LAKE & RESERVOIR ASSESSMENTS
HIWASSEE RIVER BASIN

Hiwassee Reservoir

Intensive Survey Branch
Water Sciences Section
Division of Water Resources

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GLOSSARY

Algae	Small aquatic plants that occur as single cells, colonies, or filaments. May also be referred to as phytoplankton, although phytoplankton are a subset of algae.
Algal biovolume	The volume of all living algae in a unit area at a given point in time. To determine biovolume, individual cells in a known amount of sample are counted. Cells are measured to obtain their cell volume, which is used in calculating biovolume
Algal density	The density of algae based on the number of units (single cells, filaments and/or colonies) present in a milliliter of water. The severity of an algae bloom may be determined by the algal density as follows: Mild bloom = 10,000 to 20,000 units/ml Mild bloom = 20,000 to 30,000 units/ml Severe bloom = 30,000 to 100,000 units/ml Extreme bloom = Greater than 100,000 units/ml
Algal Growth Potential Test (AGPT)	A test to determine the nutrient that is the most limiting to the growth of algae in a body of water. The sample water is split such that one sub-sample is given additional nitrogen, another is given phosphorus, a third may be given a combination of nitrogen and phosphorus, and one sub-sample is not treated and acts as the control. A specific species of algae is added to each sub-sample and is allowed to grow for a given period of time. The dry weights of algae in each sub-sample and the control are then measured to determine the rate of productivity in each treatment. The treatment (nitrogen or phosphorus) with the greatest algal productivity is said to be the limiting nutrient of the sample source. If the control sample has an algal dry weight greater than 5 mg/L, the source water is considered to be unlimited for either nitrogen or phosphorus.
Centric diatom	Diatoms are photosynthetic algae that have a siliceous skeleton (frustule) found in almost every aquatic environment including fresh and marine waters, as well as moist soils. Centric diatoms are circular in shape and are often found in the water column.
Chlorophyll *a*	Chlorophyll *a* is an algal pigment that is used as an approximate measure of algal biomass. The concentration of chlorophyll *a* is used in the calculation of the NCTSI, and the value listed is a lake-wide average from all sampling locations.
Clinograde	In productive lakes where oxygen levels drop to zero in the lower waters near the bottom, the graphed changes in oxygen from the surface to the lake bottom produces a curve known as clinograde curve.
Coccoid	Round or spherical shaped cell
Conductivity	This is a measure of the ability of water to conduct an electrical current. This measure increases as water becomes more mineralized. The concentrations listed are the range of values observed in surface readings from the sampling locations.
Dissolved oxygen	A measurement of oxygen concentrations found at the sampling locations.
Dissolved oxygen saturation	The capacity of water to absorb oxygen gas. Often expressed as a percentage, the amount of oxygen that can dissolve into water will change depending on a number of parameters, the most important being temperature. Dissolved oxygen saturation is inversely proportion to temperature, that is, as temperature increases, water's capacity for oxygen will decrease, and vice versa.
Eutrophic	Describes a lake with high biological productivity and low water transparency.

