Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Swan Creek Embayment
Wheeler Reservoir
Intensive Basin Survey 2013

WHEL-13: Swan Creek approx 1 mile downstream of Limestone CR 45 bridge (Limestone Co 34.669/-87.002)

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 Swan 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 Swan Creek embayment (WHEL-13) during the 2013 growing season (Apr-Oct). This is the third intensive basin assessment of the Tennessee River and the second assessment of the Swan 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.

The Swan Creek embayment from the Tennessee River to Alabama Highway 24 is listed on the 2012 Alabama's Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its water use classifications. The waterbody is listed for elevated nutrients from agricultural and municipal sources as well as urban/storm sewer runoff.

Figure 1. Photo of Swan Ck at WHEL-13.

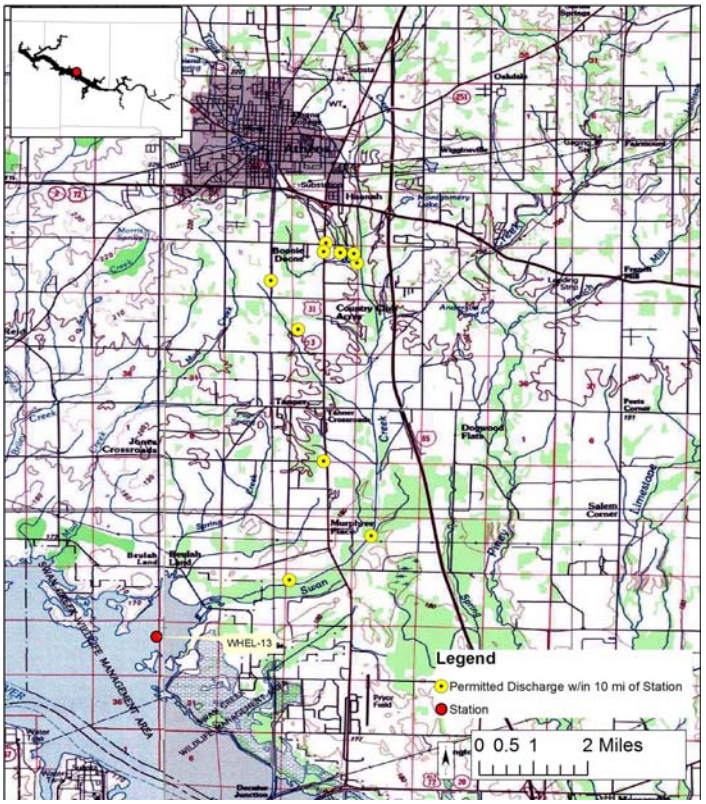


Figure 2. Map of Swan Ck embayment of Wheeler Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Swan 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 57 mi^2 watershed is predominantly hay/pasture (Fig. 3). As of October 1, 2013, ADEM has issued a total of 24 NPDES permits within the watershed. Ten of those permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Swan Ck embayment at WHEL-13 is a shallow embayment that flows into the north bank of the Tennessee River at approximately river mile 300 near Decatur, AL. Swan Ck has a mean bottom depth of 1.26 m (Table 2) at the sampling location.

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-13**

Basin		Tennessee R
Drainage Area (mi^2)		57
Ecoregion[a]		71g
% Land use		
Open Water		1%
Developed	Open Space	5%
	Low Intensity	<1%
	Medium Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	24%
	Evergreen Forest	2%
	Mixed Forest	5%
Shrub/Scrub		5%
Herbaceous		1%
Hay/Pasture		49%
Cultivated Crops		6%
Wetlands	Woody	2%
# NPDES Permits[b]	TOTAL	24
Construction Stormwater		16
Municipal Individual		3
Underground Injection Control		5

