

Town Creek Embayment Guntersville Reservoir Intensive Basin Survey 2015 & 2018

Tennessee River Basin

GUNM-7: Town Creek approximately 0.5 mi downstream of AL 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, to 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 2017 Monitoring Strategy (ADEM 2017).

In 2015 and 2018, ADEM monitored the Town Creek tributary embayment of Guntersville Reservoir as part of the intensive basin assessment of the Tennessee River under the RRMP (Figure 1). This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Town Creek embayment (GUNM-7) during the 2015 and 2018 growing seasons (Apr-Oct). This is the fourth and fifth 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)] were compared to ADEM’s historical data and established criteria.

A consumption advisory was issued by the Alabama Department of Public Health in 2016 for mercury in fish collected from the Town Creek embayment. As a result, the entire Town Creek embayment was listed on Alabama’s 2016 Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its water use classification.

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 2016 National Land Cover Dataset, land use within the 215 mi² watershed is predominantly agriculture [(Pasture/Hay 41%) (Crops 9%)] and forest (36%) (Figure 3). As of January 28, 2016, ADEM has issued a total of 36 NPDES permits within the watershed. No permits are located within 10 mi of the station (Figure 2).



Figure 1. Town Creek at GUNM-6.

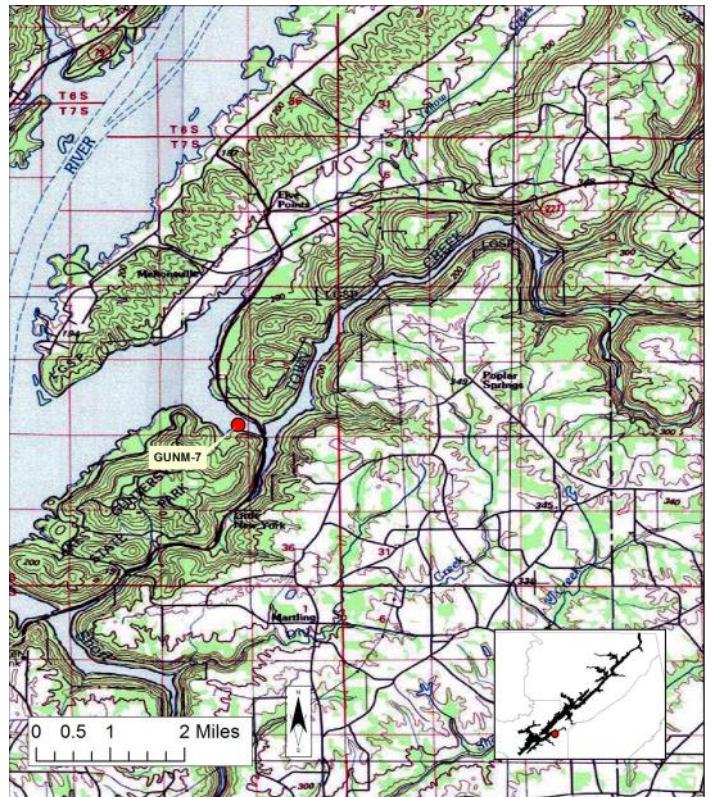


Figure 2. Map of the Town Creek embayment of Guntersville Reservoir. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

Basin	Tennessee R	
Drainage Area (mi ²)	215	
Ecoregion ^a	68c	
Assessment Unit	AL06030001-0705-111	
% 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 outfalls ^b	TOTAL	36
Construction Stormwater	14	
Mining	11	
Industrial General	11	

a. Plateau Escarpment

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.

SITE DESCRIPTION

The Town Creek embayment at GUNM-7 is located just west of Gunterville, AL. It is a fairly large embayment, flowing into the Tennessee River near Gunterville State Park. North Sauty Creek has a mean bottom depth of 9.4 meters at the sampling location (Table 2).

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 2018a), Surface Water Quality Assurance Project Plan (ADEM 2018b), and Quality Management Plan (ADEM 2018c).

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 results. Carlson's TSI was calculated from the corrected chl *a* concentrations (Carlson 1977).

