Alabama Department of Environmental Management

Tennessee River Basin

Rivers and Reservoirs Monitoring Program

Round Island Creek Embayment
Wheeler Reservoir
Intensive Basin Survey 2018 & 2021

WHEL-8: Round Island Creek approx. 1.5 mi upstream of confluence with TN River (Limestone Co 34.69864/-87.05074)

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 2021, ADEM monitored the Round Island Creek (Wheeler 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 Round Island Creek (Wheeler Lake) embayment (WHEL-8) during the 2018 and 2021 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 fish tissue data collected by ADEM at WHEL-8. Therefore, as an indication of an impaired use, Round Island Creek (Wheeler Lake) from the confluence with the Tennessee River (Wheeler Lake) upstream to the end of the embayment was listed on ADEM's 2016 §303(d) list of impaired waterbodies.

Figure 1. Round Island Creek (Wheeler Lake) at WHEL-8.

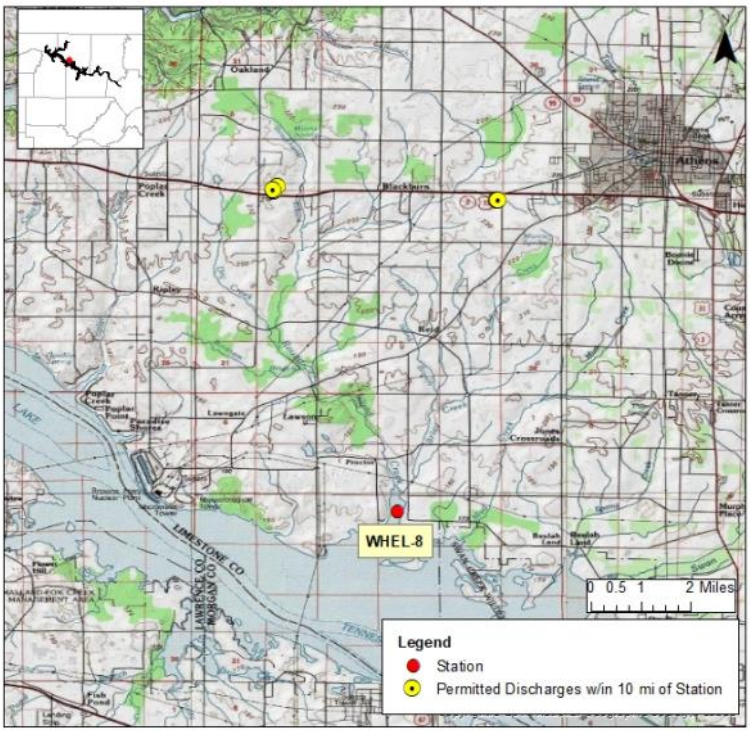


Figure 2. Map of the Round Island Creek (Wheeler Lake) embayment. Though additional discharges may occur in the watershed (Table 1), only permitted discharges within 10 miles of the station are displayed on the map.

WATERSHED CHARACTERISTICS

Watershed land uses are summarized in Table 1. Round Island Creek (Wheeler Lake) embayment is classified *Swimming/Fish & Wildlife (S/F&W)* and located in the Eastern Highland Rim ecoregion (71g). Based on the 2021 National Land Cover Dataset, land use within the 50 mi^2 watershed is predominantly cropland and pasture (Figure 3). As of February 13, 2024, ADEM has issued permits for a total of seven NPDES outfalls within the watershed (Figure 2).

Table 1. Summary of Watershed **WHEL-8**

Basin		Tennessee R
Assessment Unit		AL06030002-1103-111
Drainage Area (mi^2)		50
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	6%
	Evergreen Forest	2%
	Mixed Forest	1%
Shrub/Scrub		1%
Herbaceous		1%
Hay/Pasture		32%
Cultivated Crops		34%
Wetlands	Woody	14%
	Emergent Herb.	1%
# NPDES outfalls[b]	TOTAL	7
Industrial General		7

