

## Indian Creek Embayment Wheeler Reservoir Intensive Basin Survey 2013

**WHEL-3:** Indian Creek approx 1 mi upstream of confluence with TN River (Madison Co 34.58431/-86.72915)

### 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 2013, ADEM monitored the Indian 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 Indian Creek embayment (WHEL-3) during the 2013 growing season (Apr-Oct). This is the third 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 [chlorophyll *a* (chl *a*); algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson’s trophic state index (TSI)] from 2013 were compared to ADEM’s historical data and established criteria.

### WATERSHED CHARACTERISTICS

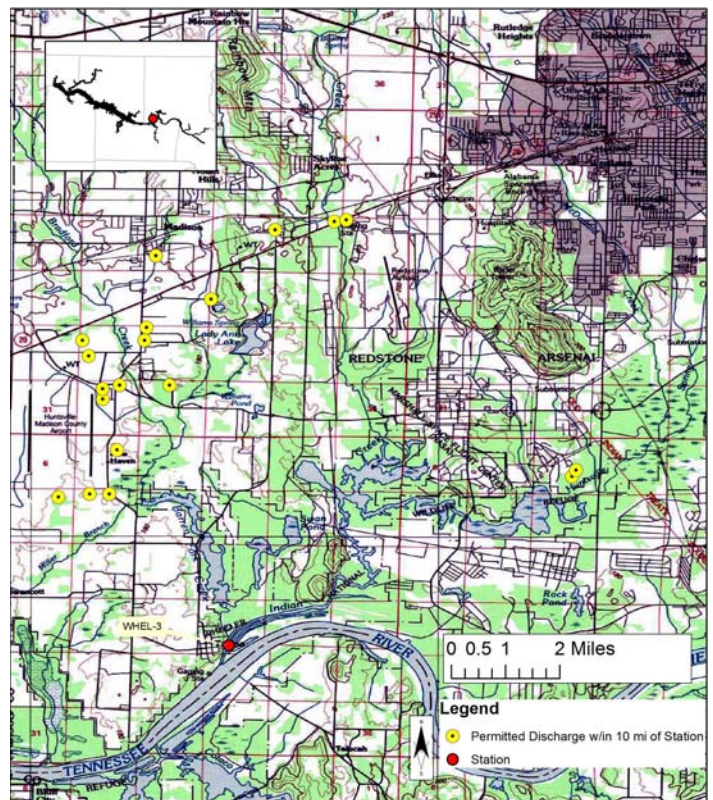
Watershed land uses are summarized in Table 1. Indian Creek is classified as a *Public Water Supply/Fish & Wildlife (PWS/F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 191 mi<sup>2</sup> watershed is predominantly developed (44%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 294 NPDES permits within the watershed. Nineteen of those permits are located within 10 mi of the station (Fig. 2).

### SITE DESCRIPTION

The Indian Creek embayment at WHEL-3 is located just south of Redstone Arsenal near Huntsville, AL. Nearly the entire watershed is contained within the Huntsville city limits. It is a riverine embayment that flows into the Tennessee River near river mile 321. Indian Creek has a mean bottom depth of 5.06 m (Table 2) at the sampling location.



**Figure 1.** Photo of Indian Creek at WHEL-3.



**Figure 2.** Map of Indian Creek embayment of Wheeler Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

## 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 2013b), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013a).

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 2013 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

