Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Second Creek Embayment
Wheeler Reservoir
Intensive Basin Survey 2013

WHEL-10: Second Creek approx 0.5 mi downstream of Hwy 72 bridge (Lauderdale Co 34.837/-87.371)

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 Second 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 Second Creek embayment (WHEL-10) 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. Second Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Western Highland Rim ecoregion (71f). Based on the 2006 National Land Cover Dataset, land use within the 57 mi^2 watershed is predominantly hay/pasture (Fig. 3). As of October 1, 2013, ADEM has issued a total of 4 NPDES permits within the watershed. Two of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Second Ck embayment at WHEL-10 is a clear, fairly deep embayment which flows into the Tennessee River just upstream of the Wheeler Dam. Second Ck has a mean bottom depth of 9.14 m (Table 2) at the sampling location.

Figure 1. Photo of Second Ck at WHEL-10.

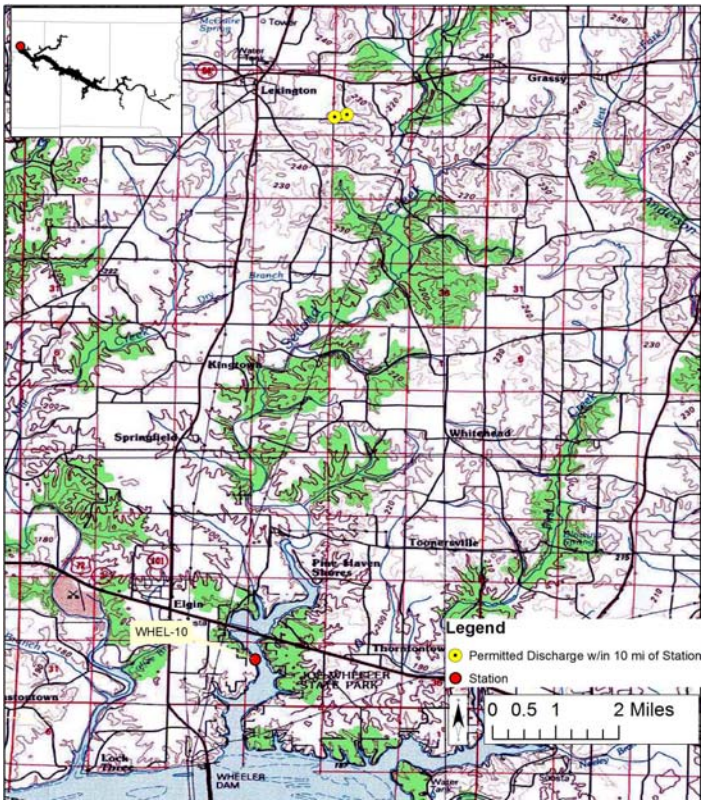


Figure 2. Map of Second Ck embayment of Wheeler Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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. 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-10**

Basin		Tennessee R
Drainage Area (mi^2)		57
Ecoregion[a]		71f
% Land use		
Open Water		1%
Developed	Open Space	5%
	Low Intensity	<1%
	Medium Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	24%
	Evergreen Forest	2%
	Mixed Forest	5%
Shrub/Scrub		5%
Herbaceous		1%
Hay/Pasture		49%
Cultivated Crops		6%
Wetlands	Woody	2%
# NPDES Permits[b]	TOTAL	4
Construction Stormwater		2
Municipal Individual		1
Underground Injection Control		1