RESULTS

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

The mean growing season TN value increased from 2013 to 2015, but decreased in 2018 (Figure 4). Monthly TN concentrations were highest in April in both 2015 and 2018.

The mean growing season TP concentration appeared to decrease over time between 2003-2018 (Figure 4). The highest monthly TP concentration was measured in April during 2015 and 2018.

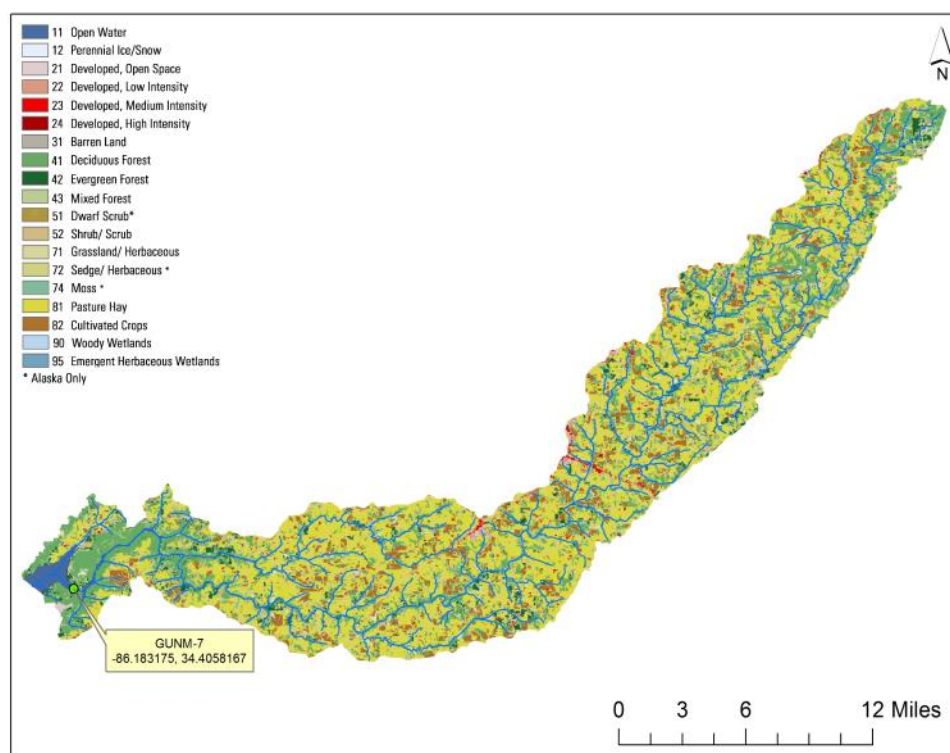


Figure 3. Land use within the Town Creek watershed at

Table 2. Summary of water quality data collected April-October, 2015 and 2018. 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 2015	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	7	2.9	18.1	4.4	6.1	5.4
Total Dissolved Solids (mg/L)	7	77.0	126.0	111.0	107.1	15.1
Total Suspended Solids (mg/L)	7	3.0	8.0	5.0	5.4	1.7
Hardness (mg/L)	4	12.9	83.5	81.5	64.8	34.7
Alkalinity (mg/L)	7	14.7	62.1	55.3	50.4	16.6
Photic Zone (m)	7	1.87	5.00	4.28	4.02	1.13
Secchi (m)	7	0.71	2.52	1.75	1.74	0.63
Bottom Depth (m)	7	7.7	10.5	9.5	9.2	1.1
Chemical						
Ammonia Nitrogen (mg/L) ^J	7	<	0.007	0.091	0.011	0.021
Nitrate+Nitrite Nitrogen (mg/L) ^J	7	<	0.002	0.956	0.009	0.153
Total Kjeldahl Nitrogen (mg/L)	7		0.274	1.270	0.618	0.667
Total Nitrogen (mg/L) ^J	7	<	0.283	1.531	0.694	0.820
Dis Reactive Phosphorus (mg/L) ^J	7	<	0.005	0.012	0.004	0.006
Total Phosphorus (mg/L)	7		0.020	0.045	0.023	0.026
CBOD-5 (mg/L) ^J	7	<	2.0	2.0	1.0	1.0
Chlorides (mg/L)	7		3.4	7.8	6.2	6.3
Biological						
Chlorophyll a (mg/m ³)	7	<	1.00	16.60	9.08	6.93
E. coli (MPN/DL) ^J	3	<	1	3	1	2
GUNM-7 2018						
Physical						
Turbidity (NTU)	7	3.2	13.2	4.7	5.4	3.5
Total Dissolved Solids (mg/L)	7	<	1.0	95.0	84.0	71.4
Total Suspended Solids (mg/L)	7		3.0	14.0	6.0	6.7
Hardness (mg/L)	4		56.8	61.9	60.4	59.9
Alkalinity (mg/L)	7		35.0	63.4	56.7	54.7
Photic Zone (m)	7		2.32	4.19	3.75	3.53
Secchi (m)	7		0.84	1.87	1.56	1.44
Bottom Depth (m)	7		9.0	10.1	9.6	9.6
Chemical						
Ammonia Nitrogen (mg/L) ^J	7	<	0.015	0.054	0.008	0.020
Nitrate+Nitrite Nitrogen (mg/L) ^J	7	<	0.007	0.852	0.004	0.151