## RESULTS

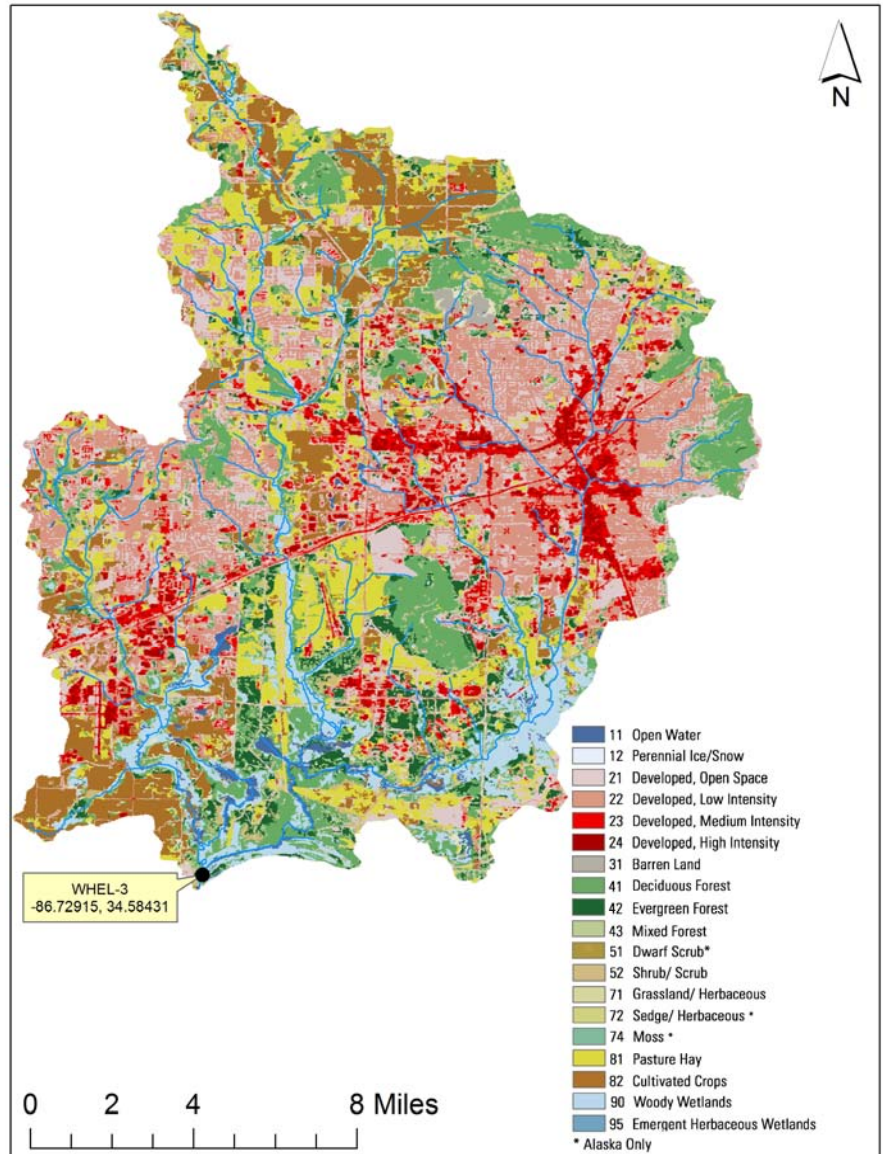
The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2.

**Table 1: Summary of Watershed WHEL-3**

Basin	Tennessee R
Drainage Area (mi <sup>2</sup> )	191
Ecoregion <sup>a</sup>	71g
% Land use	
Open Water	1%
Developed	Open Space 16%
	Low Intensity 20%
	Medium Intensity 6%
	High Intensity 2%
Barren Land	<1%
Forest	Deciduous Forest 13%
	Evergreen Forest 5%
	Mixed Forest 3%
Shrub/Scrub	4%
Herbaceous	1%
Hay/Pasture	12%
Cultivated Crops	11%
Wetlands	Woody 6%
	Emergent Herb. <1%
# NPDES Permits <sup>b</sup>	TOTAL 294
401 Water Quality Certification	26
Construction Stormwater	179
Mining	5
Small Mining	4
Industrial General	54
Industrial Individual	6
MS4	1
Municipal Individual	4
Underground Injection Control	15

a. Eastern Highland Rim

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



**Figure 3.** Land use within the Indian Creek watershed at WHEL-3.

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.

The mean growing season TN value was higher in 2013 than 2009 (Fig. 4). Monthly TN concentrations peaked in July and October.

The mean growing season TP concentration was lower in 2013 compared to 2003-2009. (Fig. 4). Monthly TP concentration were generally low and peaked in July.