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

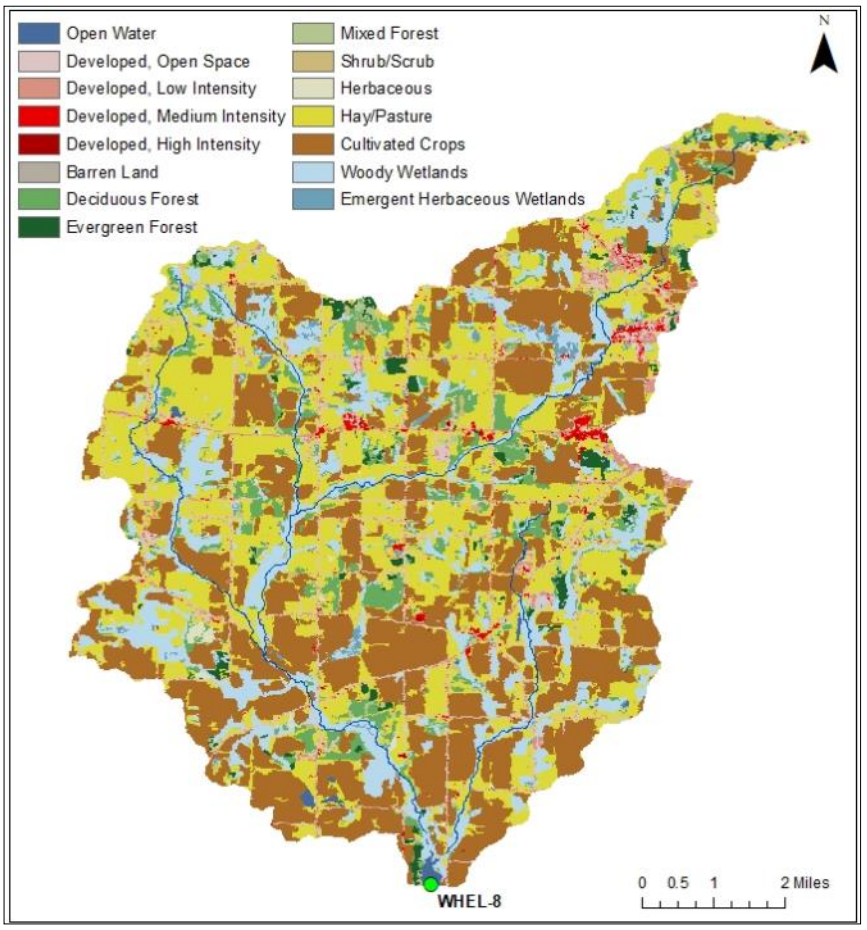


Figure 3. Land use within the Round Island Creek (Wheeler Lake) watershed at WHEL-8.

SITE DESCRIPTION

The Round Island Creek (Wheeler Lake) embayment at WHEL-8 is located just south of Athens, AL. It is a fairly wide and shallow embayment, which flows into the Tennessee River near river mile 297. Round Island Creek (Wheeler Lake) had a mean bottom depth of 2.6m in 2018 and 2.9m in 2021 (Table 2) at the sampling location.

METHODS

Water quality samples were conducted at monthly intervals, April-October in 2018 and 2021. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2021), 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 2021 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 2013, but annual means declined to about 1 mg/L since then (Figure 4). Monthly TN concentrations were highest in April in 2018 and in July in 2021 (Figure 5).

Mean growing season TP concentrations decreased 2003 to 2015 and appeared to level off since then, though more recent annual means may be trending slightly upward (Figure 4). The highest monthly TP value was observed in April in 2018 and in May in 2021(Figure 5).

Table 2. Summary of water quality data collected April-October, 2018 and 2021. 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-8 2018	N		Min	Max	Med	Avg	SD
Physical							
Turbidity (NTU)	7		9.4	40.5	14.8	19.4	11.2
Total Dissolved Solids (mg/L)	7		66.0	95.0	85.0	83.0	9.9
Total Suspended Solids (mg/L)	7		8.0	30.0	13.0	16.4	8.5
Hardness (mg/L)	4		49.8	64.0	57.4	57.2	5.9
Alkalinity (mg/L)	7		43.2	60.5	55.2	53.1	6.3
Photic Zone (m)	7		1.39	2.29	2.02	1.95	0.30
Secchi (m)	7		0.39	0.87	0.66	0.63	0.17
Bottom Depth (m)	7		2.0	3.1	2.7	2.6	0.3
Chemical							
Ammonia Nitrogen (mg/L)[J]	7	<	0.007	0.182	0.004	0.030	0.067
Nitrate+Nitrite Nitrogen (mg/L)	7	<	0.004	0.575	0.178	0.261	0.264
Total Kjeldahl Nitrogen (mg/L)	7		0.395	1.180	0.912	0.833	0.312
Total Nitrogen (mg/L)	7	<	1.248	5.238	1.002	1.094	0.547
Dis Reactive Phosphorus (mg/L)[J]	7	<	0.004	0.080	0.004	0.015	0.029
Total Phosphorus (mg/L)	7		0.026	0.124	0.039	0.050	0.035
CBOD-5 (mg/L)	7	<	2.0	4.2	2.2	2.4	1.2
Chlorides (mg/L)	7		3.9	6.9	6.0	5.8	1.0
Biological							
Chlorophyll a (mg/m³)	7		3.20	30.30	10.70	13.49	9.56
E. coli (MPN/DL)[J]	4	<	1	36	26	22	16