Eutrophication	The process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation of a lake.
Limiting nutrient	The plant nutrient present in lowest concentration relative to need limits growth such that addition of the limiting nutrient will stimulate additional growth. In northern temperate lakes, phosphorus (P) is commonly the limiting nutrient for algal growth
Manganese	A naturally occurring metal commonly found in soils and organic matter. As a trace nutrient, manganese is essential to all forms of biological life. Manganese in lakes is released from bottom sediments and enters the water column when the oxygen concentration in the water near the lake bottom is extremely low or absent. Manganese in lake water may cause taste and odor problems in drinking water and require additional treatment of the raw water at water treatment facilities to alleviate this problem.
Mesotrophic	Describes a lake with moderate biological productivity and water transparency
NCTSI	North Carolina Trophic State Index was specifically developed for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). It takes the nutrients present along with chlorophyll *a* and Secchi depth to calculate a lake's biological productivity.
Oligotrophic	Describes a lake with low biological productivity and high water transparency.
pH	The range of surface pH readings found at the sampling locations. This value is used to express the relative acidity or alkalinity of water.
Photic zone	The portion of the water column in which there is sufficient light for algal growth. DWR considers 2 times the Secchi depth as depicting the photic zone.
Secchi depth	This is a measure of water transparency expressed in meters. This parameter is used in the calculation of the NCTSI value for the lake. The depth listed is an average value from all sampling locations in the lake.
Temperature	The range of surface temperatures found at the sampling locations.
Total Kjeldahl nitrogen	The sum of organic nitrogen and ammonia in a water body. High measurements of TKN typically results from sewage and manure discharges in water bodies.
Total organic nitrogen (TON)	Total Organic Nitrogen (TON) can represent a major reservoir of nitrogen in aquatic systems during summer months. Similar to phosphorus, this concentration can be related to lake productivity and is used in the calculation of the NCTSI. The concentration listed is a lake-wide average from all sampling stations and is calculated by subtracting Ammonia concentrations from TKN concentrations.
Total phosphorus (TP)	Total phosphorus (TP) includes all forms of phosphorus that occur in water. This nutrient is essential for the growth of aquatic plants and is often the nutrient that limits the growth of phytoplankton. It is used to calculate the NCTSI. The concentration listed is a lake-wide average from all sampling stations.
Trophic state	This is a relative description of the biological productivity of a lake based on the calculated NCTSI value. Trophic states may range from extremely productive (Hypereutrophic) to very low productivity (Oligotrophic).
Turbidity	A measure of the ability of light to pass through a volume of water. Turbidity may be influenced by suspended sediment and/or algae in the water.
Watershed	A drainage area in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Overview

The Hiwassee River Basin is located in the remote southwestern corner of North Carolina. This mountainous basin covers approximately 640 mi^2 in Cherokee and Clay counties. The largest rivers are the Hiwassee River and the Valley River. Many of the streams in the basin are located within the US Forest Service's Nantahala National Forest. This basin contains the Level IV ecoregions of the High Mountains, the Southern Crystalline Ridges and Mountains and The Broad Basins.

The High Mountains ecoregions include northern portions of Clay County and contain the drainages of Big Tuni Creek and Fires Creek. Land use in this area is mostly forest and the terrain is rugged. The Southern Crystalline Ridges and Mountains ecoregions are located in the eastern portion of Clay County and include the Shooting Creek catchment. While elevations are still significant, the overall terrain is less steep than those seen in the High Mountains, and there is slightly more overall agricultural land use. The Broad basins are located in the southern half of Clay County and include most of the Tusquitee and Brasstown Creek drainages. The lessened relief allows for more agricultural and residential land use in these areas. The predominant land use in this subbasin is forest, with lesser amounts of agricultural and residential impacts.

Three lakes were sampled in this river basin by DWR staff in 2014 – Hiwassee Reservoir, Chatuge Lake and Appalachia Lake. All three reservoirs are managed by the Tennessee Valley Authority, which monitors these lakes every other year and information regarding their water quality program can be found at www.tva.com/environment/water/index.htm.

A statewide fish consumption advisory for largemouth bass due to mercury contamination was issued by the NC Department of Health and Human Services, Division of Public Health. This advisory includes lakes in Hiwassee River Basin which may support largemouth bass. Chatuge Lake also has a fish consumption advisory for white bass due to elevated levels of mercury (http://www.epi.state.nc.us/epi/fish/current.html).

Assessment Methodology

For this report, data from January 1, 2010 through December 31, 2014 were reviewed. Lake monitoring and sample collection activities performed by DWR field staff are in accordance with the Intensive Survey Unit Standard Operating Procedures Manual (http://portal.ncdenr.org/c/document_library/get_file?uuid=522a90a4-b593-426f-8c11-21a35569dfd8&groupId=38364) An interactive map of the state showing the locations of lake sites sampled by DWR may be found at http://portal.ncdenr.org/web/wq/ambient-lakes-map.

