

Bakers Creek Embayment Wheeler Reservoir Intensive Basin Survey 2013

Tennessee River Basin

WHEL-11: Bakers Creek upstream of confluence with TN River (Morgan Co 34.63767/-87.02961)

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 Bakers Creek tributary embayment of Wheeler 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 Bakers Creek embayment (WHEL-11) during the 2013 growing season (Apr-Oct). This is the third intensive basin assessment of the Tennessee River and the second assessment of the Bakers Creek embayment 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 2009 data and established criteria.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Bakers Creek is classified as a *Fish & Wildlife (F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 15 mi² watershed is predominantly developed (37%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of 40 NPDES permits within the watershed. Twenty-nine of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Bakers Ck embayment at WHEL-11 is a small embayment, which flows into the south bank of the Tennessee River just downstream of Decatur, AL. Bakers Ck has a mean bottom depth of 1.92 m (Table 2) at the sampling location.



Figure 1. Photo of Bakers Ck at WHEL-11.

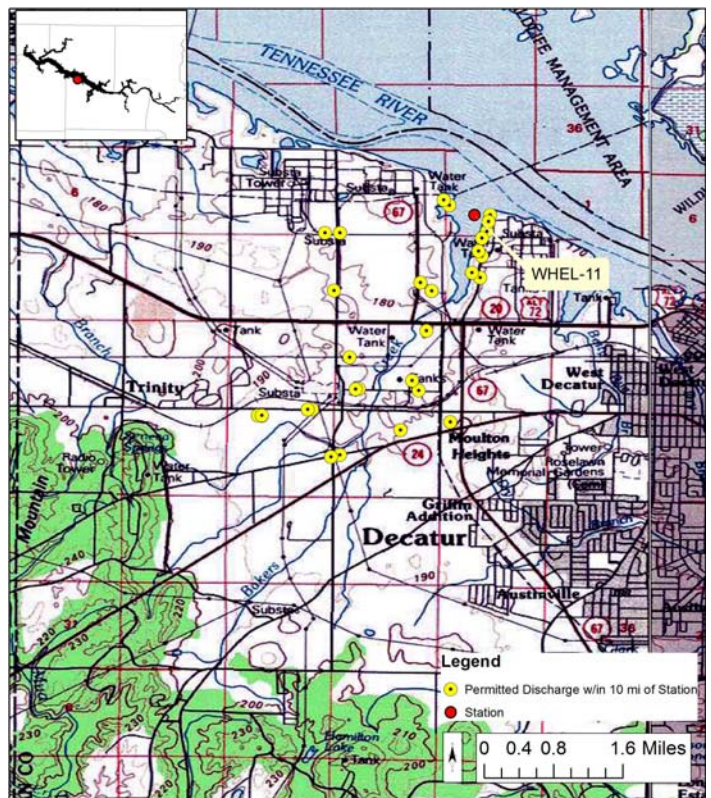


Figure 2. Map of Bakers Ck embayment of Wheeler Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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-11**

Basin		Tennessee R
Drainage Area (mi ²)		15
Ecoregion ^a		71g
% Land use		
Open Water		3%
Developed	Open Space	16%
	Low Intensity	11%
	Medium Intensity	7%
High Intensity		3%
Barren Land		<1%
Forest	Deciduous Forest	9%
	Evergreen Forest	3%
	Mixed Forest	2%
Shrub/Scrub		6%
Herbaceous		2%
Hay/Pasture		23%
Cultivated Crops		10%
Wetlands	Woody	5%
# NPDES Permits ^b		TOTAL
401 Water Quality Certification		1
Construction Stormwater		15
Industrial General		19
Industrial Individual		5

