

Second Creek Embayment
Pickwick Reservoir
Intensive Basin Survey 2009

PICL-4: Second Creek approx 1 mi upstream of CR 14 bridge (Lauderdale Co 34.92624/-88.04680)

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 Second Creek tributary embayment of Pickwick 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 Second Creek embayment (PICL-4) 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 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 2009 were compared to ADEM’s 2003 data and established criteria.



Figure 1. Photo of Second Creek at PICL-4

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Second Creek is classified as a *Public Water Supply/Swimming/Fish & Wildlife (PWS/S/F&W)* stream located in the Southeastern Plains ecoregion (65j). Based on the 2006 National Land Cover Dataset, land use within the 73 mi² watershed is predominantly forest (70%) (Fig. 3). As of October 1, 2013, ADEM has issued a total of one NPDES permit within the watershed. No permits are located within 10 mi of the station (Fig. 2).

SITE DESCRIPTION

The Second Creek embayment at PICL-4 is a fairly wide embayment surrounded by residential houses to the west and a park to the east, located near the community of Waterloo, AL. The embayment has a mean bottom depth of 4.9 m (Table 2) at the sampling location and flows into the main channel near Tennessee River mile 227.

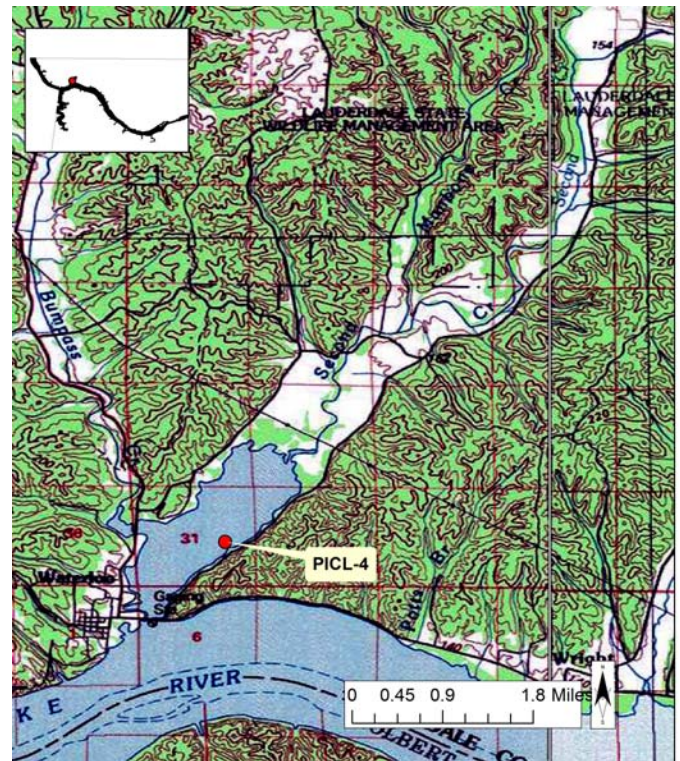


Figure 2. Map of Second Creek Embayment of Pickwick Reservoir. Though additional permits may occur in the watershed (Table 1), only permitted discharges within 10 miles upstream of the station are displayed on the map.

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

Mean growing season chl *a*, TSI, 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 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 ranges of the graphs in Figs. 4-5 were set to maximum values reservoir-wide so all embayment reports on the same reservoir could be compared.

Table 1: Summary of Watershed PICL-4

Basin		Tennessee R
Drainage Area (mi ²)		73
Ecoregion ^a		65j
% Land use		
Open Water		2%
Developed	Open Space	2%
	Low Intensity	<1%
	Medium Intensity	<1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	53%
	Evergreen Forest	13%
	Mixed Forest	4%
Shrub/Scrub		12%
Herbaceous		4%
Hay/Pasture		6%
Cultivated Crops		2%
Wetlands	Woody	1%
	Emergent Herb.	<1%
# NPDES Permits ^b		TOTAL
Municipal Individual		1