Total Kjeldahl Nitrogen (mg/L)	7		0.304	0.633	0.539	0.518
Total Nitrogen (mg/L) ^J	7	<	0.383	1.485	0.610	0.670
Dis Reactive Phosphorus (mg/L) ^J	7	<	0.004	0.008	0.002	0.003
Total Phosphorus (mg/L) ^J	7		0.007	0.061	0.014	0.021
CBOD-5 (mg/L)	7	<	2.0	2.0	1.0	1.0
Chlorides (mg/L)	7		3.9	6.2	4.9	5.0
Biological						
Chlorophyll a (mg/m ³)	7		9.61	29.90	21.90	20.40
E. coli (MPN/DL) ^J	4	<	1	2	1	1

J= one or more of the values is an estimate; N= # samples.

RESULTS (con't)

The mean growing season chl *a* value declined from 2003 to 2015, but increased in 2018 (Figure 4). In 2015, the highest monthly chl *a* concentration was measured in August. The highest monthly chl *a* measurement of 2018 was collected in September.

While TSI conditions have remained eutrophic all years sampled, the mean TSI value decreased 2003-2015, reaching near mesotrophic conditions in 2015. Mean TSI increased from 2015 to 2018 (Figure 4). In 2015, monthly TSI in Town Creek was oligotrophic from August to June, increasing to eutrophic conditions the remainder of the growing season. Eutrophic conditions were measured each month during 2018.

The mean growing season TSS value appears to have steadily increased since 2009 (Figure 5). Monthly TSS concentrations were highest in April during both 2015 and 2018.

AGPT results show that Town Creek was co-limiting in 2003, nitrogen-limiting in 2009, and phosphorus-limiting in 2013 (Table 3). Raschke and Schultz (1987) found that maximum standing crop (MSC) values below 5.0 mg/L are considered to be protective of reservoir and lake systems. The most recent mean MSC measured in 2013 was 5.6 mg/L. No AGPT samples were collected during the 2015 or 2018 sampling seasons.

DO concentrations at the Town Creek sampling location were above the ADEM criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) for all samples collected during the 2015 and 2018 growing seasons (ADEM Admin. Code R. 335-6-10-09) (Figure 6).

Table 3. Algal growth potential test results (expressed as mean maximum standing crop (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

