

North Sauty Creek Embayment Guntersville Reservoir Intensive Basin Survey 2009

GUNM-5: North Sauty Creek immediately upstream of AL Hwy 79 bridge (Jackson Co 34.59347/-86.09138)

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 2009, ADEM monitored the North Sauty 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 North Sauty Ck embayment (GUNM-5) during the 2009 growing season (Apr-Oct). This is the second 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 [chl *a*; algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson's trophic state index (TSI)] from 2009 were compared to ADEM's 2003 data and established criteria.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. North Sauty 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 71 mi² watershed is predominantly forest (54%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 10 NPDES permits within the watershed. Eight of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The North Sauty Ck embayment at GUNM-5 is located just west of Scottsboro, AL. It is a fairly large embayment joined by Blue Spring and Archie Creeks before flowing into the Tennessee River near river mile 377. North Sauty Ck has a median bottom depth of 5.2 m (Table 2) at the sampling location and is dominated by grasses much of the year except for the main channel.



Figure 1. Photo of North Sauty Ck at GUNM-5

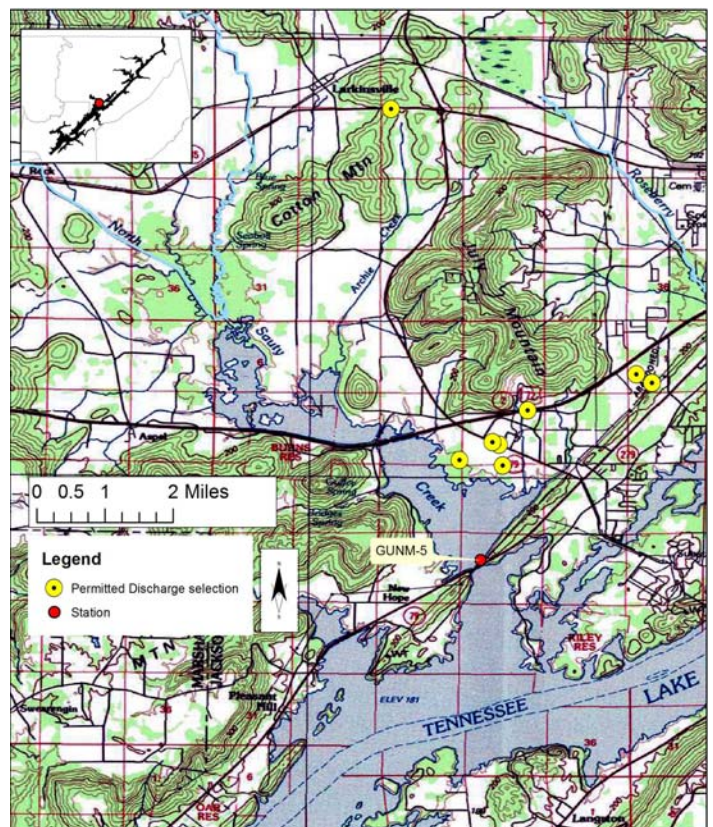


Figure 2. Map of North Sauty Ck Embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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 2009), Surface Water Quality Assurance Project Plan (ADEM 2008a), and Quality Management Plan (ADEM 2008b).

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 2009 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 of the graphs in Fig. 4 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

Table 1: Summary of Watershed GUNM-5

Basin		Tennessee R
Drainage Area (mi ²)		71
Ecoregion ^a		68b
% Landuse		
Open Water		6%
Developed	Open Space	3%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	44%
	Evergreen Forest	4%
	Mixed Forest	6%
Shrub/Scrub		3%
Herbaceous		2%
Hay/Pasture		19%
Cultivated Crops		7%
Wetlands	Woody	4%
	Emergent Herb.	<1%
# NPDES Permits ^b		TOTAL
Construction Stormwater		2
Mining		1
Industrial General		6
Industrial Individual		1

