

**Raccoon Creek Embayment  
Guntersville Reservoir  
Intensive Basin Survey 2013**

**GUNM-2:** Raccoon Creek approx. 2 miles upstream of lake confluence (Jackson Co 34.75049/-85.83659)

**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 Raccoon Creek tributary embayment of Guntersville Reservoir as part of the intensive basin assessment of the Tennessee River for the second time 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 Raccoon Ck embayment (GUNM-2) 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 2003 data and established criteria.

**WATERSHED CHARACTERISTICS**

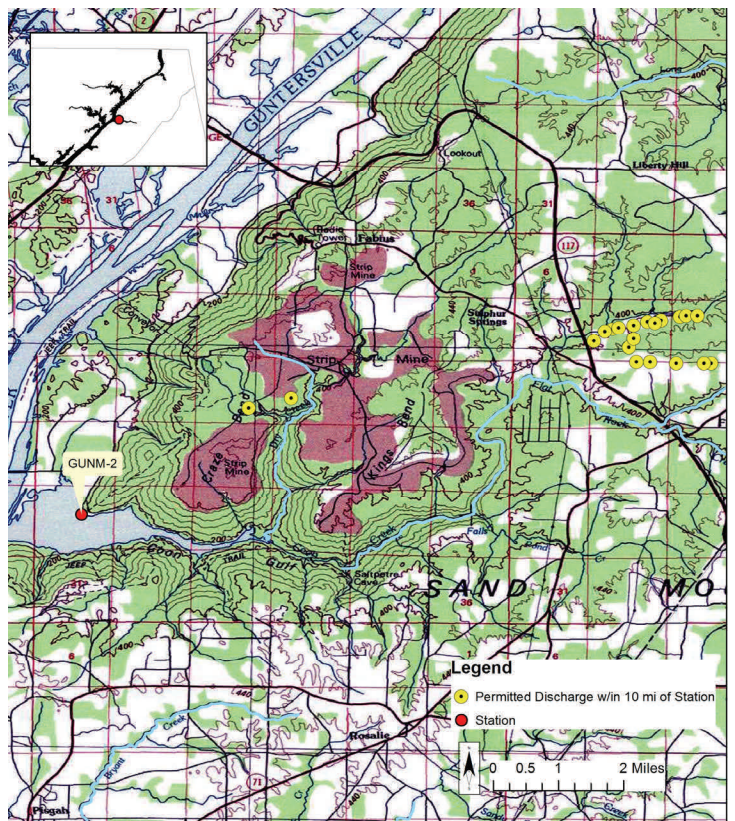
Watershed land uses are summarized in Table 1. Raccoon Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Sequatchie Valley ecoregion (68b). Based on the 2006 National Land Cover Dataset, land use within the 89 mi<sup>2</sup> watershed is predominantly forest (52%) and hay/pasture (22%) (Fig. 3). As of January 12, 2015, ADEM has issued a

**SITE DESCRIPTION**

The Raccoon Ck embayment is located just west of Flat Rock, AL and flows into Guntersville Reservoir near river mile 396. Raccoon Ck has a mean bottom depth of 3.01 m (Table 2) at the sampling location.



**Figure 1.** Photo of Raccoon Ck at GUNM-2.



**Figure 2.** Map of the Raccoon Ck embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles 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 discharge data, if available, and ADEM's previously collected data to help interpret the 2013 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

