Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Cypress Creek Embayment
Pickwick Reservoir
Intensive Basin Survey 2018 & 2020

PICL-1: Cypress Creek approx. 0.5 miles upstream of AL Hwy 20 (Lauderdale Co 34.78814/-87.69709)

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 2018 and 2020, ADEM monitored the Cypress Creek (Pickwick Lake) tributary embayment 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 Cypress Creek (Pickwick Lake) embayment (PICL-1) during the 2018 and 2020 growing seasons (Apr-Oct). These are the fifth and sixth intensive basin assessments 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 2014 based on fish tissue data collected by ADEM at station PICL-1. Therefore, as an indication of an impaired use, Cypress Creek (Pickwick Lake) from the confluence with the Tennessee River (Pickwick Lake) upstream to the end of the embayment was listed on Alabama's 2016 §303(d) list of impaired waterbodies.

Figure 1. Cypress Creek (Pickwick Lake) at PICL-1.

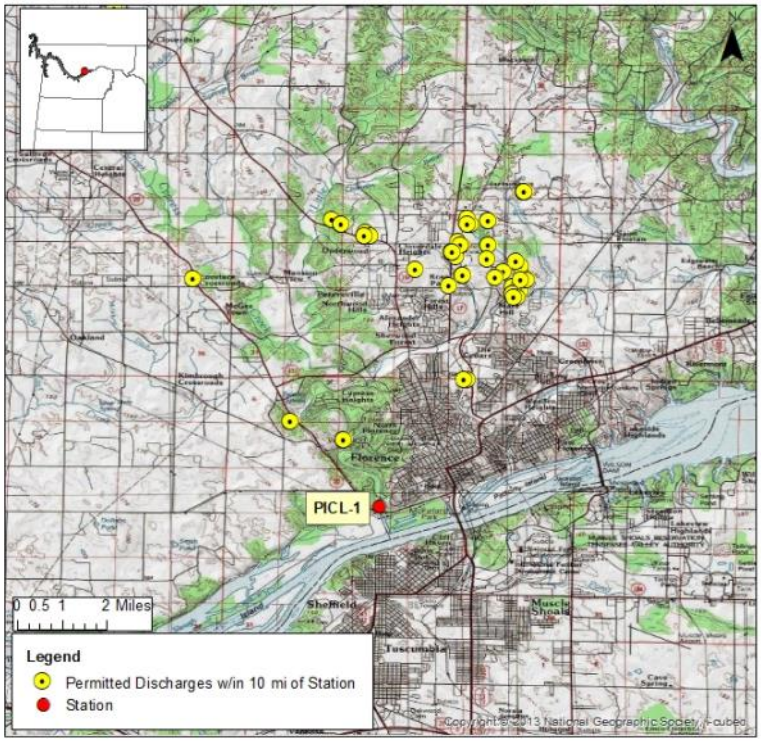


Figure 2. Map of the Cypress Creek (Pickwick Lake) embayment. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Cypress Creek (Pickwick Lake) embayment is classified *Public Water Supply/Fish & Wildlife (PWS/F&W)* and located in the Eastern Highland Rim ecoregion (71g). Based on the 2021 National Land Cover Dataset, land use within the 213 mi^2 watershed is predominantly forest (35%) and hay/pastureland (Figure 3). As of February 13, 2024, ADEM has issued permits for a total of 47 NPDES outfalls within the watershed. Several of those permits are located within 10 mi of the station (Figure 2).

Table 1. Summary of Watershed **PICL-1**

Basin		Tennessee R
Assessment Unit		AL06030005-0605-111
Drainage Area (mi^2)		213
Ecoregion[a]		71g
% Landuse		
Open Water		<1%
Developed	Open Space	7%
	Low Intensity	4%
	Medium Intensity	1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	29%
	Evergreen Forest	4%
	Mixed Forest	2%
Shrub/Scrub		3%
Herbaceous		2%
Hay/Pasture		34%
Cultivated Crops		6%
Wetlands	Woody	6%
	Emergent Herb.	<1%
# NPDES outfalls[b]	TOTAL	47
Mining		0
Industrial General		44
Industrial Individual		1
Municipal		1
State Indirect Discharge		1

a. Eastern Highland Rim
b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Feb 13, 2024.