a. Sequatchie Valley

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

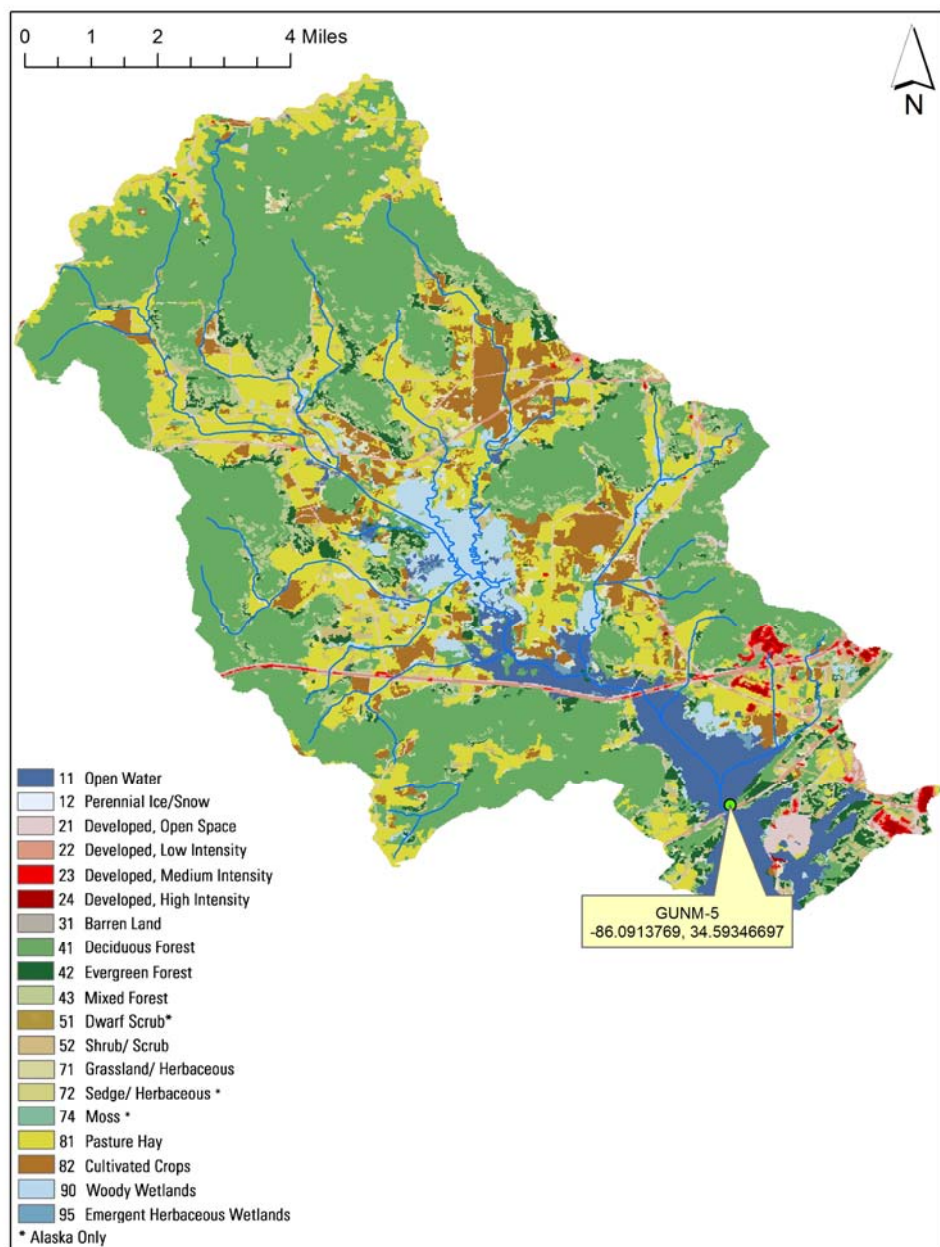


Figure 3. Landuse within the North Sauty Creek watershed at GUNM-5.

