Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Big Nance Creek Embayment
Wilson Reservoir
Intensive Basin Survey 2018 & 2020

WILL-1: Big Nance Creek immediately upstream of AL Hwy 101 bridge (Lawrence Co 34.77935/-87.39315)

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 Big Nance Creek (Wilson 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 Big Nance Creek (Wilson Lake) embayment (WILL-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 fish consumption advisory for mercury was issued by the Alabama Department of Public Health (ADPH) in 2014 based on records from ADEM station WILL-1. Therefore, as an indication of impaired use, Big Nance Creek (Wilson Lake) from the confluence with the Tennessee River (Wilson Lake) upstream to the end of the embayment was listed on ADEM's §303(d) list of impaired waterbodies.

Figure 1. Big Nance Creek (Wilson Lake) at WILL-1.

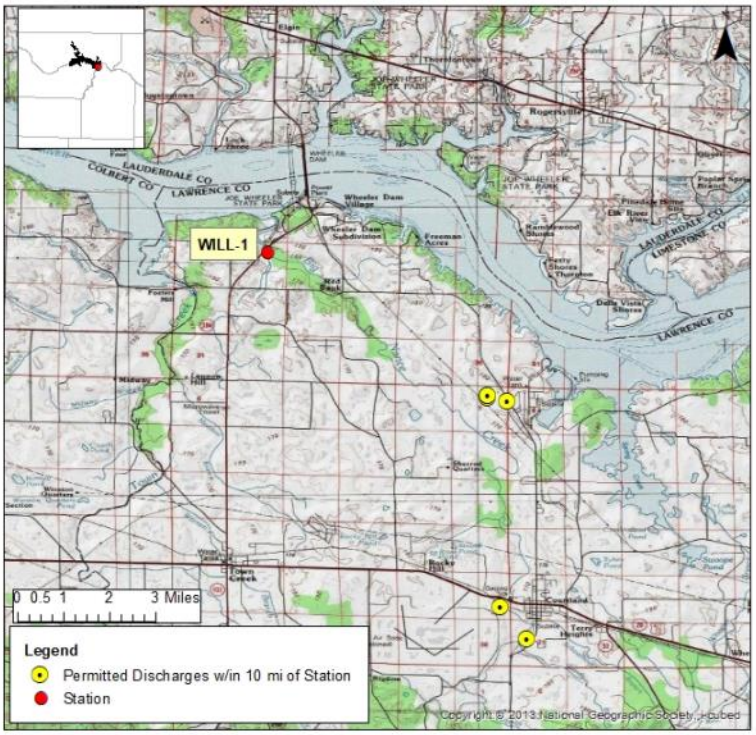


Figure 2. Map of the Big Nance Creek (Wilson Lake) embayment. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Big Nance Creek (Wilson Lake) embayment is classified *Fish & Wildlife (F&W)* and located in the Eastern Highland Rim ecoregion (71g). Based on the 2021 National Land Cover Dataset, land use within the 194 mi^2 watershed is predominantly pastureland with some forest (25%) and cultivated crops (Figure 3). As of February 13, 2024, ADEM has issued permits for a total of 20 NPDES outfalls within the watershed (Figure 2).

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

Basin		Tennessee R
Assessment Unit		AL06030005-0105-111
Drainage Area (mi^2)		194
Ecoregion[a]		71g
% Landuse		
Open Water		1%
Developed	Open Space	5%
	Low Intensity	3%
	Medium Intensity	1%
	High Intensity	<1%
Barren Land		<1%
Forest	Deciduous Forest	17%
	Evergreen Forest	5%
	Mixed Forest	3%
Shrub/Scrub		2%
Herbaceous		2%
Hay/Pasture		34%
Cultivated Crops		17%
Wetlands	Woody	11%
	Emergent Herb.	1%
# NPDES outfalls[b]	TOTAL	20
Mining		2
Industrial General		11
Industrial Individual		0
Municipal		7
State Indirect Discharge		0

