

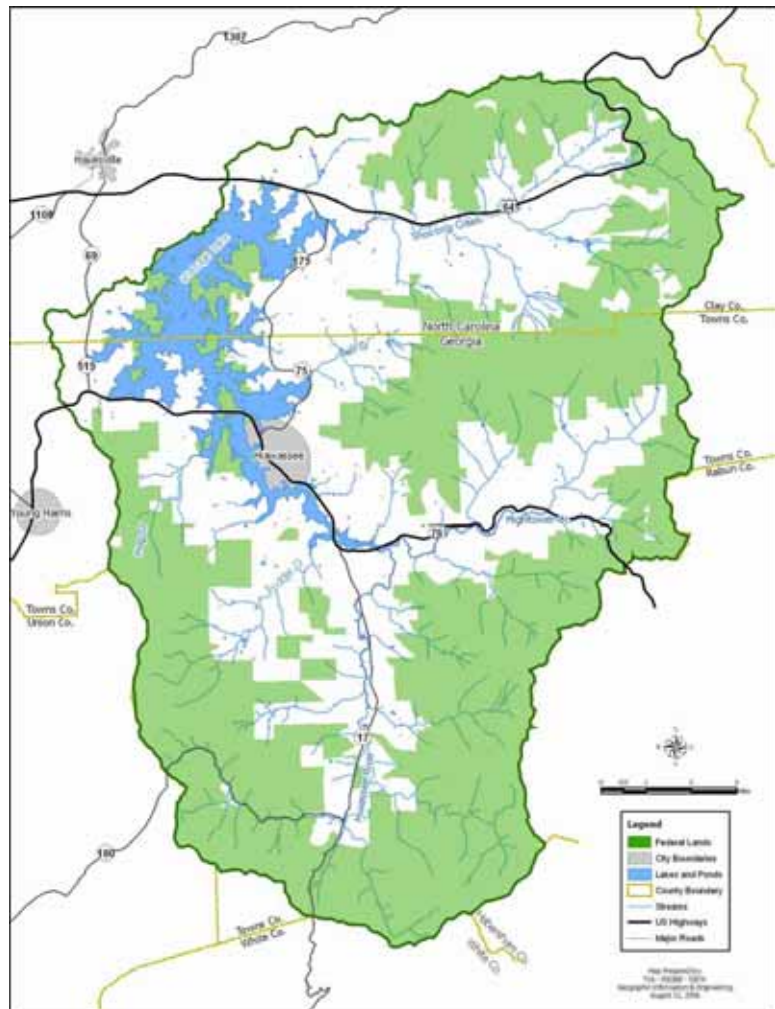
# Executive Summary

## General Description of the Lake and Watershed

Lake Chatuge is a 7,000-acre impoundment of the Hiwassee River located in the Blue Ridge Mountains of North Georgia and Western North Carolina. The reservoir straddles the border of the two states and the area of land draining to the dam lies wholly within Towns County, GA and Clay County, NC. The Lake Chatuge dam is the uppermost of four dams on the Hiwassee River, three of which were built and are still owned by the Tennessee Valley Authority (TVA).

Lake Chatuge lies within three hours of drive time from four major cities in four different states: Atlanta, Georgia; Chattanooga, Tennessee; Greenville, South Carolina; and Asheville, North Carolina. Hiawassee, GA is the only municipality that lies within the watershed; however, Young Harris, GA and Hayesville, NC are located just a few miles outside the watershed boundary.

More than 37 percent of the Lake Chatuge watershed (70.3 mi<sup>2</sup>) lies within two National Forests: Nantahala National Forest in North Carolina and Chattahoochee National Forest in Georgia. The headwaters of the Hiwassee River and several major tributary streams lie within this federally protected forestland and feed Lake Chatuge, offering substantial water quality protection.



Lake Chatuge makes up about six percent of the drainage area above Chatuge Dam. The watershed is primarily forested (80.4%) and in 2002 there were still more than 10,000 acres (9.1%) of land in agricultural uses including pasture, cropland, and hay land. Developed land is increasing and, as of 2002, represented more than four percent of the drainage area (about 5,000 acres). The vast majority of the agricultural lands in the watershed are pastures and hay lands; there are less than 50 acres of traditional row crops.