The mean growing season TN value was higher in 2009 than in 2003 (Fig. 4). Monthly TN concentrations were generally low and peaked in October.

Contrary to mean TN concentration, the mean growing season TP concentration was slightly lower in 2009 (Fig. 4). The highest monthly TP concentrations were measured in May and July.

In 2009, the growing season mean chl *a* value was lower than 2003 (Fig. 4). Monthly chl *a* concentrations peaked in August.

Mean TSI remained eutrophic in 2009 (Fig. 4). Monthly TSI in North Sauty Ck was lower to mid eutrophic April-October.

The mean growing season TSS value was lower in 2009 than 2003 (Fig. 5). Monthly TSS concentrations were highest in September and lowest in June and October.

AGPT results show that GUNM-5 was nitrogen limited in both 2003 and 2009 (Table 3). The mean maximum standing crop (MSC) value was 2.14 mg/L, which is below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems. The previous MSC value for North Sauty Ck was also below 5 mg/L.

The DO concentration in the GUNM-5 station was above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

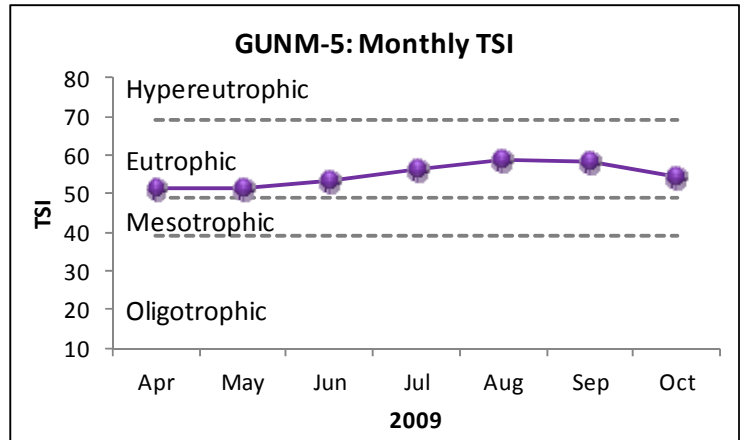
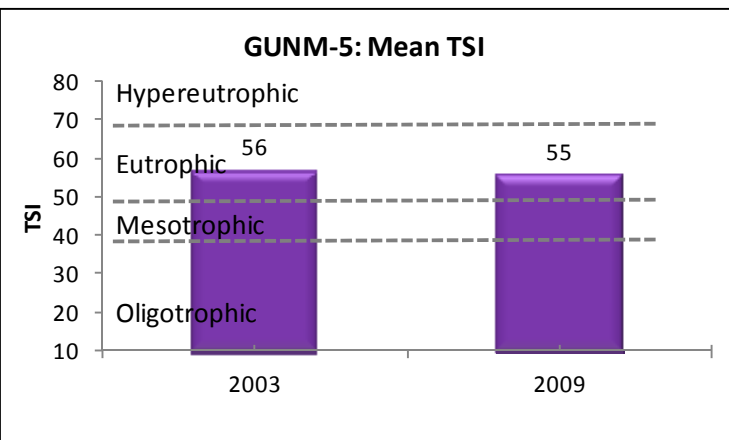
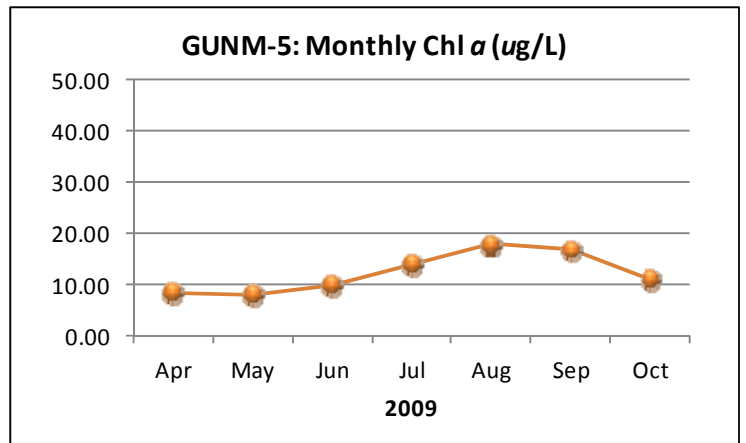
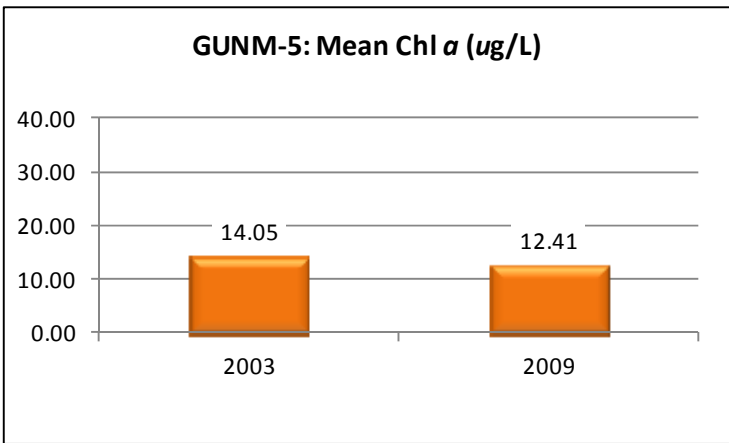
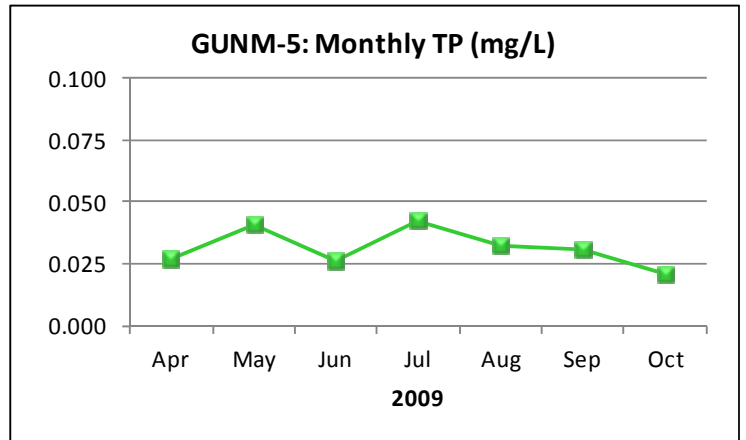
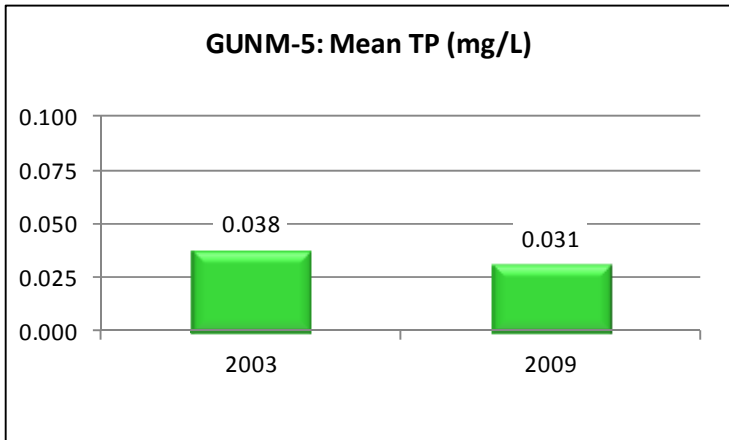
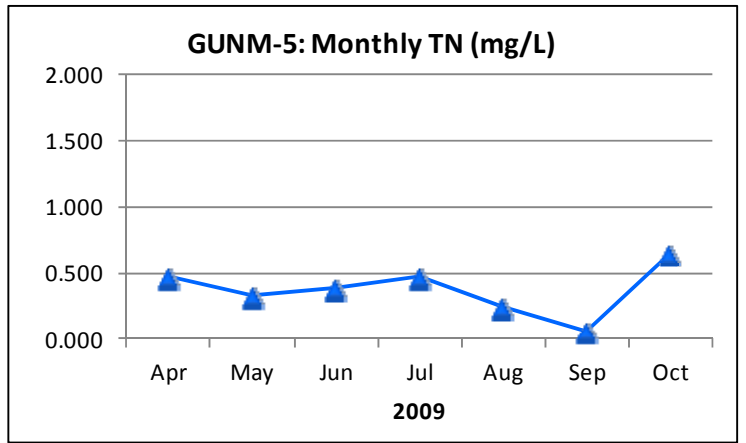
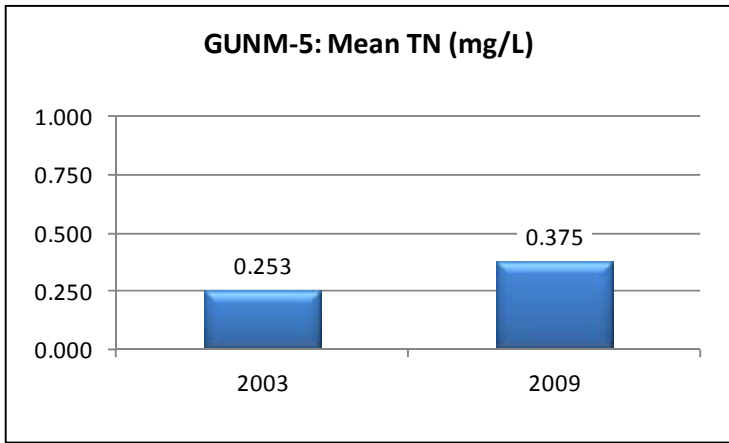