All lakes were sampled during the growing season from May through September. Data were assessed for excursions of the state's Class C water quality standards for chlorophyll *a*, pH, dissolved oxygen, water temperature, turbidity, and surface metals. Other parameters discussed in this report include Secchi depth and percent dissolved oxygen saturation. Secchi depth provides a measure of water clarity and is used in calculating the trophic or nutrient enriched status of a lake. Percent dissolved oxygen saturation gives information on the amount of dissolved oxygen in the water column and may be increased by photosynthesis or depressed by oxygen-consuming decomposition.

For algae collection and assessment, water samples are collected from the photic zone, preserved in the field and taken concurrently with chemical and physical parameters. Samples were quantitatively analyzed to determine assemblage structure, density (units/ml) and biovolume (m^3/mm^3).

For the purpose of reporting, algal blooms were determined by the measurement of unit density (units/ml). Unit density is a quantitative measurement of the number of filaments, colonies or single celled taxa in a waterbody. Blooms are considered mild if they are between 10,000 and 20,000 units/ml. Moderate blooms are those between 20,000 and 30,000 units/ml. Severe blooms are between 30,000 and 100,000 units/ml. Extreme blooms are those 100,000 units/ml or greater.

An algal group is considered dominant when it comprises 40% or more of the total unit density or total biovolume. A genus is considered dominant when it comprises 30% or more of the total unit density or total biovolume.

Additional data considered as part of the use support assessment include historic DWR water quality data, documented algal blooms and/or fish kills, problematic aquatic macrophytes, or listing on the EPA's 303(d) List of Impaired Waters.

For a more complete discussion of lake ecology and assessment, please go to http://portal.ncdenr.org/web/wq/ess/isu. The 1992 North Carolina Lake Assessment Report (downloadable from this website) contains a detailed chapter on ecological concepts that clarifies how the parameters discussed in this review relate to water quality and reservoir health.

Quality Assurance of Field and Laboratory Lakes Data

Data collected in the field via single or multiparameter water quality meters are entered into the Ambient Lakes Database within 24 hours of the sampling date. These data are then reviewed for accuracy and completeness within a week of entry. Data that have not been reviewed are given a 'P' code for 'Provisional' (data has been entered but not been verified for accuracy and/or completeness). Data that have been verified are given an 'A' code for 'Accepted'.

Chemistry data from the DWR Water Quality Laboratory are entered into the Lakes Database within 48 hours of receipt from the lab. As with the field data, laboratory results are coded 'P' until the entered data is verified for entry accuracy and completeness, after which, the code is changed to 'A'. Generally, laboratory data entered into the Lakes Database are verified within a week following the initial entry.

Data, either laboratory or field, which appear to be out of range for the lake sampled are double checked against field sheets or the laboratory results form by the Lakes Data Administrator for possible data entry error. If there are data entry mistakes, possible equipment, sampling, and/or analysis errors, these are investigated and corrected if possible. If the possible source of an error cannot be determined, the data remains in the database. If an error is determined, the data value is removed from the appropriate database parameter field and placed in the 'Notes' field along with a comment regarding the error. Chemistry results received from the laboratory that have been given an qualification code are also entered into the 'Notes' field along with the assigned laboratory code. Laboratory qualification coded data or data which may be in error due to sampling, handling, and/or equipment problems are only entered into the 'Notes' field and never in the data field(s) in the Ambient Lakes Database.

Additional information regarding the Quality Assurance Program is covered in the Ambient Lake Monitoring Program Quality Assurance Plan. Version 2.0 (March 28, 2014) of this document is available on the ISU website (http://portal.ncdenr.org/web/wq/ess/isu).

Weather Overview for Summer 2014

May 2013 began cool for most of the state but ended warm. Precipitation in the western mountains, (including the Hiwassee River Basin), ranged from 25% to 95% of normal for the month (Figure 1). Temperatures in June were closer to normal for the month while precipitation ranged from 75% to 200% June turned out to be warm throughout the state and ranked as the 33rd warmest June on record.