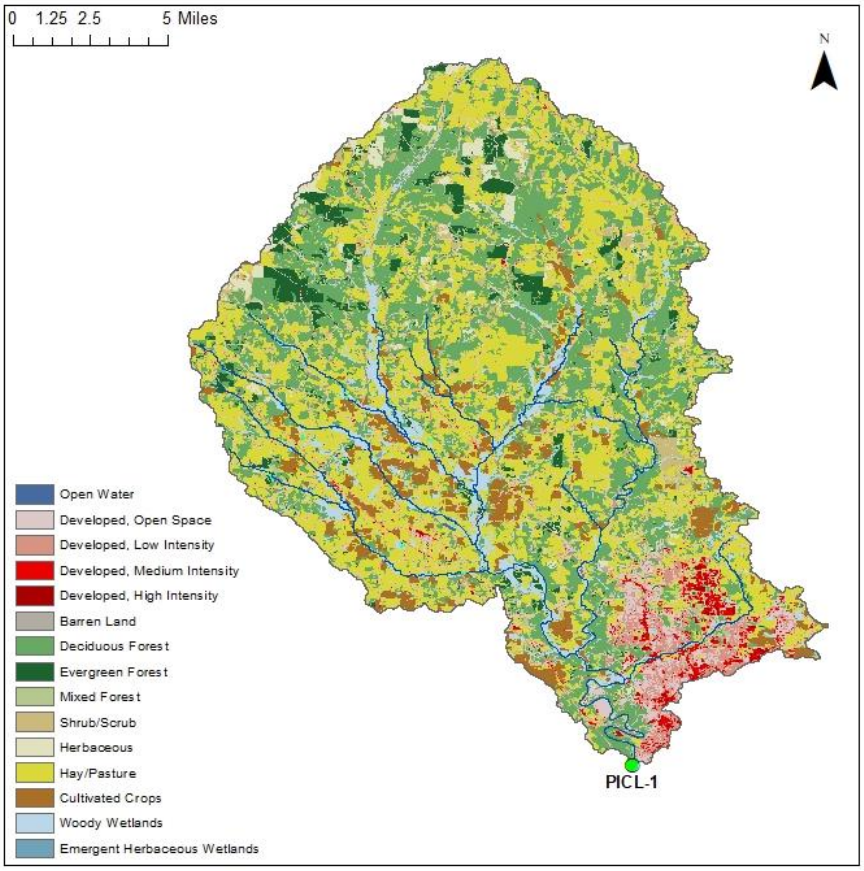


Figure 3. Land use within the Cypress Creek (Pickwick Lake) watershed at PICL-1.

SITE DESCRIPTION

The Cypress Creek (Pickwick Lake) embayment at PICL-1 is located just west of Florence, AL, and flows into the Tennessee River near river mile 255. It had a mean bottom depth of 4.4m in 2018 and 3.7m in 2020 (Table 2) at the sampling location, which is located just upstream of the McFarland Park fishing pier.

METHODS

Water quality assessments were conducted at monthly intervals, April-October in 2018. The 2020 sampling schedule was modified to accommodate Departmental precautions related to COVD-19 that occurred early in the sampling season. As a result, no water quality samples were collected in April and May, and two samples were collected in the months of September and October to account for the missed sampling events early in the season. In 2020, the late September chl *a* sample was lost by the lab, so the 2020 mean is calculated from six monthly samples, not seven as is standard for all other growing season means. These modifications are noted in related graphs. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2020), Surface Water Quality Assurance Project Plan (ADEM 2018a), and Quality Management Plan (ADEM 2018b).

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 2018 and 2020 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 4-7 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 decreased since 2015 (Figure 4). Monthly TN concentrations were highest in April in 2018 and early September in 2020 (Figure 5).

