LAKE & RESERVOIR ASSESSMENTS
ROANOKE RIVER BASIN

Lake Isaac Walton

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 Roanoke River basin extends from its source in the Blue Ridge Mountains of Virginia to the Albemarle Sound in North Carolina, encompassing mountainous, piedmont, and coastal topography as it flows generally east- southeastward. This constitutes 3,503 square miles of drainage area and approximately 2,389 miles of streams and rivers. Fifteen counties and 42 municipalities are also included in the basin. Though the spread of urban and suburban development has occurred in the Roanoke River basin as elsewhere in the state, the greatest portion of land cover in the basin has remained forest and, to a lesser extent, agriculture-based. Nonpoint source runoff and numerous small point source dischargers associated with development and agricultural activities have great potential to affect water quality in the basin.

Eleven lakes in this river basin were sampled by DWR staff in 2019. Three of these lakes are on the 303(d) List of Impaired Waters (Table 1). Belews Lake was listed for water temperatures exceeding 32° C. Kernersville Reservoir and Lake Roxboro were listed for elevated chlorophyll *a* concentration and Farmer Lake was listed for both chlorophyll *a* and elevated turbidity (https://files.nc.gov/ncdeq/Water%20Quality/Planning/TMDL/303d/2018/2018-NC-303-d--List-Final.pdf).

Table 1. Roanoke River Basin Lakes on the 2018 303(d) List of Impaired Waters.

Lake	Location	Violation
Belews Lake	From a point 1.8 mile downstream of the Forsyth-Stokes County Line to a line across the reservoir 1.75 miles upstream of the dam, excluding the Arm of Belews Lake described below which are classified "WS-IV&B"	Water Temperature >32ºC
Kernersville Reservoir	From a point 0.5 mile upstream of backwaters of Kernersville Reservoir to Town of Kernersville Water Supply Dam	Chlorophyll *a*
Farmer Lake	Upper reservoir-From a point 0.5 mile upstream of mouth of Nats Fork to dam at Farmer Lake	Chlorophyll *a* Turbidity
Lake Roxboro	From backwaters of Lake Roxboro to dam at Lake Roxboro	Chlorophyll *a*

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 Roanoke River Basin which may support largemouth bass. Lake Gaston also has a fish consumption advisory for walleye 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 driest portion of the state was along the Virginia border (Henderson in Vance County had 1.4" of rain and Reidsville in Rockingham County had 1.3" of rain).

June brought a return of regular rainfall in North Carolina. The statewide precipitation average was 7.1" (8th wettest June since 1895). 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. Localized parts of the northern Piedmont and Coastal Plain received at least three inches of rain.

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. 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 had minimal impacts in the Roanoke River Basin with the exception of the coastal region where four to six inches of rain fell.

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. 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, including the western portion of the Roanoke River Basin. 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.

LAKE & RESERVOIR ASSESSMENTS

HUC 03010102

John H. Kerr Reservoir

Ambient Lakes Program Name	John H. Kerr Reservoir			
Trophic Status (NC TSI)	Mesotrophic			
Mean Depth (meters)	11.0			
Volume ($10^6 m^3$)	448.0			
Watershed Area (mi^2)	19712.0			
Classification	B			
Stations	ROA037A	ROA037E	ROA037I	ROA037IJ
Number of Times Sampled	5	5	5	5

The John H. Kerr Reservoir (also called Kerr Lake) is a multipurpose impoundment constructed and operated by the US Army Corps of Engineers to provide flood control, recreation and hydroelectric power. The reservoir crosses the North Carolina-Virginia state line with the majority of the lake located in Virginia. Kerr Reservoir is the first of three-chain lake impoundments on the Roanoke River in North Carolina and has a mean hydraulic retention time of 124 days. Major tributaries to Kerr Lake include the Roanoke River, Hyco River, and the Dan River. Sampling of the lake is confined to the Nutbush Creek Arm because it is the only portion of the lake that lies within North Carolina.

Kerr Lake was sampled monthly from May through September in 2019. Secchi depths were lowest at the upper end of Nutbush Creek arm (ROA037A) and generally greatest at the downstream sampling site near the North Carolina/Virginia state line (ROA037IJ; Appendix A). Surface pH values ranged from 7.2 to 8.5 s.u. and surface conductivity ranged from 76 to 102 µmhos/cm

Total phosphorus ranged from <0.02 to 0.03 mg/L and total Kjeldahl nitrogen ranged from 0.27 to 0.45 mg/L (Appendix A). Total organic nitrogen in the Nutbush Creek arm ranged from 0.24 to 0.44 mg/L. Chlorophyll *a* ranged from 4.6 to 19.0 µg/L. These values were similar to those previously observed for this reservoir by DWR. Turbidity ranged from 1.5 to 5.4 NTU. An Algal Growth Potential Test conducted on water samples collected in August determined that phosphorus and nitrogen were the co-limiting nutrients for algal growth in this reservoir. The AGPT results at the sampling site in the Mill Creek arm of the lake (ROA037B) indicated that the growth of algae was co-limited by the availability of nitrogen and phosphorus at this location (Table 2).

Table 2. Algal Growth Potential Test, John H. Kerr Reservoir, August 28, 2019.

Algal Growth Potential Test Results

August 2019

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient(s)
	Control	C+N	C+P	
ROA037B	0.57	0.43	0.59	Nitrogen + Phosphorus

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

*These stations tended towards nitrogen limitation, but differences were not statistically significant.

Based on the calculated NCTSI scores for May through September, John H. Kerr Reservoir was determined to exhibit moderate biological productivity (mesotrophic conditions) in 2019. The Nutbush Creek arm of this reservoir has been predominantly mesotrophic since it was first monitored by DWR in 1981.

Hanging Rock Lake

Ambient Lakes Program Name	Hanging Rock Lake
Trophic Status (NC TSI)	Oligotrophic
Mean Depth (meters)	1.0
Volume ($10^6 m^3$)	0.003
Watershed Area (mi^2)	2.1
Classification	B
Stations	ROA003A
Number of Times Sampled	5

Hanging Rock Lake is a 12 acre impoundment located within Hanging Rock State Park. The original earthen and concrete dam was built in 1938 as a Civilian Conservation Corps project. The 445-acre watershed is primarily forested. Hanging Rock Lake has a classification of B (suitable for swimming).

This small reservoir was sampled monthly from May through September 2019 by DWR staff. Secchi depths ranged from 1.3 to 2.5 meters, indicating that the clarity of the water was good (Appendix A). Surface dissolved oxygen ranged from 7.2 to 8.2 mg/L and surface pH ranged from 5.7 s.u. in August to 8.1 s.u. in May. Conductivity values were low, ranging from 11 to 13 µmhos/cm.

Total phosphorus, ammonia and nitrite plus nitrate were at or below the DWR Laboratory detection levels in 2019 (Appendix A). Total Kjeldahl nitrogen ranged from 0.20 to 0.30 mg/L and total organic nitrogen ranged from 0.19 to 0.29 mg/L. Chlorophyll *a* values for Hanging Rock Lake were low, ranging from 4.0 to 13.0 µg/L. Turbidity ranged from <1.0 to 3.6 NTU. Based on the NTSI scores in 2019, Hanging Rock Lake was determined to exhibit very low biological productivity (oligotrophic conditions). This small reservoir has been determined to be oligotrophic since it originally monitored by DWR in 1985.

Kernersville Reservoir

Ambient Lakes Program Name	Kernersville Reservoir
Trophic Status (NC TSI)	Eutrophic
Mean Depth (meters)	5.0
Volume ($10^6 m^3$)	0.4
Watershed Area (mi^2)	9.1
Classification	WS-IV B
Stations	ROA0092A
Number of Times Sampled	5

Kernersville Reservoir, an impoundment of Belews Creek constructed in 1952, serves as a back-up water supply for the Town of Kernersville. Since 1984, Kernersville has been buying potable water from the City of Winston-Salem. Upstream land use within the watershed has become industrialized.

Kernersville Reservoir was sampled five times in 2019 by DWR staff. Secchi depths ranged from 1.3 to 2.5 meters, indicating that the clarity of the water was good. Surface dissolved oxygen ranged from 5.8 to 9.6 mg/L and surface pH ranged from 7.2 to 8.4 s.u.(Appendix A). Surface conductivity ranged from 128 to 159 µmhos/cm.

Total phosphorus values in 2019 ranged from 0.03 to 0.04 mg/L and total Kjeldahl nitrogen ranged from 0.58 to 0.96 mg/L (Appendix A). NH_3 ranged from <0.02 to 0.05 mg/L and $NO_2 + NO_3$ was less than the DWR Laboratory detection level. Total organic nitrogen ranged from 0.57 to 0.91 mg/L. Chlorophyll *a* ranged from 22.0 to 32.0 µg/L. Kernersville Reservoir was determined to be eutrophic (exhibiting elevated biological productivity) based on the calculated NCTSI scores for 2019. This reservoir has been eutrophic since it was first monitored in 1998 by DWR.

