

Spring Creek Embayment  
Wheeler Reservoir  
Intensive Basin Survey 2009

**WHEL-9:** Spring Creek approx 0.5 mi upstream of CR400 bridge (Lawrence Co 34.72263/-87.28049)

**BACKGROUND**

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program (now known as the Rivers and Reservoirs Monitoring Program (RRMP) was initiated by 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 2009, ADEM monitored the Spring Creek tributary embayment of Wheeler Reservoir as part of the intensive basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Spring Creek embayment (WHEL-9) during the 2009 growing season (Apr-Oct). This is the second intensive basin assessment of the Tennessee River since ADEM began sampling on a basin rotation. 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)] from 2009 were compared to ADEM’s 2003 data and established criteria.

**WATERSHED CHARACTERISTICS**

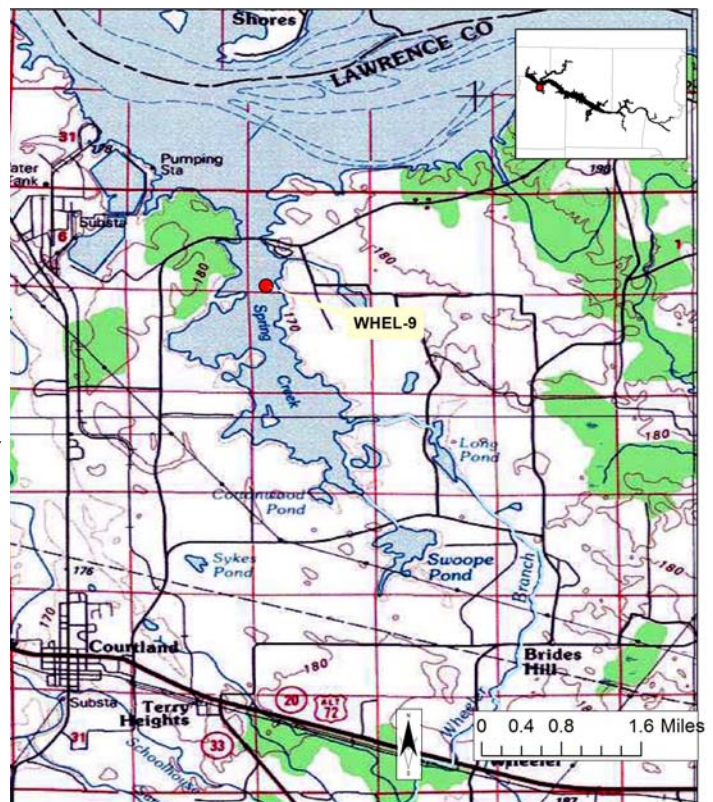
Watershed land uses are summarized in Table 1. Spring Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the small 18 mi<sup>2</sup> watershed is predominantly cultivated crops (52%) (Fig. 3). As of October 1, 2013, ADEM has issued no NPDES permits within the watershed (Fig. 2).

**SITE DESCRIPTION**

The Spring Creek embayment at WHEL-9 is located near the community of Courtland, AL, halfway between Florence and Decatur. It is a narrow, deep embayment which flows into the Tennessee River near river mile 283. Spring Creek has a mean bottom depth of 8.98 m (Table 2) at the sampling location and is fairly clear most of the year.



**Figure 1.** Photo of Spring Creek at WHEL-9



**Figure 2.** Map of Spring Creek embayment of Wheeler Reservoir. No permitted discharges exist within this watershed.

## METHODS

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 2009), 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. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2009 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