Table 2. Summary of water quality data collected April-October, 2018 and 2020. 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-1 2018	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	6	6.8	12.3	9.6	9.6	2.3
Total Dissolved Solids (mg/L)	7	43.0	86.0	54.0	58.7	15.6
Total Suspended Solids (mg/L)	7	4.0	11.0	7.0	6.7	2.4
Hardness (mg/L)	4	46.7	70.6	60.0	59.4	12.4
Alkalinity (mg/L)	7	29.3	69.6	48.3	53.2	15.5
Photic Zone (m)	7	3.47	4.70	3.83	3.94	0.41
Secchi (m)	7	0.75	1.56	1.01	1.14	0.32
Bottom Depth (m)	7	4.2	4.7	4.2	4.4	0.2
Chemical						
Ammonia Nitrogen (mg/L)[J]	7	< 0.007	0.016	0.008	0.008	0.005
Nitrate+Nitrite Nitrogen (mg/L)	7	0.374	0.690	0.609	0.554	0.125
Total Kjeldahl Nitrogen (mg/L)[J]	7	0.120	0.288	0.230	0.226	0.061
Total Nitrogen (mg/L)[J]	7	1.809	2.721	0.810	0.780	0.117
Dis Reactive Phosphorus (mg/L)[J]	7	0.007	0.028	0.014	0.015	0.007
Total Phosphorus (mg/L)	7	0.025	0.046	0.028	0.031	0.007
CBOD-5 (mg/L)	7	< 2.0	< 2.0	1.0	1.0	0.0
Chlorides (mg/L)	7	2.4	3.4	2.5	2.7	0.4
Biological						
Chlorophyll a (mg/m³)	7	< 0.10	17.60	1.78	4.77	6.76
E. coli (MPN/DL)[J]	4	19	248	46	89	106
PICL-1 2020	**N**	**Min**	**Max**	**Med**	**Avg**	**SD**
Physical						
Turbidity (NTU)	7	2.4	8.2	4.5	4.7	2.1
Total Dissolved Solids (mg/L)[J]	7	38.0	85.0	66.0	62.7	19.0
Total Suspended Solids (mg/L)[J]	7	3.0	34.0	4.0	8.7	11.2
Hardness (mg/L)	4	43.4	154.0	59.6	79.1	50.8
Alkalinity (mg/L)[J]	7	40.4	59.5	51.6	51.3	6.6
Photic Zone (m)	7	3.34	4.29	3.72	3.72	0.34
Secchi (m)	7	1.19	2.36	1.74	1.82	0.49
Bottom Depth (m)	7	3.3	4.3	3.7	3.7	0.3
Chemical						
Ammonia Nitrogen (mg/L)[J]	7	< 0.044	< 0.044	0.022	0.022	0.000
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	0.303	0.692	0.586	0.557	0.138
Total Kjeldahl Nitrogen (mg/L)[J]	7	< 0.120	0.260	0.060	0.114	0.078
Total Nitrogen (mg/L)[J]	7	< 1.419	2.412	0.681	0.671	0.113
Total Phosphorus (mg/L)[J]	7	< 0.028	0.082	0.014	0.030	0.025
Chlorides (mg/L)	7	1.9	3.3	2.6	2.5	0.4
Biological						
Chlorophyll a (mg/m³)	6	< 1.00	15.00	0.50	3.01	5.88
E. coli (MPN/DL)	4	19	326	161	166	150

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

RESULTS (con't)

The mean growing season TP concentration has been <0.04 mg/L since 2003 (Figure 4). In 2018, monthly TP concentrations were less than 0.05 mg/L all months sampled (Figure 5). In 2020, the highest monthly TP concentration was observed in August.

In 2018, the mean growing season chl *a* was the highest it had been since 2003, but concentrations decreased in 2020 (Figure 4). In 2018, the highest monthly chl *a* concentration was measured in August (Figure 5). In 2020, most monthly readings were below the minimum detection limit with the highest concentration of chl *a* measured in August.

The mean TSI indicates Cypress Creek (Pickwick Lake) has remained mesotrophic since 2013 (Figure 4). Monthly TSI calculations indicate the embayment reached eutrophic conditions in August and September of 2018, but was oligotrophic much of the growing season (Figure 5). In 2020, it was oligotrophic all months sampled, except August, which was eutrophic.