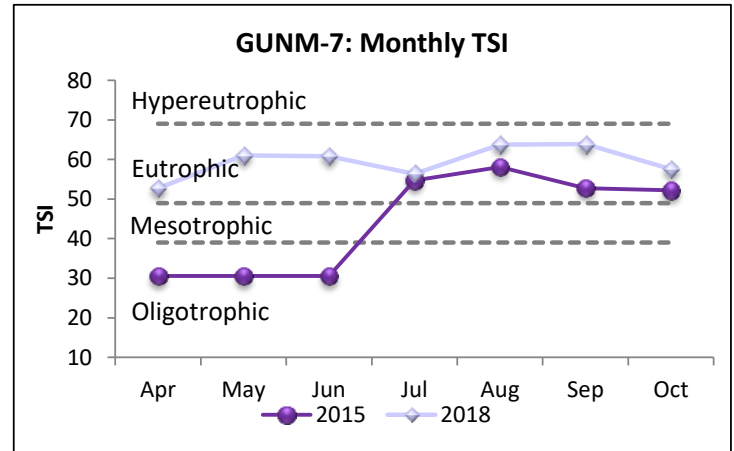
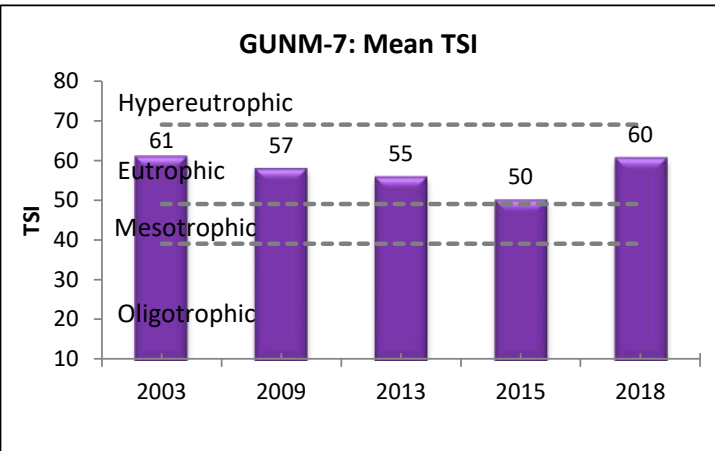
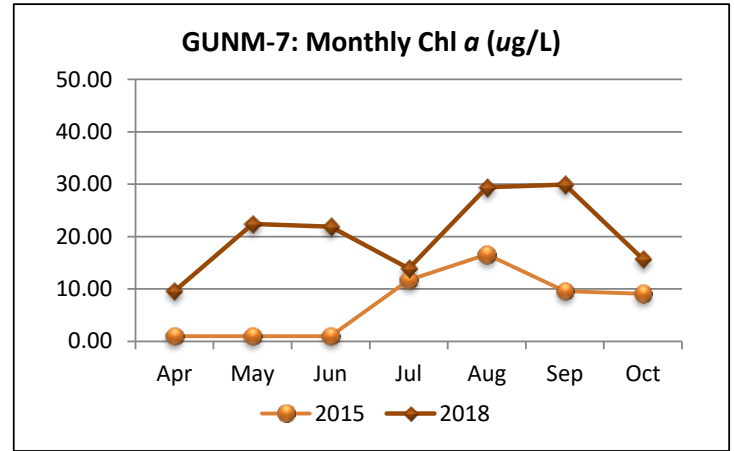
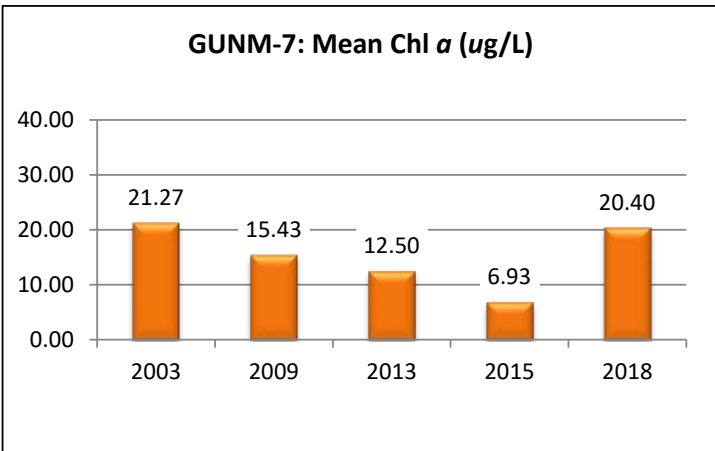