## RESULTS

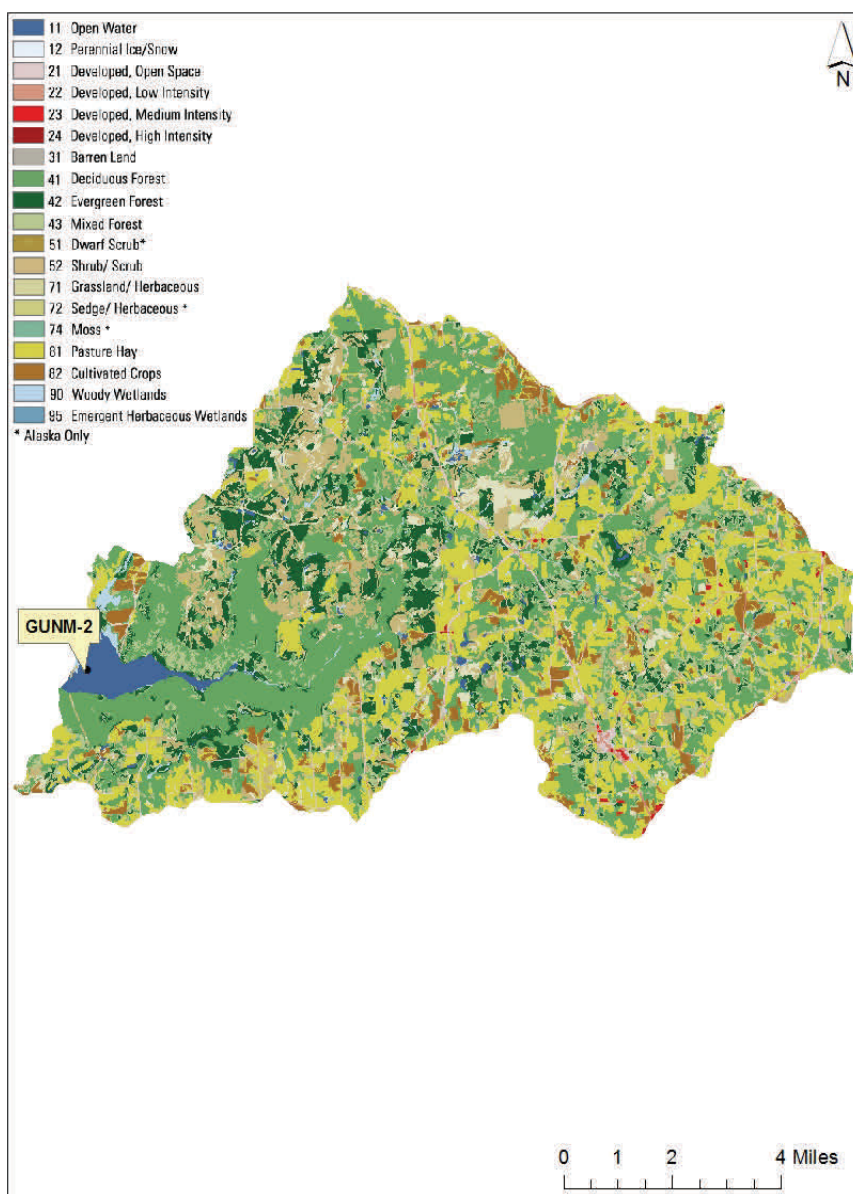
The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis ranges of the graphs in Figs. 4-6 were set to maximum values reservoir wide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

**Table 1: Summary of Watershed GUNM-2**

Basin	Tennessee R	
Drainage Area (mi <sup>2</sup> )	89	
Ecoregion <sup>a</sup>	68b	
% Landuse		
Open Water	2%	
Developed	Open Space	3%
	Low Intensity	<1%
	Medium Intensity	<1%
Barren Land	<1%	
Forest	Deciduous Forest	32%
	Evergreen Forest	10%
	Mixed Forest	10%
Shrub/Scrub	11%	
Herbaceous	4%	
Hay/Pasture	22%	
Cultivated Crops	4%	
Wetlands	Woody	<1%
	Emergent Herb.	<1%
# NPDES Permits <sup>b</sup>	TOTAL	56
Construction Stormwater	9	
Mining	45	
Municipal Individual	2	

a. Sequatchie Valley

b. # NPDES permits do wnlo aded from ADEM's NPDES Management System database, Jan 12, 2015.



**Figure 3.** Land use within the Crow Creek watershed at GUNM-2.

The mean growing season TN value was higher in 2013 than in 2003 (Fig. 4). Monthly TN concentration increased April-July and August-October.

The mean growing season TP concentration was lower in 2013 compared to 2003 (Fig. 4). Monthly TP concentrations were similar April-October.