a. Eastern Highland Rim

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

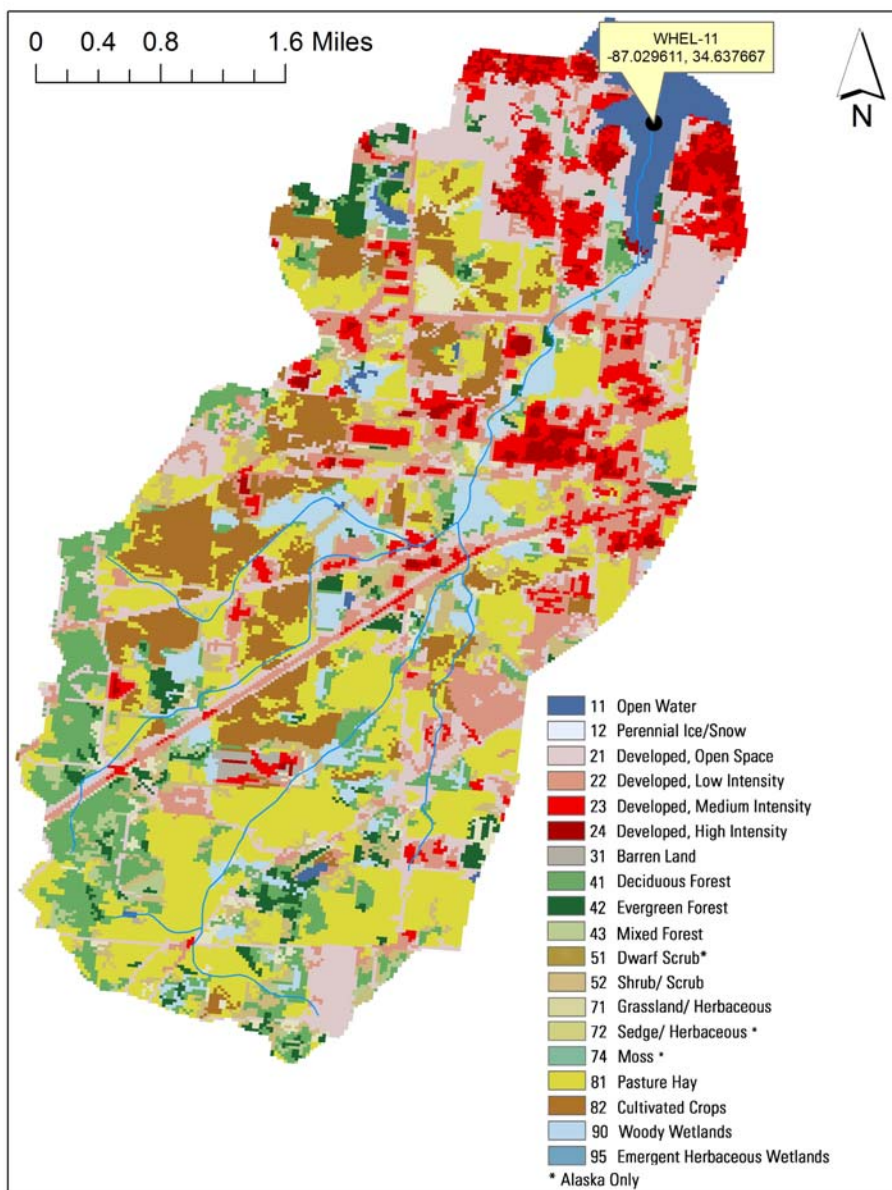


Figure 3. Landuse within the Bakers Creek watershed at WHEL-11.

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

The mean growing season TP value in 2013 was lower than in 2009 (Fig. 4). The highest monthly TN concentrations were measured in May and August.

In 2013, the growing season mean chl *a* value was higher than 2009 (Fig. 4). The highest monthly chl *a* concentration was measured in June while the lowest was measured in October.

Mean TSI values indicate the embayment was eutrophic in 2013 and 2009. Monthly TSI values in Bakers Ck indicate eutrophic conditions April-August (Fig. 4) with near hypereutrophic conditions in June.

The mean growing season TSS value was higher in 2013 than 2009 (Fig. 5). Monthly TSS concentrations peaked in August and were similar most other months sampled.

AGPT results show that WHEL-11 was nitrogen limited in 2013 and non-limited in 2009 (Table 3). Mean maximum standing crop (MSC) values from 2013 and 2009 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-11 station remained 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).