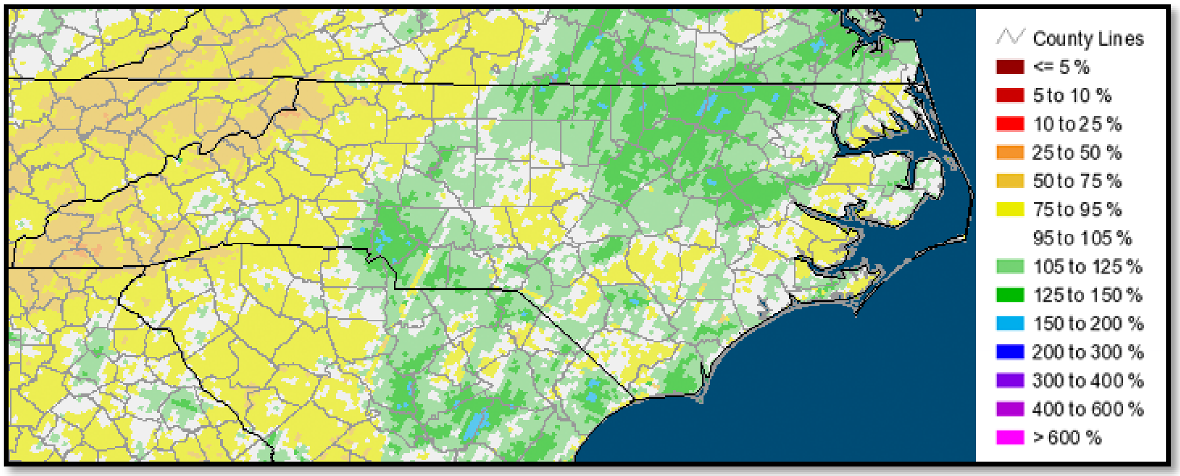

Figure 1. Percent of normal precipitation for March, April and May 2013 (State Climate Office of North Carolina, June 4, 2014, (http://nc-climate.ncsu.edu/climateblog?id=77).

In contrast to June, July and August 2014 in North Carolina turned out to be cooler than normal. The cool mean temperatures for these months was driven by the cooler than normal maximum temperatures. Near normal precipitation fell in the western mountains of the state during these three months (Figure 2).

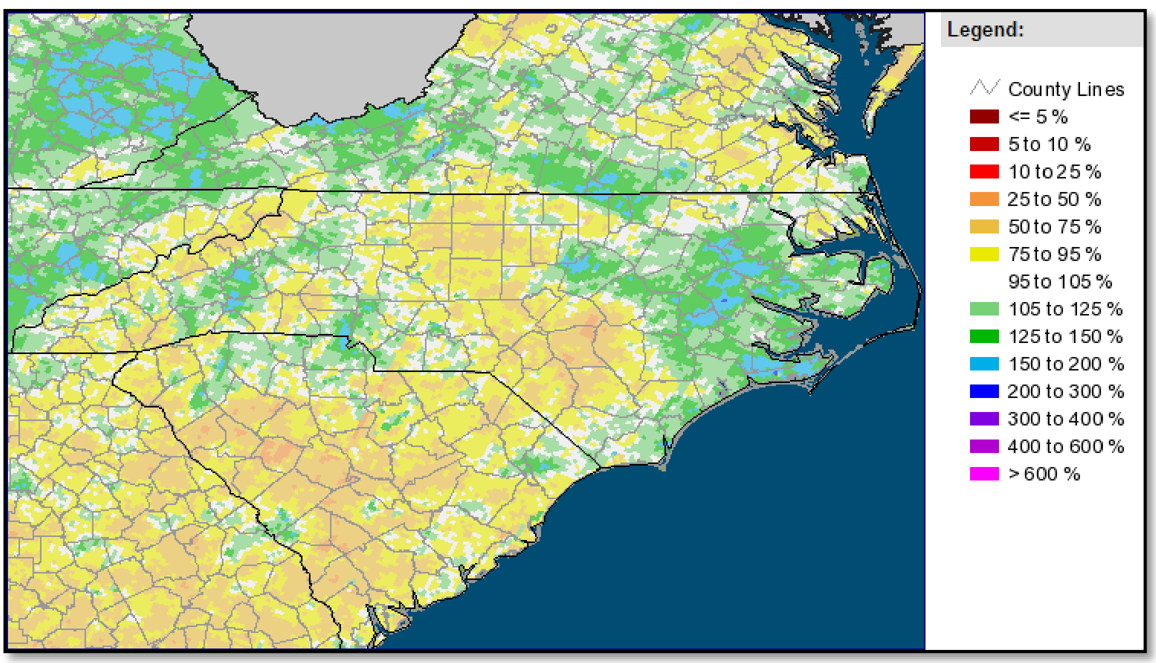

Figure 2. Percent of normal precipitation for June, July and August 2014 (State Climate Office of North Carolina, September 9, 2014, (http://nc-climate.ncsu.edu/climateblog?id=98).