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

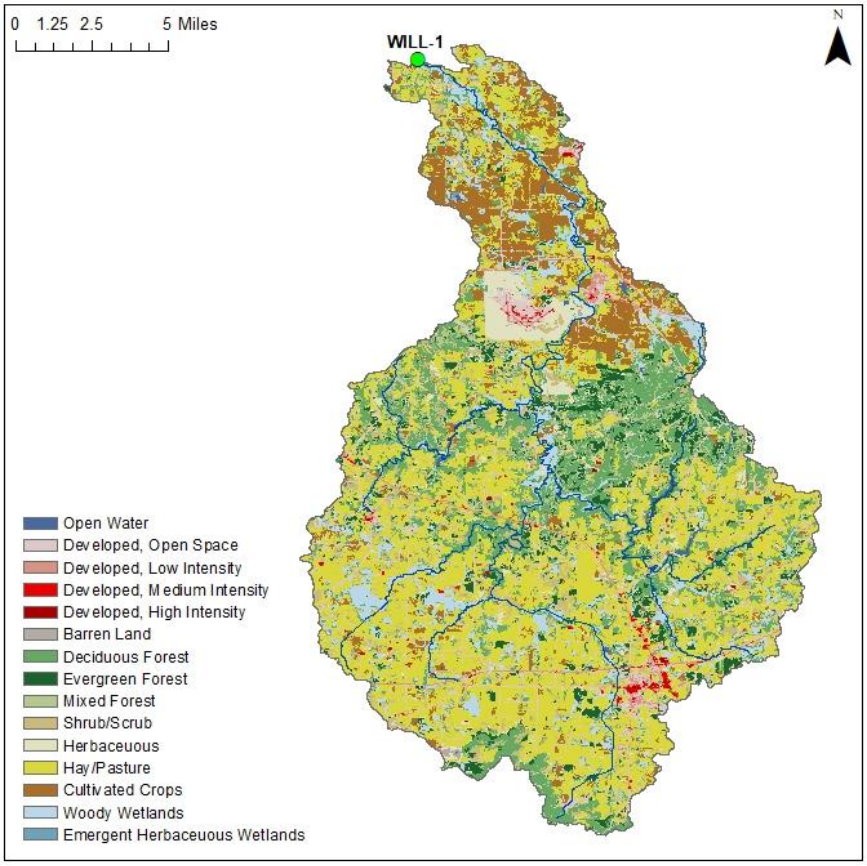


Figure 3. Land use within the Big Nance Creek (Wilson Lake) watershed at WILL-1.

SITE DESCRIPTION

The Big Nance Creek (Wilson Lake) embayment at WILL-1 is located just downstream of the Joe Wheeler Reservoir dam and upstream of State Highway 101. It is a clear, shallow embayment. The embayment had a mean bottom depth of 1.1m in 2018 and 1.4m in 2020 (Table 2) at the sampling location.

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 two samples were collected in October to account for the missed sampling event early in the season. In 2020, the early October chl *a* and TN samples were lost by the lab, so the 2020 means for these parameters are 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.

Mean growing season TN values increased 2003 to 2015 but have remained stable the last three sampling years (Figure 4). Monthly TN concentrations were highest in May in both 2018 and 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.