a. Southeastern Plains

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

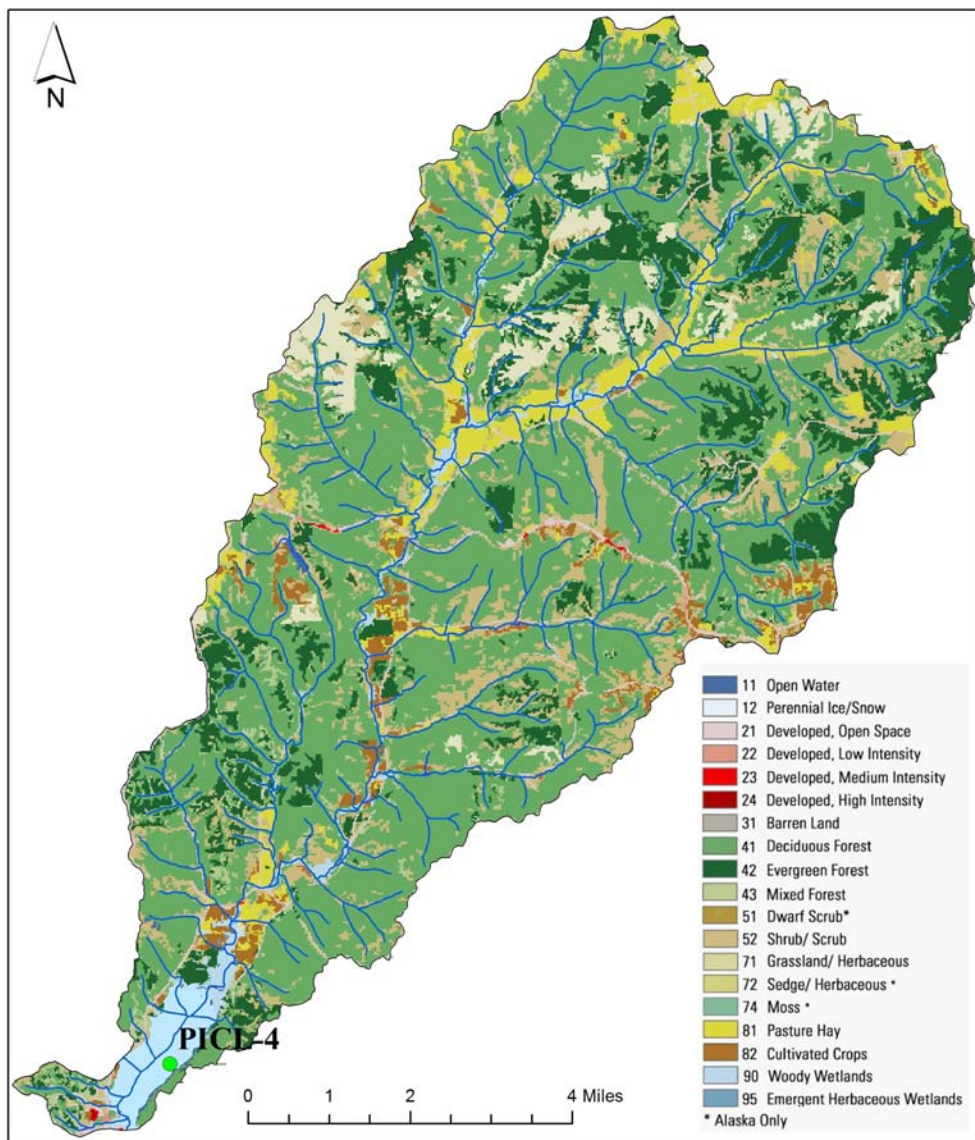


Figure 3. Land use within the Second Creek watershed at PICL-4.

In 2009, the growing season mean chl *a* value was nearly the same as 2003 (Fig. 4). Monthly chl *a* concentrations generally increased April-October with a peak in August.

Mean TSI was eutrophic in 2009, exactly the same value as 2003. Monthly TSI in Second Creek was eutrophic April-October (Fig. 4).

The mean growing season TSS value was lower in 2009 than 2003 (Fig. 4). Monthly TSS concentration was highest in July and low most other months sampled.

AGPT results show that PICL-4 was nitrogen limited in 2009 and phosphorus limited in 2003 (Table 3). The mean maximum standing crop (MSC) values from both years were below the 5.0 mg/L value that Raschke and Schultz (1987) defined as protective of reservoir and lake systems.

The DO concentration in the PICL-4 station was well 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. 5).

