LAKE & RESERVOIR ASSESSMENTS
ROANOKE RIVER BASIN

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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.

Nine lakes in this river basin were sampled by DWR staff in 2014 and two additional lakes were sampled in 2013. Three of these lakes are on the 303(d) List of Impaired Waters (Table 1). Kernersville Reservoir and Lake Roxboro were listed for elevated chlorophyll *a* concentration and Farmer Lake was listed for both chlorophyll *a* and elevated turbidity.

Table 1. Roanoke River Basin Lakes on the 2012 303(d) List of Impaired Waters.

Lake	Location	Violation	303(d) Year
Kernersville Reservoir	From a point 0.5 mile upstream of backwaters of Kernersville Reservoir to Town of Kernersville Water Supply Dam	Chlorophyll *a*	2012
Farmer Lake	Upper reservoir-From a point 0.5 mile upstream of mouth of Nats Fork to dam at Farmer Lake	Chlorophyll *a* Turbidity	2010
Lake Roxboro	From backwaters of Lake Roxboro to dam at Lake Roxboro	Chlorophyll *a*	2012

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 (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 northeast piedmont, (including the Roanoke River Basin), ranged from 105% to 200% of normal for the month (Figure 1). Temperatures in June were closer to normal for the month while precipitation decreased, ranging from 25% to 125% of normal. June turned out to be warm throughout the state and ranked as the 33rd warmest June on record.

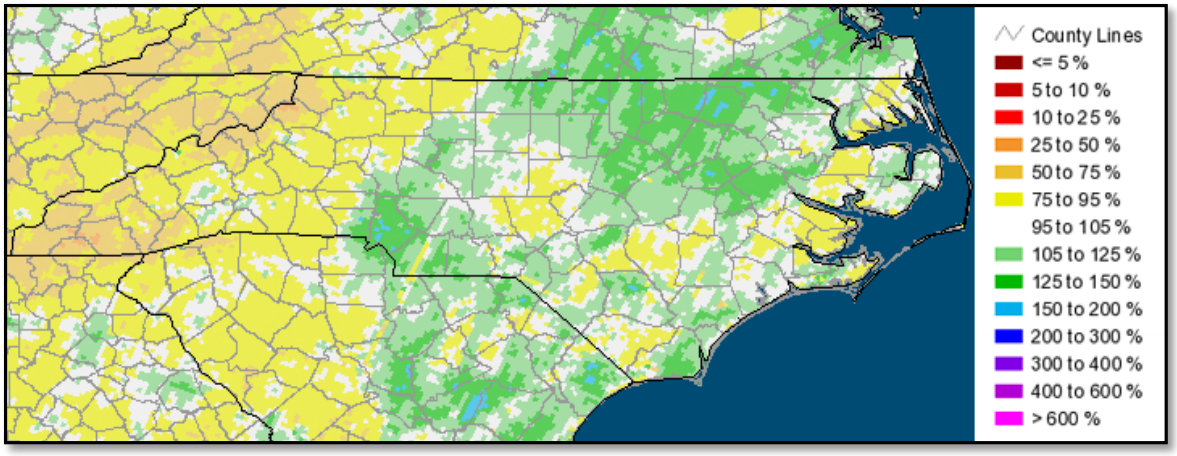

Figure 1. Percent of normal precipitation for March, April and May 2013 (State Climate Office of North Carolina, June 4, 2014, (http://nc-climate.ncsu.edu/climateblog?id=77).

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 Roanoke River Basin during these three months (Figure 2).

