

A Plan for Monitoring Algae in Tellico Reservoir

by

Water Quality Improvement Committee of WATeR

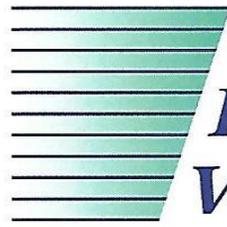
Introduction

The Tellico Reservoir was formed when the Tennessee Valley Authority (TVA) completed the Tellico Dam on the Little Tennessee River in 1979 creating a 16,500-acre impoundment extending more than 30 miles upstream to the base of Chilhowee Dam. The Tellico Reservoir Watershed is defined for purposes of this study as the region in which creeks and rainfall flow into the Reservoir, but it excludes the drainage area upstream of Chilhowee Dam. This upstream region drains runoff primarily from national forests and the North Carolina side of the Great Smokey Mountains National Park. There are no major cities and very little industry throughout this region. The headwaters of the smaller Tellico River are also primarily located in national forests and considered clean. Consequently, the water feeding into Tellico Reservoir in this area is exceptionally unpolluted. The inflow of clean water to the Reservoir continues for 10 miles or so downstream from Chilhowee Dam.

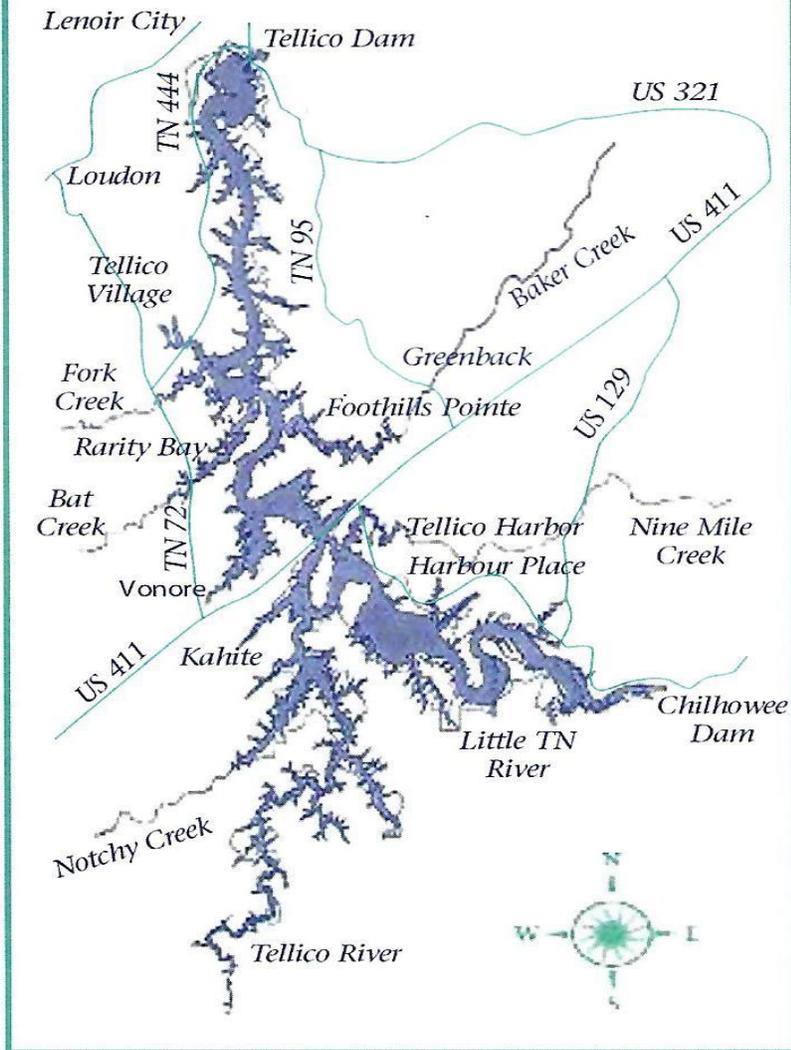
However, most streams flowing into the Reservoir beyond this area meander through agricultural areas and are classified by the Tennessee Department of Environment and Conservation (TDEC) as impaired, due to excess concentrations of nutrients, sediment, and E coli. Runoff from urban and industrial parks also contribute undesirable pollutants. Although both industry and urbanization are confined to proper TVA designated zones, both sources have experienced exceptional growth, a trend which is expected to continue. The population in new communities around the Reservoir is currently estimated at about 15,000 residents.