Belews Lake

Ambient Lakes Program Name	Belews Lake			
Trophic Status (NC TSI)	Oligotrophic			
Mean Depth (meters)	15.0			
Volume ($10^6 m^3$)	228.0			
Watershed Area (mi^2)	120.0			
Classification	WS-IV C			
Stations	ROA009E	ROA009G	ROA009H	ROA009J
Number of Times Sampled	9	9	9	9

Belews Lake is located on Belews Creek, a tributary of the Dan River in the northern Piedmont of the state. Construction of the dam was completed in 1973. The lake was constructed by Duke Energy to provide a source of condenser cooling water for the Belews Creek Steam Station. The maximum depth of Belews Lake is approximately 144 feet (44 meters). The watershed is mostly forested and agricultural with some urban areas. Retention time of Belews Lake is approximately 4.1 years.

DWQ staff sampled Belews Lake four times during the summer of 2017 and five times in 2019. In 2017, surface dissolved oxygen ranged from 6.4 to 7.7 mg/L and surface water temperature ranged from 26.7 C° to 34.0 C° (Appendix A). Surface pH values ranged from 7.2 s.u. to 7.8 s.u. Secchi depths in 2017 ranged from 1.2 to 4.1 meters. Total phosphorus NH3 and NO2 + NO3 values were less than the DWR Laboratory detection levels. Total organic nitrogen ranged from 0.19 to 0.30 mg/L. Chlorophyll *a* ranged from 2.1 to 3.2 µg/L. In 2017, NCTSI scores indicated that the trophic state of Belews Lake was oligotrophic (exhibited very low biological productivity).

In 2019, surface dissolved oxygen values ranged from 6.9 to 8.3 mg/L and surface water temperature ranged from 24.4 C° to 34.7 C° (Appendix A). Surface pH ranged from 7.6 to 8.3 s.u. Secchi depths in 2019 ranged from 1.7 to 3.5 meters. In 2019, total phosphorus and ammonia values were less than the DWR Laboratory detection levels. Total organic nitrogen ranged from 0.24 to 0.31 mg/L and chlorophyll a ranged from 2.2 to 13.0 µg/L. In 2019, Belews Lake was again determined to have low biological productivity (oligotrophic) based on the calculated NCTSI scores. This reservoir has been consistently oligotrophic since it was first monitored by DWR in 1981.

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HUC 03010104

Farmer Lake

Ambient Lakes Program Name	Farmer Lake		
Trophic Status (NC TSI)	Eutrophic		
Mean Depth (meters)	6.0		
Volume ($10^6 m^3$)	6.5		
Watershed Area (mi^2)	125		
Classification	WS-II HQW CA		
Stations	ROA027G	ROA027J	ROA027L
Number of Times Sampled	9	10	10

Farmer Lake, a water supply reservoir for the City of Yanceyville, was built in 1983. The reservoir is an impoundment of an unnamed tributary of Country Line Creek in Caswell County. Farmer Lake is also used extensively for recreational fishing. The land uses within the watershed include agriculture and forests.

DWR staff sampled this lake once a month from May through September in 2017 and 2019. In 2017, surface dissolved oxygen was greatest in September (9.3 mg/L) at the sampling site located in the upper end of the reservoir (ROA027G) in May and lowest (7.3 mg/L) at the dam (ROA027L, Appendix A). Surface pH values ranged from 7.1 to 8.7 s.u. and Secchi depths ranged from 0.3 to 1.5 meters. Total phosphorus concentrations in 2017 were greatest at the upper reservoir sampling site (range = <0.02 to 0.8 mg/L) and total organic nitrogen demonstrated a similar concentration pattern in Farmer Lake (range = 0.41 to 0.80 mg/L). Due to the greater concentrations of nutrients present at ROA027G, the highest chlorophyll *a* values also occurred at this site (50 µg/L in September). This chlorophyll *a* value was greater than the state water quality standard of 40 µg/L (Appendix A). Turbidity values ranged from 3.3 at the dam to 45 NTU near the upper end of the lake. This latter turbidity value exceeded the state water quality standard of 25 NTU.

Surface dissolved oxygen at the surface of the reservoir in 2019 ranged from 6.2 to 10.1 mg/L and surface pH ranged from 7.4 to 8.5 s.u. Total phosphorus concentrations were greatest at the upper end of Farmer Lake (ROA027G). Overall, total phosphorus ranged from <0.02 to 0.12 mg/L and total organic nitrogen ranged from 0.34 to 0.81 mg/L. Chlorophyll *a* in 2019 ranged from 3.1 to 47.0 µg/L and exceeded the state water quality standard twice. A turbidity value at the upper end of the lake in May (45 NTU) exceeded the state water quality standard.

The Region 4, EPA Laboratory conducted an Algal Growth Potential Test (AGPT) on a water sample collected by DWR field staff in August (Table 3). The AGPT results at the sampling site near the dam (ROA027L) indicated that the growth of algae was co-limited by the availability of nitrogen and phosphorus.

Table 3. Algal Growth Potential Test, Farmer Lake, August 28, 2019.

Algal Growth Potential Test Results

August 2019

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient(s)
	Control	C+N	C+P	
ROA027L*	0.51	0.70	0.38	Nitrogen + Phosphorus

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

*These stations tended towards nitrogen limitation, but differences were not statistically significant.

Farmer Lake was determined to exhibit elevated biological productivity (eutrophic conditions) in 2017 and 2019. With the exception of 2002 when low rainfall conditions contributed to mesotrophic conditions, Farmer Lake has been consistently eutrophic since it was first monitored by DWR in 1991.

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HUC 03010105

Hyco Lake

Ambient Lakes Program Name	Hyco Lake			
Trophic Status (NC TSI)	Mesotrophic			
Mean Depth (meters)	20.0			
Volume ($10^6 m^3$)	99.0			
Watershed Area (mi^2)	256.0			
Classification	WS-V B			
Stations	ROA030C	ROA030E	ROA030F	ROA030G
Number of Times Sampled	5	5	5	5

Hyco Lake is located on the Hyco River approximately three miles south of the North Carolina-Virginia State line in Person and Caswell Counties. This reservoir was constructed in 1965 to provide cooling water for the Duke Energy Roxboro Steam Plant. Hyco Lake has maximum depth of 49 feet (15 meters) and a mean hydraulic retention time of 180 days. The drainage area for Hyco Lake is characterized by rolling hills and land use along the 159 mile (256 kilometer) shoreline is primarily residential, forested, and agriculture.

DWR field staff sampled Hyco Lake monthly from May through September 2019. Secchi depths ranged from 0.5 to 2.2 meters (Appendix A). Surface dissolved oxygen ranged from 6.6 to 9.8 mg/L and surface pH ranged from 7.3 to 8.1 s.u. Surface water temperature ranged from 23.0 C° to 34.8 C° and surface conductivity in Hyco Lake ranged from 77 to 205 µmos/cm.

Total phosphorus values ranged from <0.02 mg/L to 0.06 mg/L and total Kjeldahl nitrogen ranged from 0.33 to 0.56 mg/L (Appendix A). Total organic nitrogen in Hyco Lake in 2019 ranged from 0.32 to 0.55 mg/L. Chlorophyll *a* values were low, ranging from 6.1 to 20.0 µg/L. Hyco Lake was determined to exhibit moderate (mesotrophic) biological productivity in 2019 based on the calculated NCTSI scores. This reservoir has varied between very low biological productivity (oligotrophic conditions) and mesotrophic conditions since it was first monitored by DWR staff in 1983.

Lake Roxboro

Ambient Lakes Program Name	Lake Roxboro		
Trophic Status (NC TSI)	Eutrophic		
Mean Depth (meters)	6.1		
Volume ($10^6 m^3$)	11.0		
Watershed Area (mi^2)	62		
Classification	WS-II B HQW		
Stations	ROA030DA	ROA030DC	ROA030DE
Number of Times Sampled	10	10	10

Lake Roxboro is located in Caswell and Person Counties near the Town of Roxboro and covers 195 acres. The lake, which is an impoundment of South Hyco Creek, was filled in 1978 and is owned by the Town of Roxboro, which uses the lake as a source of drinking water. Land uses in the watershed include agriculture, forest, and residential areas.