a. Eastern Highland Rim

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

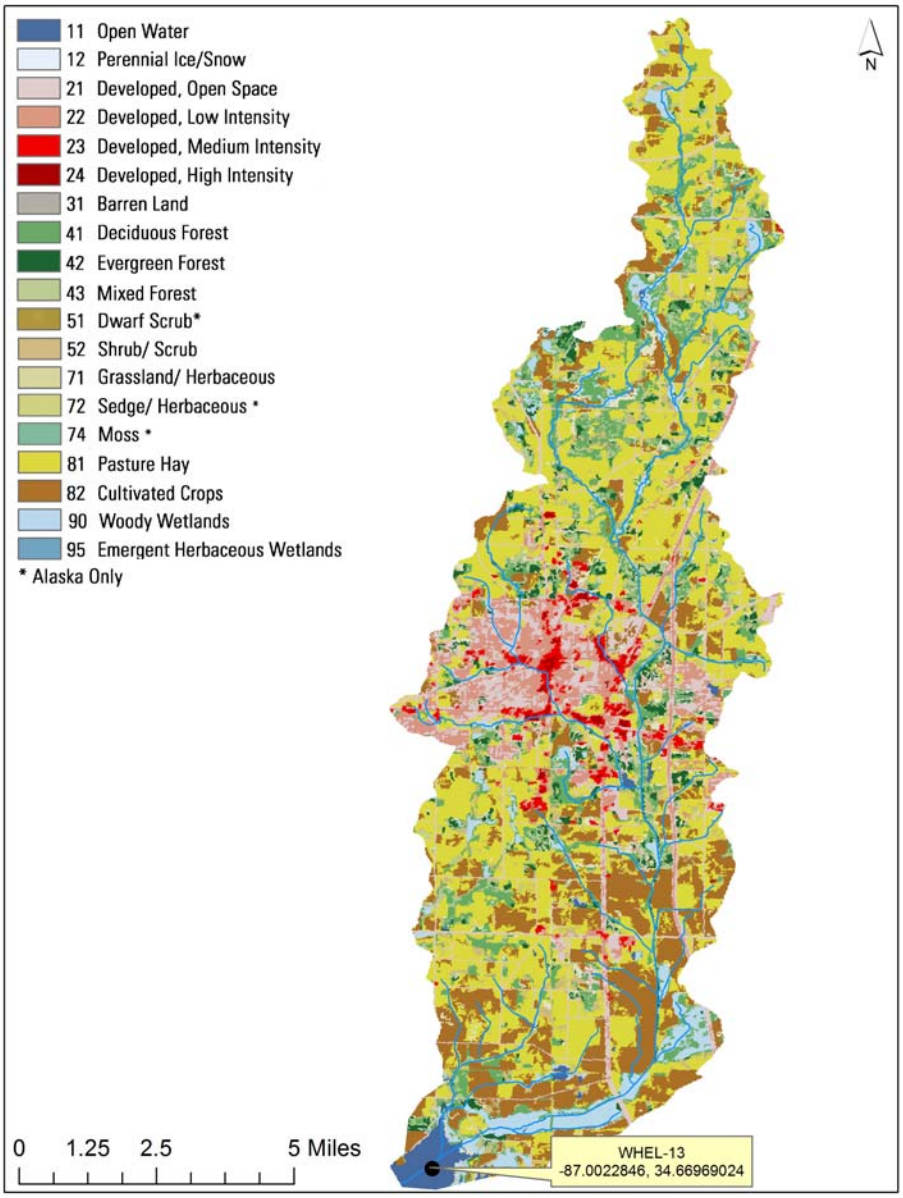


Figure 3. Landuse within the Swan Creek watershed at WHEL-13.

The mean growing season TN value was lower in 2013 than in 2009 (Fig. 4). Monthly TN concentrations were highest in May and October.

The mean growing season TP value was lower in 2013 than in 2009 (Fig. 4). Monthly TP concentrations were highest in July, August, and October.