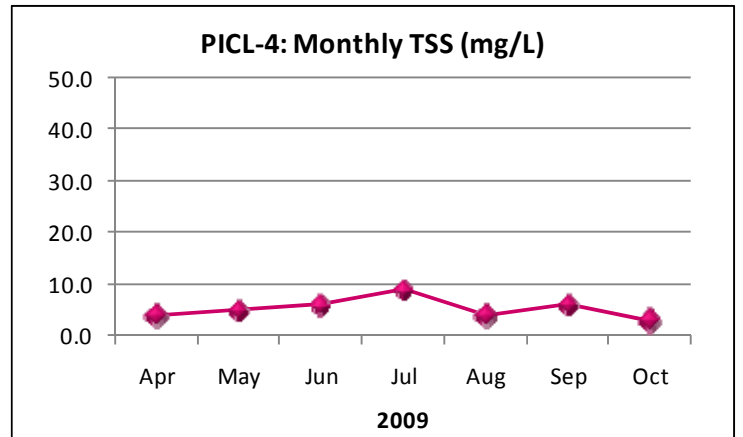
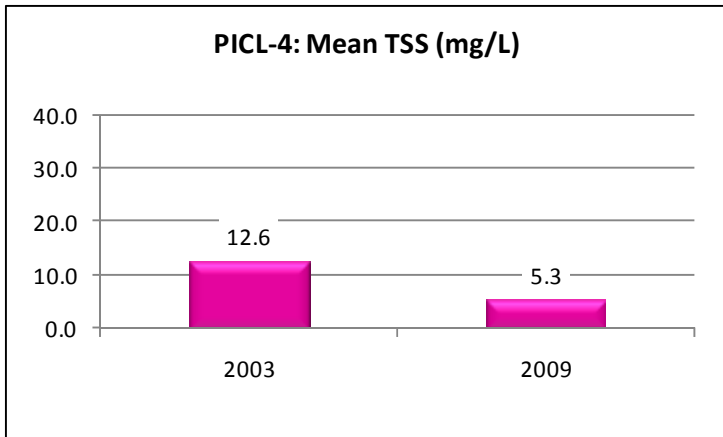
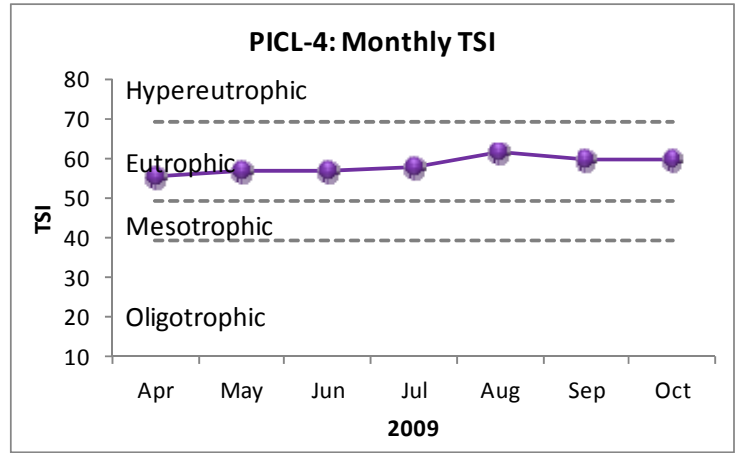
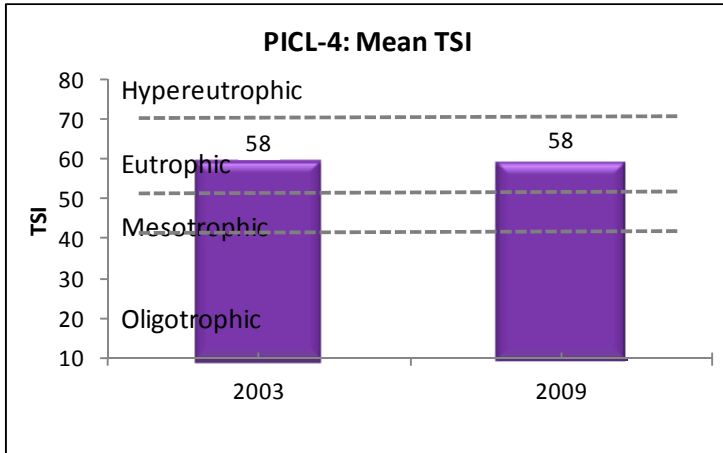
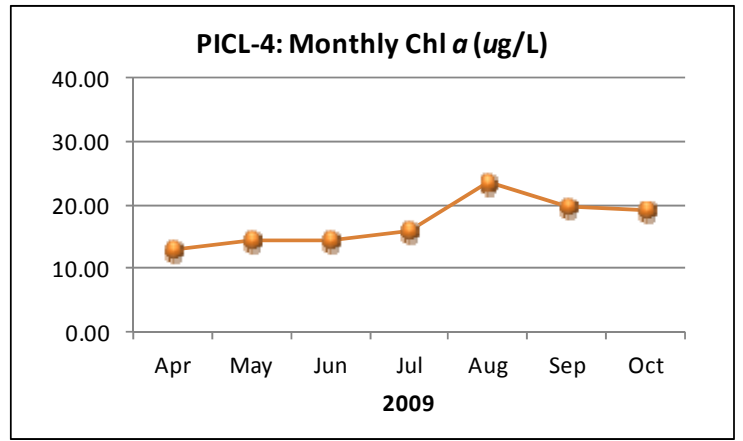
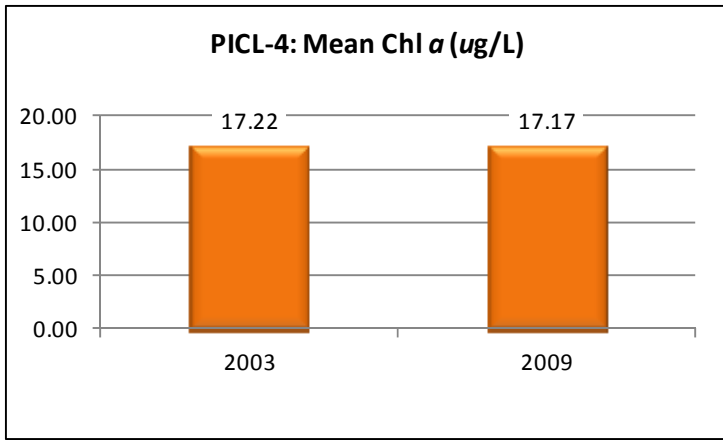