DWR staff sampled this lake five time in 2017 and 2019 during the months of May through September. Surface dissolved oxygen in 2017 ranged from 6.6 to 10.2 mg/L and surface water temperatures ranged from 19.9 C° to 31.6 C° (Appendix A). Surface pH values ranged from 6.6 to 8.6 s.u. Secchi depths in 2017 ranged from 0.5 to 1.1 meters. The concentration of total phosphorus in Lake Roxboro ranged from 0.03 to 0.09 mg/L and total Kjeldahl nitrogen ranged from 0.73 to 1.10 mg/L. Total organic nitrogen values ranged from 0.72 to 1.01 mg/L. Chlorophyll *a* in Lake Roxboro ranged from 16 to 100 µg/L, which was greater than the state water quality standard of 40 µg/L.

In 2019, surface dissolved oxygen ranged from 6.3 mg/L near the dam in September to 10.7 mg/L at the upper end of the lake in June (Appendix A). Surface water temperatures ranged from 24.5 C° to 29.5 C° and surface pH ranged from 6.8 to 8.8 s.u. Secchi depths in 2019 were less than a meter with the exception of a measurement near the dam in September that was 1.1 meters. Total phosphorus values ranged from 0.03 to 0.08 mg/L with the greatest values observed at the upper end of the lake (ROA030DA). Total Kjeldahl nitrogen ranged from 0.67 to 1.10 mg/L and total organic nitrogen ranged from 0.66 to 1.09 mg/L. Chlorophyll *a* values in 2019 ranged from 10 to 81 µg/L.

The Region 4, EPA Laboratory conducted an Algal Growth Potential Test (AGPT) on a water sample collected by DWR field staff on August 28, 2019 (Table 4). The AGPT results at the sampling site near the dam (ROA030DE) indicated that the growth of algae was co-limited by the availability of nitrogen and phosphorus.

Table 4. Algal Growth Potential Test, Lake Roxboro, August 28, 2019.

Algal Growth Potential Test Results

August 2019

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient(s)
	Control	C+N	C+P	
ROA030DE*	1.03	1.28	0.99	Nitrogen + Phosphorus

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

*These stations tended towards nitrogen limitation, but differences were not statistically significant.

Based on the calculated NCTSI scores for 2017 and 2019, Lake Roxboro was determined to exhibit elevated biological productivity or eutrophic conditions. Since it was first monitored by DWR staff in 1981, Lake Roxboro has been predominantly eutrophic.

Mayo Reservoir

Ambient Lakes Program Name	Mayo Reservoir		
Trophic Status (NC TSI)	Mesotrophic		
Mean Depth (meters)	9.0		
Volume (10^6 m^3)	105.0		
Watershed Area (mi^2)	133		
Classification	WS-V		
Stations	ROA0341A	ROA0342A	ROA0343A
Number of Times Sampled	5	5	5

Mayo Reservoir is located on Mayo Creek in Person County just south of the Virginia border and covers 2,800 acres (1,133 hectares). Owned by Duke Energy, the reservoir was completed in 1983 to provide cooling water for the Mayo Electric Generating Plant. Mayo Reservoir has an average retention time of 36 months. The drainage area is characterized by rolling hills with forests and agriculture.

Mayo Reservoir was sampled monthly from May through September by DWR field staff. Secchi depths for this reservoir ranged from 0.9 to 2.5 meters (Appendix A). Surface dissolved oxygen ranged from 7.1 to 10.3 mg/L and surface water temperatures ranged from 21.8 C° to 31.4 C°. Surface pH values varied from 7.3 to 8.3 s.u. and surface conductivity ranged from 67 to 92 µmos/cm.

Total phosphorus in Mayo Reservoir was ranged from <0.02 to 0.04 mg/L (Appendix A). Total Kjeldahl nitrogen ranged from 0.20 to 0.51 mg/L and total organic nitrogen ranged from 0.19 to 0.50 mg/L. Chlorophyll *a* ranged from 3.4 to 18.0 µg/L. Overall, Mayo Reservoir was determined to exhibit moderate biological productivity or mesotrophic conditions in 2019 based on the calculated NCTSI scores for May through September. Trophic conditions have varied between mesotrophic and oligotrophic since 1983 when monitoring by DWR began.

Lake Isaac Walton

Ambient Lakes Program Name	Lake Isaac Walton		
Trophic Status (NC TSI)	Eutrophic		
Mean Depth (meters)	3.5		
Volume ($10^6 m^3$)	0.3		
Watershed Area (mi^2)	508		
Classification	WS-II HQW CA		
Stations	ROA031C	ROA031E	ROA031H
Number of Times Sampled	5	5	5

Lake Isaac Walton (also called Roxboro Lake) is located in Person County near the Town of Roxboro and is the primary water supply for the town. The lake was built in the 1930's and Satterfield and Storys Creeks are the main tributaries. Maximum depth is about 23 feet (seven meters) and retention time is approximately 30 days. The watershed is comprised of agricultural land, pastures, and residential areas.

This lake was sampled monthly from May through September in 2019. Surface dissolved oxygen ranged from 6.7 to 9.5 mg/L and surface water temperatures ranged from 23.9 C° to 30.0 C° (Appendix A). Surface pH values ranged from 7.2 to 8.9 s.u. Secchi depths in Lake Isaac Walton ranged from 0.4 to 2.0 meters.

Total phosphorus ranged from 0.02 to 0.06 mg/L and total Kjeldahl nitrogen ranged from 0.39 to 0.90 mg/L. Total organic nitrogen ranged from 0.37 to 0.89 mg/L. Chlorophyll *a* in Lake Isaac Walton ranged from 5.7 to 67.0 µg/L. For each sampling date, the highest chlorophyll *a* value was observed at the most upstream lake sampling site (ROA031C. The Region 4, EPA Laboratory conducted an Algal Growth Potential Test (AGPT) on a water sample collected by DWR field staff on August 28, 2019 (Table 5). The AGPT results at the sampling site near the dam (ROA031H) indicated that the growth of algae was co-limited by the availability of nitrogen and phosphorus.

Table 5. Algal Growth Potential Test, Lake Isaac Walton, August 28, 2019.

Algal Growth Potential Test Results

August 2019

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient(s)
	Control	C+N	C+P	
ROA031H*	0.71	0.86	0.58	Nitrogen + Phosphorus

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

*These stations tended towards nitrogen limitation, but differences were not statistically significant.

Based on the calculated NCTSI scores, Lake Isaac Walton was determined to have elevated biological productivity or eutrophic conditions in 2019. This reservoir has consistently been found to be eutrophic since it was first monitored by DWR staff in 1986.

Lake Gaston

Ambient Lakes Program Name	Lake Gaston			
Trophic Status (NC TSI)	Mesotrophic			
Mean Depth (meters)	29.0			
Volume ($10^6 m^3$)	512.0			
Watershed Area (mi^2)	21340.0			
Classification	WS-IV, V B			
Stations	ROA0382A	ROA038A	ROA039	ROA039B
Number of Times Sampled	5	5	5	5

Lake Gaston is located on the North Carolina - Virginia border just downstream from the John H. Kerr Reservoir dam on the Roanoke River. The lake was built in 1962 by the Virginia Electric and Power Company for generating hydroelectric power. The drainage area of the lake is comprised of forested land with some agriculture, residential development and urbanized areas.

DWR staff monitored Lake Gaston monthly from May through September 2019. Secchi depths ranged from 0.3 to 2.0 meters (Appendix A). Surface dissolved oxygen concentrations ranged from 4.0 mg/L at the upper end of the reservoir to 9.4 mg/L. Surface dissolved oxygen concentrations were lowest at the sampling site at the upper end of the reservoir (ROA0382A) and the value observed at this site in September (4.0 mg/L) was at the limit of the state water quality standard of 4.0 mg/L for an instantaneous dissolved oxygen reading. Surface water temperatures ranged from 21.7 C° to 30.3 C° and surface pH values in 2019 ranged from 7.1 to 9.1 s.u.

Total phosphorus concentrations ranged from <0.02 to 0.05 mg/L and total Kjeldahl nitrogen ranged from 0.27 to 0.45 mg/L. Total organic nitrogen ranged from 0.23 to 0.41 mg/L. Chlorophyll *a* values ranged from 2.4 to 13.0 µg/L. The invasive aquatic weed, *Hydrilla verticillata* is present in Lake Gaston Efforts to control this plant have included stocking the lake with triploid Grass Carp and applications of herbicides

In 2019, Lake Gaston demonstrated moderate biological productivity (mesotrophic conditions) and has been predominantly mesotrophic since it was first monitored by DWR in 1981. In November 2009, the North Carolina State Health Director issued a fish consumption advisory for walleye and largemouth bass in Lake Gaston due to high levels of mercury found in this fish.

