

## Cotaco Creek Embayment Wheeler Reservoir Intensive Basin Survey 2013

**WHEL-4:** Cotaco Creek approx immediately upstream of Sharps Ford Bridge (Morgan Co 34.54297/-86.72628)

### 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 Cotaco 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 Cotaco Creek embayment (WHEL-4) 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

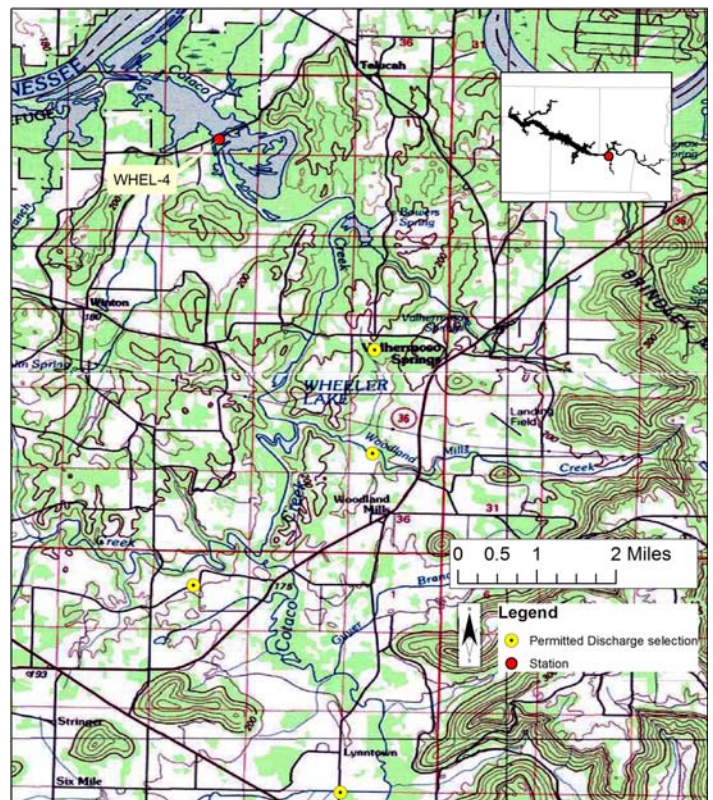
Watershed land uses are summarized in Table 1. Cotaco Creek is classified as a *Swimming/Fish & Wildlife (S/F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 238 mi<sup>2</sup> watershed is a mix of hay/pasture (33%) and forest (45%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 23 NPDES permits within the watershed. Four of those permits are located within 10 mi of the station (Fig. 2).

### SITE DESCRIPTION

The Cotaco Creek embayment at WHEL-4 is located southwest of Huntsville, AL near Valhermoso Springs, AL. It is a riverine embayment that flows into the Tennessee River near river mile 319. Cotaco Creek has a mean bottom depth of 4.57 m (Table 2) at the sampling location.