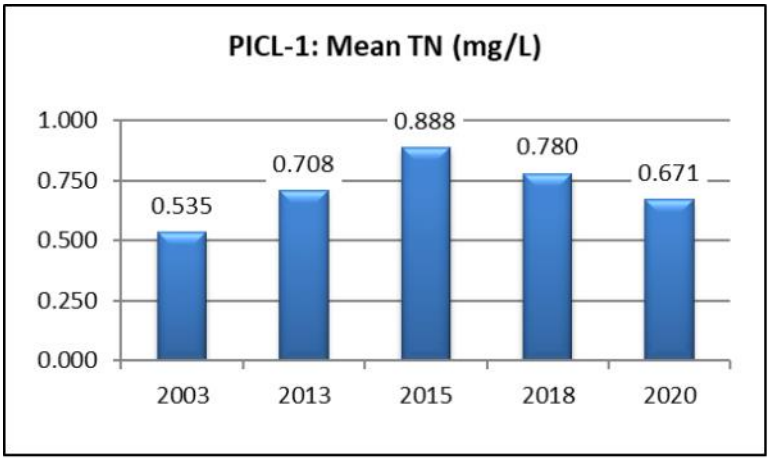
Mean growing season TSS concentrations were below 10 mg/L all years sampled since 2009 (Figure 4). In both 2018 and 2020, monthly TSS measurements were near 10 mg/L all months sampled except early September 2020, which was sampled after a rain event that likely caused the elevated TSS (Figure 6).

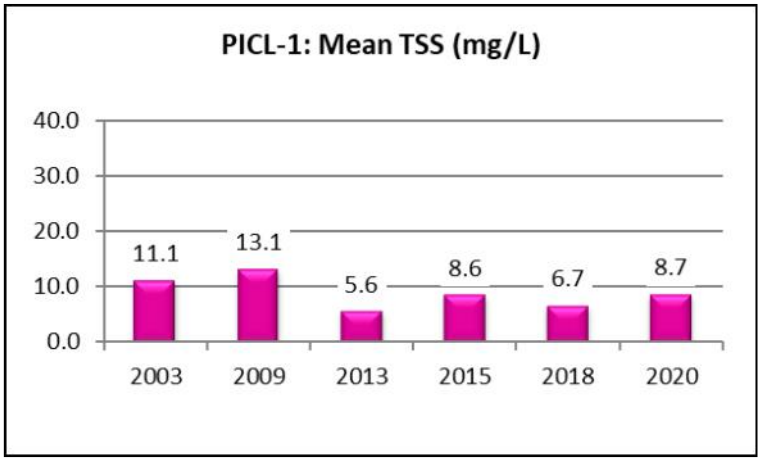
AGPT results show that Cypress Creek (Pickwick Lake) was phosphorus-limited in all years that samples were collected (Table 3). While all samples were above the maximum standing crop (MSC) value of 5.0 mg/L that Raschke and Schultz (1987) found protective of reservoir and lake systems, samples were below 20.0 mg/L MSC, which they define as protective of flowing stream and river systems.

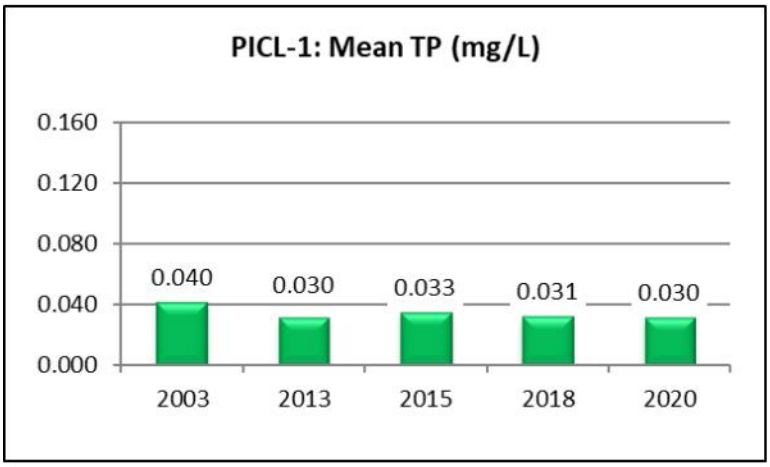
Dissolved oxygen (DO) concentrations at PICL-1 were above the ADEM minimum criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in all months sampled during both 2018 and 2020 (ADEM Admin. Code R. 335-6-10-.09) (Figure 7).