The Water Quality Improvement Committee (WQIC) is composed of a team of experienced retirees with expertise in various aspects of environmental water resources. Their mission is to protect and improve water quality throughout the watershed of the Tellico Reservoir. WQIC is an arm of the Watershed Association of the Tellico Reservoir (WATeR), an all-volunteer 501(c3) organization incorporated in Tennessee in 2001.

The WQIC team has supported local agencies such as the Natural Resources Conservation Service (NRCS), the University of Tennessee Extension Service, and county soil conservation districts who are working with farmers to implement Best Management Practices to limit runoff pollution. These projects are showing improvements in water quality, but changes require time to heal the ecosystem of the streams. Urbanization, which increases stormwater runoff containing fertilizer, is likely offsetting much of the reduction from agricultural contribution. Therefore, the WQIC is adding emphasis on residential areas for environmental water quality protection.



TELLICO RESERVOIR WATERSHED



Environmental Concern

The environmental concern addressed by this project is the potential of a Harmful Algae Bloom (HAB) in the Reservoir. The presence of excess concentrations of nutrients (i.e., nitrogen and phosphorus) from stormwater runoff containing fertilizer can contribute to algae blooms and the formation of HAB. The U.S. Environmental Protection Agency (USEPA) and therefore TDEC consider this a primary water resource environmental issue. High levels of algal growth are due to the presence of phytoplankton, single cell algae that are ubiquitous in the surface layers of freshwater lakes and streams. There are three main classes of phytoplankton: dinoflagellates, diatoms, and cyanobacteria. While the first two are considered harmless, excess growth due to high levels of nutrients can lead to increased amounts of organic matter in a lake. This in turn decreases the dissolved oxygen concentrations below levels necessary to sustain other aquatic life. In the extreme, fish kills can result. The third class, cyanobacteria, produce cytotoxins which are harmful to humans and animals. High concentrations of cytotoxins can make a lake unsuitable for swimming and other recreational activities.

There are numerous examples of this concern ranging in size from 6,300 square miles of an annual dead zone in the Gulf of Mexico emanating from nutrients in the Mississippi River, to small urban ponds. WQIC was recently asked for advice in dealing with a HAB in a residential area in Maryville, TN (photo below). This is a spring-fed pond surrounded by homes whose yards drained into the pond.



Residential Pond in Maryville, TN with Algae Bloom

Residents living near Tellico Reservoir have noticed that the water appears greener than several decades ago. This is consistent with a recent article in *American Scientist*, Vol 109 which reported that “A study of satellite images found that one-third of U.S. rivers have undergone significant color changes over the past few decades. The color variations are related to the levels of algae and sediment in the water...indicating that human involvement is a driver of the shift.”

Warm water with little flow containing higher levels of nitrogen and phosphorus promotes a hazardous algae bloom. The probability of a cyanobacteria bloom occurring increases when water temperature exceeds 68 degrees F and phosphorus concentrations exceeds 10ug/l (G. Knoecklein – *NALMS Workshop “Ecology of Cyanobacteria”*, 2021). Numerous coves in embayments with negligible flow rates and manicured lawns along the shoreline provide ideal conditions for algal growth. Population increase teamed with a warming climate will exacerbate this condition.

The USEPA developed the Cyanobacteria Assessment Network (CyAN). This network has noted the presence of concentrations of cyanobacteria in Tellico Reservoir. Some very high concentrations were measured in 2019.

The WQIC performed a study in 2020 to investigate the current trophic status of the Reservoir. Generally, the variables indicated the reservoir was borderline mesotrophic/eutrophic. Water clarity was relatively consistent, even when compared with a longer TVA record. Laboratory tests of samples collected at several locations were analyzed to classify types and concentrations of phytoplankton, a sample of which is presented below. This monitoring experience will serve as a guide for an expanded Reservoir monitoring program.

Algae Identification July and September 2020

- Baker Creek
 - 18 species – 28 species
 - 6,805 units - 7,027 units
 - Diatoms 5,200 units – 1,200
 - *Planktolyngba limnetica*
 - 1,000 units - 3,650
- Fork Creek
 - 14 species – 21 species
 - 12,171 units - 7,829 units
 - Pennate Diatom 11,300 units – 5,900
 - *Planktolyngba & Microcystis*
 - 80 Units – 23 & 0
 - *Aphanocapsa delicatissima*
 - 0 – 69 (10,330 cells/ml)
- Yacht Club
 - 16 species - 18 species
 - 4,689 units - 3,244 units
 - *Planktolyngba limnetica*
 - 3,600 units - 320 units
 - Diatom 800 units - 1,600
- Bat Creek
 - 15 species - 19 species
 - 7,870 units - 10,950 units
 - *Planktolyngba limnetica*
 - 4,200 units - 6,700
 - Diatom 2,800 units - 1,940

None of the algae found above are in a dangerous category, but could be a nuisance if they bloom.