**Figure 1.** Photo of Cotaco Creek at WHEL-4.



**Figure 2.** Map of Cotaco 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.

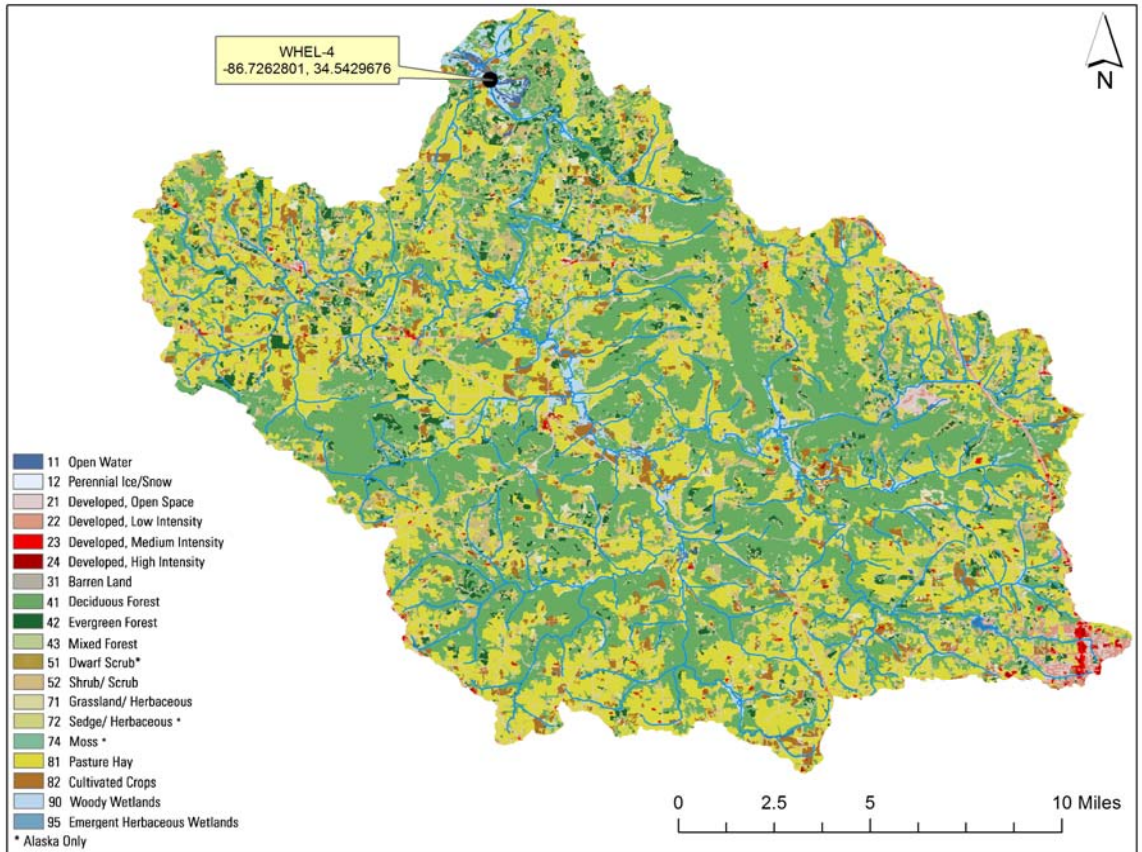


Figure 3. Land use within the Cotaco Creek watershed at WHEL-4.

## RESULTS

Table 1: Summary of Watershed WHEL-4

Basin	Tennessee R
Drainage Area (mi <sup>2</sup> )	238
Ecoregion <sup>a</sup>	71g
% Land use	
Open Water	1%
Developed Open Space	4%
Low Intensity	1%
Medium Intensity	<1%
High Intensity	<1%
Barren Land	<1%
Forest Deciduous Forest	36%
Evergreen Forest	4%
Mixed Forest	5%
Shrub/Scrub	7%
Herbaceous	2%
Hay/Pasture	33%
Cultivated Crops	4%
Wetlands Woody	2%
Emergent Herb.	<1%
# NPDES Permits <sup>b</sup> TOTAL	23
Construction Stormwater	9
Small Mining	1
Industrial General	8
Municipal Individual	4
Underground Injection Control	1

a. Eastern Highland Rim

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

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.

The mean growing season TN value increased 2003-2013 (Fig. 4). Monthly TN concentrations were similar Apr-Oct with a decrease in June.

The mean growing season TP concentration was lower in 2013 than 2009 (Fig. 4). Monthly TP concentrations were similar Apr-Oct.

The growing season mean chl *a* value decreased 2003 or 2013 (Fig. 4). Monthly chl *a* concentrations increased Apr-Oct.

