

Town Creek Embayment Guntersville Reservoir Intensive Basin Survey 2013

Tennessee River Basin

GUNM-7: Town Creek approximately 0.5 mi downstream of Hwy 227 bridge (Marshall Co 34.40582/-86.18318)

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 Town Creek tributary embayment of Guntersville 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 Town Ck embayment (GUNM-7) 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. Town Creek is classified as a *Swimming/Fish & Wildlife (S/F&W)* stream located in the Plateau Escarpment ecoregion (68c). Based on the 2006 National Land Cover Dataset, land use within the 215 mi² watershed is predominantly agriculture [(Pasture/Hay 41%) (Crops 9%)] (Fig. 3). As of October 1, 2013, ADEM has issued a total of 17 NPDES permits within the watershed. No permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Town Ck embayment at GUNM-7 is located just west of Guntersville, AL. It is a fairly large embayment, flowing into the Tennessee River near Guntersville State Park. Town Ck has a mean bottom depth of 9.53 m (Table 2) at the sampling location.



Figure 1. Photo of Town Ck at GUNM-7.

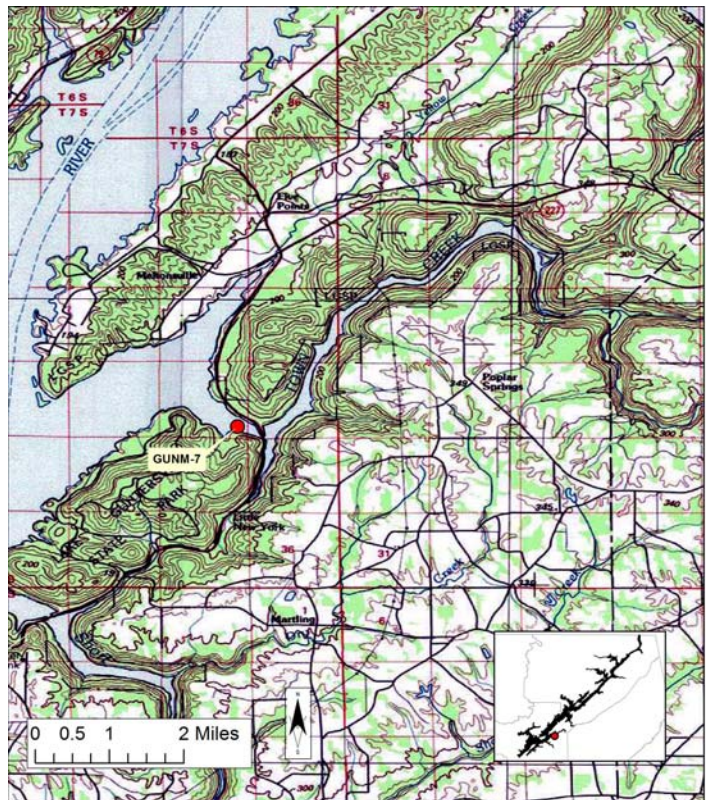


Figure 2. Map of Town Ck embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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.