WILL-1 2018	N	Min	Max	Med	Avg	SD
Physical						
Turbidity (NTU)	6	4.1	18.9	7.2	8.4	5.4
Total Dissolved Solids (mg/L)	7	74.0	162.0	130.0	128.4	28.4
Total Suspended Solids (mg/L)	7	3.0	23.0	7.0	9.3	7.4
Hardness (mg/L)	4	51.9	150.0	130.5	115.7	44.2
Alkalinity (mg/L)[J]	7	50.4	206.0	118.0	118.2	49.1
Photic Zone (m)	7	0.80	1.40	1.10	1.09	0.19
Secchi (m)	7	0.43	1.40	1.00	0.94	0.29
Bottom Depth (m)	7	0.8	1.4	1.1	1.1	0.2
Chemical						
Ammonia Nitrogen (mg/L)[J]	7	< 0.007	0.019	0.004	0.006	0.006
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	0.709	2.800	1.220	1.624	0.855
Total Kjeldahl Nitrogen (mg/L)	7	0.211	0.928	0.337	0.470	0.267
Total Nitrogen (mg/L)[J]	7	3.138	9.708	1.950	2.094	0.839
Dis Reactive Phosphorus (mg/L)[J]	7	0.008	0.127	0.030	0.042	0.040
Total Phosphorus (mg/L)	7	0.039	0.186	0.053	0.070	0.053
CBOD-5 (mg/L)	7	< 2.0	< 2.0	1.0	1.2	0.4
Chlorides (mg/L)	7	2.9	5.2	4.7	4.3	0.9
Biological						
Chlorophyll a (mg/m³)	7	0.53	6.23	3.20	2.92	1.81
E. coli (MPN/DL)[J]	4	93	687	188	289	276
WILL-1 2020	**N**	**Min**	**Max**	**Med**	**Avg**	**SD**
Physical						
Turbidity (NTU)	7	2.7	26.5	9.0	11.5	8.5
Total Dissolved Solids (mg/L)[J]	7	99.0	162.0	120.0	122.4	20.6
Total Suspended Solids (mg/L)[J]	7	2.0	58.0	15.0	18.6	18.8
Hardness (mg/L)	4	13.4	134.0	86.8	80.2	54.5
Alkalinity (mg/L)[J]	7	50.0	120.0	94.5	91.5	28.7
Photic Zone (m)	7	0.93	1.38	1.10	1.13	0.16
Secchi (m)	7	0.61	1.32	1.02	0.99	0.24
Bottom Depth (m)	7	0.9	3.0	1.1	1.4	0.7
Chemical						
Ammonia Nitrogen (mg/L)[J]	7	< 0.044	< 0.044	0.022	0.022	0.000
Nitrate+Nitrite Nitrogen (mg/L)[J]	7	0.167	2.530	1.580	1.522	1.006
Total Kjeldahl Nitrogen (mg/L)[J]	6	< 0.120	2.000	0.690	0.767	0.696
Total Nitrogen (mg/L)[J]	6	< 4.152	8.940	2.550	2.388	0.559
Total Phosphorus (mg/L)[J]	7	0.036	0.310	0.096	0.135	0.103
Chlorides (mg/L)[J]	7	2.9	5.1	4.4	4.3	0.7
Biological						
Chlorophyll a (mg/m³)[J]	6	1.07	78.00	1.74	14.52	31.11
E. coli (MPN/DL)	4	34	179	77	92	65

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

RESULTS (con't)

The mean growing season TP concentration decreased 2009 to 2015 but increased in 2018 and 2020. The 2020 mean was the highest observed in all years of sampling (Figure 4). In 2018, monthly TP concentrations were highest in July (Figure 5). In 2020, the highest monthly TP concentration was observed in late October.

The mean growing season chl *a* concentration remained stable 2013 to 2018, but the 2020 was the highest observed in all years of sampling due to a high monthly concentration measured in August (Figure 4). In 2018, monthly chl *a* concentrations were highest in October (Figure 5). August was the highest monthly concentration recorded in 2020.

According to mean annual TSI, the Big Nance Creek (Wilson Lake) embayment has been oligotrophic or mesotrophic in most years sampled (Figure 4). However, conditions were eutrophic in 2020. In 2018, monthly TSI calculations indicated oligotrophic conditions April-June and mesotrophic conditions August-October (Figure 5). In 2020, the site was oligotrophic all months sampled, except July, which was mesotrophic, and August, which was hypereutrophic.

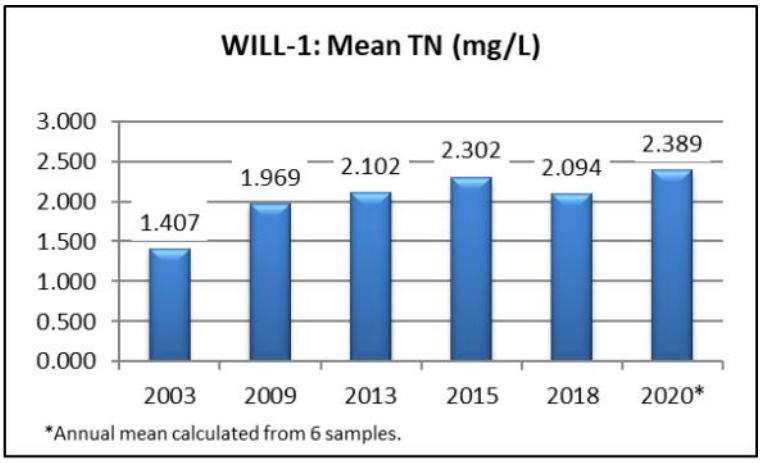
Mean growing season TSS concentrations increased since 2013 (Figure 4). The highest monthly TSS measurement was measured in July in 2018 and in late October in 2020 (Figure 6).