WHEL-8 2021	N		Min	Max	Med	Avg	SD
Physical							
Turbidity (NTU)	7		6.1	14.9	11.0	10.3	3.1
Total Dissolved Solids (mg/L)[J]	7		30.0	85.0	76.0	69.3	18.2
Total Suspended Solids (mg/L)[J]	7		5.0	16.0	12.0	11.0	4.1
Hardness (mg/L)	4		54.4	63.3	57.0	57.9	4.0
Alkalinity (mg/L)	7		43.6	56.4	52.3	50.6	5.5
Photic Zone (m)	7		2.18	3.89	2.30	2.52	0.61
Secchi (m)	7		0.63	1.46	0.87	0.94	0.29
Bottom Depth (m)	7		2.3	3.9	2.8	2.9	0.5
Chemical							
Ammonia Nitrogen (mg/L)	7	<	0.016	0.055	0.023	0.025	0.014
Nitrate+Nitrite Nitrogen (mg/L)	7		0.094	0.888	0.303	0.475	0.336
Total Kjeldahl Nitrogen (mg/L)[J]	7	<	0.324	0.987	0.162	0.379	0.329
Total Nitrogen (mg/L)[J]	7	<	1.152	3.435	0.943	0.854	0.305
Dis Reactive Phosphorus (mg/L)[J]	7	<	0.004	0.019	0.004	0.006	0.006
Total Phosphorus (mg/L)	7		0.029	0.158	0.038	0.059	0.046
CBOD-5 (mg/L)[J]	7	<	2.0	3.1	2.4	2.1	0.8
Chlorides (mg/L)	7		5.3	6.4	5.5	5.7	0.4
Biological							
Chlorophyll a (mg/m³)	7		3.20	48.80	24.70	23.91	13.61
E. coli (MPN/DL)[J]	4		5	25	13	14	9

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

RESULTS (con't)

Mean growing season chl *a* concentrations decreased from 2013 to 2015 but increased since then, with the 2021 annual mean being the highest calculated overall (Figure 4). In 2018, monthly chl *a* concentrations were highest in May (Figure 5). September was the highest monthly concentration recorded in 2021.

According to mean annual TSI, the productivity of the Round Island Creek (Wheeler Lake) embayment has been eutrophic every sampling year (Figure 4). In 2018, monthly TSI calculations indicated eutrophic conditions in all months sampled except April and June, which were mesotrophic (Figure 5). In 2021, the site was eutrophic in all months except October, which was mesotrophic.

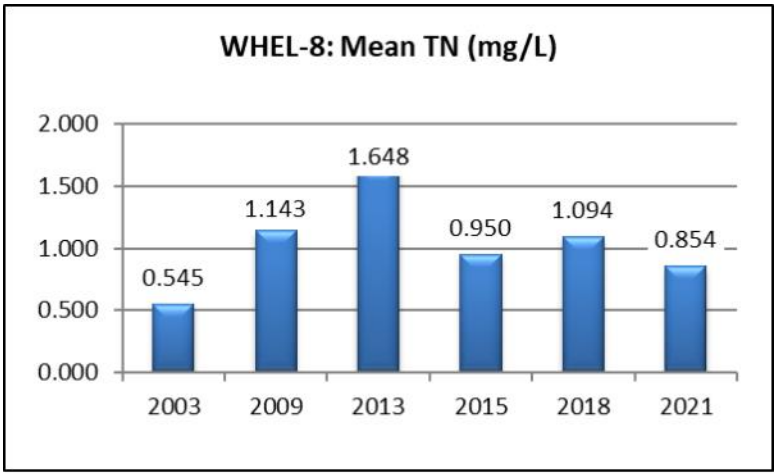
In general, mean growing season TSS concentrations decreased 2003 to 2021, with the 2021 annual mean being lowest overall (Figure 4). In 2018, the highest monthly TSS concentration was recorded in October (Figure 6). In 2021, April had the highest monthly TSS concentration, but there was little variability throughout the growing season, with values ranging from 5-16 mg/L.