Figure 4. Mean growing season (2003-2009) and monthly (April-October, 2009) TN, TP, chl a and TSI measured in the North Sauty Creek embayment of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

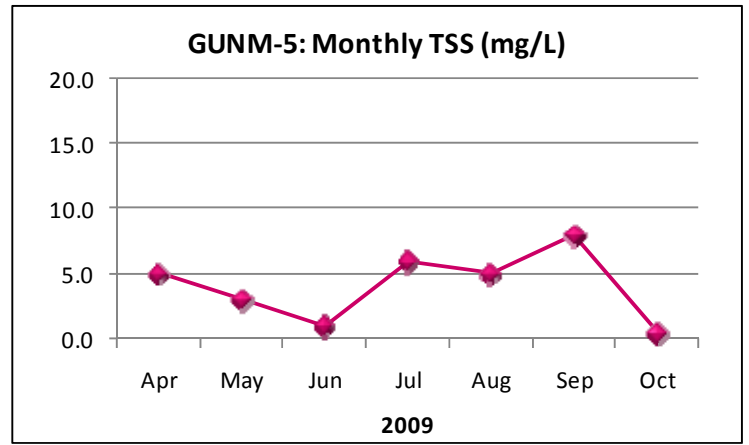
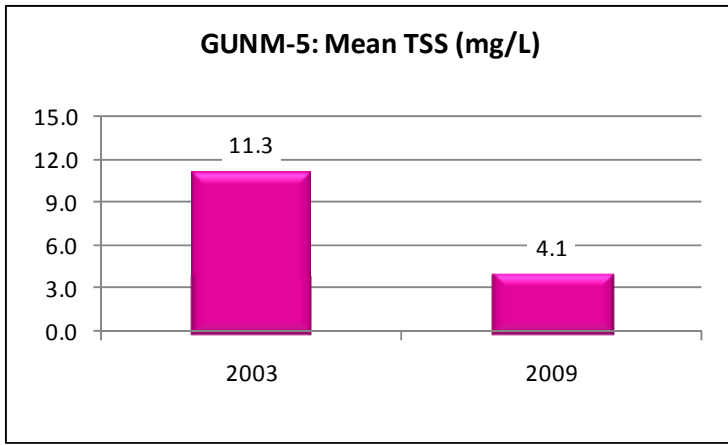