Roanoke Rapids Lake

Ambient Lakes Program Name	Roanoke Rapids Lake		
Trophic Status (NC TSI)	Mesotrophic		
Mean Depth (meters)	5.0		
Volume (10^6 m^3)	96.0		
Watershed Area (mi^2)	124819		
Classification	WS-IV B CA		
Stations	ROA039C	ROA039D	ROA039E
Number of Times Sampled	5	5	5

Roanoke Rapids Lake, located on the Roanoke River immediately downstream from Lake Gaston, is owned by the Virginia Electric and Power Company and used for hydropower generation as well as public recreation and as a water supply. The maximum depth of this reservoir is 89 feet (27 meters). The Roanoke River is the major tributary to the reservoir and drains nearly all of its 8,294 mi^2 (21,482 km^2) watershed. Releases from Lake Gaston located directly upstream account for almost all of the inflow into Roanoke Rapids Lake.

Roanoke Rapids Lake was sampled monthly from May through September 2019. Secchi depths ranged from 1.0 to 2.4 meters (Appendix A). Surface dissolved oxygen ranged from 2.8 to 8.8 mg/L. The dissolved value of 2.8 mg/L was observed in August at the most upstream sampling site (ROA039C. This value was less than the state water quality standard of 4.0 mg/L for an instantaneous reading. Surface water temperatures ranged from 24.2C° to 28.8 C°. Surface pH values were within state water quality standards and ranged from 6.2 to 8.2 s.u.

The concentration of total phosphorus in Roanoke Rapids Lake ranged from <0.02 mg/L to 0.03 mg/L (Appendix A). Total Kjeldahl nitrogen ranged from 0.32 to 0.40 mg/L and total organic nitrogen ranged from 0.31 to 0.44 mg/L. Chlorophyll *a* values ranged from 5.3 µg/L in September to 13.0 µg/L in May. Hydrilla (*Hydrilla verticillata)*, Eurasian milfoil (*Myriophyllum spicatum*) and Brazilian elodea (*Egeria densa*) are the dominant aquatic weeds in this lake. Control of these plants has been primarily through the application of herbicides in problem areas.

An Algal Growth Potential Test conducted on a water sample collected in August determined that phosphorus was the limiting nutrients for algal growth in this reservoir (Table 6).

Table 6. Algal Growth Potential Test, Roanoke Rapids Reservoir, August 28, 2019.

Algal Growth Potential Test Results

August 2019

Station	Maximum Standing Crop, Dry Weight (mg/L)			Limiting Nutrient(s)
	Control	C+N	C+P	
ROA039E	0.92	0.90	2.10	Phosphorus

Freshwater AGPT using *Selenastrum capricornutum* as test alga

C+N = Control + 1.0 mg/L Nitrate-N

C+P = Control + 0.05 mg/L Phosphate-P

Roanoke Rapids Lake was determined to have moderate biological productivity (mesotrophic conditions) in 2019. This reservoir has been predominantly mesotrophic or oligotrophic since it was first monitored by DWR staff in 1981.