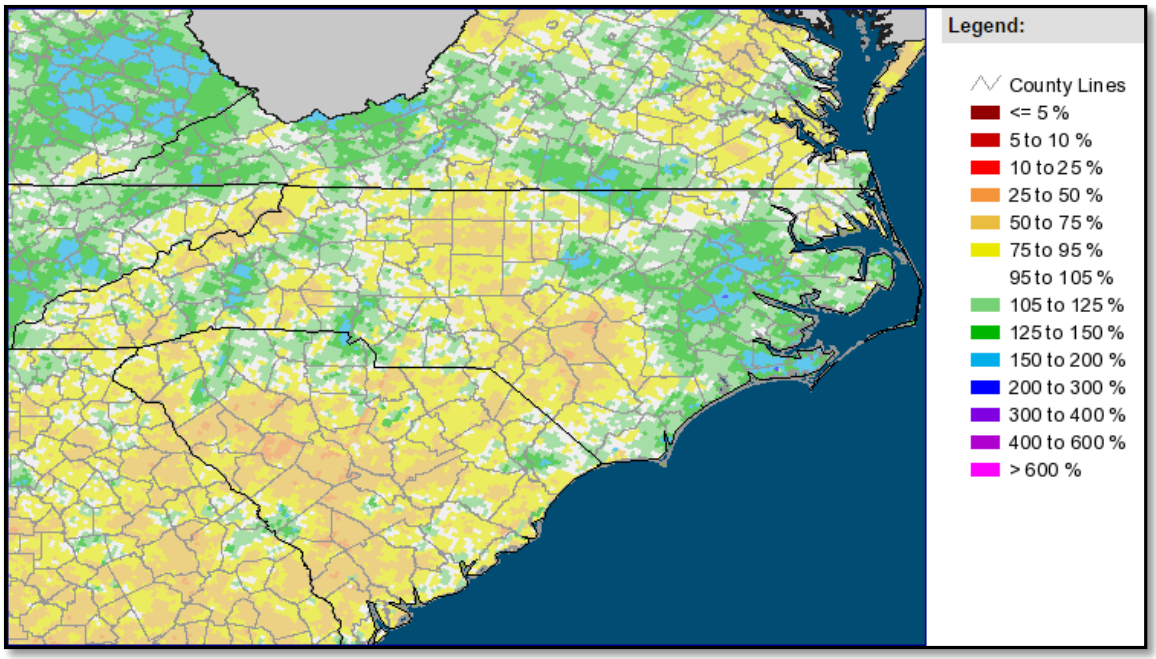

Figure 2. Percent of normal precipitation for June, July and August 2014 (State Climate Office of North Carolina, September 9, 2014, (http://nc-climate.ncsu.edu/climateblog?id=98).

After a mild summer, warm temperatures returned in late August and continued through the first week of September, then 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 Roanoke River Basin were similar to those observed in June through August.

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 2014. 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 dissolved oxygen was greatest in May. Surface dissolved oxygen, and pH values were greatest at the upper end of Nutbush Creek arm. Secchi depths ranged from 0.7 to 3.6 meters for 2014, with both values observed in September.

Total phosphorus ranged from <0.02 to 0.03 mg/L and total Kjeldahl nitrogen ranged from 0.24 to 0.52 mg/L (Appendix A). Total organic nitrogen in the Nutbush Creek arm ranged from 0.22 to 0.51 mg/L. Chlorophyll *a* ranged from 4.0 to 19.0 µg/L. These nutrient values were similar to those previously observed for this reservoir by DWR. Turbidity ranged from 1.5 to 5.1 NTU.

Based on the calculated NCTSI scores for May through September, John H. Kerr Reservoir was determined to exhibit moderate biological productivity (mesotrophic conditions) in 2014. The Nutbush Creek arm of this reservoir has been predominantly mesotrophic since it was first monitored by DWR in 1981.

LAKE & RESERVOIR ASSESSMENTS

HUC 03010103

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 2013 by DWR staff. Secchi depths ranged from 1.3 to 3.5 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 May to 7.8 s.u. in September. The May surface pH value was less than the state water quality standard of not less than 6.0 s.u.

Total phosphorus, ammonia and nitrite plus nitrate were at or below the DWR Laboratory detection levels in 2013 (Appendix A). Total Kjeldahl nitrogen ranged from 0.20 to 0.37 mg/L and total organic nitrogen ranged from 0.19 t0 0.36 mg/L. Chlorophyll *a* values for Hanging Rock Lake ranged from 2.9 to 18.0 µg/L. Turbidity ranged from 1.7 to 5.4 NTU. Based on the NTSI scores in 2013, 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 2013 by DWR staff. Secchi depths ranged from 0.6 to 0.9 meter, indicating that the clarity of the water was limited. Surface dissolved oxygen ranged from 8.3 to 6.3 mg/L and surface pH ranged from 7.5 to 8.1 s.u.(Appendix A). Surface conductivity ranged from 108 to 132 µmhos/cm.

Total phosphorus values in 2013 ranged from 0.03 to 0.04 mg/L and total Kjeldahl nitrogen ranged from 0.52 to 0.91 mg/L (Appendix A). Both NH_3 and $NO_2 + NO_3$ were less than the DWR Laboratory detection level and total organic nitrogen ranged from 0.51 to 0.90 mg/L. Chlorophyll *a* ranged from 15.0 to 26.0 µg/L. Kernersville Reservoir was determined to be eutrophic (exhibiting elevated biological productivity) based on the calculated NCTSI scores for 2013. 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	10	10	10	10

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 ten times during the summers of 2012 and 2014. In 2012, surface dissolved oxygen ranged from 6.3 to 7.3 mg/L and surface water temperature ranged from 30.7 C° to 36.9 C° (Appendix A). Surface pH values ranged from 7.6 s.u. to 8.2 s.u. Secchi depths in 2012 ranged from 2.4 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 3.9 µg/L. In 2012, NCTSI scores indicated that the trophic state of Belews Lake was oligotrophic (exhibited very low biological productivity).