## RESULTS

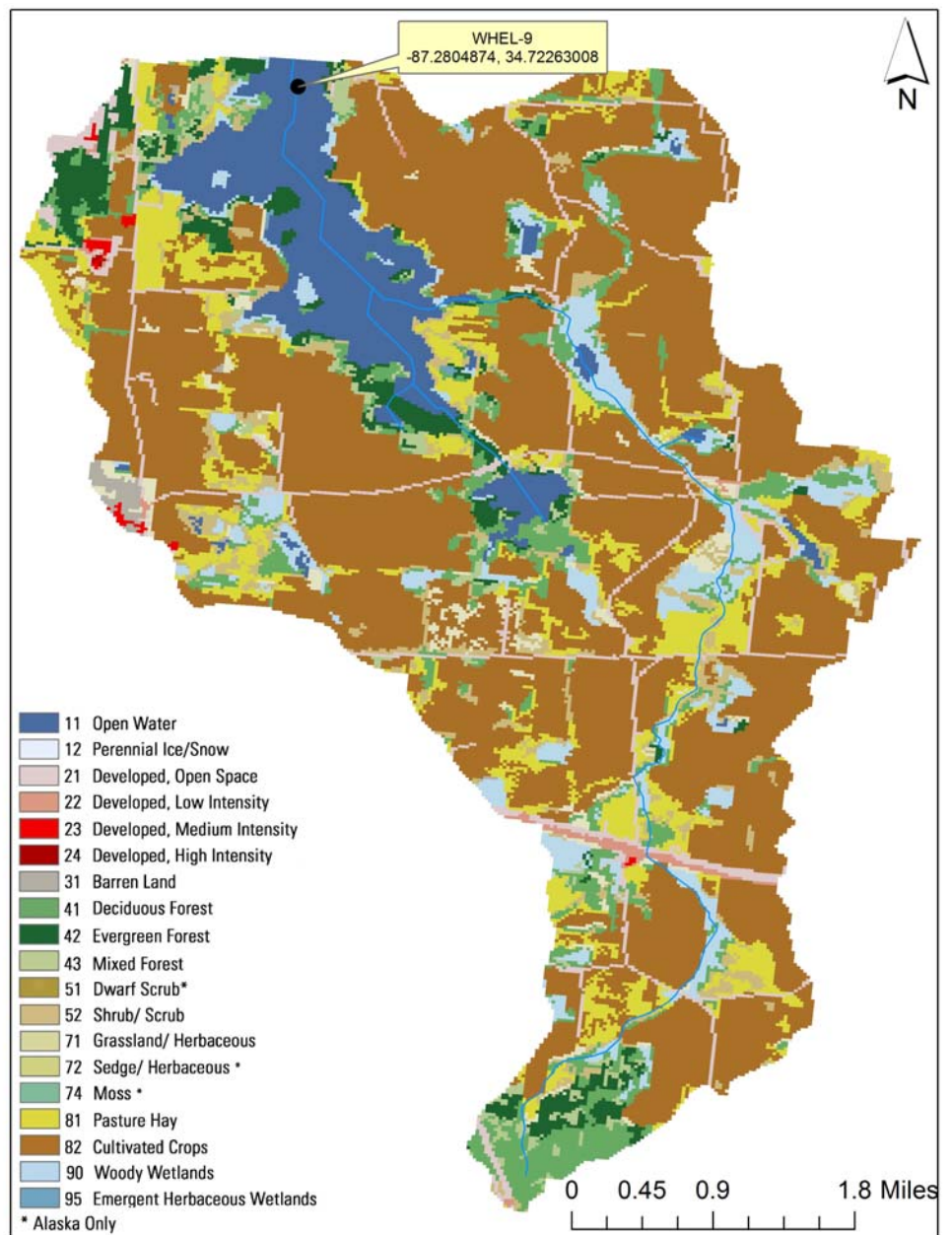
The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

**Table 1: Summary of Watershed WHEL-9**

Basin	Tennessee R
Drainage Area (mi <sup>2</sup> )	18
Ecoregion <sup>a</sup>	71g
% Land use	
Open Water	8%
Developed	Open Space 4%
	Low Intensity <1%
	Medium Intensity <1%
	High Intensity <1%
Barren Land	<1%
Forest	Deciduous Forest 7%
	Evergreen Forest 4%
	Mixed Forest 2%
Shrub/Scrub	5%
Herbaceous	2%
Hay/Pasture	10%
Cultivated Crops	52%
Wetlands	Woody 5%
	Emergent Herb. <1%
# NPDES Permits <sup>b</sup>	TOTAL 0

a. Eastern Highland Rim

b. # NPDES permits downloaded from ADEM's NPDES Management System database, Oct 1, 2013.