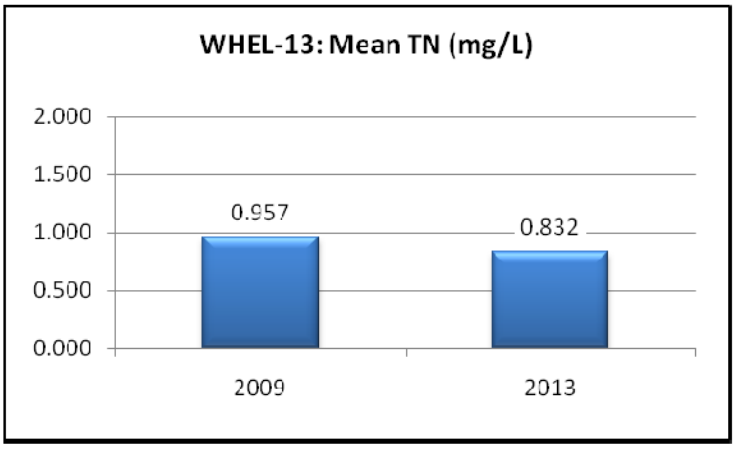
The mean growing season chl *a* value was lower in 2013 than in 2009 (Fig. 4). The highest monthly chl *a* concentration was measured in May.

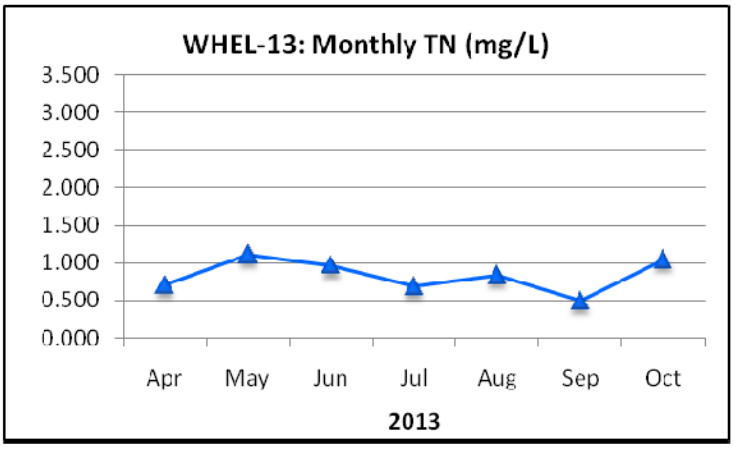
Mean TSI was eutrophic in 2013 and 2009. Monthly TSI in Swan Ck was eutrophic all months except July (Fig. 4).

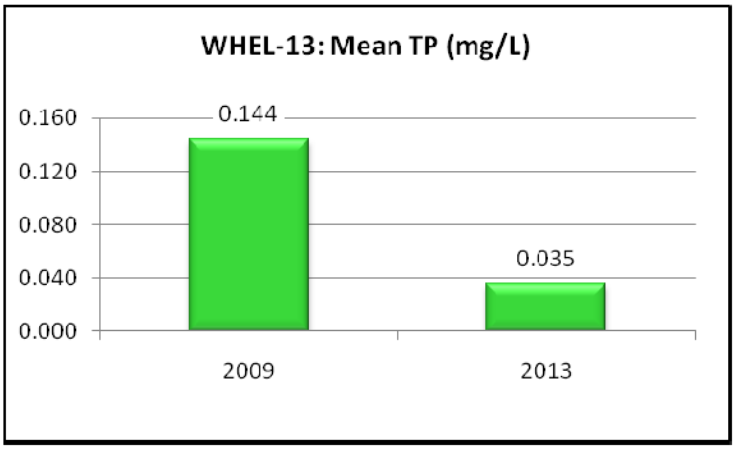
The mean growing season TSS value was lower in 2013 than 2009 (Fig. 5). Monthly TSS concentrations were highest in July, September, and October.