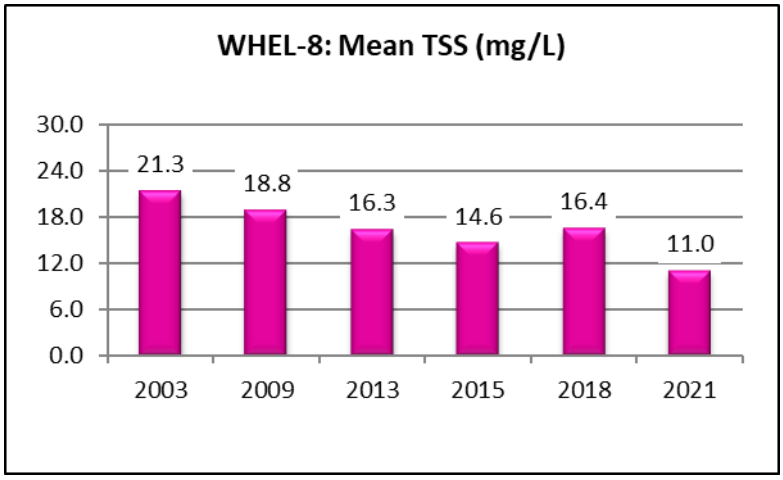
AGPT results show that Round Island Creek (Wheeler Lake) was nitrogen-limited in 2003 and 2009 and phosphorus-limited in 2013 (Table 3). All samples were greater than the maximum standing crop (MSC) value of 5.0 mg/L that Raschke and Schultz (1987) found protective of reservoir and lake systems. However, they were all below 20.0 mg/L MSC, which Raschke and Schultz define as protective of flowing stream and river systems.

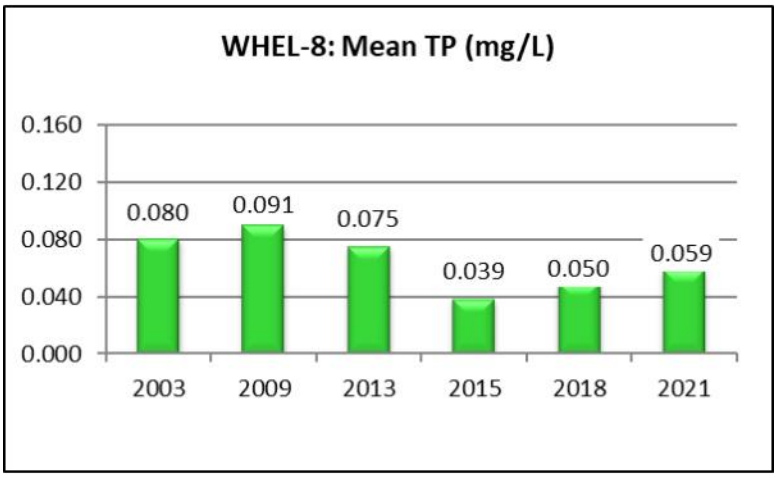
Dissolved oxygen (DO) concentrations at WHEL-8 were above the ADEM minimum criteria limit of 5.0 mg/L at 5.0 ft (1.5 m) in all months sampled during both 2018 and 2021 (ADEM Admin. Code R. 335-6-10-.09) (Figure 7).