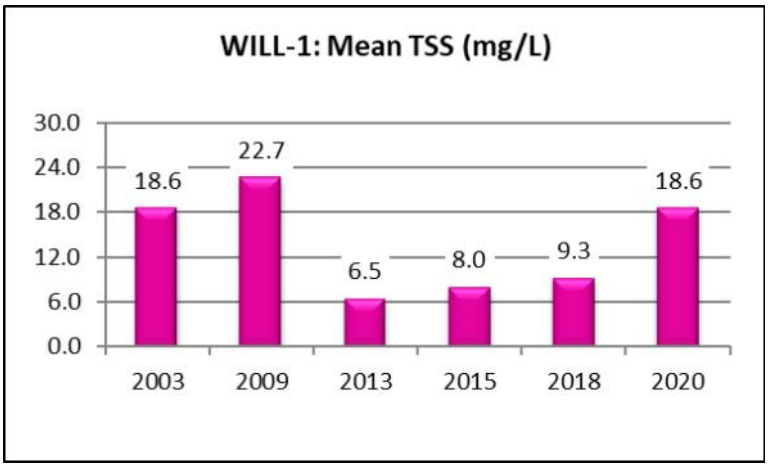
AGPT results show that Big Nance Creek (Wilson Lake) was phosphorus-limited in all years sampled (Table 3). While some samples were above the maximum standing crop (MSC) value of 5.0 mg/L that Raschke and Schultz (1987) found protective of reservoir and lake systems, all samples were below 20.0 mg/L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

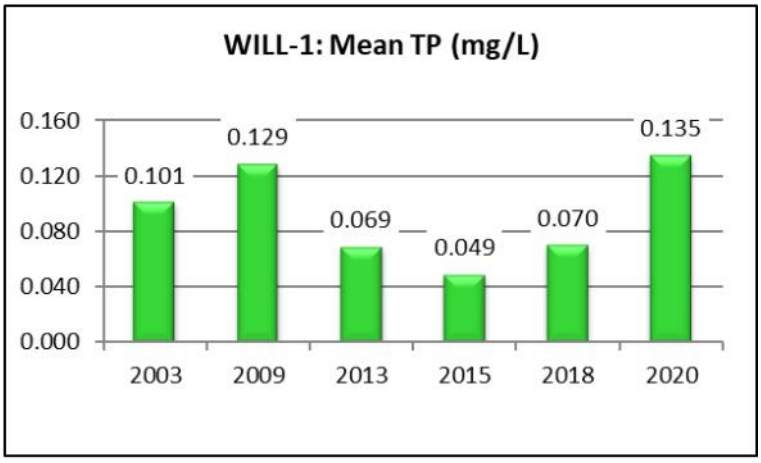
Dissolved oxygen (DO) concentrations at WILL-1 were above the ADEM minimum criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in all months sampled during both 2018 and 2020 (ADEM Admin. Code R. 335-6-10-.09) (Figure 7).

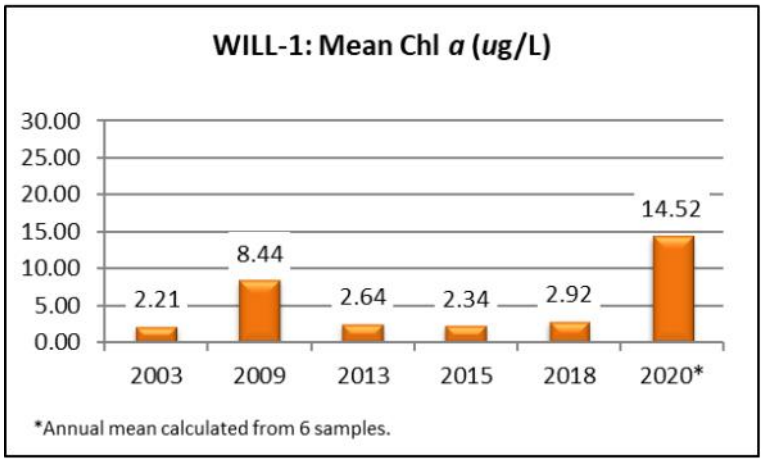
Table 3. Algal growth potential test results (expressed as mean maximum standing crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
2003	9.09	Phosphorus
2009	2.02	Phosphorus
2013	9.36	Phosphorus