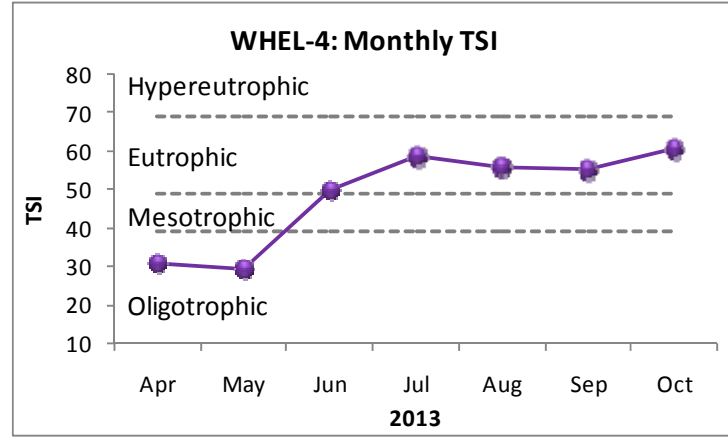
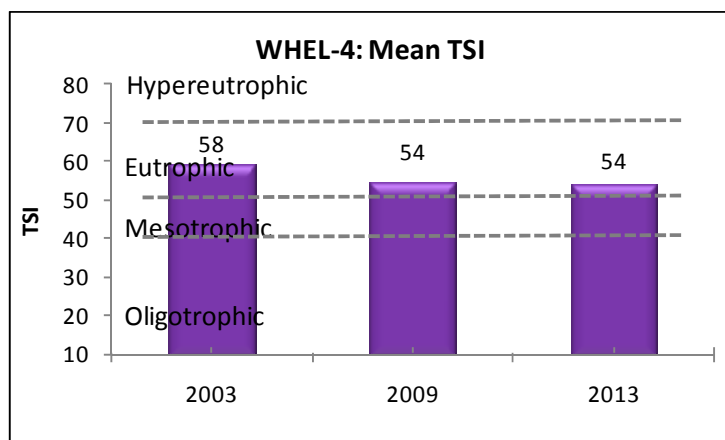
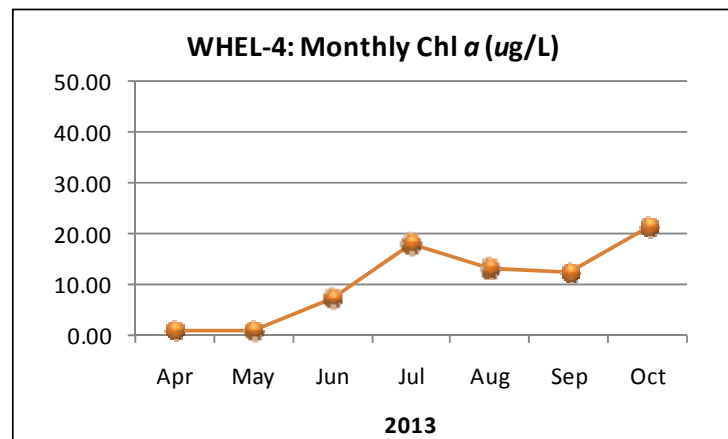
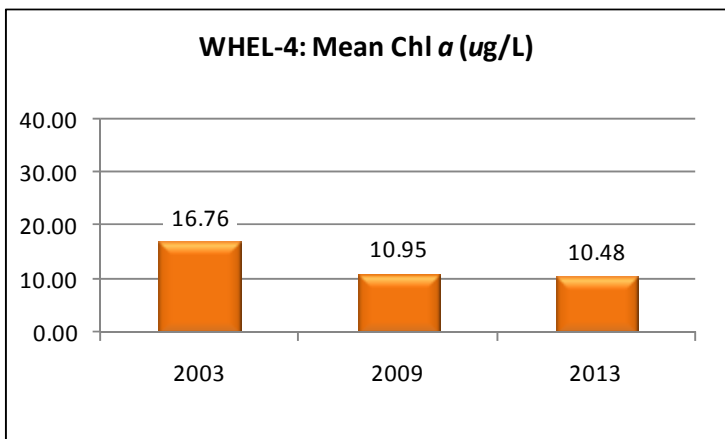
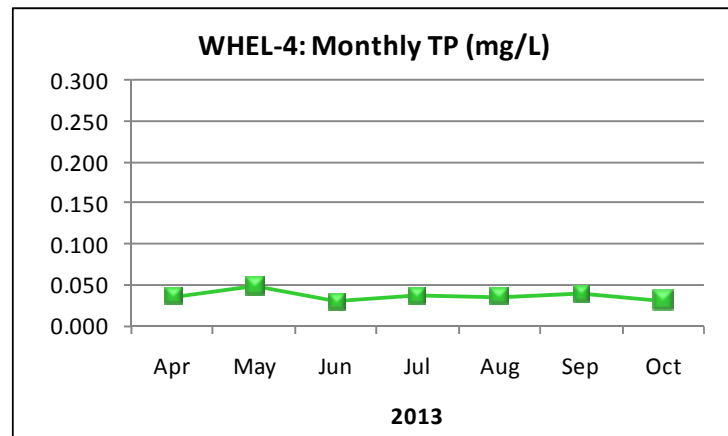