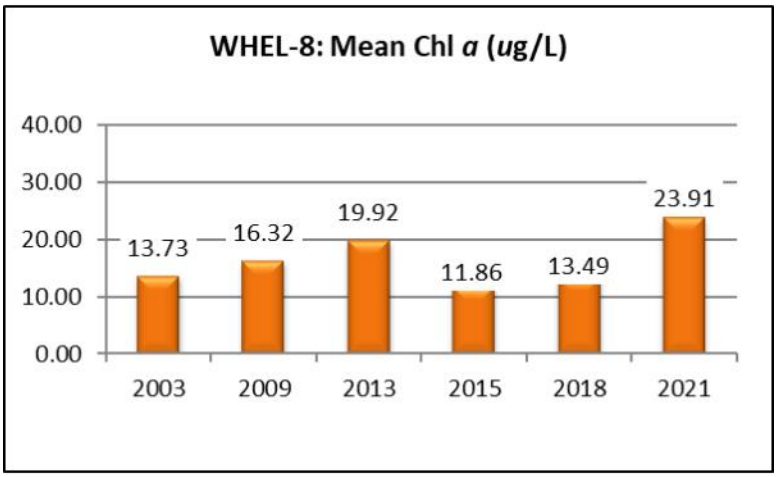
Table 3. Algal growth potential test results (expressed as mean maximum standing crop (MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

Year	Mean MSC	Limiting Nutrient
2003	5.20	Nitrogen
2009	7.95	Nitrogen
2013	8.52	Phosphorus









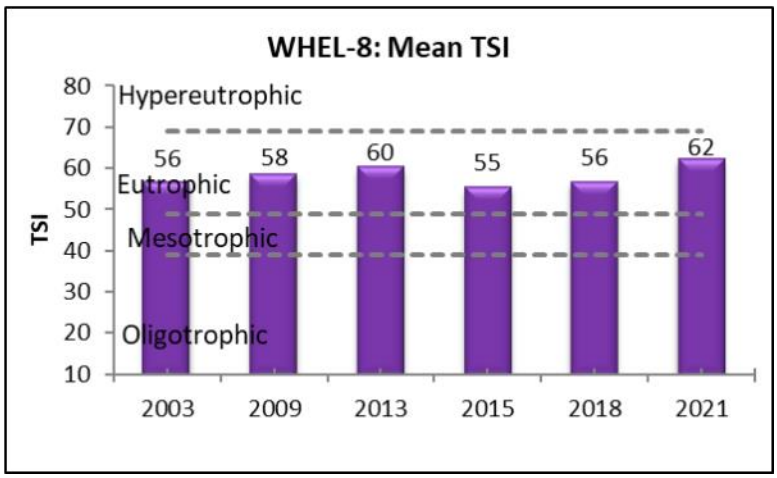
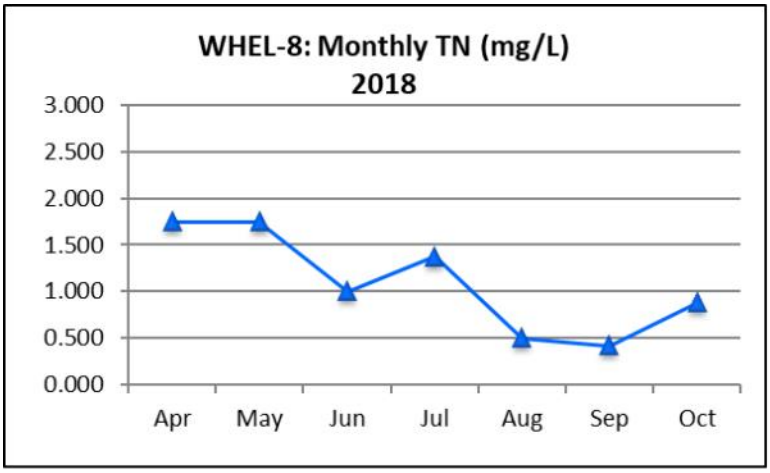
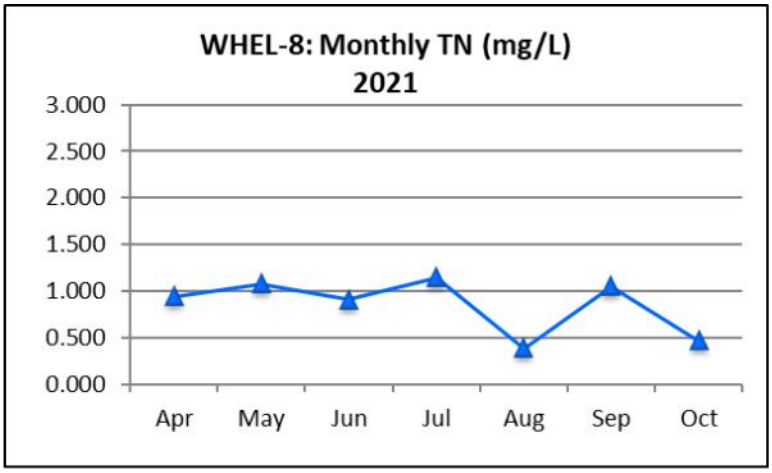
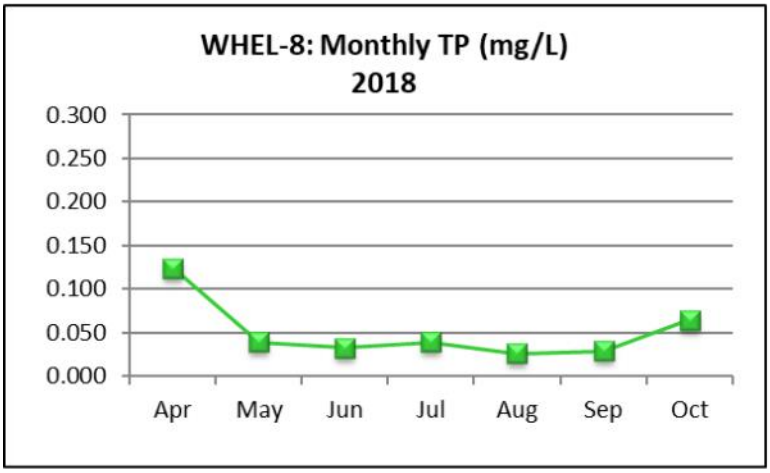
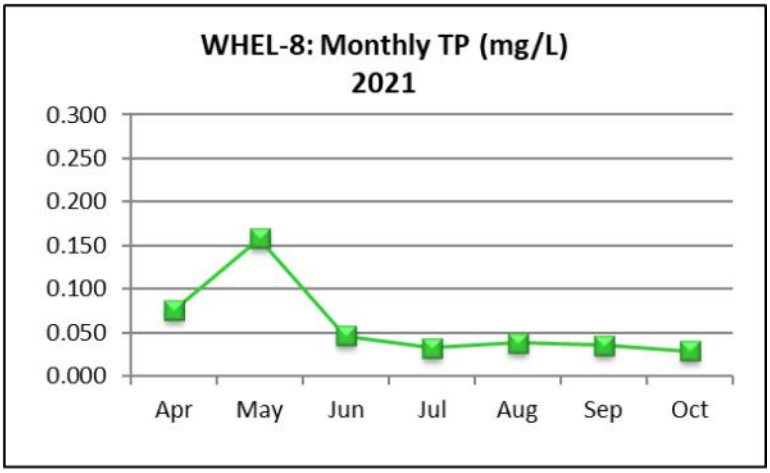