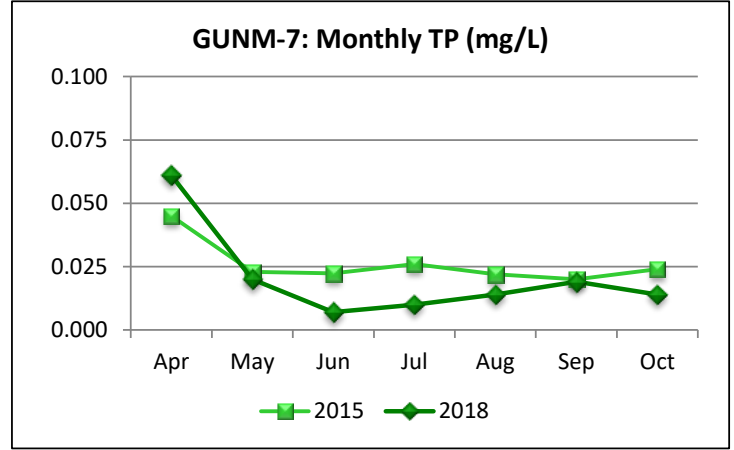
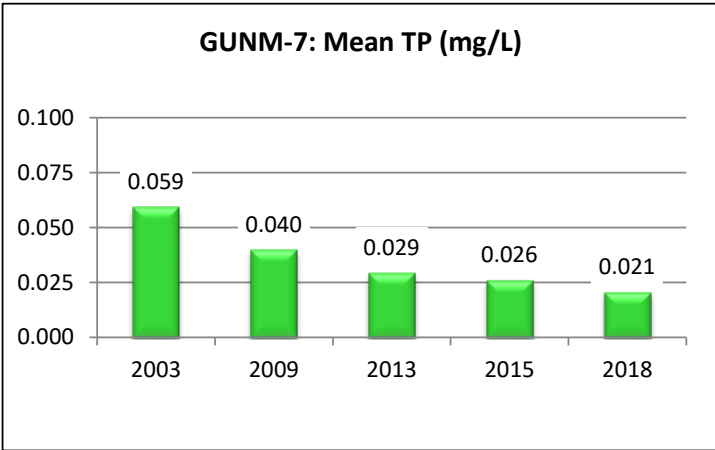
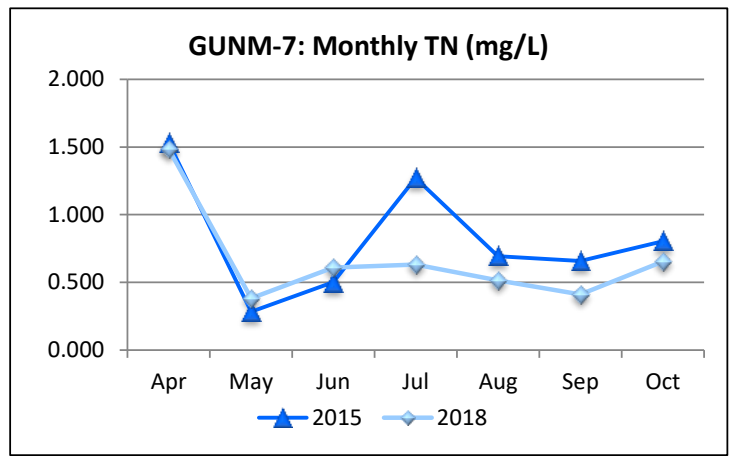
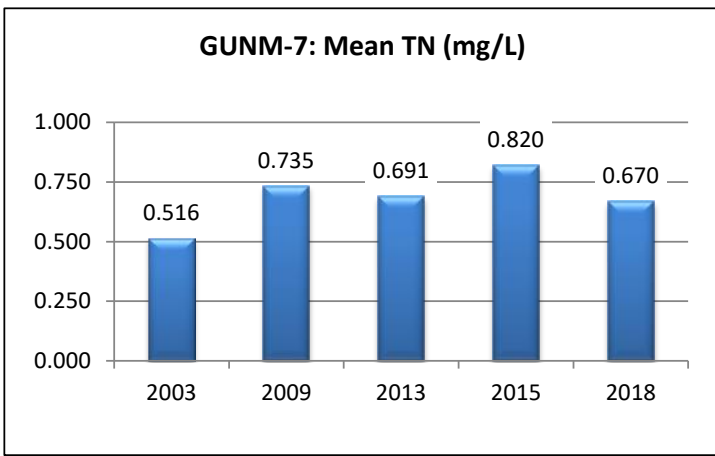