The Lake Chatuge watershed and surrounding area experienced explosive growth in the 1990s and the population continues to grow at rates higher than the states in which it lies. Between 1990 and 2000, the population of Towns County increased by 38.0%; Clay County's population increased 22.6% over the same period. As of 2005, the population of Towns County, GA is estimated by the U.S. Census Bureau to be 10,315, a 10.7% increase over the past five years. The Clay County, NC population is estimated to be 9,765 in 2005, an increase of 11.3% since 2000 (U.S. Census Bureau, 2006b). Roughly 25% of the population of Clay County and 80% of the Towns County population lives in the Lake Chatuge watershed for a total estimated 2005 population of 10,692.

## Purpose of the Action Plan

TVA regularly monitors five indicators of ecological health in each of its reservoirs, assigning a numerical score, called an Ecological Health Rating, at each assessment. The five monitored indicators are: dissolved oxygen, chlorophyll, fish community, bottom life, and sediment quality. Lake Chatuge has been monitored annually since 1998. During the 1990s, TVA's Reservoir Ecological Health Rating for Lake Chatuge declined from "Good" in 1994 and 1996 with scores in the low to mid-70s to "Poor" starting in 1998 with scores in the mid-40s and low 50s. TVA has monitored Lake Chatuge annually since 1998 and, with the exception of one "Fair" rating in 2001, the reservoir has continually been rated Poor.

The scope of the Lake Chatuge Watershed Action Plan encompasses a wide variety of water quality concerns within the 189-square mile drainage area of Lake Chatuge. Although the water quality concerns are described and discussed in detail, the purpose of the Plan is to *recommend actions* that, if implemented properly, will result in an improvement in Lake Chatuge's ecological health rating as determined by TVA's Reservoir Vital Signs Monitoring Program.

The Action Plan is based on an extensive study undertaken by the Hiwassee River Watershed Coalition (HRWC), the methods and results of which are reported herein. However, this document is not intended to be a report on the study. It is intended to be an active document that all watershed stakeholders can use for facilitating water quality improvements in Lake Chatuge over the next 5-15 years.

## Study of Lake Chatuge and its Watershed

Physical/chemical data were collected in the Lake Chatuge watershed between December 2002 and November 2003. Stream samples were collected biweekly from December 2002 through April 2003, and monthly May through November 2003 at six sites located on major tributaries to the lake and analyzed for 12 water quality parameters. Lake samples were collected from five locations on a monthly basis from April 2003 through November 2003 and analyzed for 13 water quality parameters.

Low-altitude, color infrared aerial photography was taken of the Lake Chatuge watershed in 2002 by TVA. Over a period of several months, the photography was interpreted by experienced photo-analysts for geographic features that contribute or are suspected to

contribute nonpoint source pollution within the watershed. Geographic Information System (GIS) attributes that describe the set of geographic features were then generated.

The Hydrological Simulation Program-Fortran (HSPF) model was used to calibrate the nutrient and organic concentrations flowing into Lake Chatuge from the watershed with stream field measurements collected during the 2003 sampling. Then a two-dimensional CE-QUAL-W2 water quality model of Chatuge reservoir was calibrated using lake field data collected in 2003. The reservoir model (CE-QUAL-W2) used the output of the watershed model (HSPF) as the initial input. Calibration was performed to match model output to measured water quality parameters in the reservoir.

## Study Results

The water quality study of Lake Chatuge shows that an excess of nutrients is the leading cause of low ecological health ratings. This result was expected due to elevated concentrations of algae in the lake. However, the study provided a much larger volume of data and the ability to determine which sources were contributing most to the problem.

One way that excess nutrients are entering the lake is through stormwater runoff from developed areas. Sources of nutrients in developed areas include soil erosion associated with cuts and slopes behind businesses and homes and commercial applications of fertilizer on lawns, ball fields, golf courses, and landscaping. Excess nutrients also come from large domesticated populations of Canada geese that are often fed by homeowners and allowed to nest on residential and publicly owned property around the lake shoreline. Often there is not enough woody vegetation along the shoreline of Lake Chatuge (or stream banks of tributaries) to filter runoff from these areas.