The objectives of the Tellico Reservoir Algae Monitoring study are:

- To document the algal composition of the Reservoir,
- To document the sources of nutrient inputs to the Reservoir,
- To provide data to support promotion of the Tennessee Smart Yard program, and
- To promote the need for reducing phosphorus in fertilizer around the lake.

Monitoring Plan

Site-specific monitoring will define trends, warn of approaching environmental concern, and provide guidance for corrective action. It is always preferable to anticipate and avoid a problem than to remediate after the occurrence which can be expensive and lengthy. This monitoring program is designed to gather such data for analysis and public notification.

Monitoring Locations – Sample collection sites were selected to define algae and related parameters from three regions:

- Inflow to the Reservoir
- Main channel
- Selected coves where algae might first appear.

The inflow from upstream would be monitored downstream from Chilhowee Dam at the Tallassee Boat Ramp to define conditions introduced into the Little Tennessee River from upstream sources. Similarly, the Fairview Boat Ramp, a site in the Tellico River prior to backwater from the Reservoir, would be selected. Several creeks in the downstream portion of the Watershed flow through agricultural regions and are classified as impaired because of excess concentrations of nitrogen and phosphorus. Although the flow rates of these creeks are much less than that of the two rivers, the quantity of nutrients from these creeks to the Reservoir cannot be ignored.

Two locations in the main channel are recommended as sampling sites, mid-reservoir at Mile 15 and near Tellico Dam at Mile 1. Sampling at these sites will provide data for comparison with TVA data collected over many years. Data from the site near Tellico Dam will be compared with the upstream collective sites near Chilhowee Dam and the Tellico River to imply the net addition of nutrients to the Reservoir.

To determine the contribution of nutrients from stormwater runoff from residential areas, several collection sites will be selected in isolated coves of the Reservoir which have negligible flow and surrounded by homes. These sites should not be near the mouth of any

major creek that might be a source of flow already polluted with excess nutrients. One such site should also be located to measure the contribution of nonpoint source pollution from the Tellico West Industrial Park near Mile 17.

The following table summarizes the number and distribution of sampling locations:

Regions	No. of Sites
Upstream rivers to Reservoir	2
Main Channel Miles 1 & 15	2
Creeks	5
Coves	5

Total =14

Monitoring Frequency – Water samples will be collected monthly from June through October of each year. This will assure that the Reservoir is at summer elevations and span the warmer season when algae is most likely to become a nuisance. All samples should be collected within a two-day period.

Parameters for Analysis and Reporting – Local weather conditions should be recorded for each sample collected. This will include air temperature and sky coverage. Water temperature should be recorded about one foot below the surface. A secchi disc will be used to measure the water clarity. Rainfall during the previous two days will be noted as would wind direction and velocity. Lake samples will be collected using an integrated sampler.

Samples submitted to laboratories will be analyzed for concentrations of nitrogen, phosphorus, silica, and algae concentration and classification.

The Cyanobacteria Assessment will be monitored weekly. If a Cyanobacteria bloom of “yellow” is detected, samples will be collected to determine algae presence and concentration.

Data Analysis and Reporting

Laboratory reports will be sent to the Project Manager (PM) to be distributed to all Team members as soon as available each month. Comments from Team members will be submitted to the PM for consideration. An open Team meeting will be held after results are available from the second monthly sample date to discuss trends and suggested modifications in procedure. Anyone interested may attend.

The PM is responsible for preparing a written Annual Report with findings and recommendations for modifications to the plan for next year. The Annual Report should be widely distributed including to the WATeR Board, the WATeR web site, partner agencies, and the community.

Considering that this is a new program, WATeR may choose to begin with a scaled down version of this plan for the summer of 2022 as a Pilot Program. This would consist of a limited number of sample sites, depending upon such factors as available funds and trained volunteers. Based upon experience, the plan might be revised with the full plan implemented for the summer or 2023. This plan is designed to be open-ended and to continue indefinitely.

If results indicate a trend leading to a HAB in Tellico Reservoir, it should be widely publicized, and corrective action aggressively promoted. The WQIC recently introduced the Tennessee Smart Yard (TSY) Program administered through the University of Tennessee Extension Institute as a means of restricting nonpoint source pollution from lawns. The Tellico Village Homeowners Association (HOA) is currently promoting the TSY program in Tellico Village as a pilot program. Current data collected in Tellico Reservoir will support the HOA in promoting better lawn management, and assist WATeR to promote the TSY program in other communities throughout the Watershed.