**Figure 3.** Landuse within the Spring Creek watershed at WHEL-9.

The mean growing season TN value was higher in 2009 than in 2003 (Fig. 4). Monthly TN concentrations generally declined April through September.

Contrary to mean TN concentration, the mean growing season TP concentration was slightly lower in 2009 (Fig. 4). Monthly TP concentrations were similar April-October.

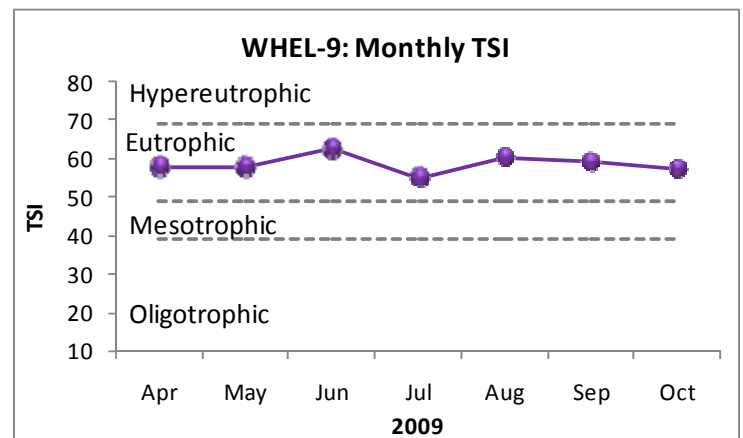