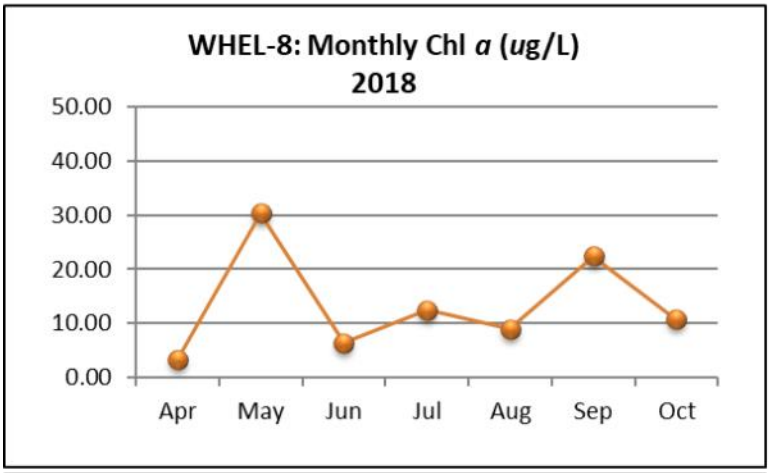
Figure 4. Mean growing season (2003-2021). TN, TP, chl *a,* and TSI measured in the Round Island Creek (Wheeler Lake) embayment (WHEL-8)**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