After a mild summer, warm temperatures returned in late August and continued through the first week of September, before cooling again. This pattern of up and down temperatures is normal for the month of September in North Carolina as the transition from summer to fall begins. Rainfall amounts in September for the western mountains were similar to those observed in June through August.

LAKE & RESERVOIR ASSESSMENTS

HUC 06020002

Chatuge Lake

Ambient Lakes Program Name	Chatuge Lake		
Trophic Status (NC TSI)	Oligotrophic		
Mean Depth (meters)	11		
Volume ($10^6 m^3$)	305		
Watershed Area (mi^2)	484		
Classification	B		
Stations	HIW00B	HIW00D	HIW00F
Number of Times Sampled	5	5	5

Chatuge Lake is a large reservoir located in the southwestern portion of the state. The lake is situated adjacent to the Nantahala National Forest and is an impoundment of the Hiwassee River upstream from Hiwassee Lake and Apalachia Lake. Approximately half of the lake lies within the state of Georgia. The lake is owned by the Tennessee Valley Authority (TVA) and was constructed in 1942 to provide hydroelectric power.

This lake has a maximum depth of 44 meters. Chatuge Lake is long (13 miles), with 212 kilometers of shoreline. The drainage area of the lake is primarily forested. Major tributaries to the Chatuge Lake include the Hiwassee River and Shooting Creek.

DWQ staff monitored Chatuge Lake monthly from May through September 2014. Secchi depths ranged from 2.3 to 4.0 meters, indicating very good water clarity (Appendix A). Surface dissolved oxygen ranged from 6.9 to 9.1 mg/L and surface water temperatures ranged from 19.6 C° to 28.0 C°. Surface pH values ranged from 7.3 to 7.9 s.u.

Nutrient concentrations in Chatuge Lake were very low in 2014. Total phosphorus, ammonia, and nitrite plus nitrate were less than the DWR Laboratory detection levels for these nutrients (Appendix A). Total Kjeldahl nitrogen ranged from 0.20 to 0.23 mg/L and total organic nitrogen ranged from 0.19 to 0.22 mg/L. Chlorophyll *a* values ranged from 2.0 to 6.6 µg/L. Based on the calculated NCTSI scores for 2014, Chatuge Lake was determined to exhibit very low biological productivity (oligotrophic conditions). This lake has been oligotrophic since it was first monitored by DWR in 1981.

Hiwassee Reservoir

Ambient Lakes Program Name	Hiwassee Reservoir				
Trophic Status (NC TSI)	Oligotrophic				
Mean Depth (meters)	47				
Volume ($10^6 m^3$)	119				
Watershed Area (mi^2)	2507				
Classification	B, C				
Stations	HIW009A	HIW009B	HIW009D	HIW009F	HIW009G
Number of Times Sampled	5	5	5	5	5

Hiwassee Reservoir lies in the western tip of North Carolina on the Hiwassee River near the Tennessee border. Built by the TVA between 1936 and 1940 to provide hydroelectric power, Hiwassee Lake is the second largest TVA lake in North Carolina. The maximum depth of the lake is 94 meters, while the length is 35 kilometers, providing 262 kilometers of shoreline at full pool. The major inflows to the lake are Hiwassee River, Nottely River, Persimmon Creek, Valley River, Hanging Dog Creek, and Beaverdam Creek. The steeply sloped watershed area is mostly forested.