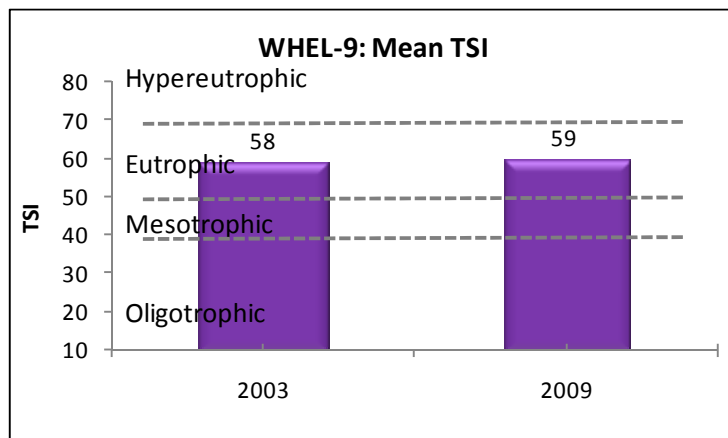
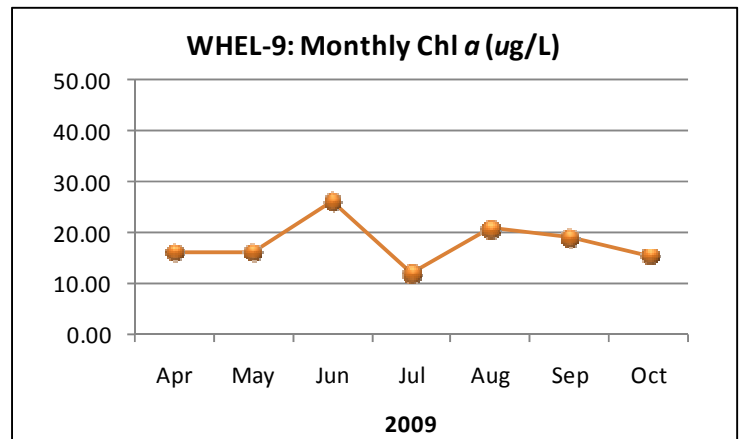
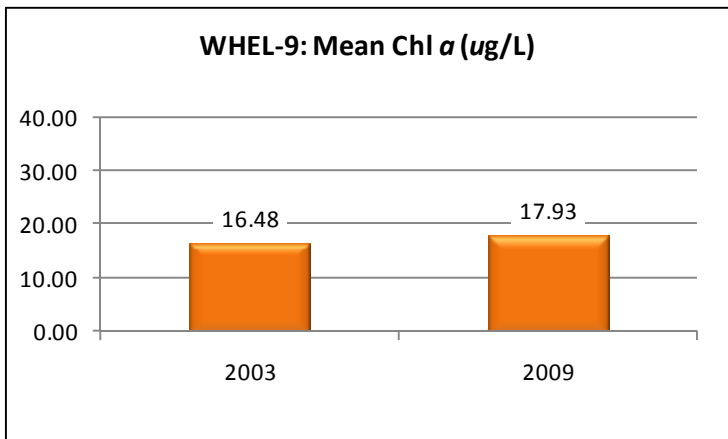
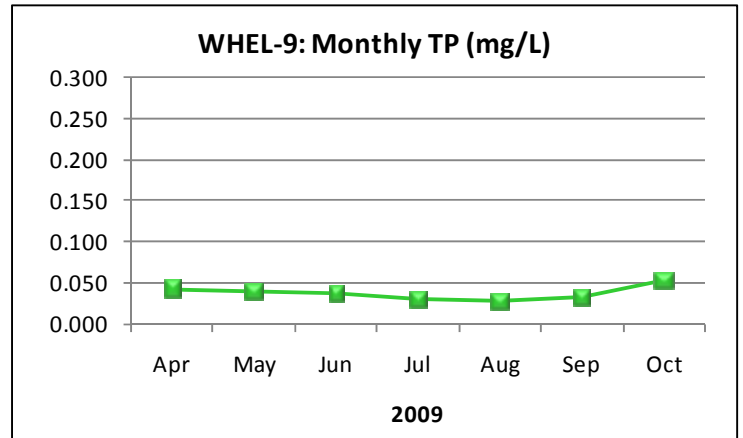
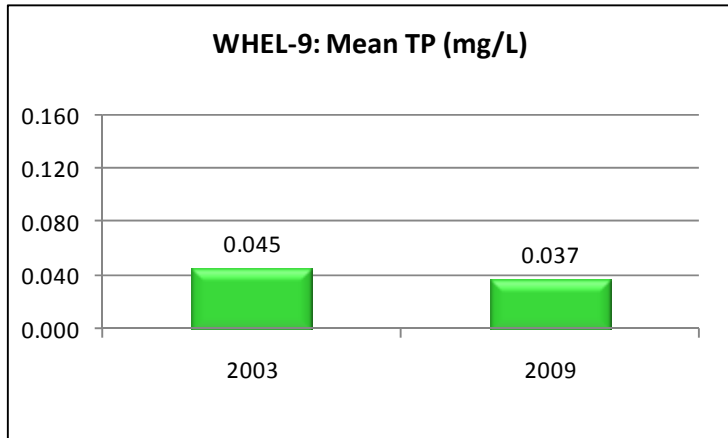
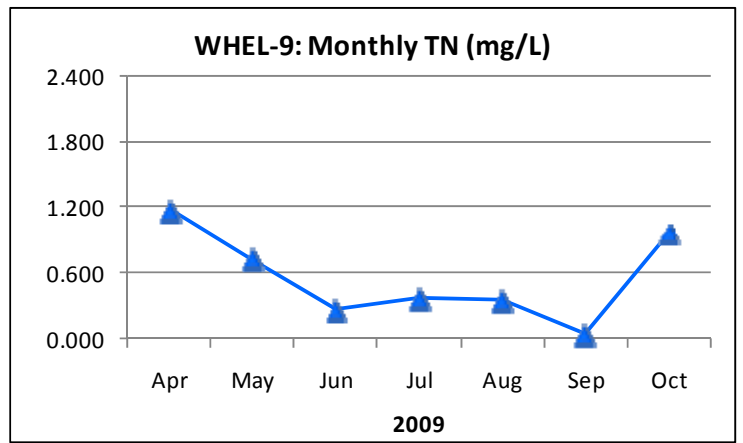
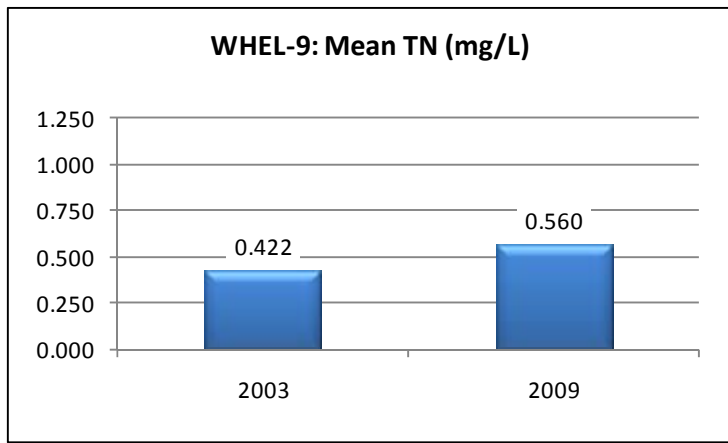
In 2009, the growing season mean chl *a* value was higher than 2003 (Fig. 4). Monthly chl *a* concentrations peaked in June.