Figure 5. Mean growing season and monthly TSS measured in the North Sauty Creek embayment of Guntersville Reservoir.

Table 2. Summary of water quality data collected April-October, 2009. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), average (Avg), and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

GUNM-5	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	7	4.6	8.8	7.0	7.2	1.4
Total Dissolved Solids (mg/L) ^J	7	70.0	164.0	100.0	102.3	31.2
Total Suspended Solids (mg/L)	7	< 1.0	8.0	5.0	4.1	2.7
Hardness (mg/L)	3	68.2	82.4	74.6	75.1	7.1
Alkalinity (mg/L)	7	62.6	91.4	76.0	75.7	8.9
Photic Zone (m)	7	2.26	4.30	3.41	3.34	0.72
Secchi (m)	7	0.95	1.51	1.17	1.18	0.19
Bottom Depth (m)	8	4.00	5.70	5.15	5.11	0.38
Chemical						
Ammonia Nitrogen (mg/L)	7	< 0.006	0.014	0.007	0.005	0.002
Nitrate+Nitrite Nitrogen (mg/L) ^J	7	< 0.002	0.132	0.017	0.039	0.048
Total Kjeldahl Nitrogen (mg/L)	7	< 0.089	0.611	0.373	0.335	0.188
Total Nitrogen (mg/L) ^J	7	< 0.062	0.650	0.385	0.375	0.188
Dissolved Reactive Phosphorus (mg/L) ^J	7	0.006	0.010	0.006	0.007	0.002
Total Phosphorus (mg/L)	7	0.021	0.042	0.031	0.031	0.008
CBOD-5 (mg/L)	7	< 2.0	2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	3.2	7.8	5.6	5.2	1.6
Biological						
Chlorophyll a (ug/L)	7	8.19	18.16	11.04	12.41	4.04
Fecal Coliform (col/100 mL) ^J	3	< 1	6	1	3	3

^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	2.14	NITROGEN
8/17/2009	2.41	NITROGEN

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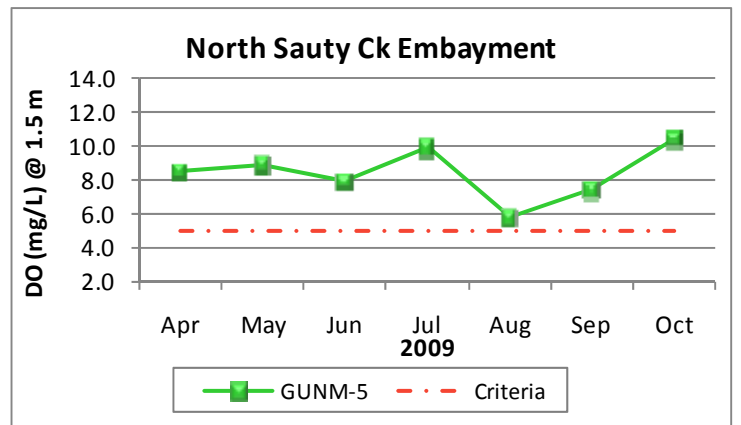


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for North Sauty Ck embayment station of Guntersville Reservoir collected April-October 2009. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

- ADEM. 2008a. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
- ADEM. 2008b. Quality Management Plan (QMP) for the Alabama Department of Environmental, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2009. 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.