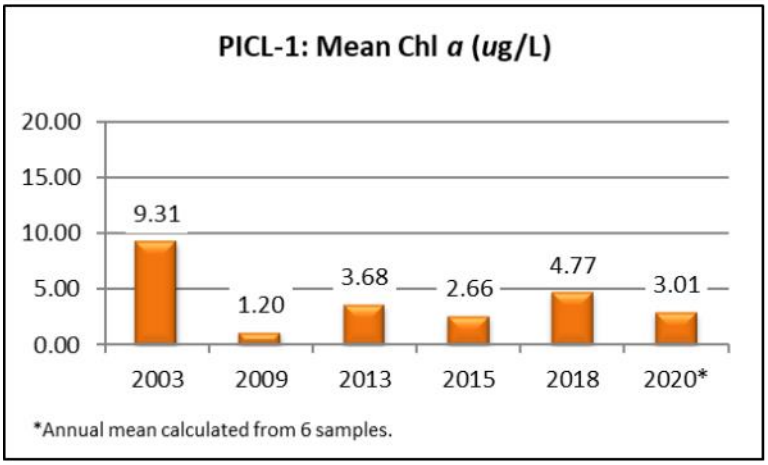
Table 3. Algal growth potential test results (expressed as mean maximum standing crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
2003	7.24	Phosphorus
2009	9.08	Phosphorus
2013	11.98	Phosphorus









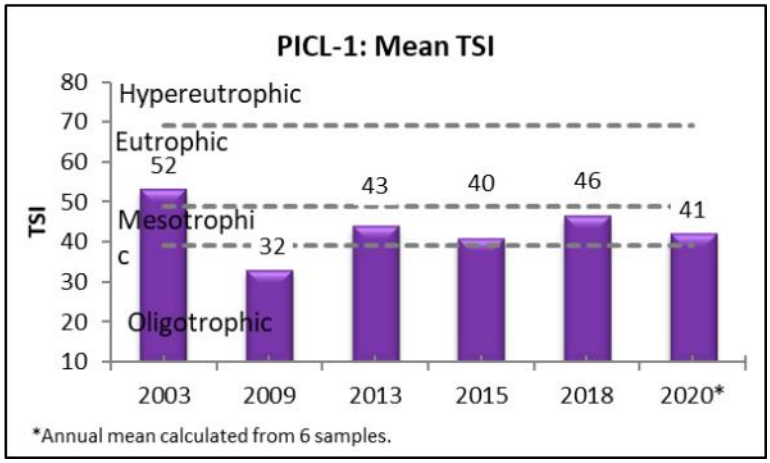
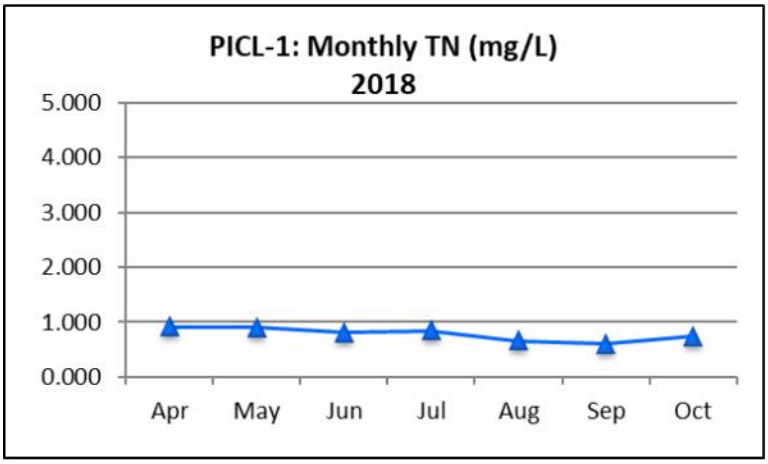
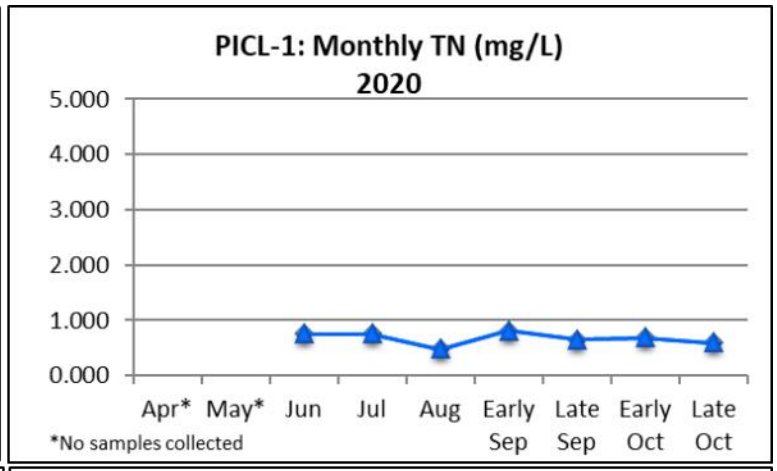
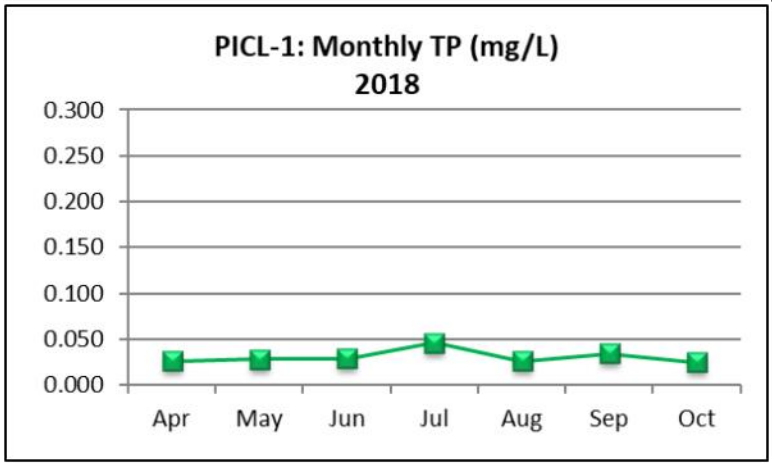
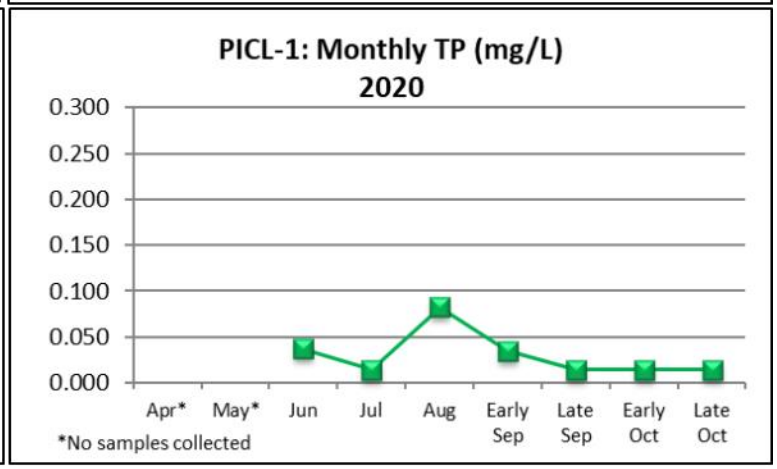