Mean TSI was eutrophic in 2009 and 2003. Monthly TSI in Spring Creek was eutrophic April-October (Fig. 4).

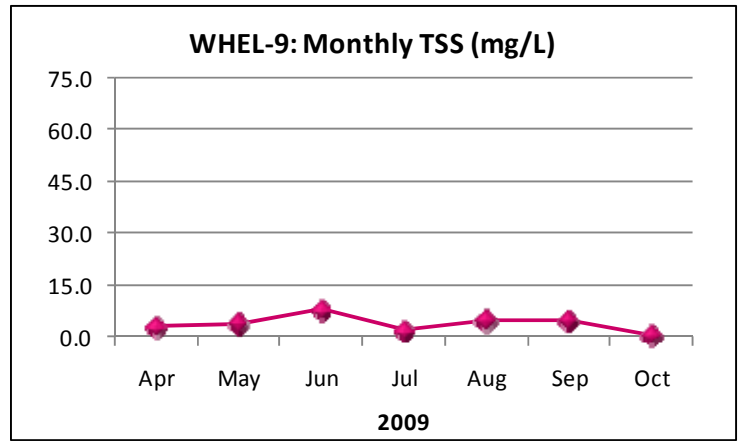
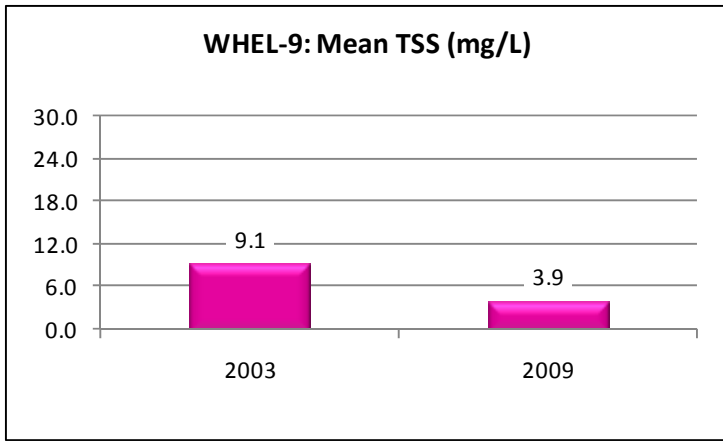
The mean growing season TSS value was lower in 2009 than 2003 (Fig. 5). Monthly TSS concentration were generally low in all months sampled.

AGPT results show that WHEL-9 was co-limited in both 2003 and 2009 (Table 3). The mean maximum standing crop (MSC) value from both years were below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

The DO concentration in the WHEL-9 station was above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).