Appendix A - Roanoke River Basin Data
January 1, 2010 Through December 31, 2014

Lake	Date	Sampling Station	SURFACE PHYSICAL DATA DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent DO 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	Total Hardnes mg/L
HUC 03010102																				
JOHN H. KERR RESERVOIR	September 18, 2019	ROA037A	7.6	27.8	7.2	92	1.0	97.3%	0.03	0.45	<0.02	<0.02	0.46	0.44	0.02	19.0	73	<12.0	5.4	
	September 18, 2019	ROA037B	7.8	27.4	7.2	86	2.0	98.3%	0.02	0.32	<0.02	<0.02	0.33	0.31	0.02	11.0	59	<6.2	2.8	25.0
	September 18, 2019	ROA037E	7.3	27.4	7.2	90	2.0	93.0%	0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	10.0	74	<6.2	3.0	
	September 18, 2019	ROA037I	6.6	26.6	7.2	96	2.8	82.9%	0.02	0.27	0.03	<0.02	0.28	0.24	0.04	5.8	60	<6.2	1.8	
	September 18, 2019	ROA037IJ	6.0	26.8	7.6	101	2.5	75.3%	0.02	0.28	0.03	<0.02	0.29	0.25	0.04	4.6	80	<6.2	1.5	
	August 28, 2019	ROA037A	7.9	28.3	7.5	93	1.5	103.0%	0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	7.7	84	<6.2	3.1	
	August 28, 2019	ROA037B	7.5	28.6	7.6	88	1.5	98.2%	0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	11.0	100	<12.0	2.3	27.0
	August 28, 2019	ROA037E	7.4	27.8	7.4	93	2.0	95.5%	<0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	10.0	74	<6.2	2.1	
	August 28, 2019	ROA037I	6.9	27.8	7.2	95	2.5	88.3%	<0.02	0.30	0.02	<0.02	0.31	0.28	0.03	5.3	84	<6.2	1.8	
	August 28, 2019	ROA037IJ	6.8	27.7	7.4	102	2.5	87.4%	<0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	6.3	68	<6.2	1.6	
	July 18, 2019	ROA037A	7.4	30.8	7.6	102	1.3	99.6%								19.0	81.0	<6.2	4.1	
	July 18, 2019	ROA037B	7.8	31.5	7.3	91	2.0	107.2%								10.0	66	<6.2	2.9	28.0
	July 18, 2019	ROA037E	6.8	30.1	7.2	97	2.0	91.0%								12.0	73	<6.2	3.8	
	July 18, 2019	ROA037I	7.3	30.7	7.4	96	2.5	99.0%								8.1	74	<12.0	2.3	
	July 18, 2019	ROA037IJ	7.6	30.9	7.7	76	2.5	102.8%								8.2	65	<6.2	2.0	
	June 26, 2019	ROA037A	9.2	27.9	8.3	92	0.9	117.1%	0.02		<0.02	<0.02			0.02	17.0		<6.2	3.7	
	June 26, 2019	ROA037B	8.6	27.6	7.7	93	1.4	109.2%	<0.02		<0.02	<0.02			0.02	8.6	69	<6.2	2.7	30.0
	June 26, 2019	ROA037E	8.7	27.5	7.9	96	1.6	110.0%	<0.02			<0.02				11.0	80	<6.2	2.1	
	June 26, 2019	ROA037I	8.4	28.5	8.0	96	1.6	109.0%	<0.02		<0.02	<0.02			0.02	7.5	72	<12.0	1.8	
	June 26, 2019	ROA037IJ																		
	May 21, 2019	ROA037A	9.2	24.1	8.3	96	1.2	110.7%	0.02	0.41	<0.02	0.07	0.48	0.40	0.08	13.0	75	<12.0	3.3	
	May 21, 2019	ROA037B	9.4	24.7	8.5	92	2.1	114.2%	0.02	0.39	<0.02	0.08	0.47	0.38	0.09	11.0	74	<6.2	2.8	30.0
	May 21, 2019	ROA037E	8.9	23.1	8.0	92	1.5	104.9%	<0.02	0.27	<0.02	0.10	0.37	0.26	0.11	8.9	65	<6.2	3.2	
	May 21, 2019	ROA037I	9.0	24.3	8.2	92	1.8	108.3%	<0.02	0.28	<0.02	0.08	0.36	0.27	0.09	8.7	80	<6.2	2.7	
	May 21, 2019	ROA037IJ	9.1	25.4	8.4	94	2.0	111.2%	<0.02	0.32	<0.02	0.07	0.39	0.31	0.08	9.4	72	<6.2	2.9	
	43606																			
HUC 03010103																				
HANGING ROCK LAKE	September 30, 2019	ROA003A	8.2	24.5	6.8	11	1.5	103.5%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02			<6.2	1.1	
	August 26, 2019	ROA003A	6.8	23.7	5.7	12	1.3	84.5%	0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	11.0	26	6.8	3.6	
	July 30, 2019	ROA003A	8.1	25.6	6.3	12	1.6	104.3%								13.0	38	<12.0	2.6	
	June 20, 2019	ROA003A	7.8	25.3	6.6	12	2.4	101.2%	<0.02		<0.02	<0.02			0.02	4.0	<25.0	<12.0	1.5	
	May 23, 2019	ROA003A	8.1	22.5	8.4	13	2.5	98.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.4	28	<12	<1.0	
KERNERSVILLE RESERVOIR	September 30, 2019	ROA0092A	8.1	26.8	7.9	159	0.8	103,9%	0.04	0.74	0.02	<0.02	0.75	0.72	0.03		135	7.8	9.0	
	August 26, 2019	ROA0092A	5.8	25.2	7.2	141	0.5	71.5%	0.04	0.96	0.05	<0.02	0.97	0.91	0.06	32.0	164	7.8	10.0	
	July 30, 2019	ROA0092A	8.6	30.2	8.3	142	0.6	116.6%	0.04	0.76	<0.02	<0.02	0.77	0.75	0.02	22.0	122	<6.2	8.6	
	June 20, 2019	ROA0092A	8.9	28.4	8.4	128	0.7	118.9%	0.03		<0.02	<0.02			0.02	23.0	110.0	7.5	9.4	
	May 23, 2019	ROA0092A	9.6	24.7	8.0	143	0.6	117.9%	0.03	0.58	<0.02	<0.02	0.59	0.57	0.02	29.0	109	6.8	8.3	
BELEWS LAKE	September 30, 2019	ROA009E	7.4	29.2	7.8	91	3.0	98.2%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02		78	<12.0	<1.0	
	September 30, 2019	ROA009G	7.6	28.4	7.8	90	3.2	98.8%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02		63	<6.2	<1.0	
	September 30, 2019	ROA009H	7.6	28.2	7.8	90	3.0	98.6%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02		78	<6.2	<1.0	28.0
	September 30, 2019	ROA009J	6.9	33.2	7.6	92	2.8	92.0%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02		74	<6.2	1.1	
	August 26, 2019	ROA009E	7.0	31.1	7.8	87	1.8	95.9%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	12.0	78	<6.2	1.8	
	August 26, 2019	ROA009G	7.5	29.9	8.2	87	1.7	100.5%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	8.2	65	<6.2	1.6	
	August 26, 2019	ROA009H	7.6	29.6	8.3	87	2.0	101.5%	<0.02	0.29	<0.02	<0.02	0.30	0.28	0.02	9.9	90	<6.2	1.6	25.0
	August 26, 2019	ROA009J	7.0	32.8	8.0	88	1.7	99.0%	<0.02	0.32	<0.02	<0.02	0.33	0.31	0.02	13.0	80	<6.2	1.9	
	July 30, 2019	ROA009E	7.6	32.8	8.1	86	2.9	108.0%								8.6	74	<6.2	1.6	
	July 30, 2019	ROA009G	7.8	31.4	8.2	86	3.0	108.3%								7.4	79	<6.2	1.3	
	July 30, 2019	ROA009H	7.7	32.0	8.2	86	2.4	107.0%								6.3	74	<6.2	1.5	26.0
	July 30, 2019	ROA009J	7.5	34.7	8.1	87	2.4	109.0%								8.2	84	<8.3	1.6	
	June 25, 2019	ROA009E	7.4	29.9		81	3.2	81.0%	<0.02		<0.02	0.12			0.13	2.6	64	<12.0	1.3	
	June 25, 2019	ROA009G	7.7	28.9		82	3.3	101.8%	<0.02		<0.02	0.14			0.15	2.8	73	<6.2	1.2	
	June 25, 2019	ROA009H	7.7	29.0		78	3.5	102.6%	<0.02		<0.02	0.13			0.14	3.1	71	<6.2	1.2	24.0
	June 25, 2019	ROA009J	7.5	30.9		82	3.2	103.0%	<0.02		<0.02	0.13			0.14	3.1	81	<6.2	3.2	
	May 13, 2019	ROA009E	8.3	24.8	7.6	89	2.3	102.9%	<0.02	0.27	<0.02	0.19	0.46	0.26	0.20	2.3	64	<12.0	1.2	
	May 13, 2019	ROA009G	8.3	24.4	7.7	89	2.5	102.6%	<0.02	0.29	<0.02	0.19	0.48	0.28	0.20	2.2	65	<6.2	1.3	
	May 13, 2019	ROA009H	8.3	24.7	7.8	89	2.8	103.2%	<0.02	0.25	<0.02	0.19	0.44	0.24	0.20	2.5	69	<6.2	1.2	24.0
	May 13, 2019	ROA009J	8.3	25.0	7.7	89	2.3	103.7%	<0.02	0.27	<0.02	0.19	0.46	0.26	0.20	2.4	83	<6.2	1.4	
	September 21, 2017	ROA009E	7.4	28.1	7.6	107	2.4	94.7%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	2.4	65	<6.2	<1.0	
	September 21, 2017	ROA009G	7.6	26.7	7.6	106	3.1	94.9%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	2.3	68	<6.2	<1.0	
	September 21, 2017	ROA009H	7.7	26.7	7.7	106	3.2	96.1%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	2.3	68	<6.2	<1.0	31.0
	September 21, 2017	ROA009J	7.2	30.1	7.7	107	3.2	95.4%	<0.02	0.32	<0.02	<0.02	0.33	0.31	0.02	2.8	54	<6.2	<1.0	
	August 10, 2017	ROA009E					2.7		<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	5.6	88	<6.2	1.5	
	August 10, 2017	ROA009G					3.2		<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	4.9	86	<6.2	1.2	
	August 10, 2017	ROA009H					3.2		<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02	4.4	89	<6.2	1.2	30.0
	August 10, 2017	ROA009J					2.9		<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	5.4	92	<12.0	1.3	
	June 22, 2017	ROA009E	6.5	31.8	7.4	103	2.3	88.7%	<0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	3.9	102		1.4	
	June 22, 2017	ROA009G	6.6	30.3	7.4	102	2.7	87.8%	<0.02	0.36	<0.02	<0.02	0.37	0.35	0.02	4.9			1.9	
	June 22, 2017	ROA009H	6.7	30.3	7.4	103	3.0	89.1%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02	3.9	74		1.4	30.0
	June 22, 2017	ROA009J	6.4	34.0	7.4	102	2.3	90.6%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	3.2	117		1.3	
	May 25, 2017	ROA009E	7.2	29.0	7.4	103	1.2	93.6%	<0.02	0.30	<0.02	0.05	0.35	0.29	0.06	5.7	112	<6.2	2.7	
	May 25, 2017	ROA009G	7.7	27.2	7.4	103	1.4	97.0%	<0.02	0.32	<0.02	0.05	0.37	0.31	0.06	6.0	66	<6.2	2.3	
	May 25, 2017	ROA009H	7.6	27.1	7.2	102	1.7	95.6%	<0.02	0.30	<0.02	0.05	0.35	0.29	0.06	6.0	102	<12.0	2.4	33.0
	May 25, 2017	ROA009J	7.4	30.8	7.5	103	1.2	99.3%	<0.02	0.34	<0.02	0.04	0.38	0.33	0.05	6.8	96	<6.2	2.6	