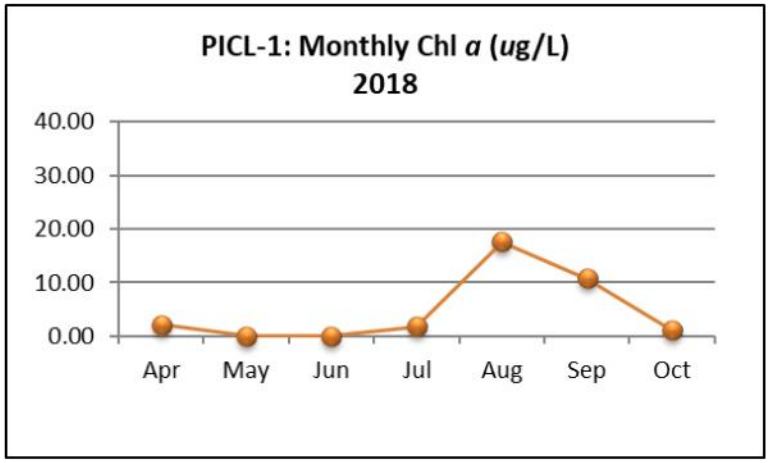
Figure 4. Mean growing season (2003-2020). TN, TP, chl *a,* and TSI measured in the Cypress Creek (Pickwick Lake) embayment (PICL-1)**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