a. Western Highland Rim

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

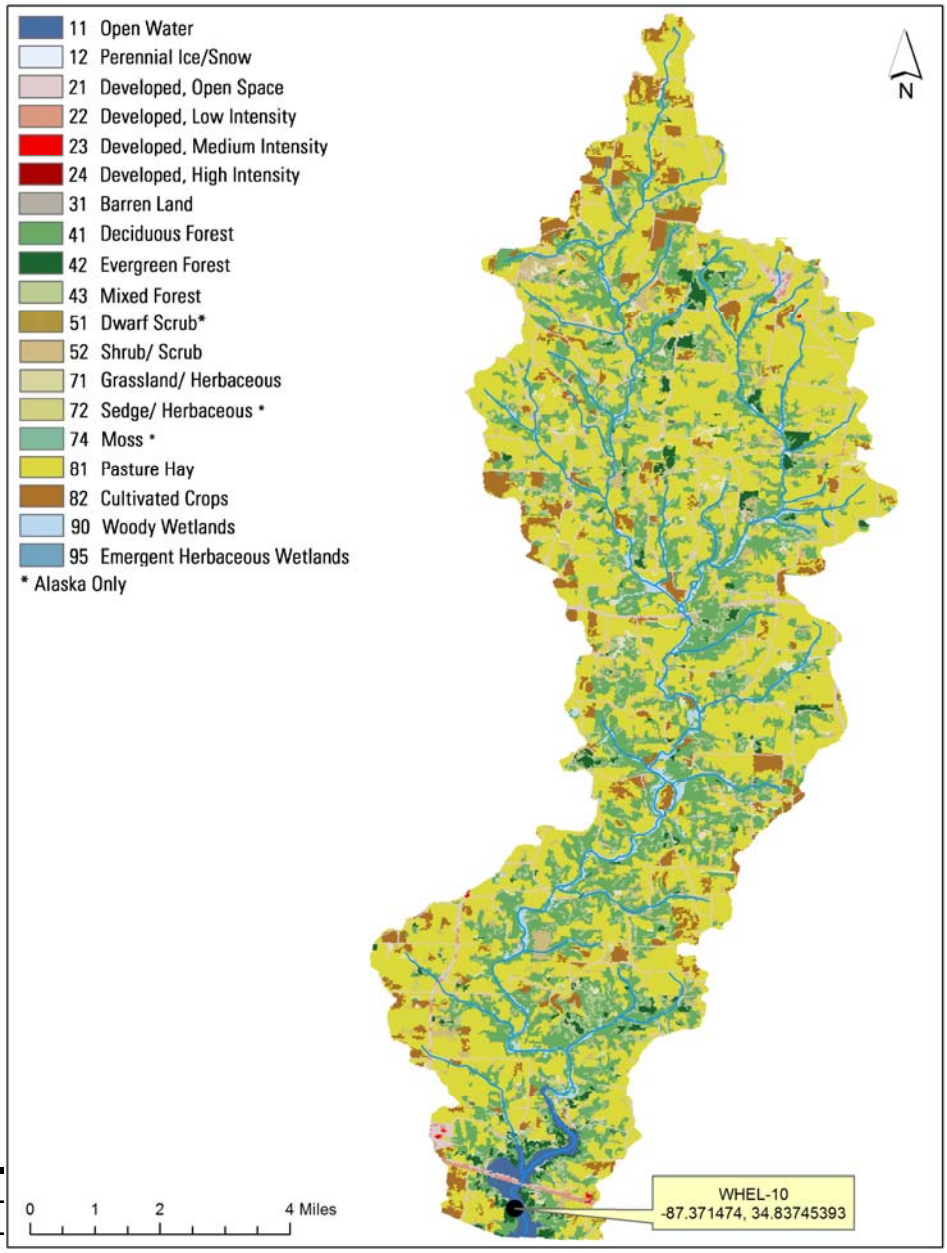


Figure 3. Landuse within the Second Creek watershed at WHEL-10.

The mean growing season TN value was higher in 2013 than in 2003-2009 (Fig. 4). The highest monthly TN concentration was measured in April.

The mean growing season TP value was lower in 2013 than in 2003-2009 (Fig. 4). Monthly TP concentrations were generally similar April-October.

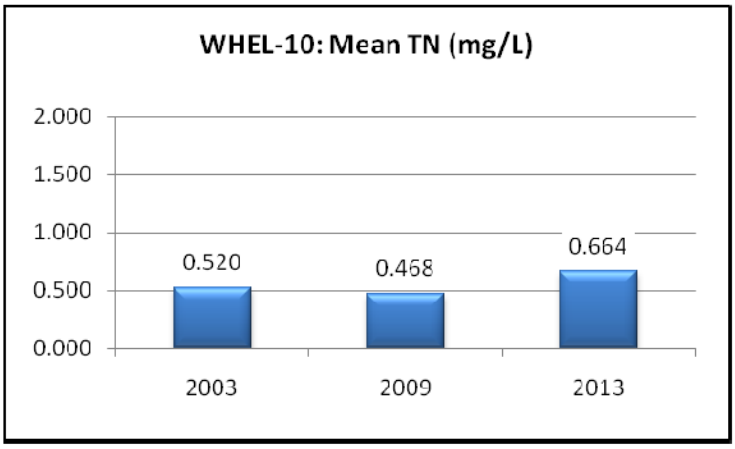
The growing season mean chl *a* value in 2013 was higher than 2009 but lower than 2003 (Fig. 4). The highest monthly chl *a* concentration was measured in June.