Appendix A - Roanoke River Basin Data
January 1, 2010 Through December 31, 2014

Lake	Date	Sampling Station	SURFACE PHYSICAL DATA: DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent DO 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	Total Hardnes mg/L
HUC 03010104																				
FARMER LAKE	September 17, 2019	ROA027G	9.7	28.1	8.5	107	0.4	125.7%	0.08	0.82	<0.02	<0.02	0.83	0.81	0.02	43.0	114	15.0	17.0	
	September 17, 2019	ROA027J	8.2	27.9	8.0	92	1.2	105.7%	0.04	0.52	<0.02	<0.02	0.53	0.51	0.02	17.0	102	<6.2	4.1	
	September 17, 2019	ROA027L	8.5	27.8	8.2	90	1.3	109.2%	0.02	0.46	<0.02	<0.02	0.47	0.45	0.02	10.0	75	<6.2	3.2	32.0
	Augusr 28, 2019	ROA027G	8.1	26.0	7.8	100	0.5	101.4%	0.07	0.67	<0.02	<0.02	0.68	0.66	0.02	20.0	102	22.0	20.0	
	Augusr 28, 2019	ROA027J	6.2	26.6	7.4	93	0.9	93.0%	0.03	0.43	<0.02	<0.02	0.44	0.42	0.02	9.1	116	<6.2	6.1	
	Augusr 28, 2019	ROA027L	7.9	26.6	7.6	89	1.6	99.6%	0.02	0.41	<0.02	<0.02	0.42	0.40	0.02	5.9	122	<6.2	3.0	31.0
	July 30, 2019	ROA027G	8.5	29.4	8.0	111	0.4	112.1%	0.08	0.69	<0.02	<0.02	0.70	0.68	0.02	32.0	127	24.0	24.0	
	July 30, 2019	ROA027J	9.2	29.3	8.3	101	1.3	121.9%	0.02	0.48	<0.02	<0.02	0.49	0.47	0.02	18.0	96	<6.2	4.2	
	July 30, 2019	ROA027L	8..3	29.3	8.0	95	1.8	110.0%	<0.02	0.45	<0.02	<0.02	0.46	0.44	0.02	9.6	104	<6.2	2.6	31.0
	June 25, 2019	ROA027G	10.1	31.0		91	0.5	138,2%	0.05		<0.02	<0.02			0.02	20.0	101	15.0	15.0	
	June 25, 2019	ROA027J	7.5	30.9		82	3.2	103.0%	<0.02		<0.02	0.130			0.14	3.1	81	<6.2	1.4	
	June 25, 2019	ROA027L	8.6	29.5		87	1.4	115.3%	0.02		<0.02	<0.02			0.02	7.2	86	<6.2	3.5	31.0
	May 28, 2019	ROA027G		28.8	7.9	114	0.6		0.12	0.68	<0.02	0.02	0.70	0.67	0.03	14.0	160	46.0	45.0	
	May 28, 2019	ROA027J		28.9	7.9	105	1.7		0.03	0.48	<0.02	<0.02	0.49	0.47	0.02	47.0	89	<6.2	5.3	
	May 28, 2019	ROA027L		28.7	7.8	92	2.0		0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	6.3	75	<6.2	4.1	30.0
	September 7, 2017	ROA027G	9.3	24.8	8.3	87	0.3	112.2%	0.08	0.81	<0.02	<0.02	0.82	0.80	0.02	50.0	106	21.0	24.0	
	September 7, 2017	ROA027J	8.5	24.5	7.7	83	0.7	102.0%	0.03	0.57	<0.02	<0.02	0.58	0.56	0.02	29.0	90	<6.2	7.3	
	September 7, 2017	ROA027L	7.3	24.1	7.4	70	1.0	86.9%	0.02	0.50	<0.02	<0.02	0.51	0.49	0.02	17.0	70	<6.2	3.3	26.0
	August 23, 2017	ROA027J	8.2	30.8	8.3	93	1.0	110.0%	0.03	0.51	<0.02	<0.02	0.52	0.50	0.02	14.0	85	<6.2	4.2	
	August 23, 2017	ROA027L	7.5	30.7	7.9	83	1.5	100.5%	0.02	0.42	<0.02	<0.02	0.43	0.41	0.02	7.9	78	<12.0	2.4	27.0
	July 13, 2017	ROA027G	8.7	33.1	8.3	94	0.3	121.4%	0.08	0.73	<0.02	<0.02	0.74	0.72	0.02	31.0	128	25.0	1.8	
	July 13, 2017	ROA027J	8.4	32.7	8.7	86	0.7	116.4%	0.02	0.60	<0.02	<0.02	0.61	0.59	0.02	19.0	102	<6.2	5.9	
	July 13, 2017	ROA027L	7.3	32.9	8.4	78	1.5	101.5%	<0.02	0.58	<0.02	<0.02	0.59	0.57	0.02	13.0	102	<6.2	3.5	21.0
	June 1, 2017	ROA027G	8.6	29.3	7.8	82	0.5	112.4%	0.08	0.61	<0.02	0.02	0.63	0.60	0.03	18.0	138	30.0	45.0	
	June 1, 2017	ROA027J	9.2	28.6	8.0	76	1.2	118.8%	0.04	0.50	<0.02	<0.02	0.51	0.49	0.02	18.0	100	7.2	16.0	
	June 1, 2017	ROA027L	8.4	28.5	8.1	71	1.1	108.3%	0.02	0.40	<0.02	<0.02	0.41	0.39	0.02	8.2	93	<6.2	5.3	24.0
	May 18, 2017	ROA027G	8.2	26.1	7.1	101	0.3	101.3%	0.06	0.48	<0.02	0.04	0.52	0.47	0.05	24.0	133	24.0	24.0	
	May 18, 2017	ROA027J	8.2	26.7	7.1	76	1.2	102.4%	0.03	0.42	<0.02	0.02	0.44	0.41	0.03	12.0	73	<6.2	5.5	
	May 18, 2017	ROA027L	8.5	26.3	7.3	60	1.1	105.4%	0.03	0.48	<0.02	0.02	0.50	0.47	0.03	7.6	80	<6.2	6.1	
HYCO LAKE	September 25, 2019	ROA030C	6.7	27.4	7.4	200	1.0	86.4%	0.02	0.46	0.02	<0.02	0.47	0.44	0.03	10.0	191	<6.2	2.7	
	September 25, 2019	ROA030E	7.5	27.6	7.6	195	1.1	96.6%	0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	15.0	164	<6.2	2.4	
	September 25, 2019	ROA030F	7.0	27.5	7.5	196	1.6	90.3%	<0.02	0.37	<0.02	<0.02	0.38	0.36	0.02	9.2	182	<6.2	2.0	
	September 25, 2019	ROA030G	7.3	27.2	7.5	205	1.7	93.1%	<0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	6.4	194	<6.2	1.7	
	August 29, 2019	ROA030C	7.0	31.2	7.5	178	1.3	96.1%	<0.02	0.40	0.02	<0.02	0.41	0.39	0.02	8.4	187	<6.2	2.4	