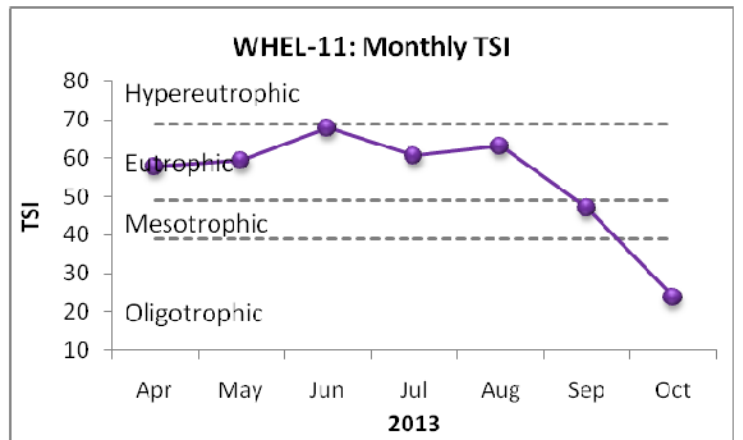
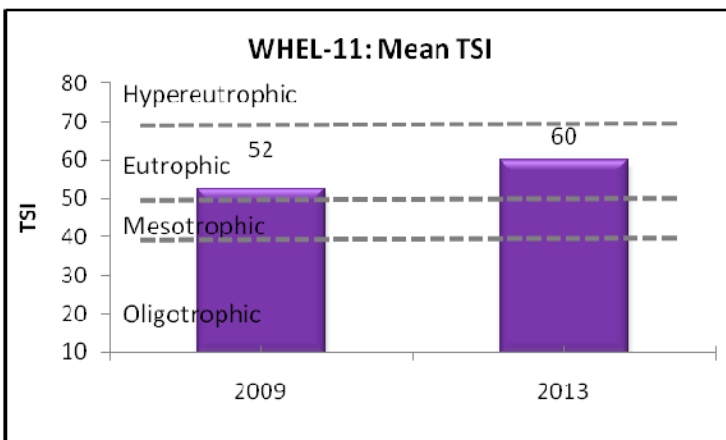
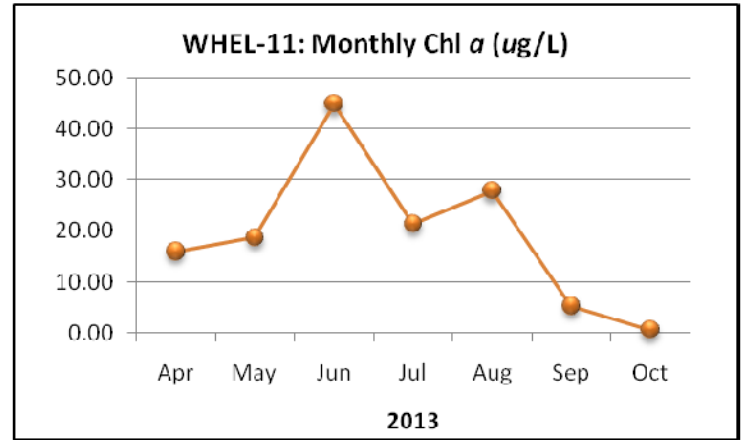
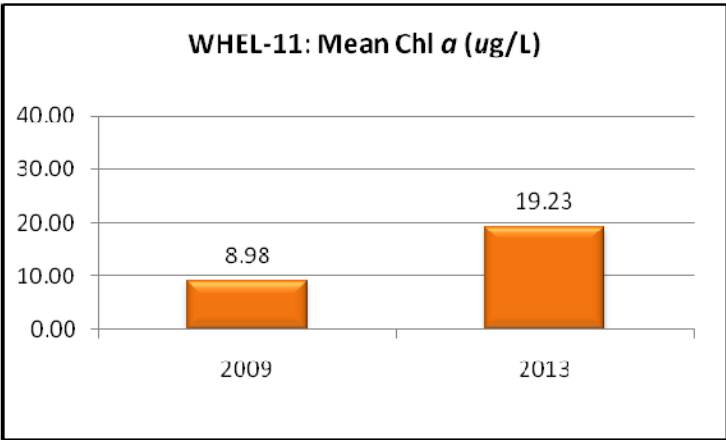