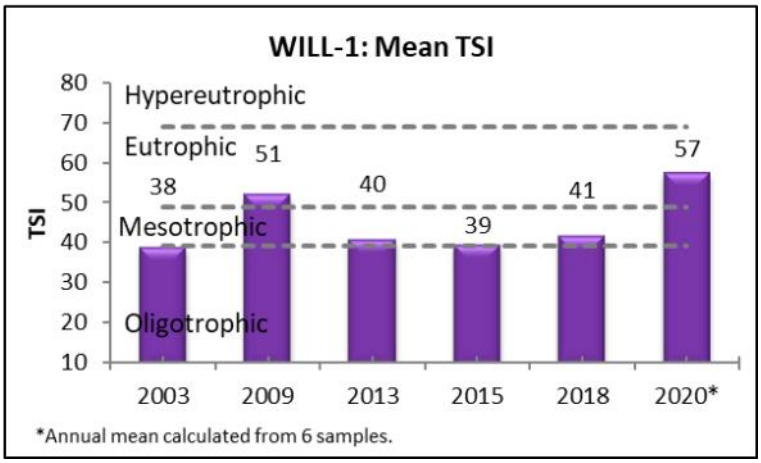
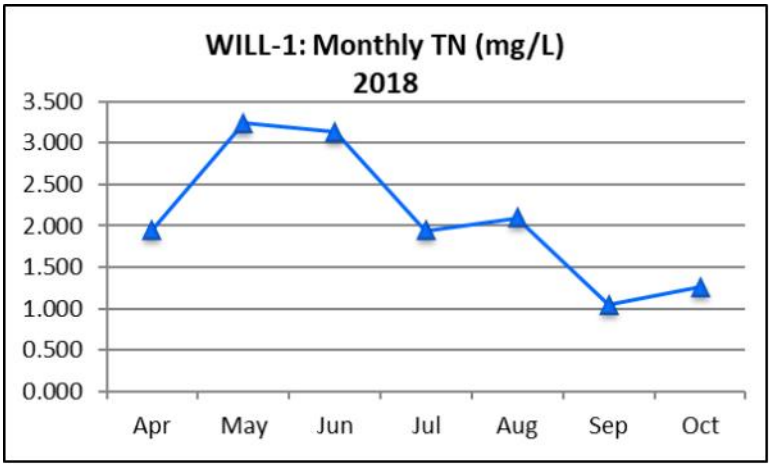
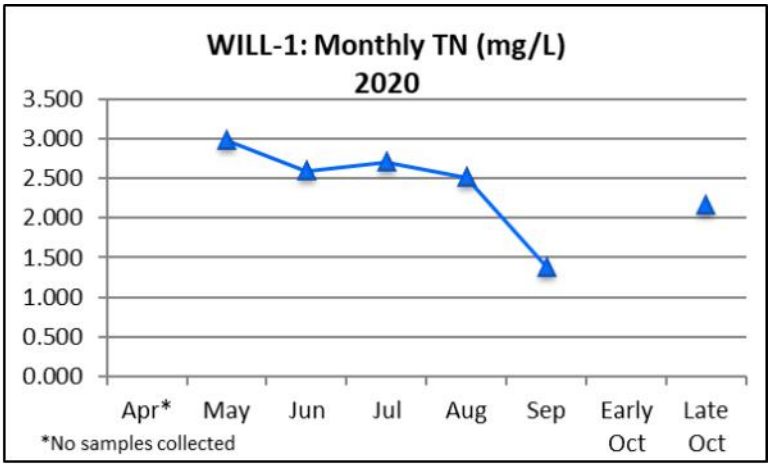
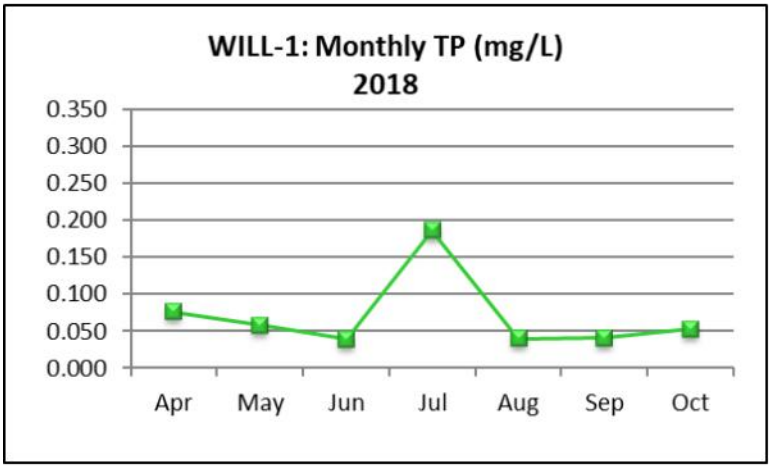
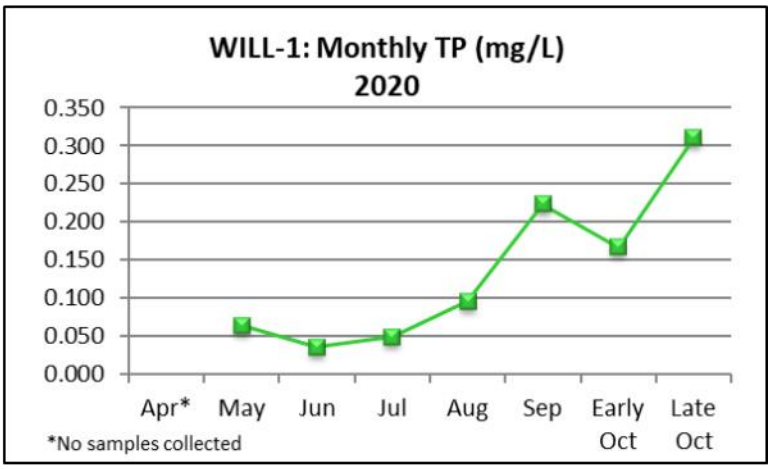