**Figure 4.** Mean growing season (2003-2009) and monthly (April-October, 2009) TN, TP, chl a and TSI measured in the Spring Creek embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



**Figure 5.** Mean growing season and monthly TSS measured in the Spring Creek embayment of Wheeler Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2009. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

WHEL-9	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	4.4	5.5	5.0	4.9	0.4
Total Dissolved Solids (mg/L) <sup>J</sup>	7	50.0	126.0	110.0	99.1	25.7
Total Suspended Solids (mg/L)	7	< 1.0	8.0	4.0	3.9	2.4
Hardness (mg/L)	3	76.1	87.6	82.6	82.1	5.8
Alkalinity (mg/L)	7	67.5	88.2	78.7	78.2	7.7
Photic Zone (m)	7	2.37	4.25	3.37	3.45	0.58
Secchi (m)	7	0.90	1.42	1.04	1.08	0.17
Bottom Depth (m)	7	8.00	9.75	9.07	8.98	0.59
<b>Chemical</b>						
Ammonia Nitrogen (mg/L)	7	< 0.006	0.040	0.007	0.011	0.013
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.002	0.533	0.012	0.195	0.241
Total Kjeldahl Nitrogen (mg/L)	7	< 0.089	0.650	0.346	0.366	0.209
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.046	1.183	0.371	0.560	0.410
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	< 0.004	0.011	0.005	0.005	0.003
Total Phosphorus (mg/L)	7	0.027	0.053	0.036	0.037	0.009
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	4.5	6.1	5.5	5.3	0.6
<b>Biological</b>						
Chlorophyll a (ug/L)	7	12.02	26.03	16.02	17.93	4.54
Fecal Coliform (col/100 mL) <sup>J</sup>	3	< 1	20	1	7	10

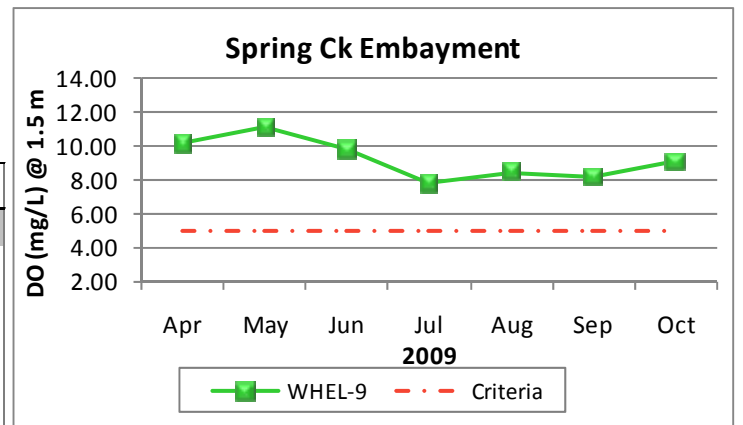
<sup>J</sup>= one or more of the values is an estimate; N= # samples.

**Table 3.** Algal growth potential test results (expressed as mean 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 (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
8/20/2003	2.24	CO-LIMITING
8/18/2009	2.37	CO-LIMITING

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Spring Creek embayment station of Wheeler Reservoir collected April-October 2009. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

- ADEM. 2008a. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
- ADEM. 2008b. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2009. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.
- ADEM. 2012. State of Alabama Water Quality Monitoring Strategy June 19, 2012. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 88 pp. <http://www.adem.alabama.gov/programs/water/wqsurvey/2012WQMonitoringStrategy>
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2010. Specific Water Quality Criteria. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.11). 2010. Water Quality Criteria Applicable to Specific Lakes. Water Quality Program. Chapter 10. Volume 1. Division 335-6.
- Carlson, R.E. 1977. A trophic state index. *Limnology and Oceanography*. 22(2):361-369.
- Raschke, R.L. and D.A. Schultz. 1987. The use of the algal growth potential test for data assessment. *Journal of Water Pollution Control Federation* 59(4):222-227.