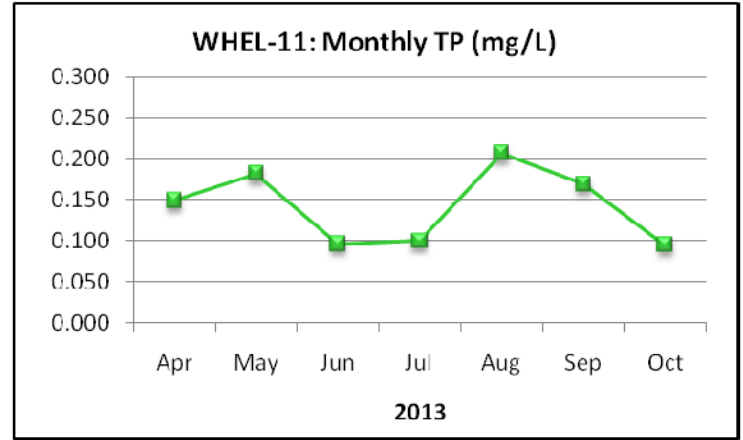
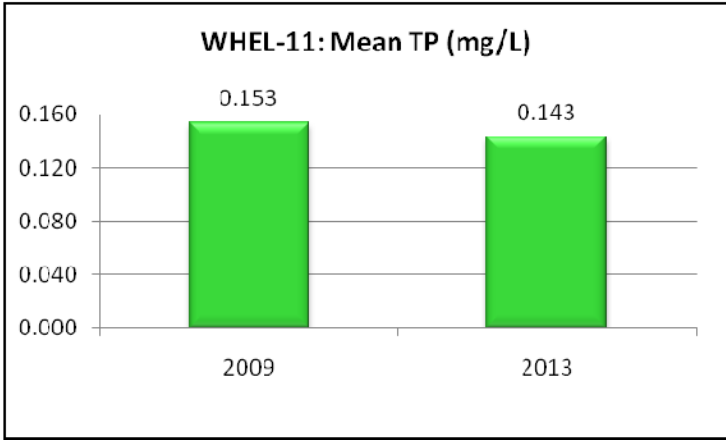
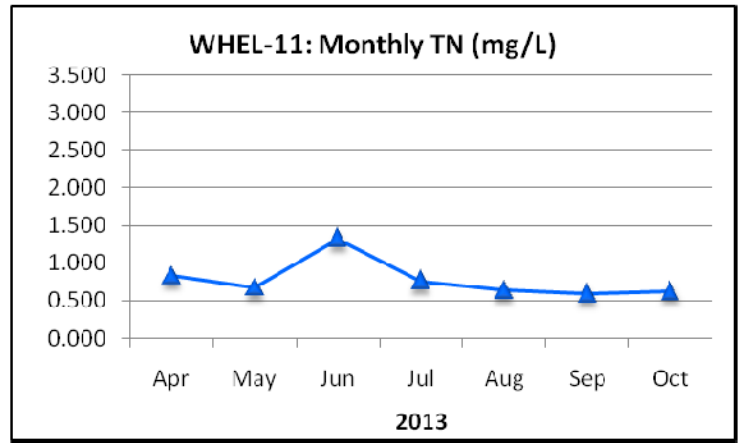
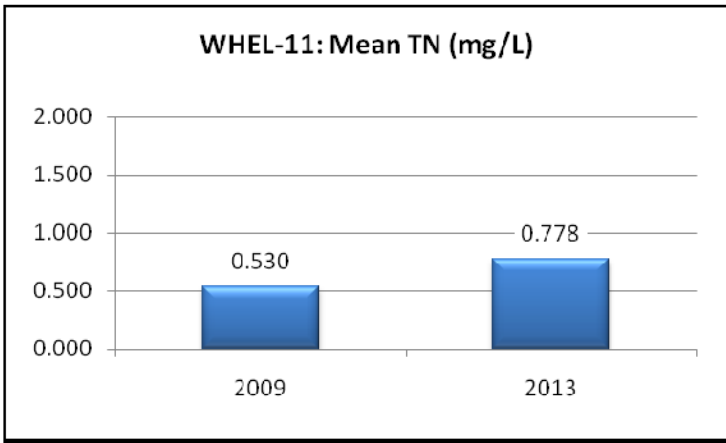


