LAKE & RESERVOIR ASSESSMENTS
HIWASSEE RIVER BASIN

Hiwassee Reservoir

Intensive Survey Branch
Water Sciences Section
Division of Water Resources
May 18, 2020

TABLE OF CONTENTS

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 2019 – 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 (https://epi.dph.ncdhhs.gov/oee/fish/advisories.html).

Assessment Methodology

For this report, data from January 1, 2015 through December 31, 2019 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://www.arcgis.com/home/webmap/viewer.html?webmap=9dbc8edafb7743a9b7ef3f6fed5c4db0&extent=-87.8069,29.9342,-71.5801,38.7611.

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 and 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.

Quality Assurance of Field and Laboratory Lakes Data

Data collected in the field via multiparameter water quality meters are uploaded into the Labworks® Database within five days of the sampling date.

Chemistry data from the DWR Water Quality Laboratory are uploaded into Labworks®. If there are data entry mistakes, possible equipment, sampling, and/or analysis errors, these are investigated and corrected, if possible. Chemistry results received from the laboratory that are given a qualification code are entered along with the assigned laboratory code.

Information regarding the WSS Chemistry Laboratory Quality Assurance Program is available on the ISB website (https://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/microbiology-inorganics-branch/methods-pqls-qa).

Weather Overview for Summer 2019

May 2019 brought summer-like heat across the state, resulting in the 3rd warmest May since 1895. A strong Bermuda high pressure system sitting of the southeast coast produced and ongoing flow of warm, moist Atlantic and Gulf of Mexico air into the state. The preliminary statewide average temperature for May was 71.0°F, which was 5.1°F above the 1981 to 2010 average. Precipitation was on the dry side with the statewide average of 2.6", making May 2019 the 17th driest May out of the past 125 years. The Mountain region of the state saw the most rainfall while the eastern regions were dry.

June brought a return of regular rainfall in North Carolina. The statewide precipitation average was 7.1" (8th wettest June since 1895). On June 7 through 10, a stalled cold front produced more than a foot of rain in the Foothills and northern Mountains. Due to the relaxing of the Bermuda high and the frequent rainfall events, temperatures in June were lower with the high temperatures one to two degrees below normal. Temperatures rose the final week of June into the upper 90s.

Elevated temperatures continued into July. Overnight temperatures ranked particularly high in the Mountains where much of the month was spent in a humid air mass that kept temperatures and dew points elevated. The rainfall in July followed a typical summertime pattern. A rainfall event on July 22 and 23 produced 4.2" of rain in Cherokee.

The summer heat retreated slightly in August as the Bermuda high system remained far to the east, allowing for more moderate temperatures across the state. Rainfall was scattered throughout the state leaving some areas wet while others remained dry. After a wet early summer, the Mountains became drier in August. Murphy received 1.6" of rain in August, making it the 5th driest August in the past 51 years for the region. As August came to a close, Hurricane Dorian formed in the Atlantic and headed east toward the US Southeast Coast.

Hurricane Dorian struck the northern Bahama Islands as a Category 5, then closely approached the Florida east coast before turning north and traveling up toward North Carolina. Dorian lost a great deal of its strength after striking the Bahamas and reached the southern coast of the state on September 5th as a Category 2 storm. Turning to the northeast, the eyewall of the hurricane traveled from the Cape Fear to Cape Lookout and then to Cape Hatteras before turning out to sea. Rainfall and winds from this hurricane was limited to the eastern part of North Carolina while the Mountain region saw little if any impacts.

September was exceptionally warm. The preliminary average statewide temperature of 74.1°F ranked this as tie 8th-warmest September in the past 125 years. The Mountain region was not spared from the early fall heat. Asheville reported 10 days with highest of 90°F or above. For the month as a whole, the average highs were 10 degrees above normal and the western two-thirds of the state were at least five degrees above normal. The western part of the state saw little if any rainfall in September. Such dry weather at this time of the year has an ominous connection to the Septembers of 1985, 1986 and 2007 which were also very dry and hot and heralded the beginning of a drought period.

t.