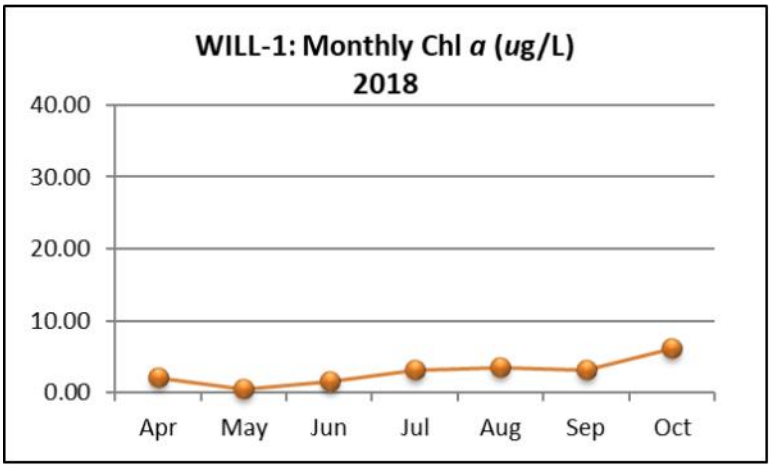
Figure 4. Mean growing season (2003-2020). TN, TP, chl *a,* and TSI measured in the Big Nance Creek (Wilson Lake) embayment (WILL-1). Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