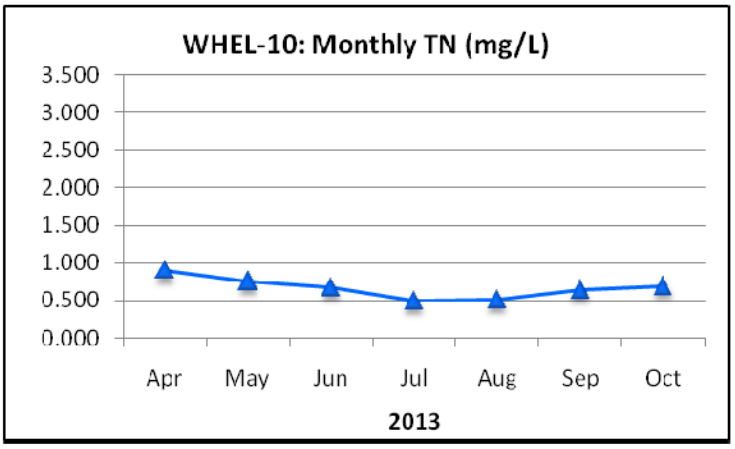
Mean TSI values have remained eutrophic all years monitored. Monthly TSI in Second Ck was eutrophic April-October (Fig. 4).

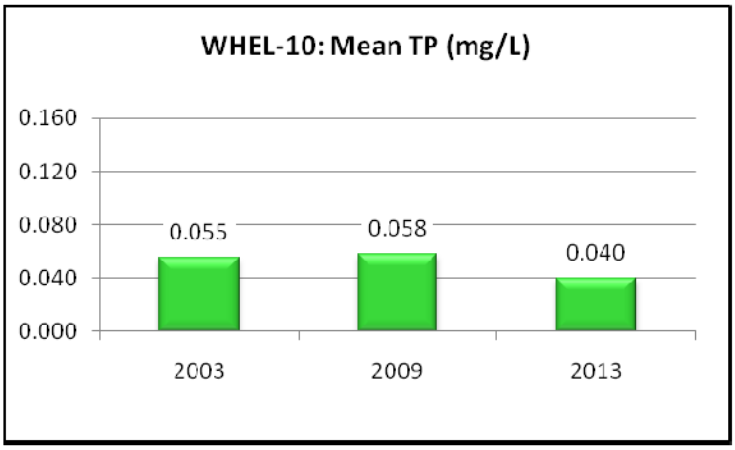
The mean growing season TSS value decreased 2003-2013 (Fig. 5). The highest monthly TSS concentration was August, though concentrations were low all season.

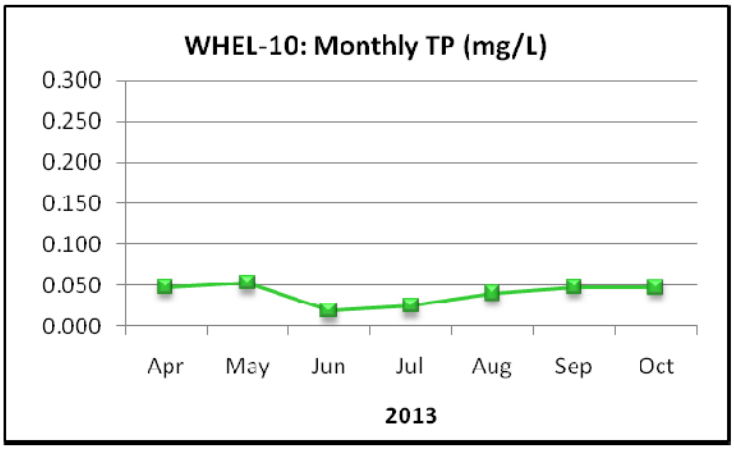
AGPT results show that WHEL-10 was nitrogen limited in 2013 and 2009 and co-limited in 2003 (Table 3). Mean maximum standing crop (MSC) values from 2013 and 2003 exceeded the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

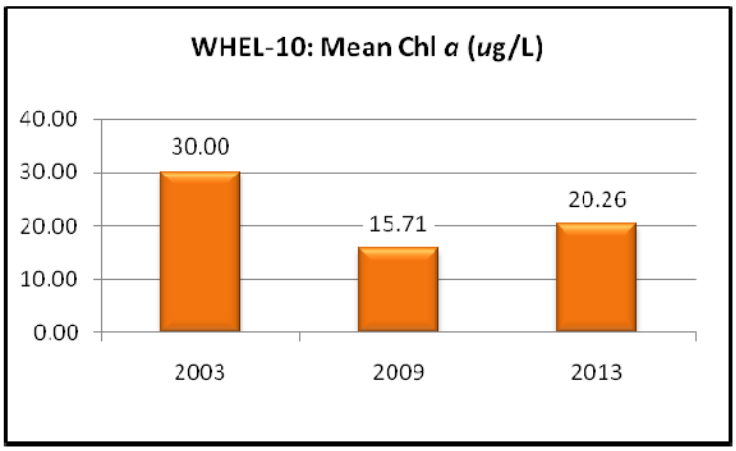
DO concentrations in the WHEL-10 station remained above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months monitored (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