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 with 212 kilometers of shoreline. The drainage area of the lake is primarily forested. Major tributaries to Chatuge Lake include the Hiwassee River and Shooting Creek.

DWQ staff monitored Chatuge Lake monthly from May through September 2019. Secchi depths ranged from 2.6 to 5.0 meters, indicating very good water clarity (Appendix A). Surface dissolved oxygen ranged from 7.5 to 9.1 mg/L and surface water temperatures ranged from 20.7 C° to 28.8 C°. Surface pH values ranged from 6.8 to 7.9 s.u.

Nutrient concentrations in Chatuge Lake were very low in 2019. 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 0.36 mg/L and total organic nitrogen ranged from 0.19 to 0.35 mg/L. Chlorophyll *a* values ranged from 2.9 to 4.2 µg/L. Based on the calculated NCTSI scores for 2019, 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 Tennessee Valley Authority (TVA) between 1936 and 1940 to provide hydroelectric power, Hiwassee Reservoir 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 the 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 2019 by DWR staff. Surface dissolved oxygen ranged from 8.1 to 9.9 mg/L and surface water temperatures ranged from 21.4 C° to 29.3 C° (Appendix A). Surface pH values ranged from 7.5 to 9.4 s.u., with the higher value observed in May at the lower end of the reservoir (HIW009G). This pH value was greater than the state water quality standard of 9.0 s.u. Secchi depths for Hiwassee Reservoir ranged from 1.5 to 4.0 meters.

Nutrient concentrations in 2019 were similar to those previously observed for this reservoir. Total phosphorus ranged from <0.02 to 0.02 mg/L while total Kjeldahl nitrogen ranged from <0.02 to 0.42 mg/L (Appendix A). Total organic nitrogen ranged from 0.09 to 0.41 mg/L. Chlorophyll *a* values ranged from 4.8 to 15.0 µg/L. Hiwassee Reservoir exhibited oligotrophic conditions or very low biological productivity in 2019 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 16 kilometers and 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 2019. Surface dissolved oxygen ranged from 7.9 to 9.6 mg/L and surface water temperatures ranged from 19.1 C° to 28.9 C° (Appendix A). Surface pH values ranged from 6.7 to 7.9 s.u. Secchi depths for Apalachia Lake ranged from 1.5 to 4.5 meters, indicating good water clarity.

Total phosphorus, ammonia and total Kjeldahl nitrogen concentrations were less than the DWR Laboratory detection level. Total organic nitrogen values were consistently 0.09 mg/L. In response to the limited availability of nutrients, chlorophyll *a* values were low (range = <1.0 to 6.9 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.

Appendix A - Hiwassee River Basin Lake Data
January 1, 2014 Through December 31, 2019