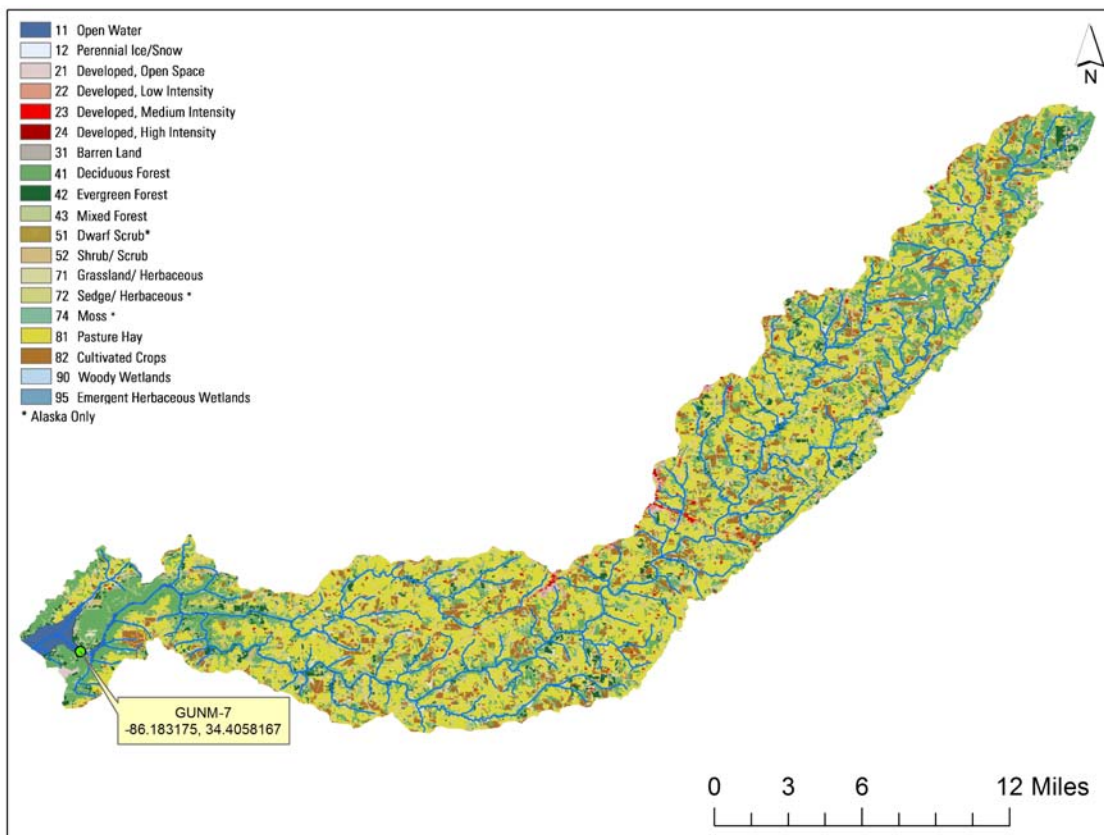


Figure 3. Land use within the Town Creek watershed at GUNM-7.

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.

The mean growing season TN value was lower in 2013 than 2009 (Fig. 4). Monthly TN concentrations gradually decreased from April through September, then reached the highest concentration in October.

The mean growing season TP concentration decreased 2003-2013 (Fig. 4). Highest monthly TP concentrations occurred in May and September.

Growing season mean chl *a* values decreased 2003-2013 (Fig. 4). Monthly chl *a* concentrations were highest in June and October.

Mean TSI remained eutrophic in 2013. Monthly TSI in Town Ck varied in between eutrophic and mesotrophic conditions April-October (Fig. 4).

The mean growing season TSS value was higher in 2013 than 2009 (Fig. 5). Monthly TSS concentrations were highest in May and September.

AGPT results show that GUNM-7 was phosphorous limited in 2013 (Table 3). The mean maximum standing crop (MSC) value was 5.6 mg/L, which is slightly above the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

DO concentrations in the GUNM-7 station were above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months sampled (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

Table 1: Summary of Watershed GUNM-7

Basin	Tennessee R
Drainage Area (mi ²)	215
Ecoregion ^a	68c
% Landuse	
Open Water	1%
Developed	Open Space 5%
	Low Intensity <1%
	Medium Intensity <1%
	High Intensity <1%
Barren Land	<1%
Forest	Deciduous Forest 22%
	Evergreen Forest 4%
	Mixed Forest 10%
Shrub/Scrub	4%
Herbaceous	2%
Hay/Pasture	41%
Cultivated Crops	9%
Wetlands	Woody 0%
	Emergent Herb. <1%
# NPDES Permits ^b	TOTAL 17
401 Water Quality Certification	1
Construction Stormwater	6
Mining	3
Industrial General	7