Hiwassee Reservoir was monitored monthly from May through September 2014 by DWR staff. Surface dissolved oxygen ranged from 7.5 to 9.3 mg/L and surface water temperatures ranged from 21.5 C° to 28.9 C° (Appendix A). Surface pH values ranged from 7.1 to 8.8 s.u., with the higher value observed in May at the lower end of the reservoir (HIW009G). Secchi depths for Hiwassee Reservoir ranged from 3.0 to 5.0 meters.

Nutrient concentrations in 2014 were similar to those previously observed for this reservoir. Total phosphorus and ammonia were less than the DWR Laboratory detection levels while total Kjeldahl nitrogen ranged from <0.02 to 0.30 mg/L (Appendix A). Total organic nitrogen ranged from 0.09 to 0.29 mg/L. Chlorophyll *a* values were low, ranging from 2.1 to 6.8 µg/L. Hiwassee Reservoir exhibited oligotrophic conditions or very low biological productivity in 2014 based on the calculated NCTSI scores for May through September. This reservoir has been consistently oligotrophic since it was first monitored by DWR in 1981.

Apalachia Lake

Ambient Lakes Program Name	Apalachia Lake		
Trophic Status (NC TSI)	Oligotrophic		
Mean Depth (meters)	18		
Volume ($10^6 m^3$)	8		
Watershed Area (mi^2)	2605		
Classification	B		
Stations	HIW011A	HIW011C	HIW012
Number of Times Sampled	5	5	5

Apalachia Lake is a run-of-the-river reservoir located within the Nantahala National Forest in the mountains of western North Carolina. It is situated immediately downstream of Hiwassee Lake on the Hiwassee River. The lake is owned by the Tennessee Valley Authority and was constructed to generate hydroelectric power. Construction of the dam began in 1941 and completed in 1943. Apalachia Lake has a maximum depth of 36 meters, a length of 10 miles (16 kilometers) and 31 miles (50 kilometers) of shoreline at full pool level. Major tributaries to the lake include Hiwassee River, Camp Creek, and both North and South Shoal Creeks. The drainage area consists of forested, mountainous terrain.

DWR staff sampled Apalachia Lake monthly from May through September 2014. Surface dissolved oxygen ranged from 6.2 to 9.3 mg/L and surface water temperatures ranged from 20.5 C° to 27.3 C° (Appendix A). Surface pH values were greatest in May (7.8 s.u.) and the lowest value (7.0 s.u.) was observed near the upper end of the reservoir (HIW011A) in September. Secchi depths for Apalachia Lake ranged from 2.5 to 4.0 meters.

Total phosphorus concentrations were less than the DWR Laboratory detection level and total Kjeldahl nitrogen ranged from <0.02 to 0.27 mg/L. Total organic nitrogen ranged from 0.09 to 0.26 mg/L. In response to the limited availability of nutrients, chlorophyll *a* values were low (range = 1.2 to 6.8 µg/L). Based on the calculated NCTSI scores, Apalachia Lake was determined to have very low biological productivity or oligotrophic conditions. This reservoir has been oligotrophic since it was first monitored by DWR in 1981.

