Turbidity (NTU)	7	1	15	12	11	5
	Secchi (m)	7	0.64	0.89	0.81	0.76	0.11
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	22	---
WEIC-5	Alkalinity (mg/L)	7	36.3	75.6	53.4	56.1	14.0
	Hardness (mg/L)	4	37.9	76.0	60.4	58.7	15.9
	Total Dissolved Solids (mg/L)	7	36.0	137.0	97.0	94.7	32.7
	Total Suspended Solids (mg/L)	7	6.0	32.0	8.0	14.7	10.3
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.052	0.008	0.022	0.019
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.125	0.003	0.026	0.045
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.715	0.470	0.441	0.206
	Total Nitrogen (mg/L)	7	0.200	0.750	0.470	0.467	0.180
	Total Phosphorus (mg/L)	7	0.019	0.111	0.042	0.047	0.031
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.015	0.004	0.006	0.005
	Chlorophyll a (mg/L)[J]	7	5.34	26.03	16.02	16.42	8.30
	Turbidity (NTU)	7	6	15	9	10	3
	Secchi (m)	7	0.62	1.10	0.97	0.88	0.22
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	1	---
WEIC-6	Alkalinity (mg/L)	7	95.9	118.1	112.3	109.9	7.4
	Hardness (mg/L)	4	101.0	112.0	106.5	106.5	5.8
	Total Dissolved Solids (mg/L)	7	66.0	245.0	158.0	169.4	63.1
	Total Suspended Solids (mg/L)	7	3.0	32.0	19.0	17.9	9.1
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.044	0.008	0.016	0.014
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.051	0.003	0.013	0.019
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.920	0.587	0.531	0.329
	Total Nitrogen (mg/L)	7	0.080	0.970	0.590	0.544	0.342
	Total Phosphorus (mg/L)	7	0.057	0.111	0.084	0.086	0.020
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.050	0.019	0.021	0.015
	Chlorophyll a (mg/L)[J]	7	5.34	46.28	30.51	28.82	12.99
	Turbidity (NTU)	6	8	17	14	12	6
	Secchi (m)	6	0.52	0.80	0.63	0.56	0.26
	Fecal Coliform (col/100 mL)	1	---	---	---	< 1	---
WEIC-7	Alkalinity (mg/L)	7	45.5	61.3	53.3	54.0	5.6
	Hardness (mg/L)	4	50.1	60.6	56.8	56.1	4.7
	Total Dissolved Solids (mg/L)	7	47.0	228.0	104.0	122.9	60.1
	Total Suspended Solids (mg/L)	7	4.0	38.0	21.0	19.3	13.5
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.113	0.024	0.033	0.038
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.131	0.014	0.041	0.055
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	1.276	0.660	0.645	0.361
	Total Nitrogen (mg/L)	7	0.100	1.280	0.670	0.684	0.355
	Total Phosphorus (mg/L)	7	0.021	0.108	0.062	0.059	0.029
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.024	0.005	0.008	0.008
	Chlorophyll a (mg/L)[J]	7	2.14	44.50	27.23	28.46	13.75

Station	Parameter	N	Min	Max	Median	Avg	SD
WEIC-7	Turbidity (NTU)	7	8	28	12	14	7
	Secchi (m)	7	0.50	0.87	0.62	0.67	0.15
	Fecal Coliform (col/100 mL)	1	---	---	---	< 1	---
WEIC-8	Alkalinity (mg/L)	7	37.9	60.3	53.1	50.5	7.5
	Hardness (mg/L)	4	44.4	58.9	55.6	53.6	6.5
	Total Dissolved Solids (mg/L)	7	48.0	152.0	83.0	91.0	34.9
	Total Suspended Solids (mg/L)	7	4.0	46.0	13.0	19.6	15.6
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.076	0.008	0.025	0.027
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.199	0.053	0.065	0.072
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.966	0.615	0.548	0.278
	Total Nitrogen (mg/L)	7	0.080	0.970	0.620	0.614	0.271
	Total Phosphorus (mg/L)	7	0.017	0.076	0.050	0.052	0.023
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.019	0.008	0.009	0.005
	Chlorophyll a (mg/L)[J]	7	3.20	37.91	27.23	23.39	12.73
	Turbidity (NTU)	7	9	23	10	12	5
	Secchi (m)	7	0.49	0.92	0.76	0.75	0.14
	Fecal Coliform (col/100 mL)	1	---	---	---	< 1	---
WEIC-9	Alkalinity (mg/L)	7	40.7	61.5	50.6	51.0	6.8
	Hardness (mg/L)	4	41.5	63.3	53.0	52.7	8.9
	Total Dissolved Solids (mg/L)	7	44.0	155.0	114.0	109.7	39.2
	Total Suspended Solids (mg/L)	7	4.0	35.0	13.0	15.3	9.9
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.020	0.008	0.011	0.006
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.003	0.059	0.002	0.013	0.022
	Total Kjeldahl Nitrogen (mg/L)	7	< 0.150	0.743	0.532	0.431	0.245
	Total Nitrogen (mg/L)	7	0.080	0.800	0.530	0.443	0.258
	Total Phosphorus (mg/L)	7	0.024	0.080	0.039	0.046	0.021
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.046	0.002	0.016	0.019
	Chlorophyll a (mg/L)[J]	7	2.67	32.57	22.70	21.13	9.12
	Turbidity (NTU)	6	9	21	11	11	6
	Secchi (m)	7	0.48	0.92	0.68	0.72	0.16
	Fecal Coliform (col/100 mL)[J]	1	---	---	---	8	---
WEIC-12	Alkalinity (mg/L)	7	31.8	56.3	50.9	49.4	8.1
	Hardness (mg/L)	4	51.1	56.5	54.9	54.4	2.3
	Total Dissolved Solids (mg/L)	7	63.0	166.0	82.0	97.9	40.2
	Total Suspended Solids (mg/L)	7	2.0	32.0	10.0	13.4	10.6
	Ammonia Nitrogen (mg/L)	7	< 0.015	0.046	0.008	0.016	0.014
	Nitrate+Nitrite Nitrogen (mg/L)	7	< 0.307	0.538	0.389	0.420	0.081
	Total Kjeldahl Nitrogen (mg/L)	7	0.150	0.376	0.269	0.263	0.111
	Total Nitrogen (mg/L)	7	0.500	0.770	0.740	0.686	0.115
	Total Phosphorus (mg/L)*	6	< 0.071	0.101	0.087	0.086	0.014
	Dissolved Reactive Phosphorus (mg/L)	7	< 0.004	0.099	0.053	0.052	0.032
	Chlorophyll a (mg/L)J	7	2.14	24.56	10.68	10.53	7.65
	Turbidity (NTU)	7	10	14	11	12	1
	Secchi (m)	7	0.65	1.07	0.77	0.81	0.13
	Fecal Coliform (col/100 mL)	7	2	83	25	31	31

J=one or more of the values provided are estimated; < = Actual value is less than the detection limit;
*=one value excluded as a statistical outlier