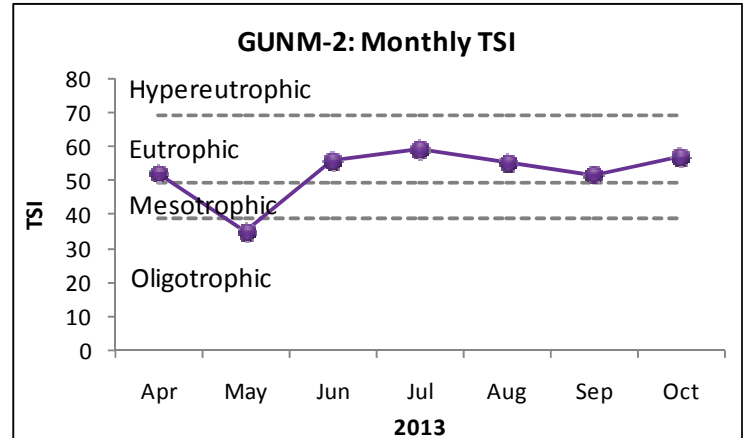
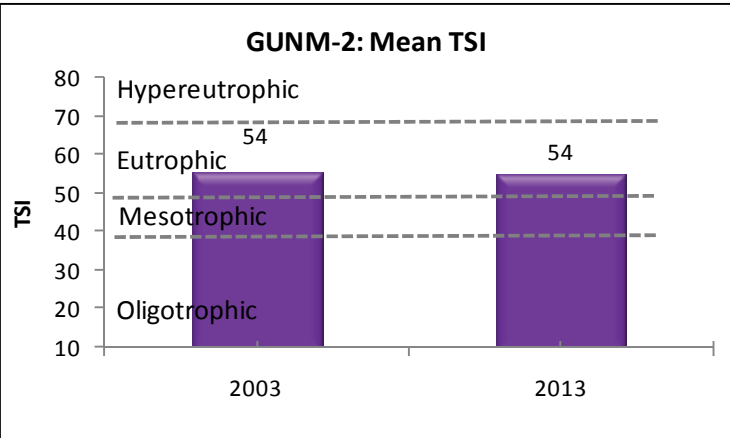
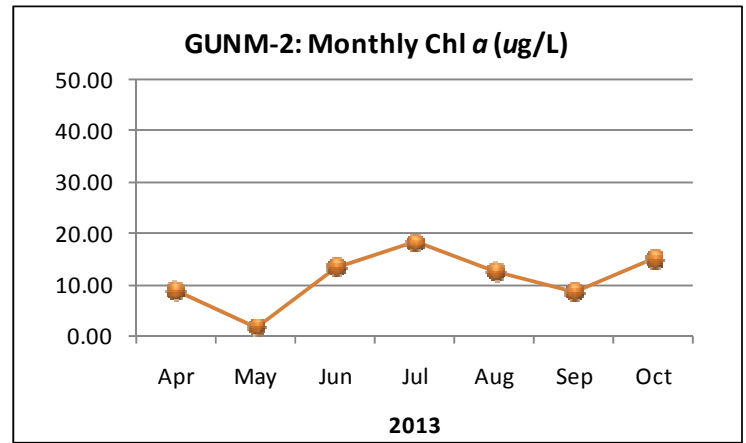
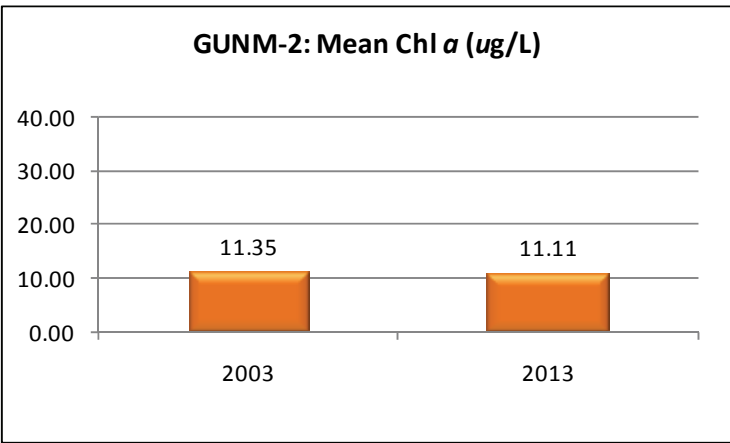
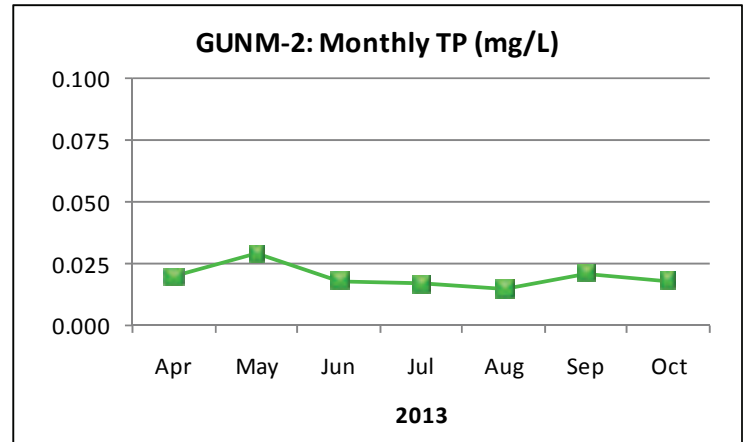
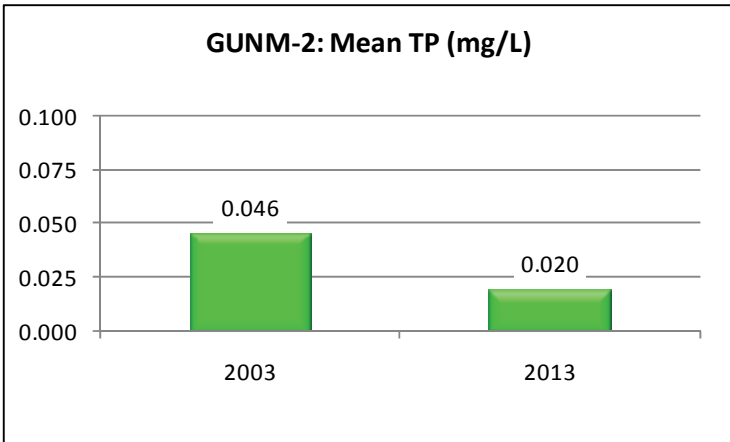