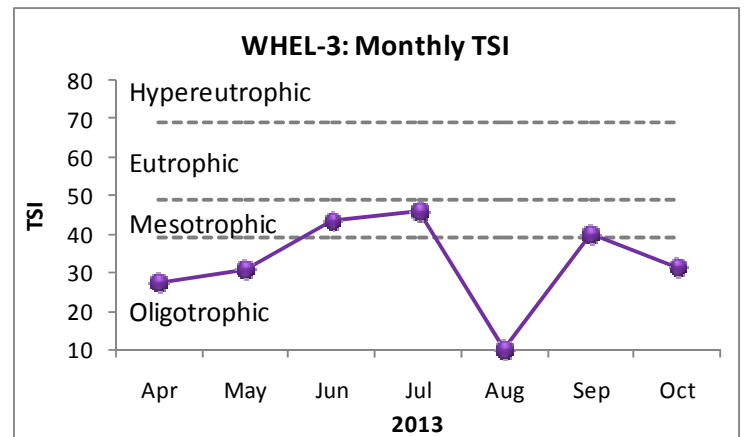
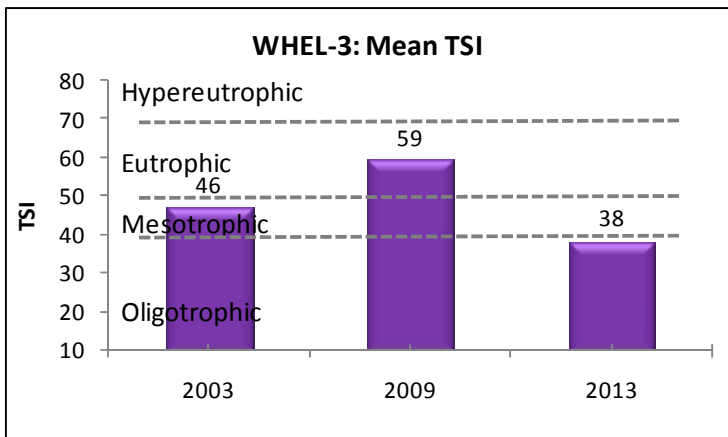
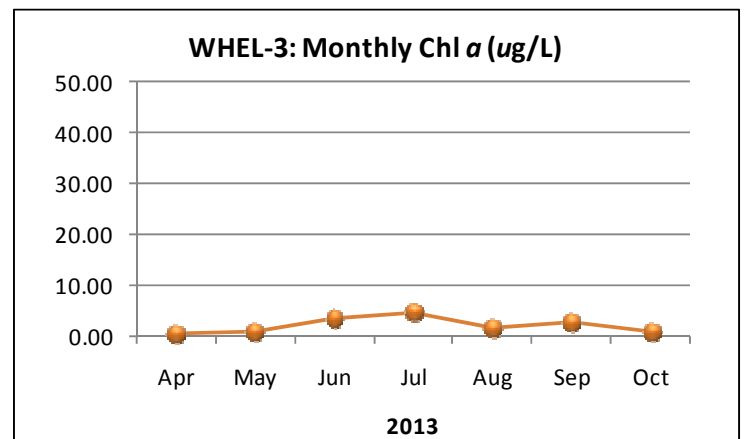
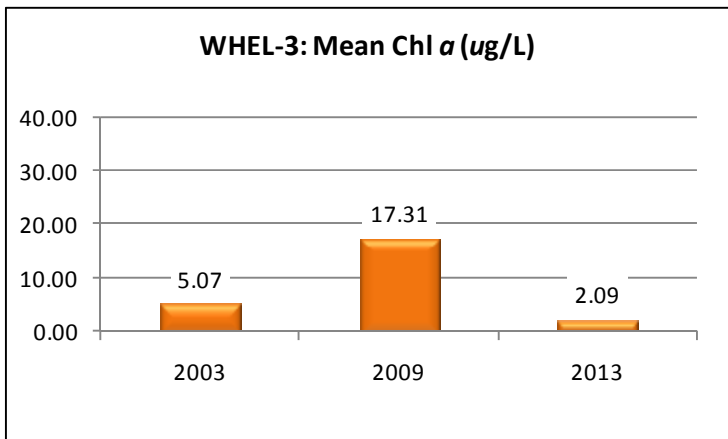
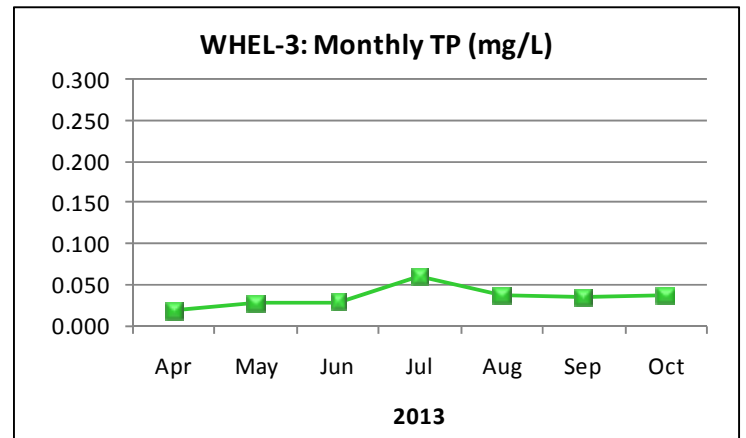
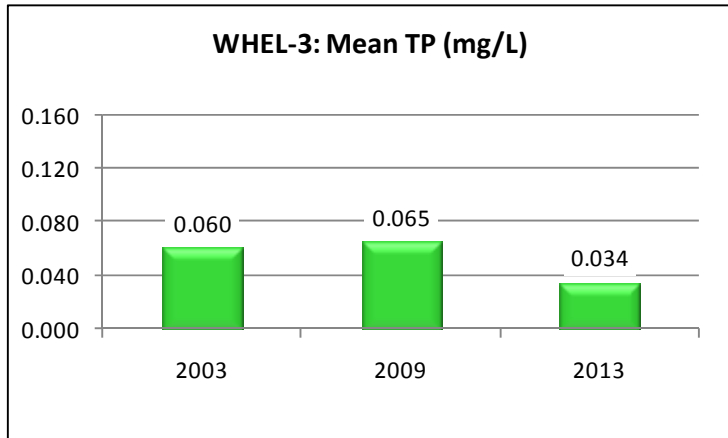
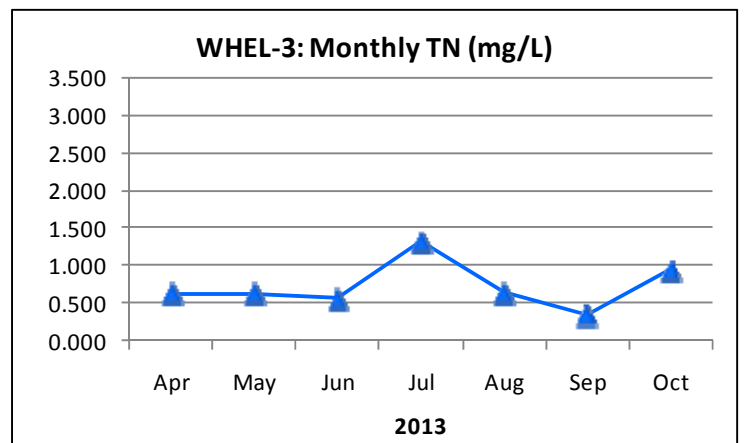
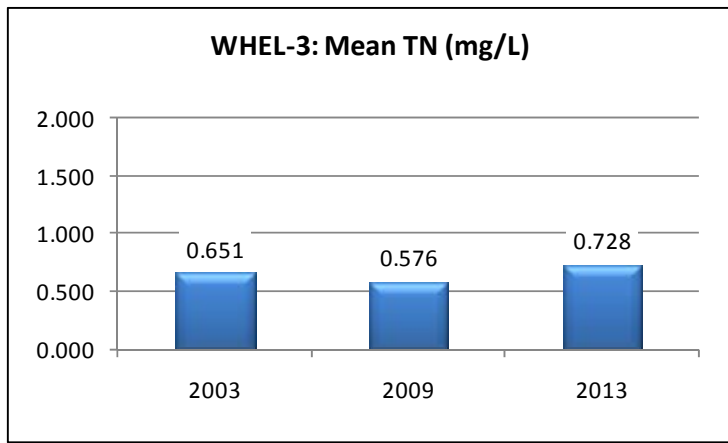
In 2013, the growing season mean chl *a* value was lower than 2009 (Fig. 4). Monthly chl *a* concentrations were low and similar April –October.