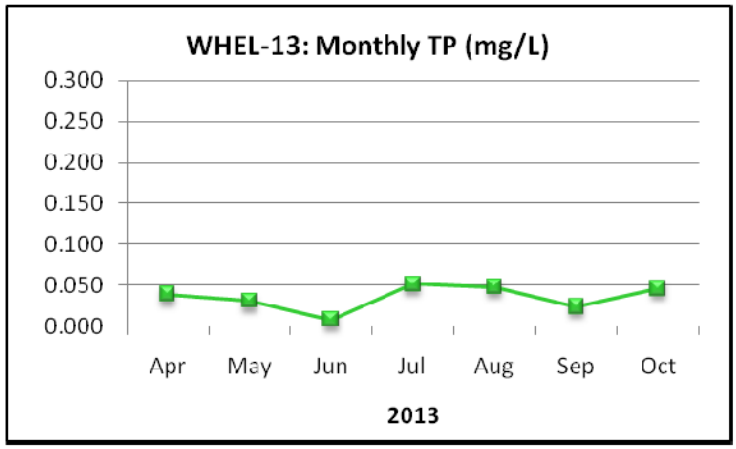
AGPT results show that WHEL-13 was nitrogen limited in 2009 and 2013 (Table 3). The mean maximum standing crop (MSC) values from 2009 and 2013 were below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

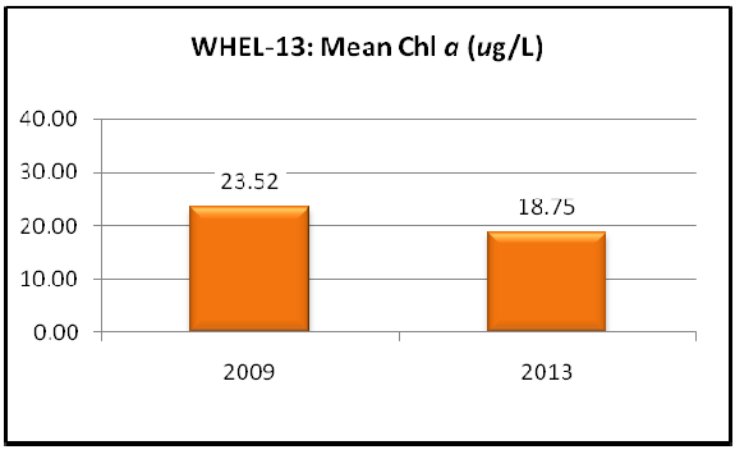
DO concentrations in the WHEL-13 station remained above the ADEM criteria limit of 5.0 mg/l at 5.0 ft (1.5 m) in all months (ADEM Admin. Code R. 335-6-10-.09) (Fig. 6).