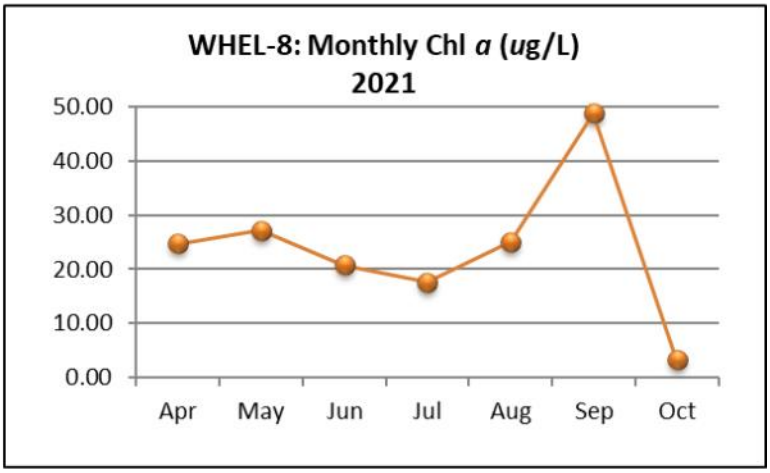


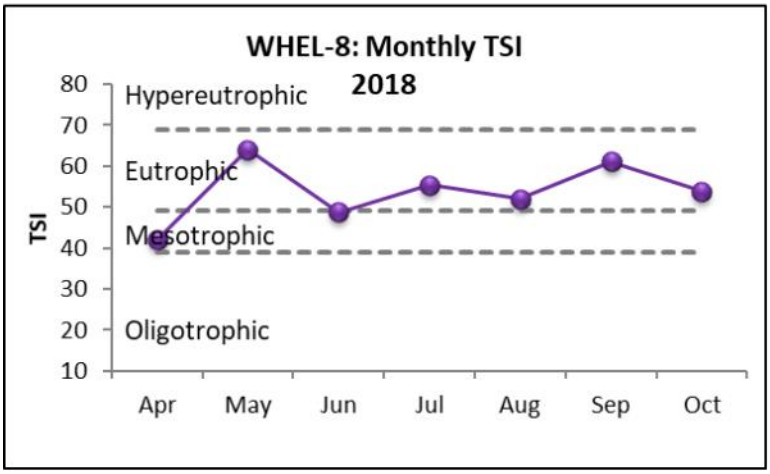












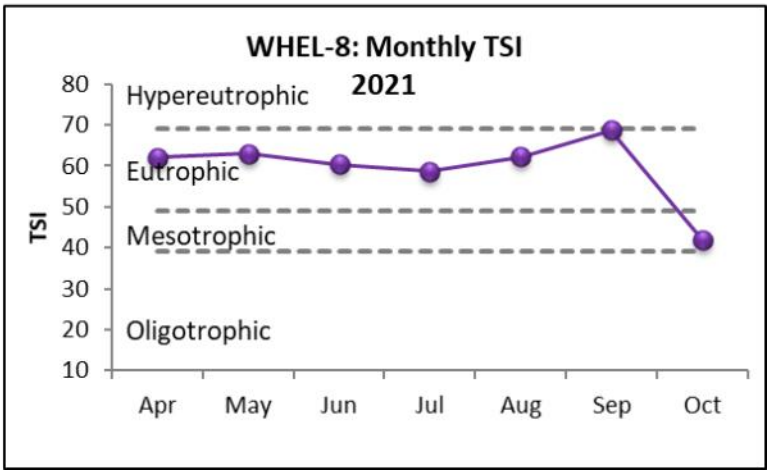


Figure 5. Monthly (April-October, 2018 & 2021) TN, TP, chl *a,* and TSI measured in the Round Island Creek (Wheeler Lake) embayment (WHEL-8)**.** Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.