Lake	Date	Sampling Station	SURFACE PHYSICAL DATA DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent SAT	PHOTIC ZONE DATA 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 26, 2019	HIW000B	7.7	25.5	7.8	23	4.5	100.9%	<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	3.6	28.0	<6.2	1.2
	September 26, 2019	HIW000D	7.6	25.8	7.1	23	3.5	100.1%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	3.7	72.0	<6.2	1.1
	September 26, 2019	HIW000F	7.7	25.5	7.5	23	4.0	100.6%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	3.3	23.0	<6.2	1.1
	August 22, 2019	HIW000B	7.5	28.8	7.4	22	3.3	104.3%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02		13.0	<6.2	<1.0
	August 22, 2019	HIW000D	7.7	28.8	7.9	23	4.0	105.9%	<0.02	0.36	<0.02	<0.02	0.37	0.35	0.02		<12.0	<6.2	<1.0
	August 22, 2019	HIW000F	7.7	28.6	7.2	22	3.3	105.4%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02		15.0	<6.2	<1.0
	July 24, 2019	HIW000B	7.7	27.4	6.9	21	4.5	104.1%								3.4	30.0	<6.2	<1.0
	July 24, 2019	HIW000D	7.7	27.4	7.0	22	5.0	103.9%								2.9	31.0	<6.2	<1.0
	July 24, 2019	HIW000F	7.8	27.4	6.8	22	4.5	105.3%								3.8	26.0	<6.2	<1.0
	June 13, 2019	HIW000B	7.9	23.7	7.4	21	3.5	100.5%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	3.0	15.0	<6.2	<1.0
	June 13, 2019	HIW000D	8.0	24.0	7.1	21	3.5	102.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	3.2	16.0	<6.2	<1.0
	June 13, 2019	HIW000F	7.9	23.9	7.1	21	3.5	99.8%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	4.2	15.0	<6.2	<1.0
	May 15, 2019	HIW000B	9.0	20.7	7.3	20	2.6	107.0%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	3.8	14.0	<6.2	<1.0
	May 15, 2019	HIW000D	8.9	21.2	7.3	22	2.8	106.6%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	4.3	15.0	<6.2	<1.0
	May 15, 2019	HIW000F	9.1	20.7	7.3	21	2.8	107.6%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	4.3	16.0	<6.2	<1.0
HIWASSEE RESERVOIR	September 25, 2019	HIW009A	8.1	26.6	8.3	29	2.5	106.2%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	7.0	28.0	<6.2	1.5
	September 25, 2019	HIW009B	8.1	26.7	7.6	29	2.5	107.0%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	7.0	37.0	<6.2	1.7
	September 25, 2019	HIW009D	8.1	26.1	7.9	29	3.3	105.7%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	6.4	29.0	<12.0	1.3
	September 25, 2019	HIW009F	8.4	26.5	7.1	28	3.3	110.4%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	5.5	26.0	<6.2	1.3
	September 25, 2019	HIW009G	8.5	26.5	7.3	26	4.0	111.4%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	5.9	24.0	<6.2	1.1
	August 21, 2019	HIW009A	8.6	29.3	8.5	29	2.8	117.3%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	7.1	13.0	<6.2	<1.0
	August 21, 2019	HIW009B	8.5	29.2	8.2	29	3.3	116.3%	<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	6.1	16.0	<6.2	<1.0
	August 21, 2019	HIW009D	8.6	28.8	8.5	28	3.0	117.3%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	5.9	14.0	<6.2	<1.0
	August 21, 2019	HIW009F	8.6	28.7	7.5	28	3.5	117.5%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	6.0	14.0	<6.2	<1.0