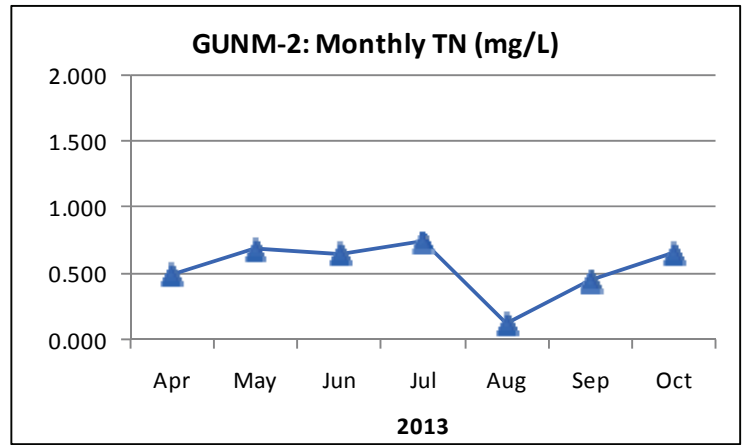
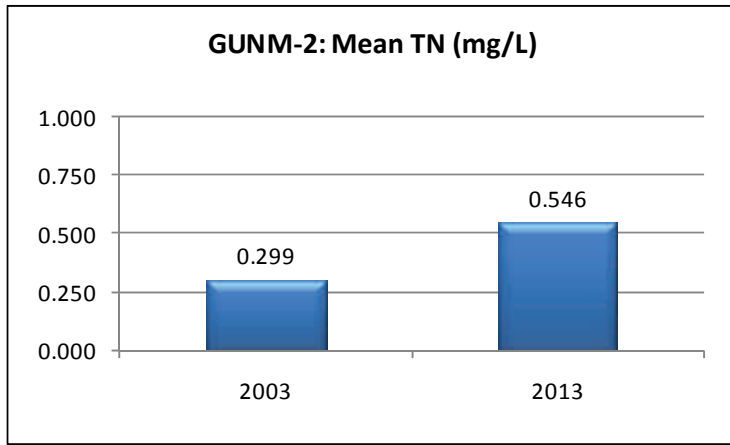
In 2013, the growing season mean chl *a* value was slightly lower than 2003 (Fig. 4). Monthly chl *a* concentrations were highest in July.