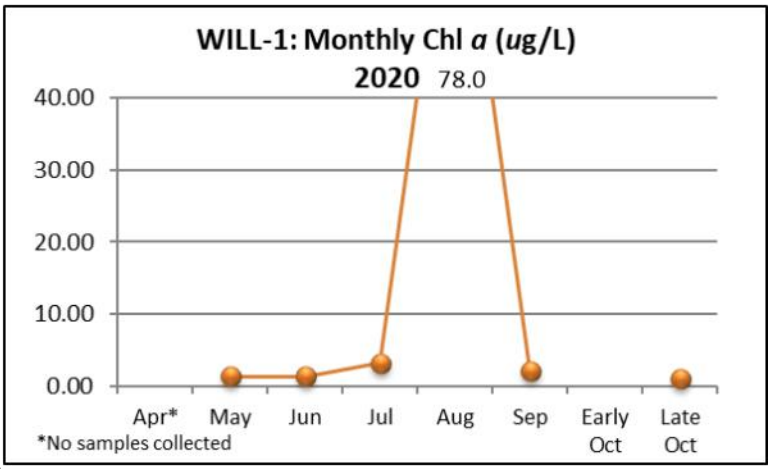


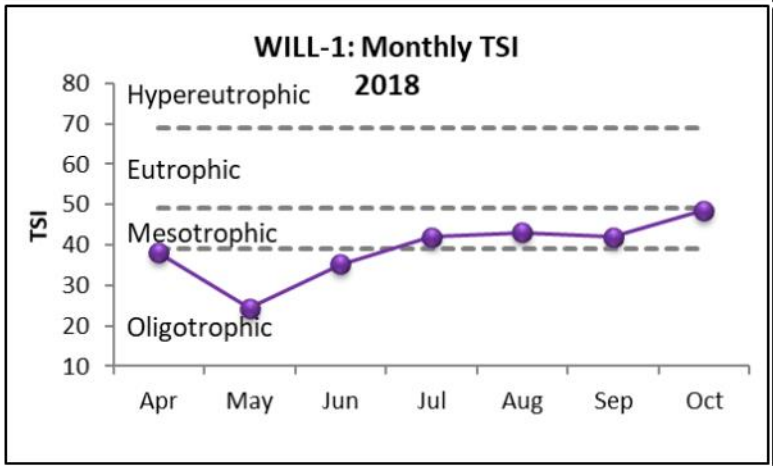












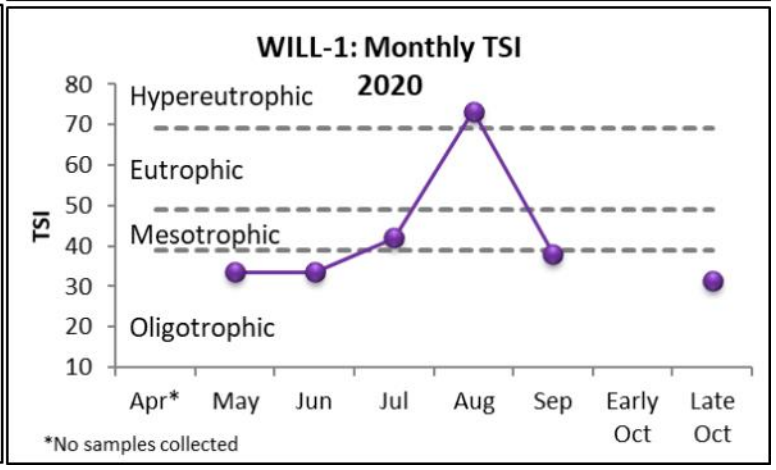


Figure 5. Monthly TN, TP, chl *a,* and TSI measured in the Big Nance Creek (Wilson Lake) embayment (WILL-1)**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