	August 21, 2019	HIW009G	8.4	29.1	8.0	26	3.5	115.0%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	4.8	12.0	<6.2	<1.0
	July 23, 2019	HIW009A	8.4	28.4	8.4	29	3.3	114.0%								6.6	36.0	<6.2	<1.0
	July 23, 2019	HIW009B	8.5	28.5	8.7	29	3.4	116.0%								7.2	28.0	<6.2	<1.0
	July 23, 2019	HIW009D	8.5	28.3	8.4	27	3.4	115.3%								7.6	32.0	<6.2	<1.0
	July 23, 2019	HIW009F	8.6	28.4	8.4	27	3.4	117.4%								7.4	21.0	<6.2	<1.0
	July 23, 2019	HIW009G	8.5	28.6	8.4	26	3.4	116.3%								7.3	29.0	<6.2	<1.0
	June 12, 2019	HIW009A	8.4	24.9	7.5	27	2.2	107.4%	<0.02	0.32	<0.02	<0.02	0.33	0.31	0.02		20.0	<6.2	<1.0
	June 12, 2019	HIW009B	8.5	25.0	7.5	27	2.2	108.1%	0.02	0.32	<0.02	0.02	0.34	0.31	0.03		20.0	<6.2	<1.0
	June 12, 2019	HIW009D	8.6	28.0	8.1	28	2.5	109.4%	<0.02	0.29	<0.02	<0.02	0.30	0.28	0.02		18.0	<6.2	<1.0
	June 12, 2019	HIW009F	8.5	25.2	8.3	27	2.6	108.3%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02		17.0	<6.2	<1.0
	June 12, 2019	HIW009G	8.9	24.9	8.0	27	3.0	113.4%	<0.02	0.42	<0.02	<0.02	0.43	0.41	0.02		<12.0	<6.2	<1.0
	May 14, 2019	HIW009A	9.1	21.6	7.7	26	1.5	109.2%	0.02	0.38	<0.02	0.05	0.43	0.37	0.06	10.0	24.0	<6.2	<1.0
	May 14, 2019	HIW009B	9.2	21.4	7.9	26	1.5	109.0%	0.02	0.25	<0.02	0.05	0.30	0.24	0.06	12.0	19.0	<6.2	<1.0
	May 14, 2019	HIW009D	9.3	21.4	7.3	25	2.0	110.6%	0.02	0.21	<0.02	0.05	0.26	0.20	0.06	15.0	22.0	<6.2	<1.0
	May 14, 2019	HIW009F	9.7	22.1	8.8	26	2.5	117.3%	0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	14.0	17.0	<6.2	<1.0
	May 14, 2019	HIW009G	9.9	22.1	9.4	26	2.5	119.8%	<0.02	0.42	<0.02	<0.02	0.25	0.23	0.02	13.0	13.0	<6.2	<1.0
APALACHIA LAKE	September 25, 2019	HIW011A	8.6	23.1	7.7	29	4.0	105.6%	<0.02	<0.20	<0.02	0.12	0.22	0.09	0.13	4.4	38.0	<6.2	<1.0
	September 25, 2019	HIW011C	8.6	24.2	7.3	28	4.5	107.5%	<0.02	<0.20	<0.02	0.08	0.18	0.09	0.09	3.8	30.0	<6.2	<1.0
	September 25, 2019	HIW012	8.7	23.8	7.1	28	4.5	108.2%	<0.02	<0.20	<0.02	0.10	0.20	0.09	0.11	4.4		<6.2	<1.0
	August 21, 2019	HIW011A	8.4	25.2	6.7	27	3.0	106.3%	<0.02	<0.20	<0.02	0.15	0.25	0.09	0.16	4.8	13.0	<6.2	<1.0
	August 21, 2019	HIW011C	9.0	28.9	6.9	26	3.5	120.9%	<0.02	<0.20	<0.02	0.08	0.18	0.09	0.09	5.8	14.0	<6.2	<1.0
	August 21, 2019	HIW012	8.5	28.7	7.3	26	4.0	115.0%	<0.02	<0.20	<0.02	0.09	0.19	0.09	0.10	5.7	12.0	<6.2	<1.0
	July 23, 2019	HIW011A	7.9	24.2	7.2	25	2.5	99.1%								5.2	88.0	<6.2	<1.0
	July 23, 2019	HIW011C	8.7	26.8	7.5	24	3.0	113.9%								5.6	32.0	<6.2	<1.0
	July 23, 2019	HIW012	8.5	27.3	7.9	24	2.6	112.8%								6.9	34.0	<6.2	<1.0
	June 12, 2019	HIW011A	8.4	21.5	6.9	24	2.5	99.2%	<0.02	<0.20							18.0	<6.2	<1.0
	June 12, 2019	HIW011C	8.8	23.4	7.1	23	2.5	107.8%	<0.02		<0.02	0.10			0.11		18.0	<6.2	<1.0
	June 12, 2019	HIW012	8.8	23.0	7.5	23	2.2	107.2%	<0.02		<0.02	0.04			0.05		19.0	<6.2	<1.0
	May 14, 2019	HIW011A	8.4	13.6	6.9	25	3.0	84.0%	<0.02	<0.20	<0.02	0.17	0.27	0.09	0.18	<1.0	22.0	<6.2	<1.0
	May 14, 2019	HIW011C	9.4	19.1	6.9	22	1.5	106.6%	<0.02	<0.20	<0.02	0.06	0.16	0.09	0.07	5.4	21.0	<6.2	<1.0
	May 14, 2019	HIW012	9.6	20.0	6.9	22	1.5	109.7%	<0.02	<0.20	<0.02	0.10	0.20	0.09	0.11	3.2	22.0	<6.2	<1.0