Mean TSI was oligotrophic in 2013, a decrease from eutrophic conditions in 2009. Monthly TSI in Indian Creek varied from oligotrophic to mesotrophic throughout the sampling period.

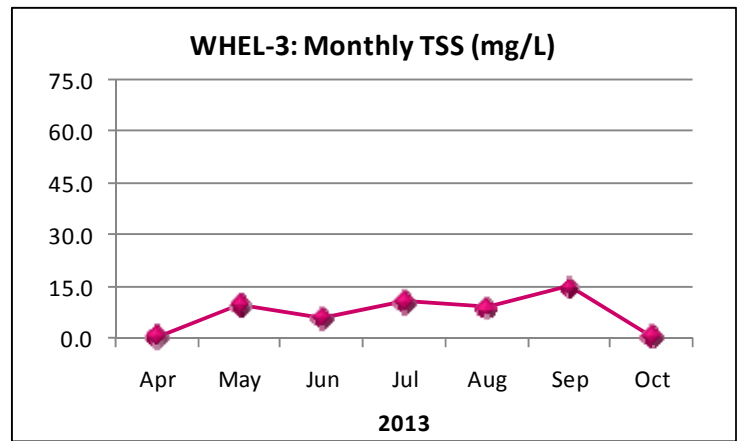
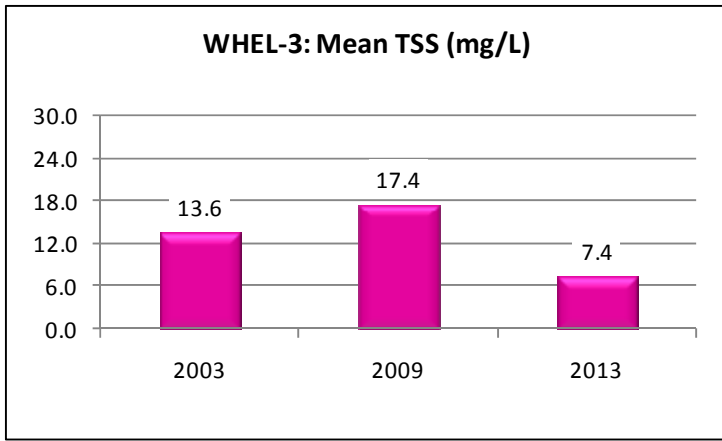
The mean growing season TSS value was lower in 2013 than 2003-2009 (Fig. 5). Monthly TSS concentration was highest in September.