	August 29, 2019	ROA030E	7.6	30.0	7.7	173	1.3	101.9%	0.02	0.45	<0.02	<0.02	0.46	0.44	0.02	20.0	184	<6.2		
	August 29, 2019	ROA030F	7.1	30.7	7.5	177	1.1	95.8%	<0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	9.7	199	<6.2	2.5	
	August 29, 2019	ROA030G	7.1	29.7	7.5	176	1.5	95.0%	<0.02	0.39	<0.02	<0.02	0.40	0.38	0.02	9.1	187	<6.2	2.2	
	July 15, 2019	ROA030C	6.6	34.8	7.5	153	1.4	95.9%								12.0	120	<6.2	2.4	
	July 15, 2019	ROA030E	7.1	34.0	7.6	149	1.6	149.0%								8.4	100	<6.2	2.2	
	July 15, 2019	ROA030F	6.9	34.0	7.5	151	1.5	98.2%								8.3	135	<6.2	1.9	
	July 15, 2019	ROA030G	7.1	33.3	7.5	149	2.2	100.4%								6.1	108	<12.0	1.7	
	June 6, 2019	ROA030C	7.2	27.2	7.3	130	1.2	92.2%	0.02	0.45	<0.02	<0.02	0.46	0.44	0.02	13.0	102	<6.2	5.1	
	June 6, 2019	ROA030E	7.7	27.1	7.6	108	1.4	97.8%	0.02	0.55	<0.02	<0.02	0.56	0.54	0.02	11.0	82	<6.2	3.2	
	June 6, 2019	ROA030F	7.3	26.6	7.3	129	1.3	92.5%	0.02	0.49	<0.02	<0.02	0.50	0.48	0.02	12.0	114	<6.2	4.7	
	June 6, 2019	ROA030G	7.8	27.4	7.6	129	1.5	100.3%	0.02	0.44	<0.02	<0.02	0.45	0.43	0.02	11.0	104	<6.2	3.1	
	May 2, 2019	ROA030C	9.8	24.1	8.1	92	0.5	117.1%	0.06	0.51	<0.02	0.05	0.56	0.50	0.06	16.0	116	6.2	18.0	
	May 2, 2019	ROA030E	9.5	24.7	8.1	77	1.0	115.2%	0.04	0.48	<0.02	0.10	0.58	0.47	0.11	20.0	89	<6.2	8.2	
	May 2, 2019	ROA030F	9.6	23.0	8.0	105	0.7	112.4%	0.05	0.56	<0.02	0.08	0.64	0.55	0.09	19.0	120	<6.2	12.0	
	May 2, 2019	ROA030G	9.6	24.0	8.1	102	0.7	114.8%	0.04	0.52	<0.02	0.06	0.58	0.51	0.07	14.0	109	<12.0	11.0	
LAKE ROXBORO	September 18, 2019	ROA030DA	8.6	28.2	7.9	76	0.6	110.7%	0.08	1.00	<0.02	<0.02	1.01	0.99	0.02	43.0	72	10.0	10.0	
	September 18, 2019	ROA030DC	8.1	27.6	8.1	73	0.9	104.0%	0.04	0.75	<0.02	<0.02	0.76	0.74	0.02	30.0	68	<6.2	4.8	
	September 18, 2019	ROA030DE	6.3	26.6	7.2	72	1.0	79.4%	0.03	0.67	<0.02	<0.02	0.68	0.66	0.02	22.0	82	<6.2	3.6	24.0
	August 28, 2019	ROA030DA	8.6	28.0	7.9	78	0.5	111.8%	0.07	0.90	<0.02	<0.02	0.91	0.89	0.02	26.0	124	10.0	9.5	
	August 28, 2019	ROA030DC	7.8	27.5	7.9	75	0.9	100.8%	0.03	0.81	<0.02	<0.02	0.82	0.80	0.02	16.0	76	<6.2	4.9	
	August 28, 2019	ROA030DE	7.4	27.2	7.6	72	1.0	94.5%	0.03	0.68	<0.02	<0.02	0.69	0.67	0.02	10.0	102	<6.2	3.2	26.0
	July 25, 2019	ROA030DA	8.5	29.5	7.0	85	0.7	113.2%								43.0	82	6.2	7.4	
	July 25, 2019	ROA030DC	7.9	28.5	6.8	82	0.9	103.1%								33.0	71	<6.2	4.7	
	July 25, 2019	ROA030DE	7.4	28.2	7.2	81	1.5	95.8%								26.0	79	<6.2	4.1	28.0
	June 12, 2019	ROA030DA	10.7	26.1	8.8	79	0.6	133.7%	0.08	1.10	<0.02	<0.02	1.11	1.09	0.02	81.0	77	13.0	10.0	
	June 12, 2019	ROA030DC	8.5	25.8	7.9	72	0.8	105.4%	0.03	0.75	<0.02	<0.02	0.76	0.74	0.02	31.0		9.0	7.9	
	June 12, 2019	ROA030DE	7.8	25,5	7.6	71	0.9	96.6%	0.03	0.76	<0.02	<0.02	0.77	0.75	0.02	24.0	70	<6.2	6.7	26.0
	May 9, 2019	ROA030DA	8.9	25.5	7.2	92	0.8	109.8%	0.06	0.73	<0.02	<0.02	0.74	0.72	0.02	31.0	82	10.0	9.3	
	May 9, 2019	ROA030DC	9.6	24.5	8.2	77	1.0	116.3%	0.04	0.68	<0.02	<0.02	0.69	0.67	0.02	25.0	112	6.8	6.9	
	May 9, 2019	ROA030DE	10.6	25.7	9.1	72	1.0	131.7%	0.04	0.82	<0.02	<0.02	0.83	0.81	0.02	32.0	67	<6.2	8.8	23.0
	September 7, 2017	ROA030DA	7.3	19.9	6.6	69	0.6	80.2%	0.07	0.98	<0.02	<0.02	0.99	0.97	0.02	80.0	80	14.0	13.0	
	September 7, 2017	ROA030DC	7.1	24.2	7.2	66	0.9	84.7%	0.04	0.78	<0.02	<0.02	0.79	0.77	0.02	29.0	70	<6.2	5.3	
	September 7, 2017	ROA030DE	6.6	23.9	7.3	67	1.1	78.3%	0.03	0.73	<0.02	<0.02	0.74	0.72	0.02	26.0	74	<6.2	4.1	25.0
	August 23, 2017	ROA030DA	7.2	29.9	7.6	80	0.5	95.1%	0.08	1.00	<0.02	<0.02	1.01	0.99	0.02	63.0	90	7.8	8.9	
	August 23, 2017	ROA030DC	7.9	29.9	8.1	75	0.8	104.4%	0.04	0.77	<0.02	<0.02	0.78	0.76	0.02	25.0	72	<6.2	4.1	
	August 23, 2017	ROA030DE	7.3	30.5	8.2	74	1.0	97.4%	0.03	0.73	<0.02	<0.02	0.74	0.72	0.02	16.0	84	<6.2	3.1	23.0
	July 12, 2017	ROA030DA	7.9	30.8	8.0	87	0.5	106.0%	0.07	0.89	<0.02	<0.02	0.90	0.88	0.02	53.0	104	8.2	7.8	
	July 12, 2017	ROA030DC	8.5	31.6	8.4	73	0.7	270.2%	0.04	0.82	<0.02	<0.02	0.83	0.81	0.02	34.0	72	<6.2	5.2	
	July 12, 2017	ROA030DE	8.1	31.6	8.1	72	0.9	267.6%	0.03	0.78	<0.02	<0.02	0.79	0.77	0.02	44.0	84	<6.2	3.9	24.0