Figure 4. Mean growing season (2003-2018) and monthly (April-October, 2015 and 2018) TN, TP, chl a and TSI measured in the Town Creek embayment (GUNM-7) of Guntersville Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

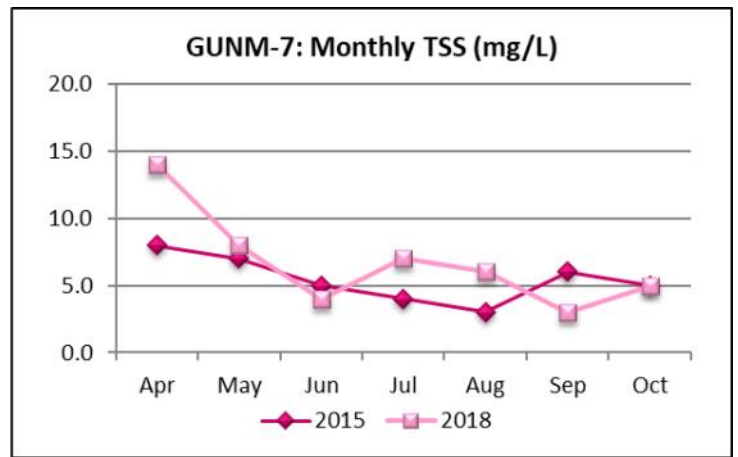
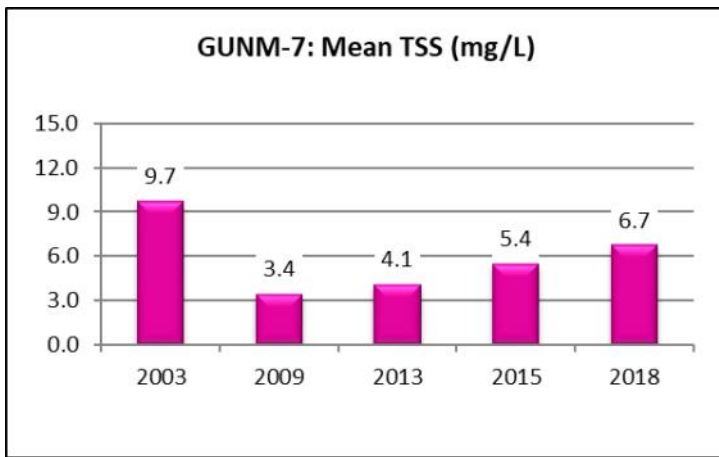


Figure 5. Mean growing season and monthly TSS measured in the Town Creek embayment (GUNM-7) of Guntersville Reservoir.

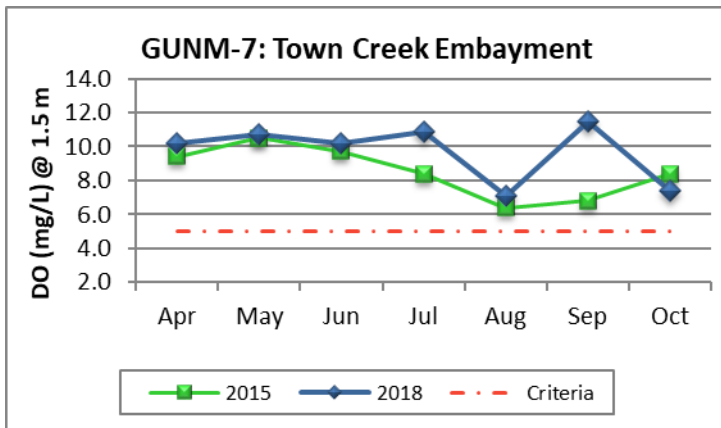


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Town Creek embayment station (GUNM-7) of Guntersville Reservoir collected April-October 2015 and 2018. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

REFERENCES

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