In 2014, surface dissolved oxygen values ranged from 6.5 to 7.5 mg/L and surface water temperature ranged from 27.7 C° to 34.8 C° (Appendix A). Surface pH ranged from 7.3 to 8.2 s.u. Secchi depths in 2014 ranged from 2.5 to 5.5 meters. As in 2012, total phosphorus, ammonia and nitrite pus nitrate values were less than the DWR Laboratory detection levels. Total organic nitrogen ranged from 0.20 to 0.31 mg/L and chlorophyll a ranged from 1.9 to 4.4 µg/L. In 2014, 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	14	14	14

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 in May, July, August and September 2012 and once a month from May through September in 2012, 2013 and 2014. In 2012, surface dissolved oxygen was greatest in May (9.3 mg/L) at the sampling site located in the upper end of the reservoir (ROA027G) in May (Appendix A). The water depth at this sampling site is shallow, ranging from one to two meters depending upon the overall lake level. In July, the surface dissolved oxygen value dropped to 5.1 mg/L at the same sampling site. Surface pH values ranged from 7.0 to 8.5 s.u. and Secchi depths ranged from 1.9 to 0.3 meters. Total phosphorus concentrations were greatest at the upper reservoir sampling site (range = 0.6 10 1.0 mg/L) and total organic nitrogen demonstrated a similar concentration pattern in Farmer Lake (range = 0.47 to 0.91 mg/L). Due to the greater concentrations of nutrients present at ROA027G, the highest chlorophyll *a* values also occurred at this site, ranging from 17.0 to 44.0 µg/L. The chlorophyll *a* values in July and September at this site were also greater than the state water quality standard of 40 µg/L (Appendix A). Turbidity values were greatest at the upper end of the reservoir, as would be expected considering the shallowness of the water column. Turbidity exceeded the state water quality standard of 25 NTU at both the upstream and mid-lake (ROA027J) sites in May and July, and only at the upper lake site in September.

Surface dissolved oxygen at the surface of the reservoir in 2013 ranged from 7.4 to 8.9 mg/L and surface pH ranged from 7.8 to 8.5 s.u. Secchi depths in 2013 ranged from 1.6 meters near the dam to 0.3 meter at the upper end of the reservoir (Appendix A). As in 2012, total phosphorus concentrations were greatest at the upper end of Farmer Lake. Overall, total phosphorus ranged from 0.4 to 0.10 mg/L and

total organic nitrogen ranged from 0.32 to 0.71 mg/L. Chlorophyll *a* in 2013 ranged from 6.5 to 29.0 µg/L. Turbidity values exceeded the state water quality standard at ROA027G in June and July 2013.

In 2014, surface dissolved oxygen ranged from 7.4 to 10.1 mg/L and surface pH ranged from 7.4 to 8.7 s.u. Secchi depths ranged from 0.2 to 1.2 meters (Appendix A). Again, total phosphorus was greatest at the upper end of the reservoir, ranging from <0.02 mg/L near the dam in July to 0.16 mg/L at the upper end in August. Total organic nitrogen concentrations followed a similar pattern and ranged from 0.48 to 0.97 mg/L. Chlorophyll *a* ranged from 5.1 to 85.0 µg/L and exceeded the state water quality standard at ROA027G in July and August. Turbidity exceeded the state water quality standard at the mid-lake and upper-lake sampling sites in May and only at the upper sampling site in July, August and September (Appendix A).

The Region 4, EPA Laboratory on water samples collected by DWR field staff on July 30, 2014 (Table 2), conducted an Algal Growth Potential Test (AGPT). 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. At the other two sites, algal growth was limited by the availability of nitrogen.

Table 2. Algal Growth Potential Test, Farmer Lake, July 30, 2014.

	Maximum Standing Crop, Dry Weight (mg/L)			
Station	Control	C+N	C+P	Limiting Nutrient
ROA027L	0.25	0.29	0.25	Nitrogen + Phosphorus*
ROA027J	0.35	0.83	0.20	Nitrogen
ROA027G	0.45	7.56	0.37	Nitrogen

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

*Sample was rerun with all treatments, including N+P, to verify nutrient limitation only (data not shown).