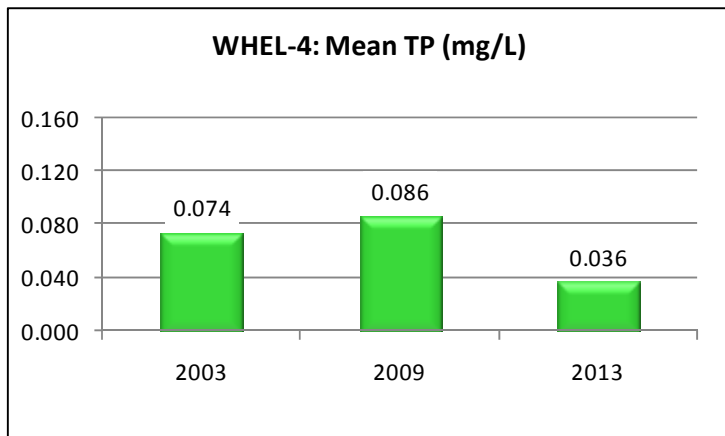
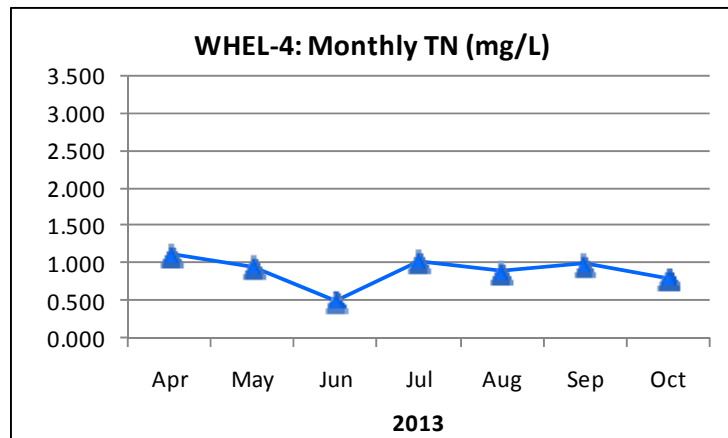
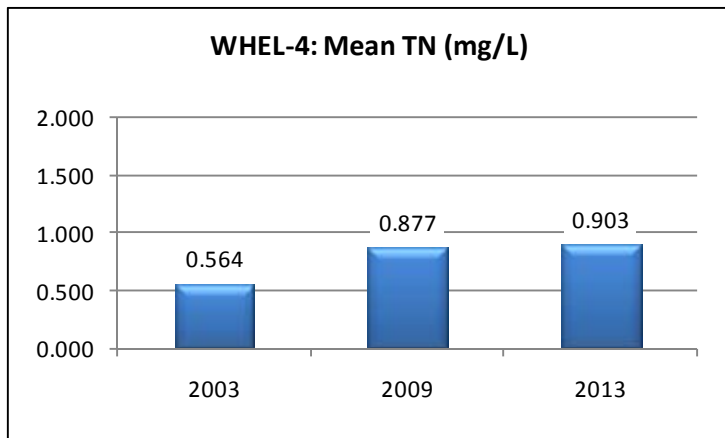
Mean TSI remained eutrophic in 2013. Monthly TSI in Cotaco Creek was eutrophic June-October (Fig. 4).