Figure 4. Mean growing season (2003-2009) and monthly (April-October, 2009) chl *a*, TSI, and TSS measured in the Second Creek embayment of Pickwick Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

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

PICL-4	N	Min	Max	Med	Mean	SD
Physical						
Turbidity (NTU)	7	3.8	6.3	4.3	4.6	1.0
Total Dissolved Solids (mg/L)	7	74.0	100.0	87.0	86.6	11.1
Total Suspended Solids (mg/L)	7	3.0	9.0	5.0	5.3	2.0
Hardness (mg/L)	3	28.9	68.0	44.1	47.0	19.7
Alkalinity (mg/L) ^J	7	20.3	57.5	33.0	33.2	12.5
Photic Zone (m)	7	3.61	4.52	3.92	4.00	0.37
Secchi (m)	7	1.19	1.48	1.29	1.30	0.09
Bottom Depth (m)	7	4.00	6.08	4.84	4.90	0.56
Chemical						
Nitrate+Nitrite Nitrogen (mg/L) ^J	7	< 0.003	0.631	0.002	0.091	0.238
Dissolved Reactive Phosphorus (mg/L) ^J	7	< 0.008	0.093	0.021	0.030	0.031
CBOD-5 (mg/L) ^J	7	1.2	2.6	1.4	1.6	0.5
Chlorides (mg/L)	7	2.0	27.8	13.2	14.9	8.6
Biological						
Chlorophyll a (ug/L)	7	12.80	23.60	16.00	17.17	3.83
Fecal Coliform (col/100 mL) ^J	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
8/19/2003	3.31	PHOSPHORUS
8/19/2009	3.06	NITROGEN

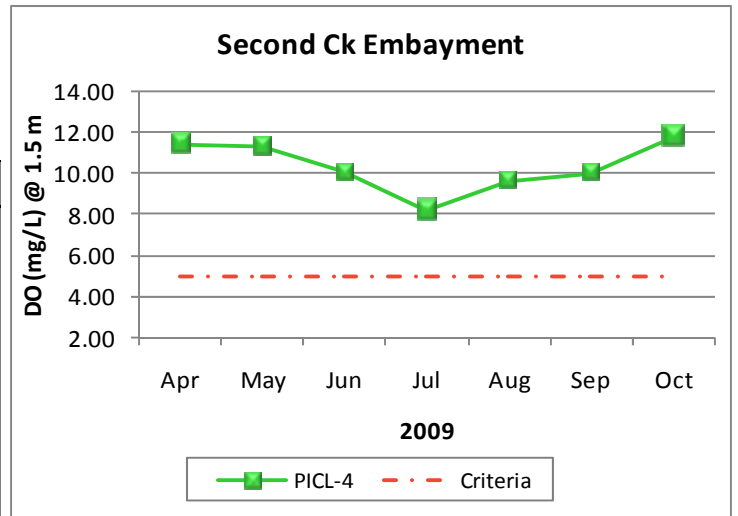


Figure 6. Monthly DO concentrations at 1.5 m (5 ft) for Second Creek embayment station of Pickwick Reservoir collected April-October 2009. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth .

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.

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