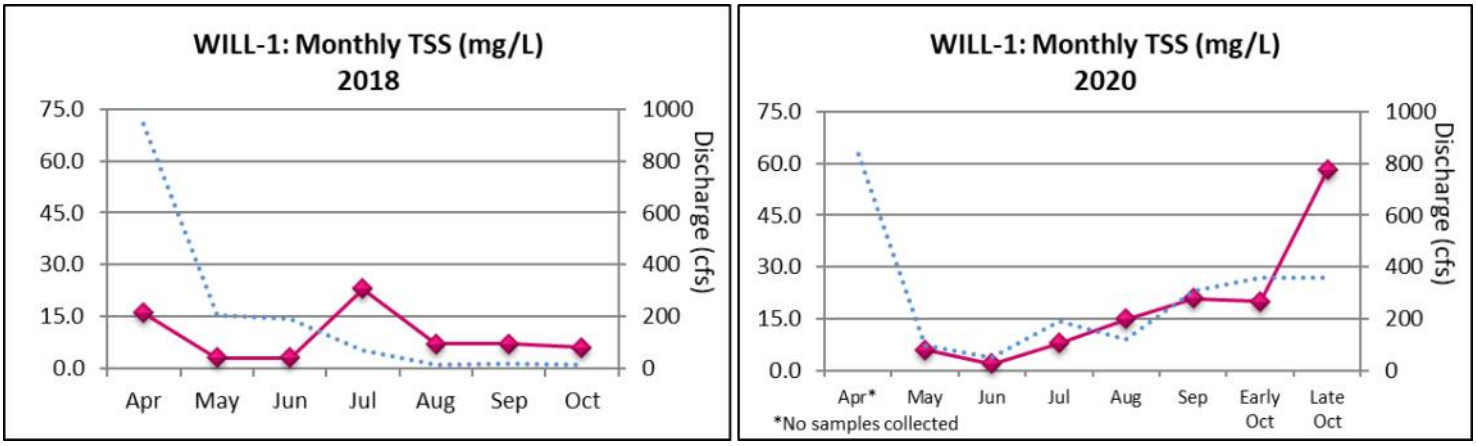


Figure 6. Monthly TSS measured in the Big Nance Creek (Wilson Lake) embayment (WILL-1) in 2018 and 2020**.** Mean monthly discharge data from USGS gage #03586500 on Big Nance Creek in Courtland, AL.

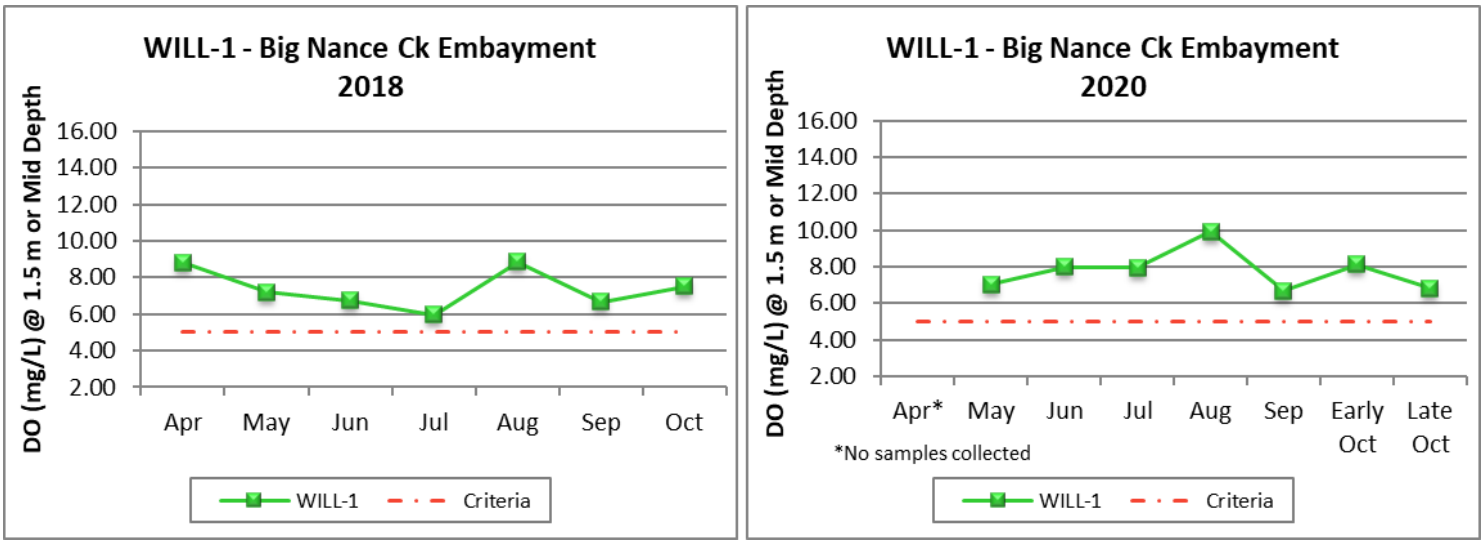


Figure 7. Monthly DO concentrations at 1.5 m (5 ft) for Big Nance Creek (Wilson Lake) embayment (WILL-1) collected in 2018 and 2020. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

REFERENCES

ADEM. 2017. State of Alabama Water Quality Monitoring Strategy. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 108 pp.

ADEM. 2020. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.

ADEM. 2018a. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama Rev 2. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 176 pp.

ADEM. 2018b. Quality Management Plan (QMP) for the Alabama Department of Environmental Management (ADEM) Rev 5.0, Montgomery, AL. 72 pp.

Alabama Department of Environmental Management Water Division (ADEM Admin. Code R. 335-6-10-.09). 2017. Specific Water Quality Criteria. 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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