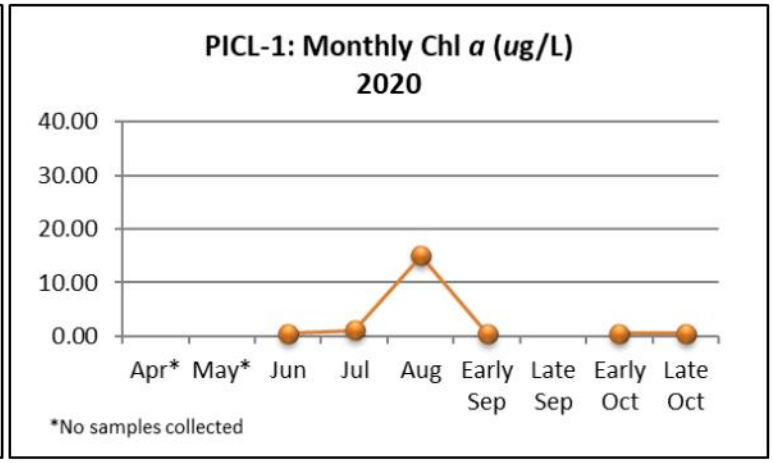


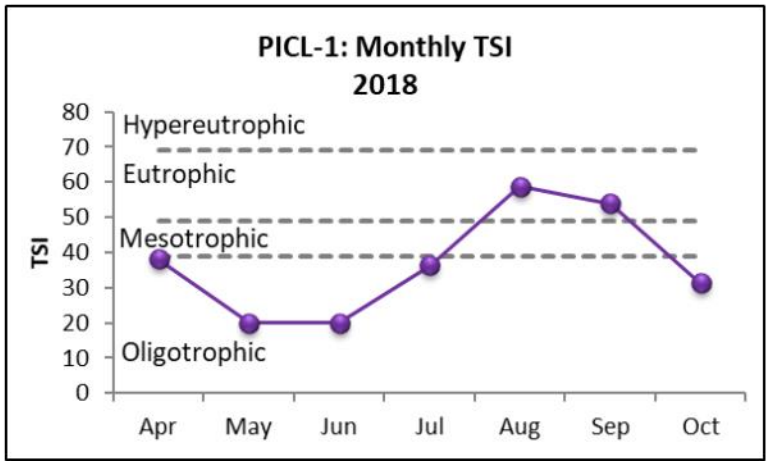












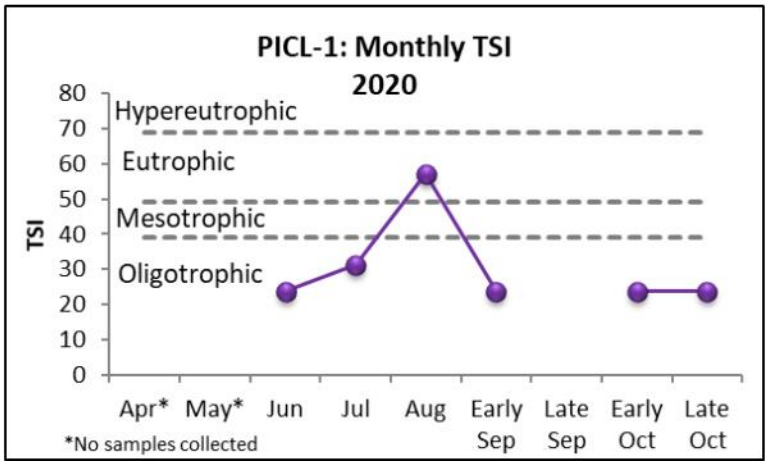


Figure 5. Monthly TN, TP, chl *a,* and TSI measured in the Cypress Creek (Pickwick Lake) embayment (PICL-1)**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