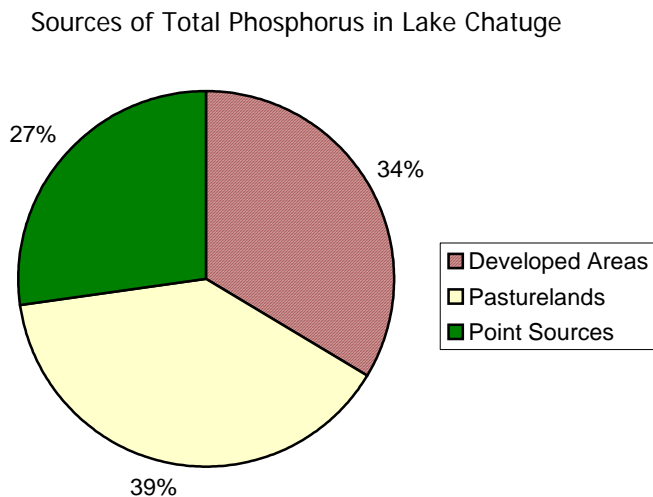
Impervious surfaces associated with developed areas also contribute heavily to the ecological health problems in Lake Chatuge. Impervious cover does not allow water to sink into the soil; examples are roads, rooftops, driveways, and parking lots. These hardened surfaces cause a larger quantity of water to run off the land at a much faster rate. Typically stormwater from developed areas is channeled into drainage systems (ditches, pipes, etc.), which carry pollutants directly into streams (or the lake). Due to the velocity of the water, runoff from impervious areas causes accelerated erosion of streambeds and banks, carrying nutrient-laden sediment into the lake. And because these surfaces absorb sunlight, the water is often heated as well. Areas of impervious cover are concentrated along the Lake's shoreline and streams, as well as in highway corridors throughout the watershed.

In 2003, nearly 2.5% (2,943.8 acres) of the Lake Chatuge watershed was covered with impervious surfaces; roads comprised half of the impervious area (1,444.7 acres). Although the 189 square mile watershed is only 2.5% covered with impervious surfaces, many localized areas within the larger watershed contain well over 50% impervious cover!

Nutrients from agricultural lands come from fertilizers (commercially-prepared or locally-generated) that are applied to the land to produce better grasses for grazing and crops of hay for winter-feeding of livestock. Nutrients also come directly from animal waste; in some areas livestock have direct access to long lengths of streams. As is the case in residential areas, there is often not enough vegetation along streams to filter runoff from these lands.

Discharges of treated wastewater, even when facilities are operating in full compliance with state and federal permits, are currently significant sources of nutrient loading to Lake Chatuge. Septic systems that are located in unsuitable areas, are improperly installed, or have not been operated and/or maintained properly, can also be significant sources of pollution. Additionally, if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded.

Both nitrogen and phosphorus (the two most significant nutrients related to algae growth) are of concern in Lake Chatuge. However, phosphorus concentrations are higher than nitrogen when compared with what would be expected for a mountain tributary reservoir.



In 2003, Lake Chatuge was receiving 9,600 pounds of phosphorus per year. There are three broadly described sources of phosphorus (pictured left), each representing about one-third of the load: pasturelands/livestock (39%), residential/commercial developed areas (34%), and treated wastewater discharges (27%).

The graphed data seem to indicate that if phosphorus in runoff from agricultural areas within the Lake Chatuge watershed is eliminated, the water quality situation could be controlled. However, upon closer examination in light of land use information, the data show that roughly 3,700 pounds of phosphorus per year is coming from 10,000 acres of agricultural land (0.37lbs/acre), but nearly the same amount (3,300 pounds per year) is coming from only 4,800 acres of developed land (0.69lbs/acre)!

Computer modeling efforts indicate that a 30% reduction in both phosphorus and nitrogen is needed to once again achieve a Good Ecological Health Rating for Lake Chatuge. Phosphorus concentrations are higher than nitrogen when compared with what would be expected for a mountain tributary reservoir. And, when actions are taken to reduce phosphorus from nonpoint sources of pollution, nitrogen is usually reduced as well.

Finally, phosphorus doesn't go through as many processes in the environment (exchange with the atmosphere, etc.) that occur with nitrogen, making it easier to measure and predict. For these reasons, HRWC has chosen phosphorus as the parameter for which to target reductions. Actions are also recommended to reduce sediment, indirectly reducing the attached nutrients as well.

## Recommended Actions

Eighteen broad objectives for plan implementation were identified based on the causes and sources of degradation for Lake Chatuge. The recommended actions listed here are based on these objectives. Please visit the Hiwassee River Watershed Coalition's website for a more detailed discussion of each recommendation:

<http://www.hrwc.net/lakechatuge.htm> or contact the HRWC office if you prefer to be mailed a hard copy.