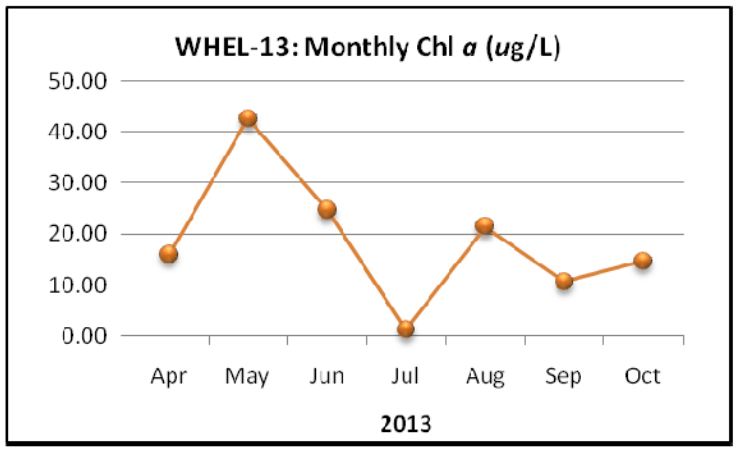


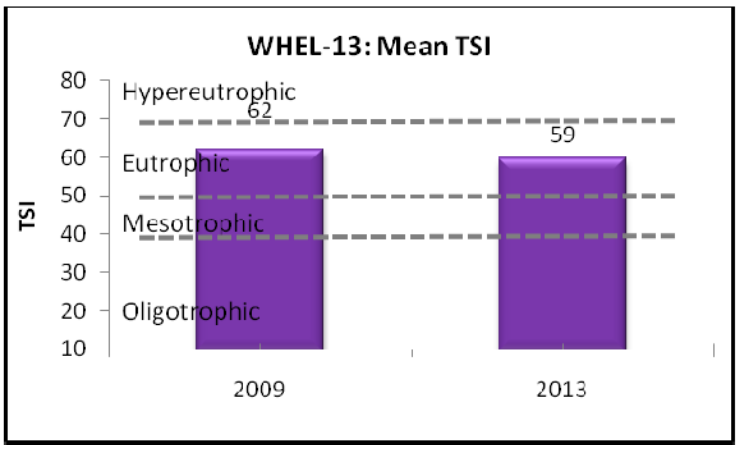












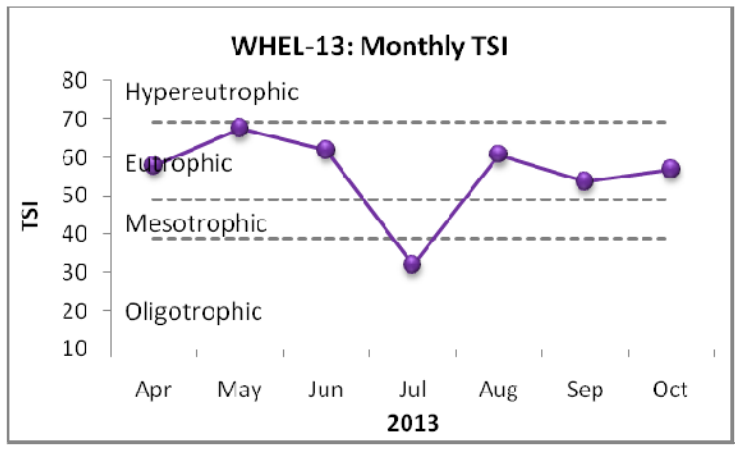
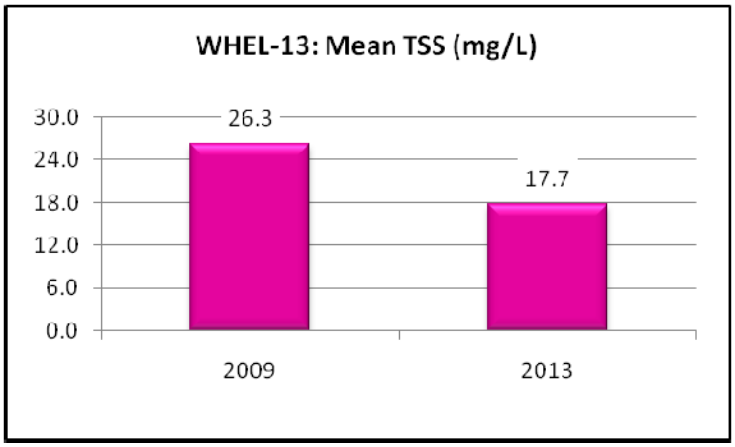


Figure 4. Mean growing season (2009-2013) and monthly (April-October, 2013) TN, TP, chl a and TSI measured in the Swan Creek embayment of Wheeler Reservoir**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