The mean growing season TSS decreased 2003-2013 (Fig. 5). Monthly TSS concentrations increased Apr.-Oct. with a peak in September.

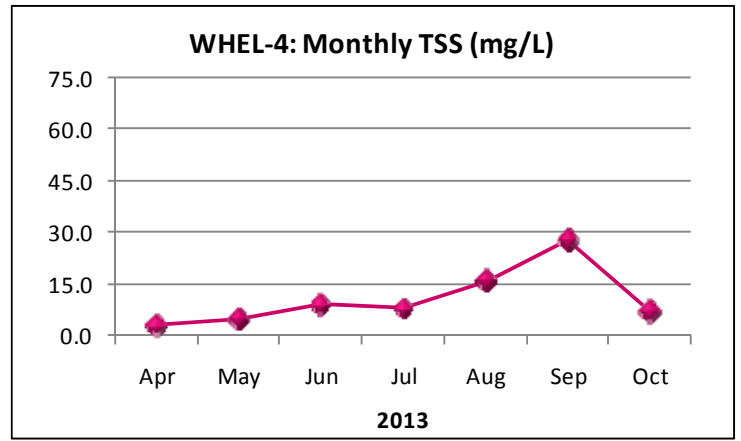
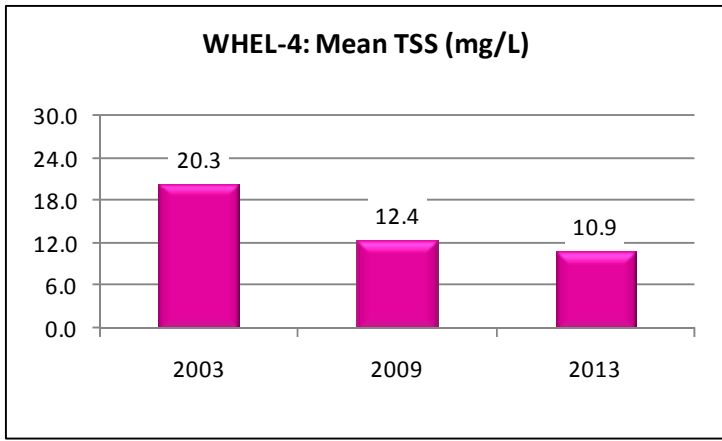
AGPT results show that WHEL-4 was phosphorous limited in 2013 (Table 3). The mean maximum standing crop (MSC) value was 4.12, which is below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

DO concentration at the WHEL-4 station was below the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) 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 Cotaco 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 Cotaco 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.

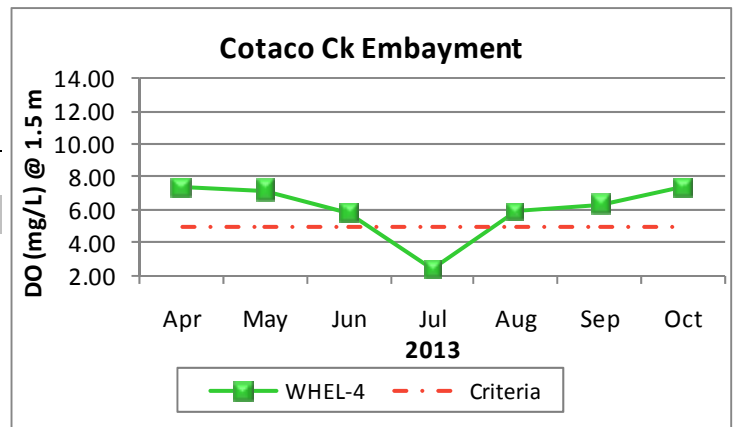
WHEL-4	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	6.9	22.8	9.4	11.9	5.7
Total Dissolved Solids (mg/L)	7	86.0	128.0	109.0	107.4	13.2
Total Suspended Solids (mg/L)	7	3.0	28.0	8.0	10.9	8.6
Hardness (mg/L)	4	68.7	82.0	77.1	76.2	5.5
Alkalinity (mg/L)	7	69.6	88.7	79.1	78.0	7.4
Photic Zone (m)	7	1.36	3.62	2.00	2.39	0.80
Secchi (m)	7	0.58	1.39	0.78	0.84	0.31
Bottom Depth (m)	7	4.00	5.10	4.60	4.57	0.40
<b>Chemical</b>						
Ammonia Nitrogen (mg/L)	7	< 0.004	0.043	0.009	0.016	0.015
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	0.002	0.521	0.118	0.196	0.207
Total Kjeldahl Nitrogen (mg/L)	7	0.439	1.000	0.690	0.706	0.210
Total Nitrogen (mg/L) <sup>J</sup>	7	0.500	1.122	0.960	0.903	0.204
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	0.005	0.022	0.006	0.009	0.006
Total Phosphorus (mg/L)	7	0.029	0.049	0.035	0.036	0.006
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	2.5	5.5	3.6	3.7	1.0
<b>Biological</b>						
Chlorophyll a (ug/L)	7	< 0.10	21.36	12.46	10.48	8.18
E. coli (col/100mL) <sup>J</sup>	3	16	173	53	80	82

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	5.01	NITROGEN
8/18/2009	3.68	NITROGEN
8/20/2013	4.12	PHOSPHOROUS

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Cotaco 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.