		SURFACE PHYSICAL DATA							PHOTIC ZONE DATA										
Lake	Date	Sampling Station	DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent SAT	TP mg/L	TKN mg/L	NH3 mg/L	NOx mg/L	TN mg/L	TON mg/L	TIN mg/L	Chla µg/L	Total Solids mg/L	Total Suspended Solids mg/L	Turbidity NTU
HUC 03020002																			
LAKE CHATUGE	September 23, 2014	HIW000B	6.9	25.3	7.5	23	3.0	84.0%	<0.02	0.22	<0.02	<0.02	0.21	0.19	0.02	4.1	24	<6.2	2.6
	September 23, 2014	HIW000D	6.9	25.6	7.4	24	3.5	84.5%	<0.02	0.21	<0.02	<0.02	0.21	0.19	0.02	4.2	26	<6.2	2.7
	September 23, 2014	HIW000F	6.9	25.3	7.3	23	3.0	84.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.5	24	<6.2	3.4
	August 12, 2014	HIW000B	7.2	27.4	7.7	23	3.5	91.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.0	14	<6.2	1.2
	August 12, 2014	HIW000D	7.3	27.4	7.7	24	3.0	92.3%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	2.2	<12	<6.2	1.9
	August 12, 2014	HIW000F	7.3	27.3	7.6	24	3.5	92.1%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.5	16	<6.2	1.9
	July 8, 2014	HIW000B	7.1	27.8	7.8	23	3.5	90.4%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.3	21	<6.2	3.1
	July 8, 2014	HIW000D	7.3	28.0	7.8	24	3.5	93.3%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	3.2		<6.2	3.2
	July 8, 2014	HIW000F	7.3	27.9	7.9	24	3.5	93.1%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	2.2	28	<6.2	2.9
	June 17, 2014	HIW000B	7.3	28.0	7.7	22	4.0	93.3%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	3.0	18		1.9
	June 17, 2014	HIW000D	7.4	27.4	7.5	23	4.0	93.6%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	3.6	16		2.9
	June 17, 2014	HIW000F	7.2	27.5	7.7	23	4.0	91.2%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.8	18		2.3
	May 5, 2014	HIW000B	8.9	21.2	7.7	22	2.5	100.3%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	6.5	18.0	<6.2	3.6
	May 5, 2014	HIW000D	8.7	20.4	7.8	23	2.3	96.5%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	6.6	20.0	<6.2	2.0
	May 5, 2014	HIW000F	9.1	19.6	7.9	22	2.5	99.3%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	6.5	20.0	<6.2	2.5
HIWASSEE RESERVOIR	September 24, 2014	HIW009A	7.9	25.7	8.2	30	3.0	96.9%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	5.7	26	<6.2	2.1
	September 24, 2014	HIW009B	7.9	25.7	8.2	30	3.0	96.9%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	5.0	27	<6.2	1.6
	September 24, 2014	HIW009D	7.6	25.5	7.3	30	4.0	92.9%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	5.8	26	<6.2	2.2
	September 24, 2014	HIW009F	7.5	26.0	7.5	29	4.0	92.5%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.8	24	<6.2	1.6
	September 24, 2014	HIW009G	7.9	25.7	7.7	28	4.0	96.9%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	4.6	28	<6.2	1.4
	August 13, 2014	HIW009A	8.2	27.4	7.9	31	4.0	103.7%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	3.6	22	<6.2	2.5
	August 13, 2014	HIW009B	7.9	27.4	8.2	30	3.0	99.9%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	3.4	20	<6.2	1.6
	August 13, 2014	HIW009D	8.2	27.2	8.1	30	4.0	103.3%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	2.2	24	<6.2	2.0
	August 13, 2014	HIW009F	7.9	27.3	7.6	29	3.5	99.7%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	2.1	23	<6.2	1.7
	August 13, 2014	HIW009G	8.0	27.3	8.3	28	4.0	101.0%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	3.6	22	<6.2	2.1