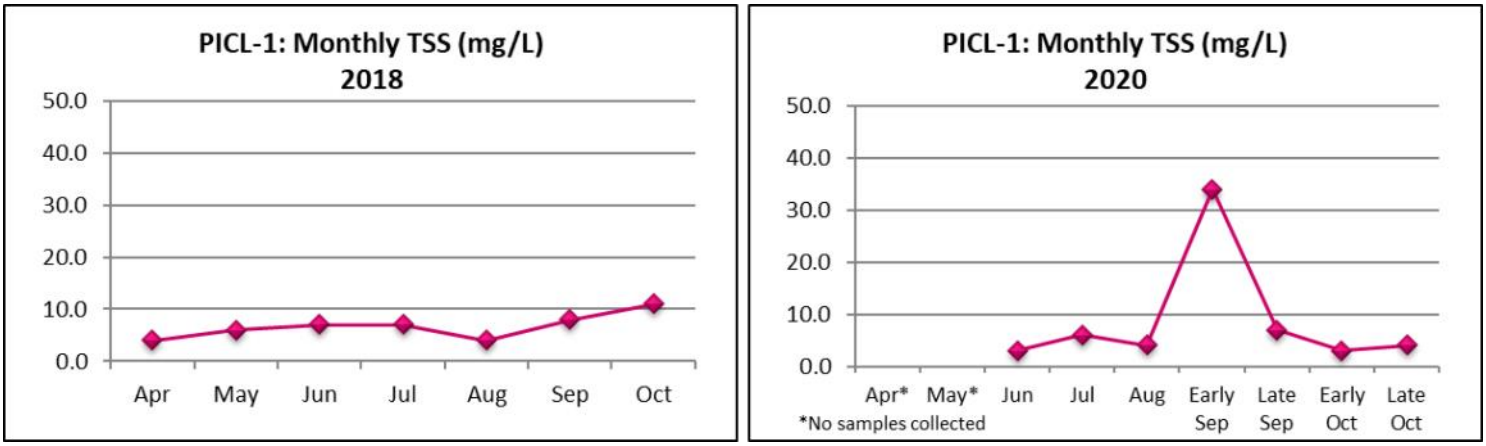


Figure 6. Monthly TSS measured in the Cypress Creek (Pickwick Lake) embayment (PICL-1) in April-October 2018 and 2020.

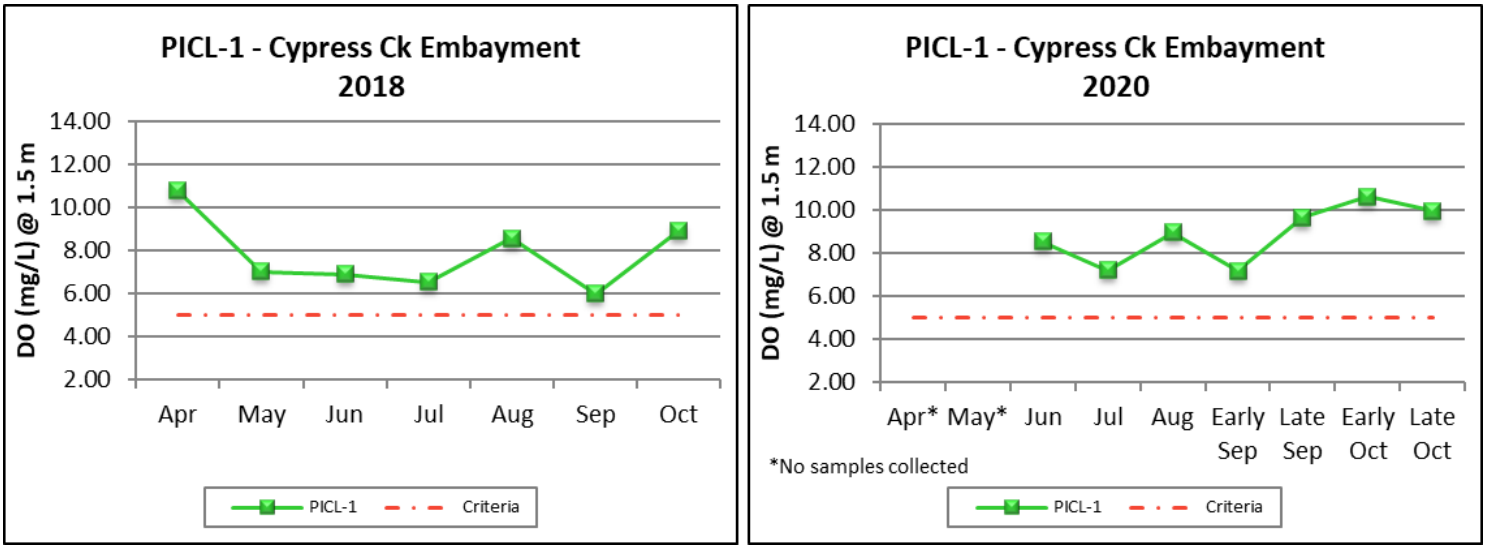


Figure 7. Monthly DO concentrations at 1.5 m (5 ft) for Cypress Creek (Pickwick Lake) embayment (PICL-1) collected in 2018 and 2020. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

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