AGPT results show that WHEL-3 was phosphorus limited in 2003-2013 (Table 3). The mean maximum standing crop (MSC) value from 2013 was 11.87 mg/L, which is above 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-3 station was above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months, though it was near the limit in July (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).



**Figure 4.** Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Indian 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 Indian Creek embayment of Wheeler Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2013. 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.

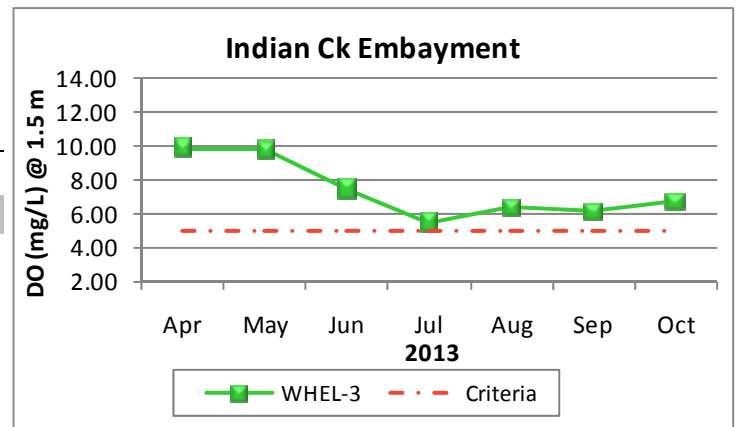
WHEL-3	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	4.4	12.0	6.4	7.4	2.4
Total Dissolved Solids (mg/L)	7	<	1.0	156.0	95.0	87.4
Total Suspended Solids (mg/L)	7	<	1.0	15.0	9.0	7.4
Hardness (mg/L)	4	54.9	70.0	66.4	64.4	7.0
Alkalinity (mg/L)	7	54.9	117.0	60.0	69.0	21.8
Photic Zone (m)	7	2.02	5.30	3.87	3.84	0.96
Secchi (m)	7	0.65	1.66	1.38	1.32	0.32
Bottom Depth (m)	7	4.90	5.30	5.20	5.06	0.35
<b>Chemical</b>						
Ammonia Nitrogen (mg/L) <sup>J</sup>	7	<	0.012	0.081	0.012	0.028
Nitrate+Nitrite Nitrogen (mg/L)	7	0.061	0.371	0.280	0.241	0.105
Total Kjeldahl Nitrogen (mg/L)	7	0.205	1.260	0.333	0.487	0.372
Total Nitrogen (mg/L)	7	0.350	1.321	0.632	0.728	0.315
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	0.006	0.026	0.015	0.017	0.007
Total Phosphorus (mg/L)	7	0.018	0.060	0.034	0.034	0.013
CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0
Chlorides (mg/L)	7	3.8	6.2	5.1	5.1	0.8
<b>Biological</b>						
Chlorophyll a (ug/L)	7	<	0.10	4.81	1.60	2.09
E. coli (col/100mL) <sup>J</sup>	3	5	12	10	9	4

J= 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
8/19/2003	10.13	PHOSPHORUS
8/18/2009	4.87	PHOSPHORUS
8/20/2013	11.87	PHOSPHORUS

FOR MORE INFORMATION, CONTACT:  
 Ransom Williams, ADEM Environmental Indicators Section  
 1350 Coliseum Boulevard, Montgomery, AL 36110  
 (334) 260-2715, rw@adem.state.al.us



**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Indian Creek embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

- ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
- ADEM. 2013a. Quality Management Plan (QMP) for the Alabama Department of Environmental Management, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2013b. 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.