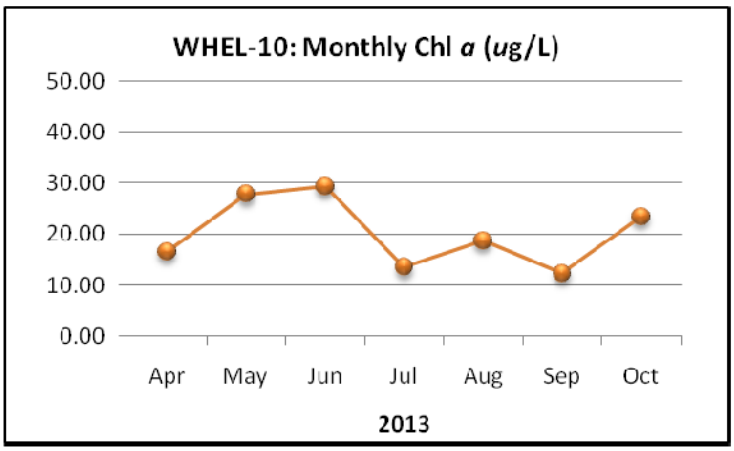


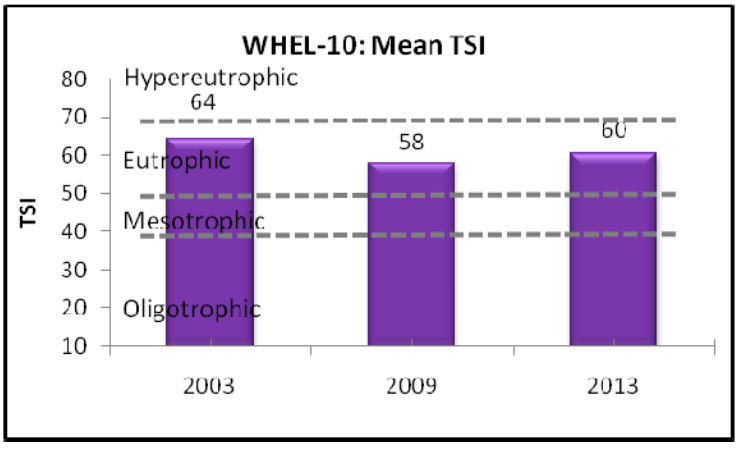












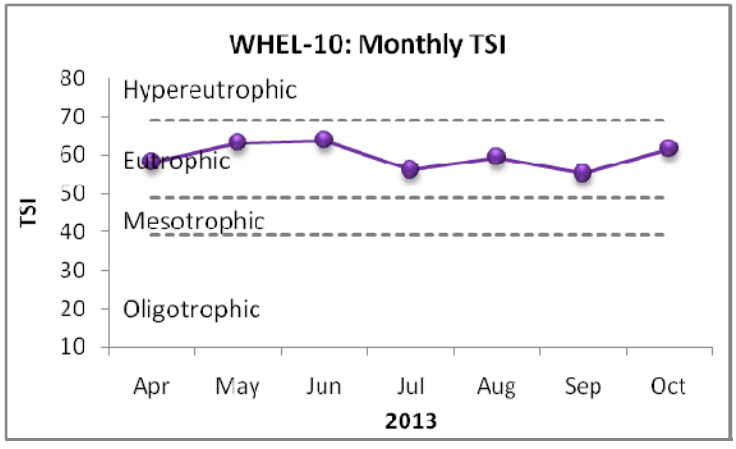
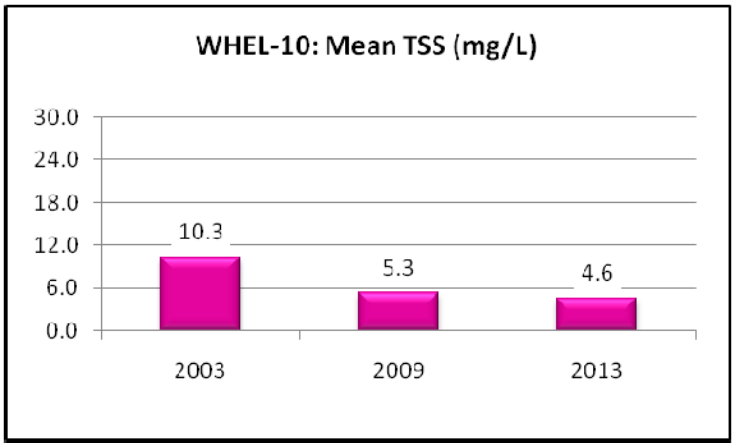