### A. Federal and NC/GA State Government Agencies should:

- Enforce applicable water quality rules and regulations and sediment/erosion control laws
- Provide increased monitoring of streams and the lake
- Provide basin-wide insight into watershed health on a regular basis
- Provide funding for management measures outlined in this plan
- Provide assistance to local governments who are trying to manage growth (technology, training & funding)
- Provide an awareness of relevant tools as they become available
- Avoid implementation of "blanket" rules and regulations
- Improve the TMDL program and implementation plans to make them meaningful

### B. Local Governments should:

- Establish a local sediment/erosion control program
- Evaluate your own properties for potential BMPs to retain/treat stormwater
- Provide funding for management measures outlined in this plan
- Review and potentially revise subdivision ordinances based on North GA Growth Readiness Consensus Recommendations
- Consider adopting a stormwater ordinance
- Plan for wastewater treatment for new development/increased population
- Consider conducting a regional planning initiative

In addition, Towns County government should:

- Continue working to regain status as a Qualified Local Government

And, the City of Hiwassee government should:

- Install and maintain best available technology at the existing wastewater treatment facility to significantly reduce nutrient loading to Lake Chatuge
- Design and implement a proactive program for handling reports of wastewater leaks and spills

And, the Clay County government should:

- Consider passing a “Mountain Protection” ordinance similar to that of Towns County

C. Lake Chatuge Watershed Residents should:

- Educate yourself & others about the issues
- Report erosion control problems to the appropriate authorities
- Restore and/or maintain a woody riparian buffer along streams and the lake
- Evaluate your home site for ways to retain or treat stormwater
- Evaluate your practices at home to find ways to minimize water usage and runoff
- If you have a septic tank, ensure that it is being maintained properly
- Encourage businesses that you patronize to implement stormwater BMPs
- Support your local governments in their efforts to implement water quality protection measures
- Don't feed or encourage nesting of domesticated populations of Canada geese
- Support HRWC

D. Developers/Builders/Grading-Clearing Contractors should:

- Educate yourself and co-workers/staff about erosion control and stormwater issues
- Design roads to follow natural contours of the land and such that no slopes are greater than 15 percent grade
- Place home sites in locations that minimize earthwork
- Design developments and home sites with stormwater and water quality in mind (minimize impervious surfaces & protect sensitive areas)
- Avoid creating cut/fill slopes that are greater than 1.5H:1V
- Restore/maintain woody riparian buffers along all waters
- Install and maintain appropriate BMPs during and after construction
- Limit underbrushing and clearing, particularly prior to sale of a property
- If you have the opportunity, educate new residents about these matters

E. Realtors should:

- Educate yourself about the value of riparian buffers and conservation-based developments
- Seek to sell responsibly developed properties first
- Limit clearing, underbrushing and grading of property
- Educate buyers/new residents about how to be sensitive to our mountain environment

F. Commercial Business/Property Owners should:

- Educate yourself about impervious surfaces and impacts to water quality
- Restore/maintain a woody riparian buffer (if your property borders water)
- Evaluate your property and/or business practices for the potential to retain/treat stormwater runoff
- Implement stormwater BMPs
- Support HRWC

G. Farmers & the Agricultural Community should:

- Rotate livestock and implement BMPs for winter feeding as needed to prevent loss of vegetation and overgrazing
- Restrict livestock access to waters by installing fencing, stream crossings, and alternative watering sources
- Restore/maintain a woody riparian buffer (if your property borders water)
- Practice good nutrient management by following an NRCS-approved nutrient management plan or recommendations of bi-annual soil analysis
- Reduce soil requirements for nitrogen amendments by sowing nitrogen-fixing legumes (e.g. clover) with grasses
- Practice no-till or minimal-till techniques when seeding or planting crops
- Consider converting steeply sloping pasture or cropland to orchard/horticulture or harvestable timber
- Consider restoring prior-converted wetlands

H. The Tennessee Valley Authority should:

- Continue to conduct lake monitoring annually
- Provide an easy to read and readily available report for the public of reservoir ecological health ratings
- Continue to provide support (and consider increasing the level of support) for annual HRWC operating expenses
- Provide funding for, and technical assistance with, BMP implementation
- Assist with education (see HRWC)

I. The Hiwassee River Watershed Coalition should:

- Provide residents, developers, builders, grading-clearing contractors, realtors and commercial businesses with educational opportunities and materials
- Seek funding to assist willing landowners with evaluation of properties and BMP implementation
- Assist local governments in drafting, adopting, and implementing ordinances and in planning
- Serve as a “clearinghouse” for information from state and federal agencies
- Assist with distribution of publications and create public awareness about available programs, funding, educational materials, and other tools available to watershed stakeholders

## Measurable Results & Implementation

Although all of the recommended actions listed above will help accomplish the goals of the Plan, for implementation purposes it is necessary to develop more specific, measurable management *strategies* for the watershed. If accomplished, the strategies discussed in this section should return Lake Chatuge to Good Ecological Health as assessed by TVA’s Reservoir Vital Signs Monitoring Program. The strategies were chosen based on the following:

- identified objectives and suggested management measures;
- ability to help achieve needed nutrient load reductions to the lake;
- cost effectiveness and relative ease of implementation;
- ability to measure the results

Six measurable management strategies were selected:

1. Reduce the Total Phosphorus load from the Hiwassee WWTP by 50%
2. Restrict from streams and/or the lake, and provide appropriate alternative watering for, a minimum of 125 animals (25%) that currently have unrestricted access
3. Improve 40% of pastures considered to be in fair condition to good condition (about 2,500 acres)
4. Improve 50% of the most degraded pasture areas to a minimum of conditions considered fair (about 440 acres)
5. Reduce the Total Phosphorus load by 30% from existing commercial areas (about 1000 acres)
6. Reduce TP load by 5% from existing residential areas (nearly 7,000 acres)

There are other combinations of actions that will also accomplish the desired results. However, these are the strategies that were deemed by the planning team to produce the largest improvements for the resources invested, based on the above criteria. In addition to these strategies, efforts must also be undertaken to ensure that new development is better development in terms of watershed and water quality protection.

A 15-year timeline spanning three phases of implementation is presented. Year 1 will begin when funding first becomes available. Strategies during the first five years (Phase I) generally involve implementation of nutrient reduction strategies at the Hiwassee wastewater treatment plant, development of a plan for handling sewage leaks and spills from the sanitary sewer system, locating and prioritizing sites for agricultural, residential, and commercial best management practices (BMPs), and beginning practice installation. During Phase I, approximately 900 acres of pasture, 240 acres of commercial development, and 1750 acres of residential development will be treated. In addition, 30 acres of critically eroding bare areas will be re-vegetated and 3,000 linear feet of riparian buffer re-planted. At the end of Phase I, funding, participation, and accomplishments will be reviewed, along with water quality data, and this plan will be re-evaluated before proceeding into Phases II and III.

HRWC will evaluate progress by tracking:

- ❖ Sites reviewed for possible BMP installation
- ❖ Practices planned
- ❖ Practices installed
- ❖ Reductions anticipated for targeted parameters associated with installed practices

In addition to sites selected for BMP installation through the formal process, HRWC plans to set up a system (hopefully online) whereby anyone can input actions taken (from the

list of recommendations) watershed-wide. This way practices will be accounted for down to the smallest backyard buffer planting or rain garden installation; the system would also allow all stakeholders to fully participate in the restoration process! New local ordinances or changes to existing ordinances that positively impact water quality will also be tracked.

Actual water quality data will be a key component of measuring success of the Action Plan. Major streams flowing into Lake Chatuge will continue to be monitored monthly for 14 parameters including turbidity, Total Suspended Solids, phosphorus, nitrogen, and nitrate/nitrite. Data throughout the life of the restoration effort will be compared periodically to more than four years of baseline data collected at the existing locations. The Tennessee Valley Authority will continue to assess the lake annually as part of its Reservoir Vital Signs Monitoring Program.

Overall project success will be determined by one or more of the following:

- Implementation of BMPs such that the targeted phosphorus reductions are met.
- Improvement in stream water quality is observed as measured by the HRWC volunteer monitoring program.
- Chlorophyll-*a* concentrations do not exceed state water quality standards.
- Improvement in TVA's Ecological Health Rating for Lake Chatuge is observed.

### Funding & Technical Assistance

During the first five years of Action Plan implementation (Phase I), nearly \$2.0 million dollars will be spent by the Towns County Water and Sewer Authority to upgrade (and expand) the Hiwassee wastewater treatment plant. Implementation of other management strategies planned for Phase I is estimated to cost \$600,000. Costs include: \$267,000 for pastureland improvements and agricultural BMPs, \$168,000 for retrofit stormwater BMPs for commercial and residential areas, \$25,000 for re-vegetation of critically eroding areas and riparian buffer plantings, \$10,000 for an education program, and \$50,000 for monitoring and evaluation. The estimated cost also includes \$100,000 over the 5-year period (\$20,000/year) for project management to help support a Lake Chatuge Watershed Restoration Coordinator; HRWC will also provide support for this position.

The total cost of restoring Lake Chatuge to "Good" ecological health - the primary goal of this Action Plan - is estimated at \$3.8 million. Approximately \$2.1 million is yet to be secured. Project leadership, including acquisition of funds, identification of sites for best management practices, installation oversight, monitoring, and evaluation will be provided by the Hiwassee River Watershed Coalition in cooperation with TVA, local officials, and community leaders.