Appendix A - Roanoke River Basin Data
January 1, 2010 Through December 31, 2014

Lake	Date	Sampling Station	SURFACE PHYSICAL DATA DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent DO 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	Total Hardnes mg/L
	June 1, 2017	ROA030DA	10.2	28.2	8.6	83	0.7	130.8%	0.09	1.10	<0.02	<0.02	1.11	1.09	0.02	100.0	106	11.0	7.0	
	June 1, 2017	ROA030DC	10.1	28.1	8.6	72	0.7	129.3%	0.04	0.81	<0.02	<0.02	0.82	0.80	0.02	29.0	92	<6.2	5.1	
	June 1, 2017	ROA030DE	9.2	26.5	7.7	68	0.8	114.5%	0.04	0.77	<0.02	<0.02	0.78	0.76	0.02	22.0	87	<6.2	5.4	23.0
	May 18, 2017	ROA030DA	8.4	23.7	7.4	82	0.6	99.3%	0.08	0.96	<0.02	<0.02	0.97	0.95	0.02	42.0	77	14.0	13.0	
	May 18, 2017	ROA030DC	10.0	24.2	7.8	67	0.7	119.3%	0.05	0.90	<0.02	0.020	0.92	0.89	0.03	33.0	67	9.8	10.0	
	May 18, 2017	ROA030DE	9.7	25.3	7.8	65	0.7	118.1%	0.05	0.94	<0.02	0.020	0.96	0.93	0.03	27.0	74	<12.0	10.0	
MAYO	September 25, 2019	ROA0341A	7.3	25.9	7.3	85	1.5	90.8%	0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	13.0	76	<12.0	2.7	
RESERVOIR	September 25, 2019	ROA0342A	7.8	25.6	7.3	91	2.0	96.7%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	7.2	72	<6.2	2.2	
	September 25, 2019	ROA0343A	7.4	25.6	7.4	92	2.5	92.1%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	3.6	93	<6.2	1.6	
	August 29, 2019	ROA0341A	7.2	27.2	7.4	81	1.4	91.7%	0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	18.0	81	<6.2	2.8	
	August 29, 2019	ROA0342A	7.2	26.9	7.4	86	2.0	91.2%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	8.2	96	<6.2	1.5	
	August 29, 2019	ROA0343A	7.1	26.6	7.4	90	2.3	89.3%	<0.02	0.32	<0.02	<0.02	0.33	0.31	0.02	6.3	86	<6.2	1.5	
	July 15, 2019	ROA0341A	8.2	31.4	8.3	81	1.7	112.8%								12.0	82	6.5	2.9	
	July 15, 2019	ROA0342A	7.8	30.8	7.9	83	1.7	105.1%								5.3	68	9.2	2.4	
	July 15, 2019	ROA0343A	7.9	30.6	8.3	89	1.9	107.0%								3.4	75	38.0	1.8	
	June 3, 2019	ROA0341A	8.3	27.8	7.8	75	1.1	106.5%	0.02	0.45	<0.02	<0.02	0.46	0.44	0.02	14.0	50	<6.2	4.1	
	June 3, 2019	ROA0342A	8.0	27.7	7.7	80	1.7	103.5%	<0.02	0.40	<0.02	<0.02	0.41	0.39	0.02	11.0	62	<12.0	3.3	
	June 3, 2019	ROA0343A	8.1	27.3	7.8	85	2.0	102.9%	<0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	7.3	67	<6.2	2.3	
	May 2, 2019	ROA0341A	10.3	23.1	8.0	67	0.9	121.4%	0.04	0.51	<0.02	<0.02	0.52	0.50	0.02	15.0	80	<6.2	5.2	
	May 2, 2019	ROA0342A	9.8	21.8	7.9	71	1.1	112.2%	0.02	0.43	<0.02	<0.02	0.44	0.42	0.02	11.0	76	<6.2	3.4	
	May 2, 2019	ROA0343A	9.2	23.0	8.0	76	1.4	108.4%	0.02	0.43	<0.02	<0.02	0.44	0.42	0.02	9.8	106	<6.2	2.2	
LAKE	September 18, 2019	ROA031C	6.7	25.8	7.2	83	0.4	82.6%	0.04	0.76	<0.02	<0.02	0.77	0.75	0.02	33.0	86	<6.2	8.8	30.0
ISAAC	September 18, 2019	ROA031E	7.2	27.4	7.4	66	0.9	91.6%	0.03	0.61	<0.02	<0.02	0.62	0.60	0.02	16.0	76	<6.2	4.7	
WALTON	September 18, 2019	ROA031H	7.2	27.1	7.4	65	1.0	90.7%	0.03	0.59	<0.02	<0.02	0.60	0.58	0.02	15.0	96	<6.2	4.5	
	August 28, 2019	ROA031C	9.5	28.3	8.1	78	0.5	124.6%	0.05	0.86	0.02	<0.02	0.87	0.84	0.03	36.0	107	9.5	11.0	27.0
	August 28, 2019	ROA031E	8.2	28.5	7.8	64	1.3	107.3%	0.02	0.50	<0.02	<0.02	0.51	0.49	0.02	9.0	78	<6.2	2.9	
	August 28, 2019	ROA031H	8.1	28.1	7.9	64	1.3	105.8%	0.02	0.50	<0.02	<0.02	0.51	0.49	0.02	7.8	82	<6.2	2.8	
	July 29, 2019	ROA031C	9.5	29.8	7.2	81	1.0	126.6%	0.04	0.90	<0.02	<0.02	0.91	0.89	0.02	67.0	90	7.5	9.2	26.0
	July 29, 2019	ROA031E	9.2	29.6	8.3	72	1.3	122.6%	0.02	0.70	<0.02	<0.02	0.71	0.69	0.02	8.1	77	<6.2	3.4	
	July 29, 2019	ROA031H	8.9	30.0	8.9	71	1.7	119.3%	0.03	0.67	<0.02	<0.02	0.68	0.66	0.02	12.0	89	<6.2	4.0	
	June 12, 2019	ROA031C	7.5	23.9	6.9	61	0.4	89.5%	0.06	0.79	<0.02	<0.02	1.01	0.78	0.23	24.0	88	12.0	25.0	22.0
	June 12, 2019	ROA031E	7.9	25.4	7.3	63	1.0	97.3%	0.02	0.55	<0.02	<0.02	0.59	0.54	0.05	17.0	57	<6.2	4.8	
	June 12, 2019	ROA031H	7.7	25.4	7.2	63	1.2	95.3%	0.02	0.46	<0.02	<0.02	0.51	0.45	0.06	16.0	34	<6.2	4.4	
	May 9, 2019	ROA031C	8.4	24.7	7.3	76	1.0	102.2%	0.05	0.54	<0.02	0.14	0.68	0.53	0.15	9.4	72	7.5	6.4	23.0
	May 9, 2019	ROA031E	8.3	24.8	7.4	65	2.0	101.6%	0.02	0.39	0.02	0.15	0.54	0.37	0.17	5.7	53	<6.2	2.6	
	May 9, 2019	ROA031H	8.3	25.1	7.3	65	2.0	101.9%	0.02	0.39	<0.02	0.15	0.54	0.38	0.16	7.9	94	<6.2	2.1	
HUC 03010106																				
ROANOKE	September 11, 2019	ROA039C	5.4	28.0	7.1	95	1.7	67.9%	<0.02	0.32	<0.02	0.07	0.39	0.31	0.08	5.3	80	<6.2	2.6	
RAPIDS	September 11, 2019	ROA039D	8.5	28.3	8.2	94	2.4	108.5%	<0.02	0.36	<0.02	<0.02	0.37	0.35	0.02	6.9	80	<6.2	2.7	
LAKE	September 11, 2019	ROA039E	8.2	27.6	8.2	94	2.0	103.7%	<0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	9.3	76	<6.2	1.8	35.0
	August 8, 2019	ROA039C	2.8	26.9	6.2	96	1.0	39.7%	<0.02	0.36	<0.02	0.09	0.45	0.35	0.10	7.4	68	<6.2	1.5	
	August 8, 2019	ROA039D	6.2	28.2	7.3	96	1.3	79.9%	0.02	0.40	<0.02	0.07	0.47	0.39	0.08	9.8	50	<6.2	3.9	
	August 8, 2019	ROA039E	7.3	28.6	7.6	96	1.6	94.6%	<0.02	0.40	<0.02	0.05	0.45	0.39	0.06	12.0	70	<6.2	2.5	35.0
	July 9, 2019	ROA039C	8.4	25.9	7.6	103	1.8	103.3%								6.1	78	<12.0	2.9	
	July 9, 2019	ROA039D	8.3	28.4	7.9	104	1.7	106.8%								5.1	72	<6.2	2.4	
	July 9, 2019	ROA039E	8.3	28.8	7.9	105	1.9	107.7%								9.4	75	<6.2	2.5	34.0
	June 18, 2019	ROA039C	6.6	24.2	7.6	94	1.5	79.0%	0.02	0.32	<0.02	0.16	0.48	0.31	0.17	6.1	88	<6.2	3.5	
	June 18, 2019	ROA039D	7.0	24.8	7.5	95	1.5	84.0%	0.02	0.34	<0.02	0.14	0.48	0.33	0.15	5.7	112	5.7	3.3	
	June 18, 2019	ROA039E	7.3	25.1	7.6	95	1.5	88.9%	0.02	0.32	<0.02	0.13	0.45	0.31	0.14	7.2	85	<6.2	3.5	31.0
	May 30, 2019	ROA039C	7.8	26.3	7.6	95	1.0	97.6%	0.03	0.39	<0.02	0.10	0.49	0.38	0.11	13.0	80	20.0	6.4	
	May 30, 2019	ROA039D	7.9	26.1	7.6	95	1.2	98.1%	0.02	0.37	<0.02	0.08	0.45	0.36	0.09	11.0	61	<6.2	3.9	
	May 30, 2019	ROA039E	8.8	26.7	7.6	95	1.5	110.0%	0.02	0.45	<0.02	0.07	0.52	0.44	0.08	10.0	71	<6.2	2.9	30.0
LAKE	September 19, 2019	ROA0382A	4.0	25.1	7.3	107	2.0	47.8%	0.03	0.45	0.22	0.06	0.51	0.23	0.28	2.4	72	<6.2	2.6	38.0
GASTON	September 19, 2019	ROA038A	6.5	26.6	7.4	102	1.3	80.3%	0.02	0.34	0.05	0.04	0.38	0.29	0.09	12.0	69	<6.2	5.5	35.0
	September 19, 2019	ROA039	6.8	26.6	7.4	101	1.3	82.4%	0.02	0.44	0.03	0.02	0.46	0.41	0.05	9.9	68	<12.0	4.0	32.0
	September 19, 2019	ROA039B	4.3	26.2	7.1	102	1.5	53.1%	0.02	0.27	<0.02	0.10	0.37	0.26	0.11	3.7	70	<6.2	1.9	24.0
	August 27, 2019	ROA0382A	5.1	26.1	7.4	104	1.5	62.9%	0.02	0.38	0.12	0.05	0.43	0.26	0.17	9.5	80	<6.2	2.2	35.0
	August 27, 2019	ROA038A	5.6	27.7	7.2	103	1.4	71.7%	0.02	0.33	0.06	0.07	0.40	0.27	0.13	10.0	94	<6.2	2.9	34.0
	August 27, 2019	ROA039	6.1	27.4	7.2	102	1.5	77.3%	0.02	0.30	0.05	0.03	0.33	0.25	0.08	9.2	84	<6.2	3.2	34.0
	August 27, 2019	ROA039B	5.1	27.6	7.0	102	1.6	64.6%	<0.02	0.33	0.03	0.03	0.36	0.30	0.06	7.9	79	<12.0	1.9	34.0
	July 11, 2019	ROA0382A	5.5	26.0	7.5	101	1.3	68.3%								3.7	76	<6.2	5.2	34.0
	July 11, 2019	ROA038A	8.5	30.3	8.2	103	1.8	114.0%								12.0	75	<6.2	2.7	34.0
	July 11, 2019	ROA039	8.5	30.0	8.2	103	1.8	112.8%								13.0	76	<6.2	2.2	34.0
	July 11, 2019	ROA039B	8.8	29.9	8.4	103	1.8	117.1%								10.0	73	<6.2	1.9	34.0
	June 19, 2019	ROA0382A	5.2	21.7	7.2	95	0.3	59.5%	0.05		<0.02	0.28			0.29	3.1	115	23.0	29.0	33.0
	June 19, 2019	ROA038A	6.3	22.5	7.3	99	1.2	73.1%	0.02		<0.02	0.25			0.26	6.4	71	<6.2	5.4	
	June 19, 2019	ROA039	7.2	23.5	7.4	100	1.3	85.6%	0.02		<0.02	0.23			0.24	8.6	77	<6.2	4.7	
	June 19, 2019	ROA039B	8.7	25.4	7.5	94	1.5	107.4%	<0.02		<0.02	0.13			0.14	13.0	69	<6.2	2.8	32.0
	May 28, 2019	ROA0382A	8.4	24.3	7.4	100	1.2	101.4%	0.02	0.35	<0.02	0.23	0.58	0.34	0.24	6.1	85	6.2	7.5	34.0
	May 28, 2019	ROA038A	9.1	25.9	9.1	96	1.5	112.9%	<0.02	0.33	<0.02	0.12	0.45	0.32	0.13	12.0	75		4.4	32.0
	May 28, 2019	ROA039	9.4	26.1	8.2	96	1.6	117.3%	<0.02	0.38	<0.02	0.09	0.47	0.37	0.10	13.0	73	<6.2	2.9	32.0
	May 28, 2019	ROA039B	9.4	26.7	8.4	95	1.6	118.6%	<0.02	0.38	<0.02	0.05	0.43	0.37	0.06	11.0	139	<6.2	2.5	31.0