Figure 4. Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Second Creek embayment of Wheeler Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



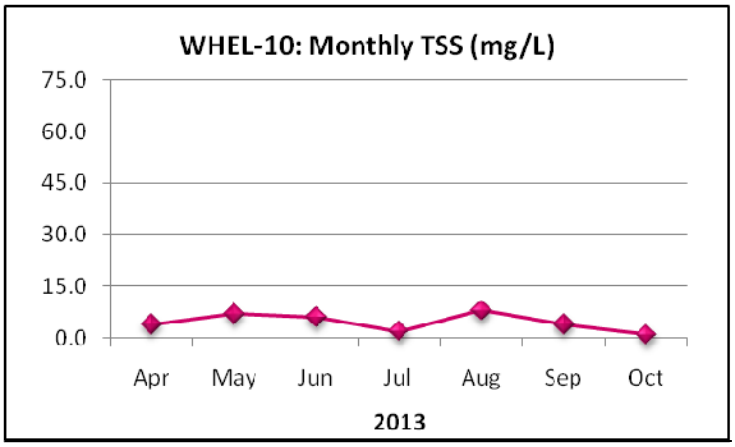


Figure 5. Mean growing season and monthly TSS measured in the Second Creek embayment of Wheeler Reservoir.

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-10	N		Min	Max	Med	Mean	SD
Physical							
Turbidity (NTU)	7		2.5	6.0	4.2	4.4	1.2
Total Dissolved Solids (mg/L)[J]	7		86.0	113.0	96.0	97.3	8.8
Total Suspended Solids (mg/L)[J]	7		1.0	8.0	4.0	4.6	2.6
Hardness (mg/L)	4		61.3	82.1	67.3	69.5	8.9
Alkalinity (mg/L)	7		39.8	56.0	43.4	44.7	5.9
Photic Zone (m)	7		3.11	5.46	4.49	4.32	0.82
Secchi (m)	7		1.14	1.75	1.49	1.44	0.23
Bottom Depth (m)	7		8.00	9.67	9.27	9.14	0.55
Chemical							
Ammonia Nitrogen (mg/L)[J]	7	<	0.015	0.082	0.014	0.023	0.027
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	<	0.005	0.313	0.021	0.107	0.127
Total Kjeldahl Nitrogen (mg/L)	7		0.471	0.663	0.531	0.557	0.074
Total Nitrogen (mg/L)[J]	7	<	0.492	0.896	0.668	0.664	0.140
Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.005	0.024	0.009	0.010	0.007
Total Phosphorus (mg/L)	7		0.019	0.053	0.048	0.040	0.013
CBOD-5 (mg/L)[J]	7	<	2.0	2.1	1.0	1.2	0.4
Chlorides (mg/L)[J]	7		3.8	5.7	4.7	4.8	0.8
Biological							
Chlorophyll a (ug/L)	7		12.30	29.40	18.70	20.26	6.78
E. coli (col/100mL)	3		1	16	13	10	8

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).

WHEL-10	MSC	Limiting Nutrient
8/20/2003	5.86	CO-LIMITING
8/18/2009	3.36	NITROGEN
8/20/2013	7.56	NITROGEN

FOR MORE INFORMATION, CONTACT:
Michael Len, ADEM Environmental Indicators Section
1350 Coliseum Boulevard, Montgomery, AL 36110
(334) 260-2787, mlen@adem.state.al.us

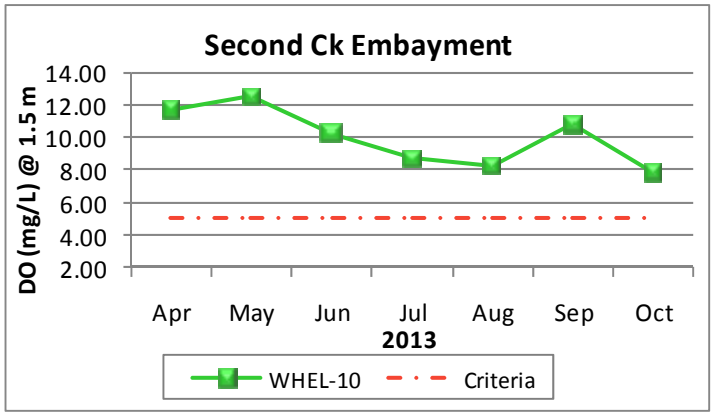


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Second Ck embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

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, 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.