Mean TSI remained eutrophic in 2013. Monthly TSI in Raccoon Ck was eutrophic most months, but reached oligotrophic levels in August (Fig. 4).

The mean growing season TSS value was lower in 2013 than 2003 (Fig. 5). Monthly TSS concentrations were highest in April and September and lowest in October.

AGPT results show that Raccoon Ck was co-limiting in 2013 and phosphorus limited in 2003 (Table 3). The mean maximum standing crop (MSC) value was 3.15 mg/L, which is below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

DO concentrations were above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) April-October 2013 (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 Raccoon Creek embayment of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

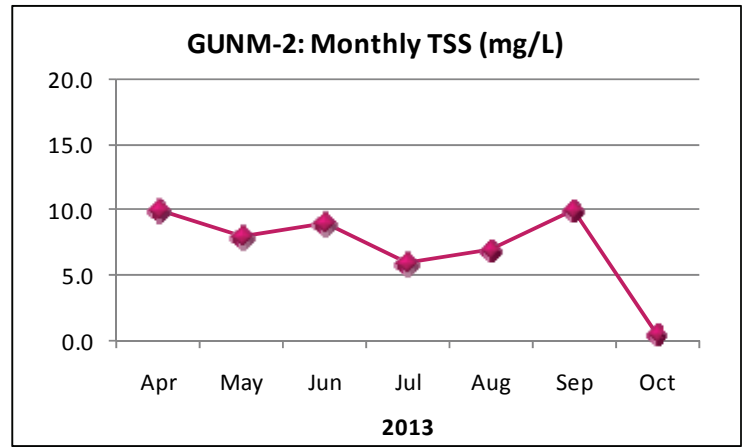
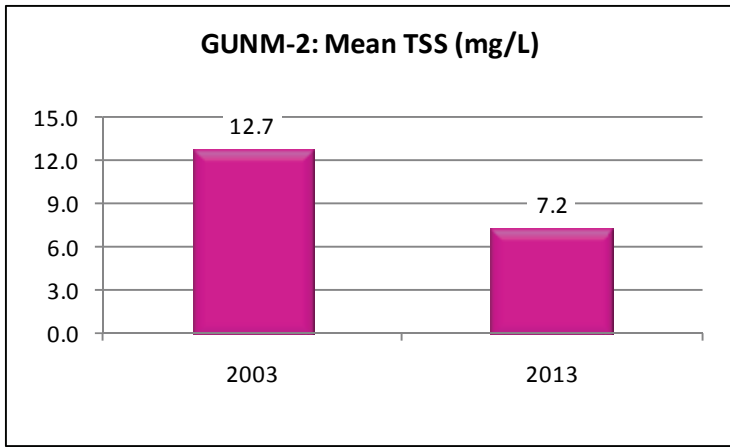


Figure 5. Mean growing season and monthly TSS measured in the Raccoon Creek embayment of Guntersville Reservoir.

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-2	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	6.1	10.4	7.9	8.1	1.3
Total Dissolved Solids (mg/L)	7	37.0	88.0	72.0	67.6	16.8
Total Suspended Solids (mg/L)	7	< 1.0	10.0	8.0	7.2	3.3
Hardness (mg/L)	4	35.9	65.8	52.5	51.7	12.4
Alkalinity (mg/L)	7	26.6	64.3	47.0	43.3	13.8
Photic Zone (m)	7	1.50	4.20	2.48	2.60	0.90
Secchi (m)	7	0.73	1.05	0.96	0.94	0.10
Bottom Depth (m)	7	1.90	4.20	3.20	3.01	1.02
<b>Chemical</b>						
Ammonia Nitrogen (mg/L)	7	< 0.004	0.018	0.009	0.007	0.003
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.002	0.318	0.008	0.090	0.132
Total Kjeldahl Nitrogen (mg/L) <sup>J</sup>	7	0.117	0.690	0.450	0.456	0.232
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.125	0.749	0.652	0.546	0.214
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	< 0.003	0.004	0.003	0.003	0.001
Total Phosphorus (mg/L)	7	0.015	0.029	0.018	0.020	0.004
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	2.2	5.7	3.4	3.5	1.3
<b>Biological</b>						
Chlorophyll a (ug/L)	7	1.60	18.16	12.46	11.11	5.39
E. coli (col/100mL) <sup>J</sup>	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
2003	2.89	PHOSPHORUS
2013	3.15	CO-LIMITING

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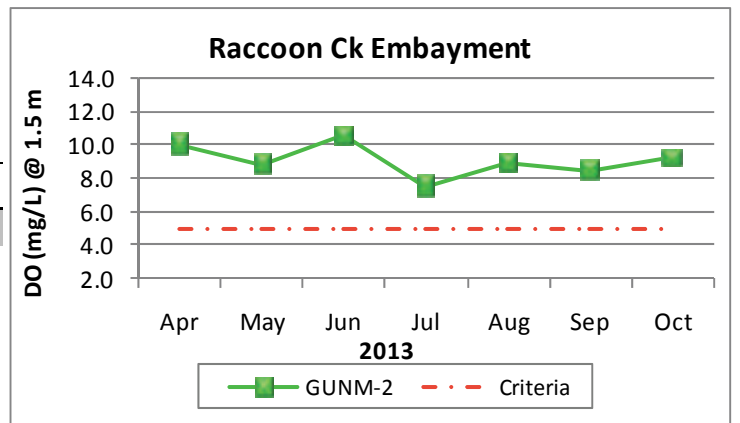


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for the Raccoon Ck embayment station of Guntersville Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

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