a. Plateau Es carpment

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

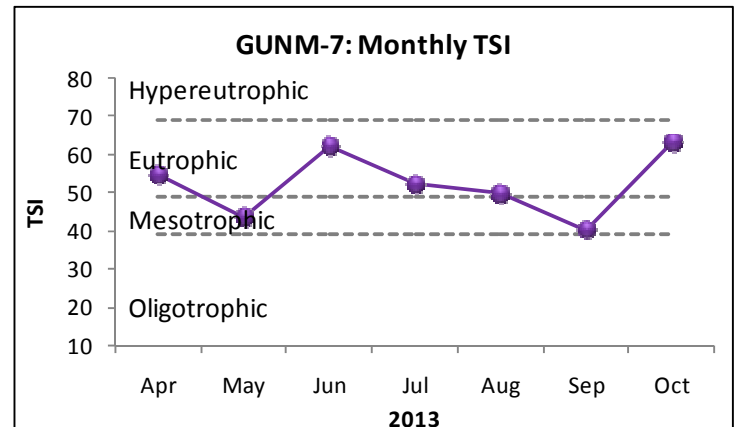
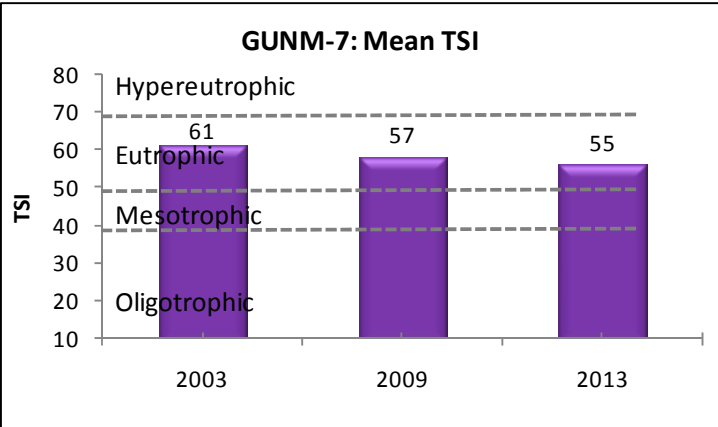
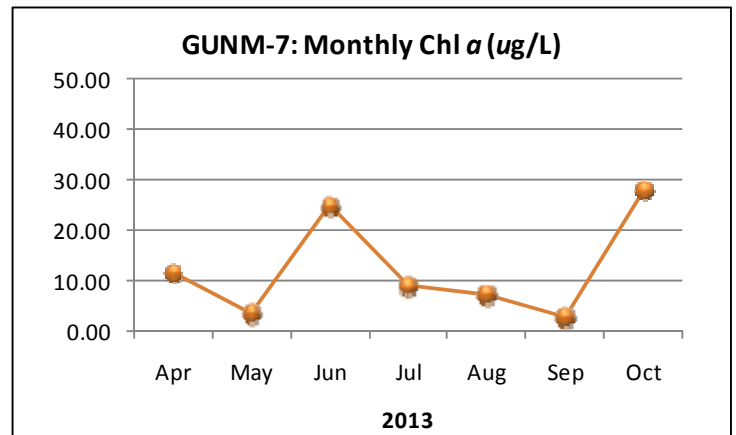