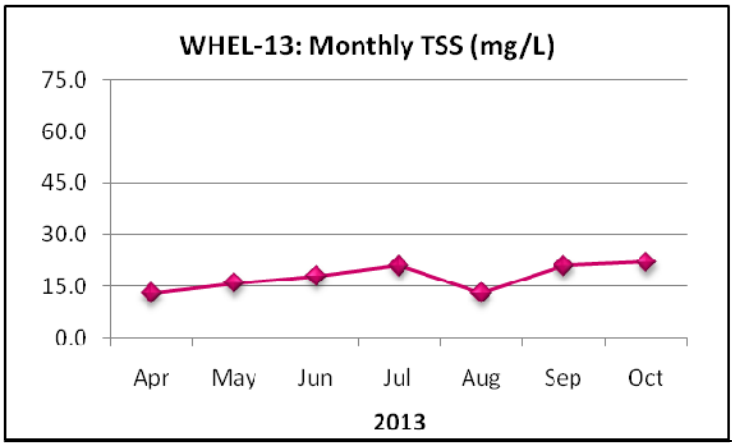


Figure 5. Mean growing season and monthly TSS measured in the Swan Creek embayment of Wheeler Reservoir.

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-13	N		Min	Max	Med	Mean	SD
Physical							
Turbidity (NTU)	7		11.8	22.9	17.8	17.2	3.5
Total Dissolved Solids (mg/L)[J]	7		83.0	240.0	103.0	121.7	53.7
Total Suspended Solids (mg/L)	7		13.0	22.0	18.0	17.7	3.8
Hardness (mg/L)	4	<	2.7	77.8	68.1	53.8	35.3
Alkalinity (mg/L)	7		31.4	49.3	40.8	40.4	6.5
Photic Zone (m)	7		0.89	1.45	1.33	1.26	0.19
Secchi (m)	7		0.46	0.84	0.58	0.61	0.13
Bottom Depth (m)	7		0.90	1.45	1.33	1.26	0.19
Chemical							
Ammonia Nitrogen (mg/L)[J]	7	<	0.000	0.396	0.008	0.069	0.145
Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.004	0.197	0.004	0.063	0.083
Total Kjeldahl Nitrogen (mg/L)	7		0.485	0.978	0.830	0.768	0.213
Total Nitrogen (mg/L)	7	<	0.490	1.108	0.834	0.832	0.222
Dissolved Reactive Phosphorus (mg/L)[J]	7	<	0.004	0.008	0.004	0.005	0.002
Total Phosphorus (mg/L)[J]	7		0.008	0.051	0.039	0.035	0.015
CBOD-5 (mg/L)[J]	7	<	2.0	3.4	2.0	2.0	1.0
Chlorides (mg/L)[J]	7	<	1.0	7.3	4.9	4.6	2.0
Biological							
Chlorophyll a (ug/L)	7		1.17	42.70	16.00	18.75	12.99
E. coli (col/100mL)	3		2	12	5	6	5

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-13	MSC	Limiting Nutrient
8/18/2009	2.07	NITROGEN
8/21/2013	3.17	NITROGEN

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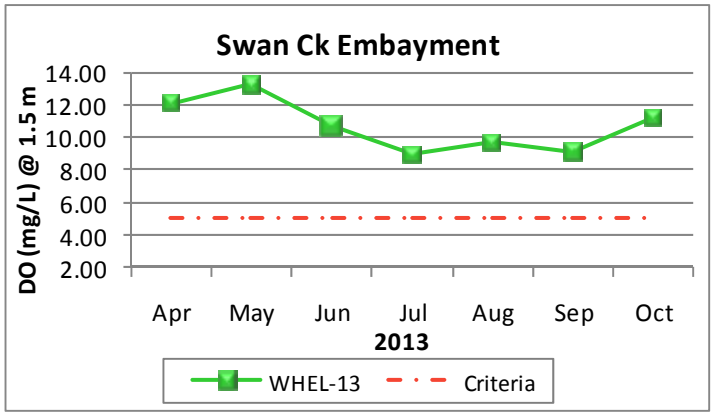

Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Swan Ck embayment station of Wheeler Reservoir collected April-October 2013. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

REFERENCES

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