	July 10, 2014	HIW009A	8.1	28.2	8.4	31	3.5	103.9%	<0.02	0.22	<0.02	0.02	0.24	0.21	0.03	4.4	28	<6.2	2.5
	July 10, 2014	HIW009B	7.9	28.9	8.5	31	4.0	102.6%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	5.3	22	<6.2	2.4
	July 10, 2014	HIW009D	7.9	27.4	8.3	30	4.0	99.9%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	5.5	62	<6.2	2.1
	July 10, 2014	HIW009F	7.7	27.8	7.9	28	5.0	98.1%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.9	36	<6.2	1.9
	July 10, 2014	HIW009G	7.7	28.1	7.8	27	5.0	98.6%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.1	24	<6.2	1.6
	June 18, 2014	HIW009A	8.3	27.2	8.1	31	3.5	104.6%	<0.02	0.21	<0.02	0.03	0.24	0.20	0.04	5.0	106		2.6
	June 18, 2014	HIW009B	8.1	27.9	8.0	30	3.5	103.3%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	6.8	86		2.0
	June 18, 2014	HIW009D	7.8	27.6	7.4	29	4.0	99.0%	<0.02	0.20	<0.02	0.02	0.22	0.19	0.03	5.6	18		2.0
	June 18, 2014	HIW009F	7.8	28.0	7.1	28	4.0	99.7%	<0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	5.2	32		1.9
	June 18, 2014	HIW009G	7.5	28.1	7.2	27	4.5	96.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	3.3	22		1.4
	May 6, 2014	HIW009A	8.8	22.9	7.8	29	3.5	102.4%	<0.02	0.23	<0.02	0.05	0.28	0.22	0.06	3.4	46	<6.2	1.5
	May 6, 2014	HIW009B	8.7	24.3	7.7	30	4.0	104.0%	<0.02	0.23	<0.02	0.06	0.29	0.22	0.07	5.6	43	<6.2	1.7
	May 6, 2014	HIW009D	9.1	21.5	8.3	29	3.5	103.1%	<0.02	0.24	<0.02	0.03	0.27	0.23	0.04	4.8	27		2.4
	May 6, 2014	HIW009F	9.4	22.4	8.6	30	4.0	108.4%	<0.02	0.20	<0.02	0.02	0.22	0.19	0.03	6.0	42	<6.2	1.8
	May 6, 2014	HIW009G	9.3	22.1	8.8	28	3.5	106.6%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	4.5	52	<6.2	1.5
APALACHIA LAKE	September 24, 2014	HIW011A	6.3	20.6	7.0	29	4.0	70.1%	<0.02	<0.20	<0.02	0.14	0.24	0.09	0.15	1.5	28	<6.2	1.8
	September 24, 2014	HIW011C	8.0	22.5	7.2	27	3.0	92.4%	<0.02	0.20	<0.02	0.04	0.24	0.19	0.05	5.6	28	1.7	<6.2
	September 24, 2014	HIW012	8.2	22.9	7.1	27	4.0	95.4%	<0.02	0.20	<0.02	0.04	0.24	0.19	0.05	5.6	25	<6.2	1.8
	August 13, 2014	HIW011A	7.8	24.5	7.3	25	3.0	93.6%	<0.02	<0.20	<0.02	0.08	0.18	0.09	0.09	1.2	16	<6.2	2.9
	August 13, 2014	HIW011C	8.1	25.4	7.4	24	3.0	98.8%	<0.02	0.20	<0.02	0.06	0.26	0.19	0.07	2.8	22	<6.2	2.6
	August 13, 2014	HIW012	8.7	25.0	7.2	25	3.0	105.3%	<0.02	0.24	<0.02	0.04	0.28	0.23	0.05	4.3	28	<6.2	2.1
	July 10, 2014	HIW011A	7.8	24.5	7.7	25	3.5	93.6%	<0.02	0.20	<0.02	0.08	0.28	0.19	0.09	1.4	24	<12.0	2.2
	July 10, 2014	HIW011C	8.1	27.0	7.8	24	4.0	101.7%	<0.02	0.20	<0.02	0.04	0.24	0.19	0.05	2.8	20	<6.2	3.0
	July 10, 2014	HIW012	7.8	26.9	7.7	25	3.5	97.7%	<0.02	0.20	<0.02	0.04	0.24	0.19	0.05	3.0	26	<6.2	2.2
	June 18, 2014	HIW011A	7.7	26.9	7.1	23	3.5	96.5%	<0.02	0.21	<0.02	0.07	0.28	0.20	0.08	3.1	18		1.3
	June 18, 2014	HIW011C	8.0	27.0	7.1	23	3.5	100.4%	<0.02	0.20	<0.02	0.04	0.24	0.19	0.05	3.3	20		1.7
	June 18, 2014	HIW012	8.0	27.3	7.1	23	2.5	101.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.3	17		2.1
	May 6, 2014	HIW011A	9.2	21.1	7.8	25	3.0	103.4%	<0.02	0.27	<0.02	0.02	0.29	0.26	0.03	5.8	24	<6.2	2.4
	May 6, 2014	HIW011C	9.1	22.0	7.8	25	3.2	104.1%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	5.7	24	<6.2	2.7
	May 6, 2014	HIW012	9.3	20.5	7.8	25	4.0	103.3%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	6.8	28	<6.2	2.2