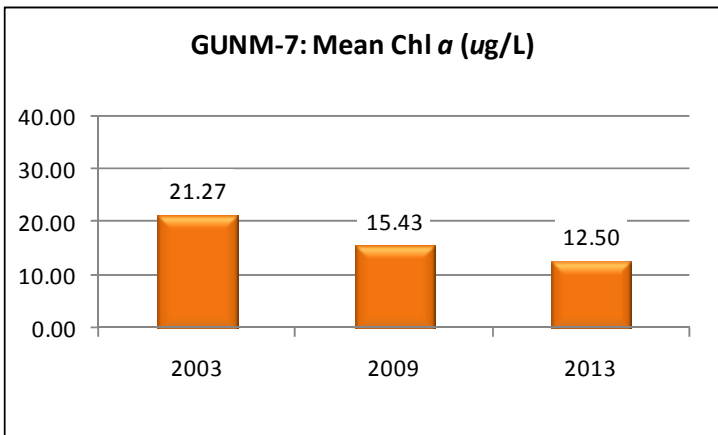
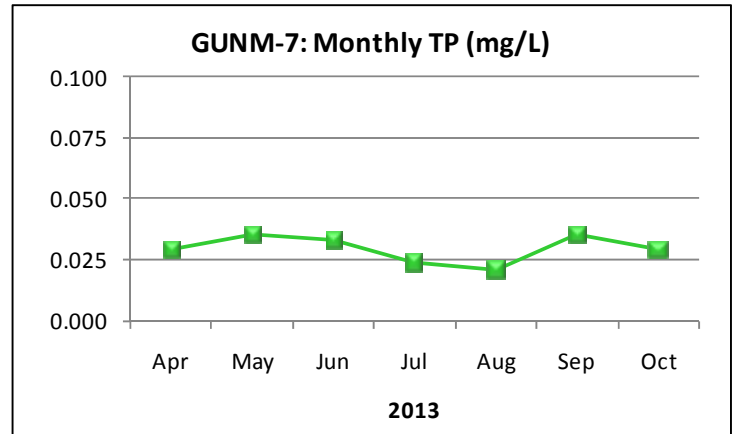
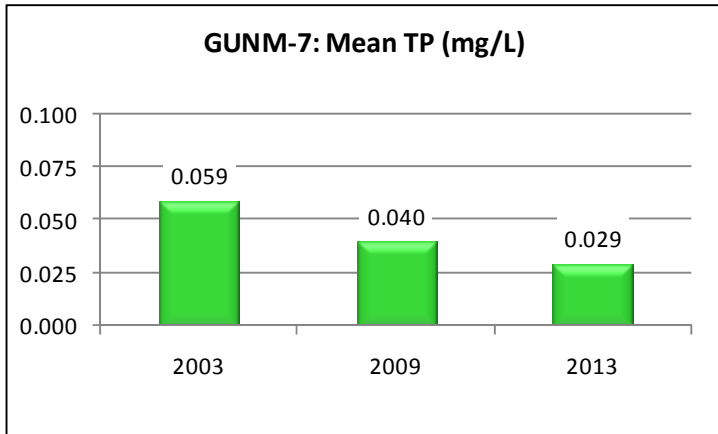
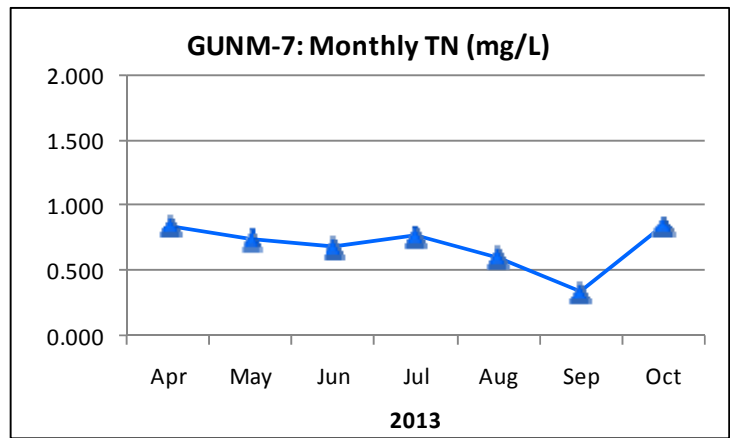
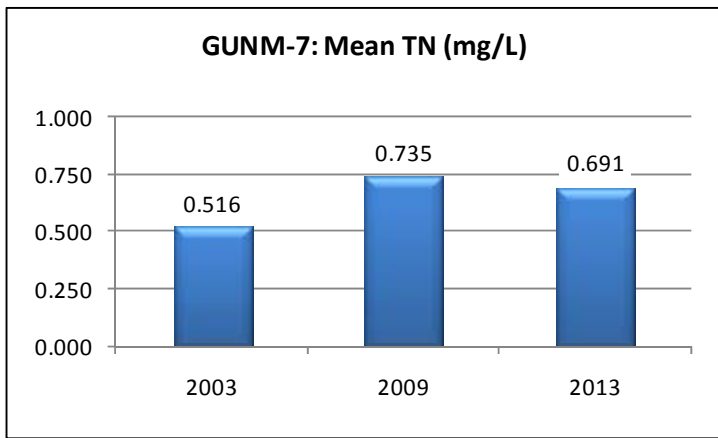