Figure 4. Mean growing season (2009-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Bakers Creek embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

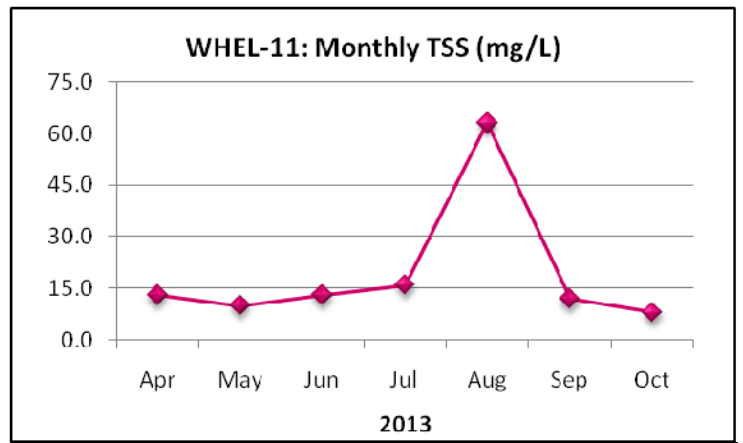
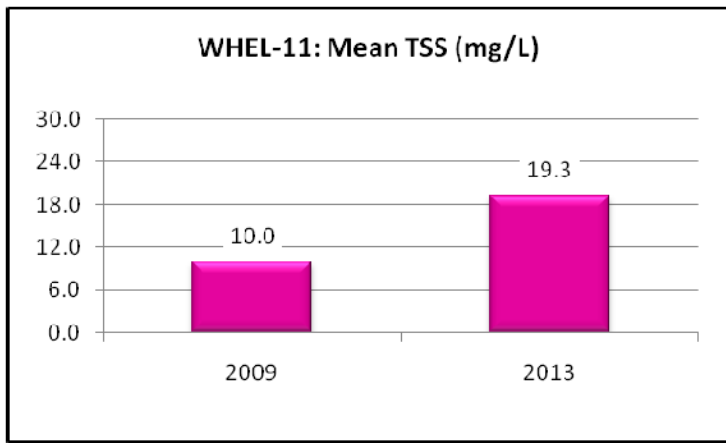


Figure 5. Mean growing season and monthly TSS measured in the Bakers Creek embayment of Wheeler Reservoir.

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-11	N	Min	Max	Med	Mean	SD
Physical						
Turbidity (NTU)	7	10.5	18.3	11.3	12.7	2.8
Total Dissolved Solids (mg/L) ^J	7	87.0	185.0	109.0	115.0	33.2
Total Suspended Solids (mg/L)	7	8.0	63.0	13.0	19.3	19.4
Hardness (mg/L)	4	61.7	91.2	70.5	73.5	12.8
Alkalinity (mg/L)	7	34.7	51.1	45.4	45.5	5.8
Photic Zone (m)	7	1.41	2.22	1.92	1.92	0.28
Secchi (m)	7	0.76	1.11	0.82	0.88	0.13
Bottom Depth (m)	7	1.00	2.22	1.92	1.92	0.28
Chemical						
Ammonia Nitrogen (mg/L) ^J	7	< 0.015	0.080	0.014	0.028	0.030
Nitrate+Nitrite Nitrogen (mg/L)	7	0.013	0.343	0.240	0.206	0.113
Total Kjeldahl Nitrogen (mg/L)	7	0.331	1.310	0.484	0.571	0.333
Total Nitrogen (mg/L)	7	0.595	1.323	0.672	0.778	0.254
Dissolved Reactive Phosphorus (mg/L)	7	0.060	0.144	0.097	0.099	0.032
Total Phosphorus (mg/L)	7	0.095	0.207	0.149	0.143	0.046
CBOD-5 (mg/L) ^J	7	< 2.0	3.9	1.0	1.7	1.2
Chlorides (mg/L) ^J	7	4.1	8.0	5.4	5.8	1.4
Biological						
Chlorophyll a (ug/L)	7	< 1.00	44.90	18.70	19.23	14.67
E. coli (col/100mL)	3	7	31	11	16	13

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-11	MSC	Limiting Nutrient
8/19/2009	21.18	NONE
8/21/2013	14.69	NITROGEN

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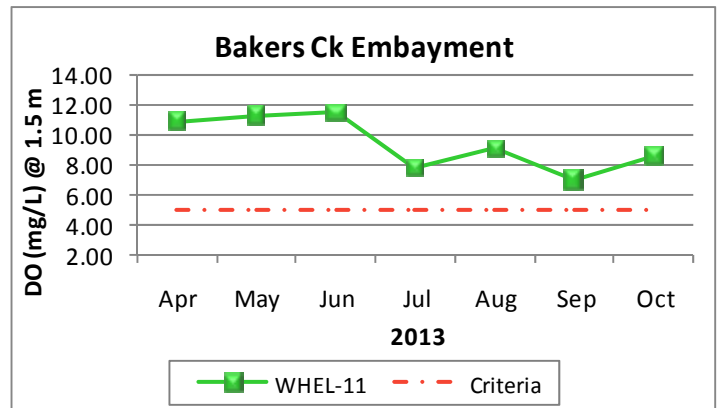


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Bakers Ck embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

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