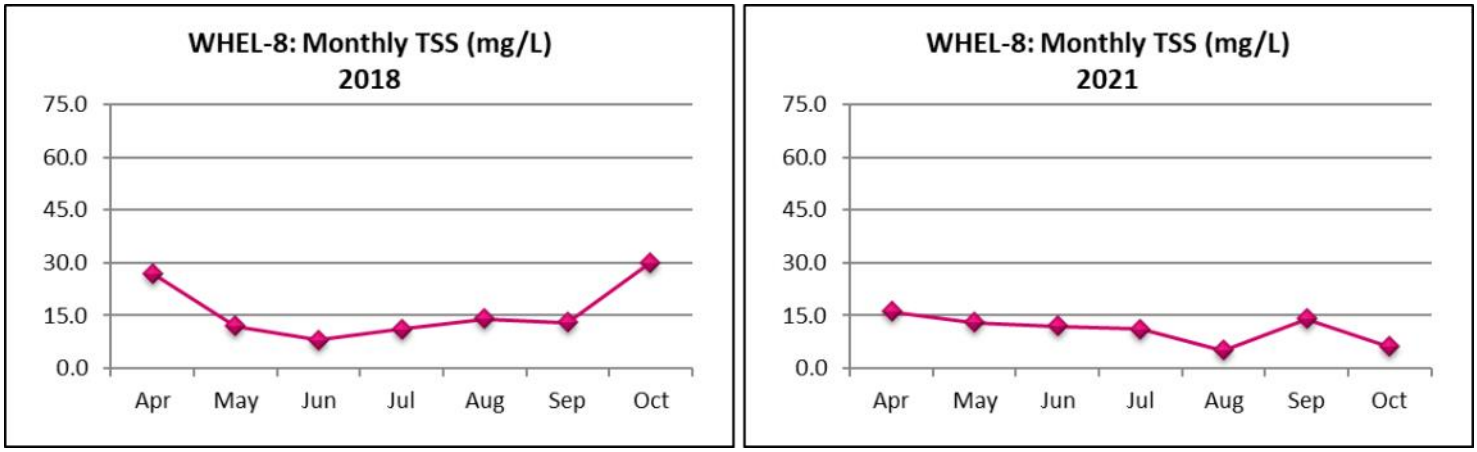


Figure 6. Monthly TSS measured in the Round Island Creek (Wheeler Lake) embayment (WHEL-8) in 2018 and 2021**.**

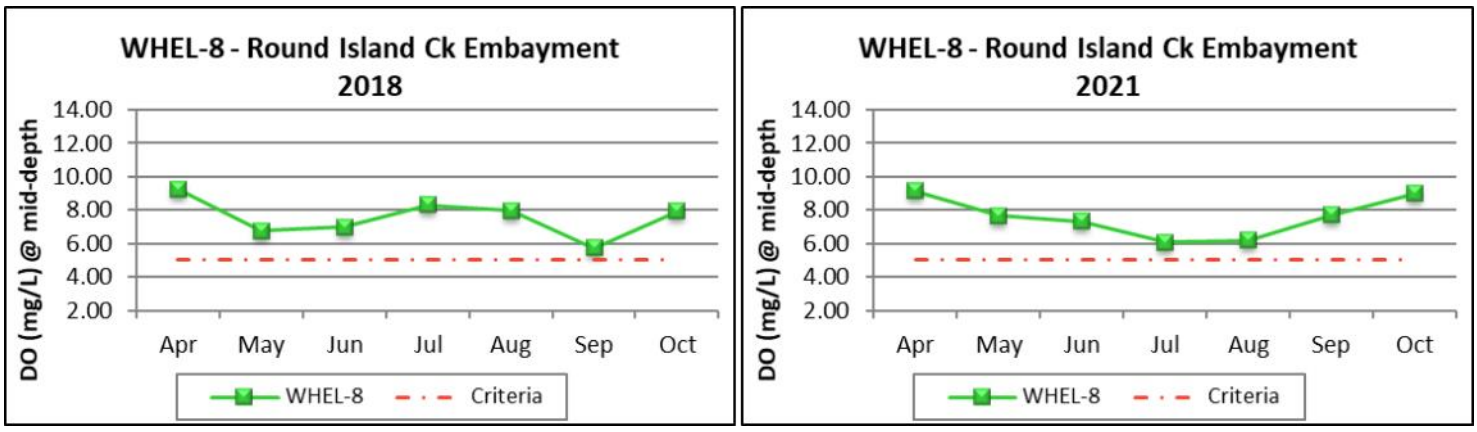


Figure 7. Monthly DO concentrations at 1.5 m (5 ft) for Round Island Creek (Wheeler Lake) embayment (WHEL-8) collected April-October 2018 and 2021. ADEM Water Quality Criteria pertaining to reservoir waters require a minimum DO concentration of 5.0 mg/L at this depth.

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