Figure 4. Mean growing season (2003-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Town Creek embayment of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

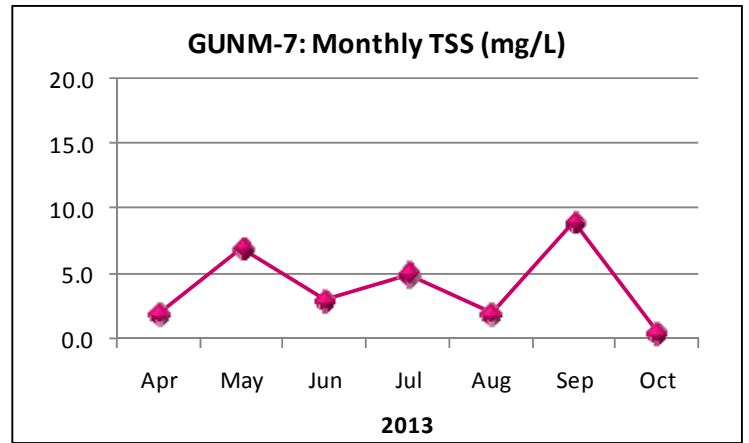
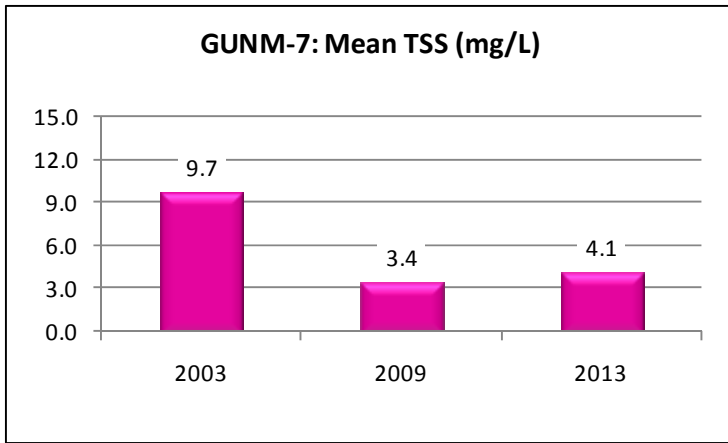


Figure 5. Mean growing season and monthly TSS measured in the Town Creek embayment of Guntersville Reservoir.

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.

GUNM-7	N	Min	Max	Med	Mean	SD
Physical						
Turbidity (NTU)	7	3.0	8.0	3.7	4.5	1.7
Total Dissolved Solids (mg/L)	7	36.0	90.0	72.0	71.4	18.4
Total Suspended Solids (mg/L)	7	< 1.0	9.0	3.0	4.1	3.1
Hardness (mg/L)	4	39.5	64.3	52.2	52.1	10.4
Alkalinity (mg/L)	7	35.9	62.2	52.4	50.3	8.8
Photic Zone (m)	7	2.73	4.68	3.28	3.48	0.66
Secchi (m)	7	1.01	1.64	1.24	1.30	0.21
Bottom Depth (m)	7	8.90	9.90	9.70	9.53	0.36
Chemical						
Ammonia Nitrogen (mg/L)	7	< 0.004	0.018	0.009	0.007	0.003
Nitrate+Nitrite Nitrogen (mg/L)	7	0.031	0.615	0.093	0.172	0.210
Total Kjeldahl Nitrogen (mg/L)	7	0.234	0.820	0.498	0.519	0.205
Total Nitrogen (mg/L)	7	0.338	0.851	0.746	0.691	0.179
Dissolved Reactive Phosphorus (mg/L) ^J	7	< 0.003	0.005	0.003	0.003	0.001
Total Phosphorus (mg/L)	7	0.021	0.035	0.029	0.029	0.005
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.4	6.0	4.8	4.7	0.9
Biological						
Chlorophyll a (ug/L)	7	2.67	28.23	9.08	12.50	10.14
E. coli (col/100mL) ^J	3	< 1	1	1	1	0

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
8/20/2003	9.33	CO-LIMITING
8/17/2009	2.58	NITROGEN
8/21/2013	5.6	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

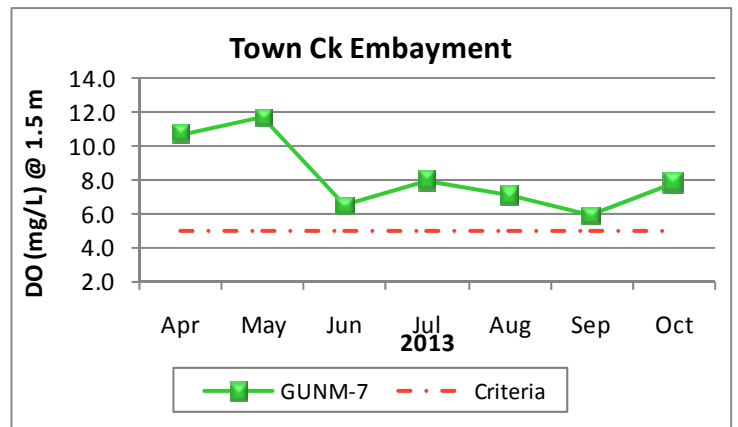


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Town Ck embayment station of Guntersville Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

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