Evidence for N limitation was present (larger cell volumes with N addition), but not statistically significant.

Farmer Lake was determined to exhibit elevated biological productivity (eutrophic conditions) in 2012, 2013 and 2014. 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 2014. Secchi depths ranged from 0.9 to 2.8 meters (Appendix A). Surface dissolved oxygen ranged from 5.4 to 8.6 mg/L and surface pH ranged from 7.2 to 7.8 s.u. Surface water temperature ranged from 26.6 C° to 32.9 C° and surface conductivity in Hyco Lake ranged from 132 to 282 µmhos/cm in 2014.

Total phosphorus values ranged from <0.02 mg/L to 0.03 mg/L and total Kjeldahl nitrogen ranged from 0.27 to 0.56 mg/L (Appendix A). Total organic nitrogen in Hyco Lake in 2014 ranged from 0.26 to 0.55 mg/L. Chlorophyll *a* values were low, ranging from 1.1 to 18.0 µg/L. Hyco Lake was determined to exhibit moderate (mesotrophic) biological productivity in 2014 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	14	14	14

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 14 times from 2012 to 2014 during the months of May through September. Surface dissolved oxygen in 2012 ranged from 6.6 to 10.2 mg/L, which was observed at the most upstream lake sampling site (ROA030DA) in May (Appendix A). Surface water temperatures ranged from 24.0 C° to 30.6 C° and surface pH values ranged from 6.9 to 8.8 s.u. Secchi depths in 2012 ranged from 0.6 to 1.5 meters. The concentration of total phosphorus in Lake Roxboro ranged from 0.02 to 0.06 mg/L and total Kjeldahl nitrogen ranged from 0.59 to 0.88 mg/L. Total organic nitrogen values ranged from 0.58 to 0.87 mg/L. Chlorophyll *a* in Lake Roxboro ranged from 13 to 60 µg/L, which was greater than the state water quality standard of 40 µg/L. This elevated chlorophyll *a* value occurred at the ROA030DA sampling site and suggests increased algal productivity, which in turn increased the level of surface dissolved oxygen at this site. It was also the only chlorophyll *a* value in 2012 to exceed the state water quality standard.

In 2013, surface dissolved oxygen ranged from 7.6 mg/L near the dam in September to 11.0 mg/L at the upper end of the lake in July (Appendix A). Surface water temperatures ranged from 20.7 C° to 31.3 C° and surface pH ranged from 8.1 to 8.9 s.u. Secchi depths in 2013 were less than a meter in July and August (overall range in 2013 was 0.6 to 1.4 meters). Total phosphorus values ranged from 0.02 to 0.08 mg/L with the greatest values observed at the upper end of the lake (ROA030DA). Total Kjeldahl nitrogen ranged from 0.44 to 0.97 mg/L and total organic nitrogen ranged from 0.43 to 0.96 mg/L. In response to the increased availability of nutrients, chlorophyll *a* values in 2013 were greater than those observed in 2012 and ranged from 9.4 to 58 µg/L. Three chlorophyll *a* values out of 12 (25%) were greater than the state water quality standard of 40 µg/L.

Surface dissolved oxygen in 2014 ranged from 6.6 to 10.7 mg/L in 2014 (Appendix A). Surface water temperatures ranged from 24.0 C° to 29.4 C° and surface pH values ranged from 7.1 to 8.5 s.u. Secchi depths in 2014 ranged from 0.6 to 1.5 meters. Nutrient concentrations in 2014 were similar to those observed in 2012 and 2013. Total phosphorus ranged from 0.02 to 0.09 mg/L and total Kjeldahl nitrogen ranged from 0.71 to 1.00 mg/L. Total organic nitrogen ranged from 0.70 to 0.99 mg/L. As in 2013, the

abundance of nutrients supported an increase in algal growth as reflected in the chlorophyll *a* values, which had a range of 20 to 110 µg/L. Five of the 12 chlorophyll *a* samples (42%) collected in 2014 exceeded the state water quality standard of 40 µg/L.

The Region 4, EPA Laboratory on water samples collected by DWR field staff on July 30, 2014 (Table 3), conducted an Algal Growth Potential Test (AGPT). Algal growth at the two lake sites sampled was limited by the availability of nitrogen.

Table 3. Algal Growth Potential Test, Lake Roxboro, July 30, 2014.

	Maximum Standing Crop, Dry Weight (mg/L)			
Station	Control	C+N	C+P	Limiting Nutrient
ROA030DE	0.26	0.54	0.21	Nitrogen
ROA030DC	0.57	1.12	0.54	Nitrogen

Based on the calculated NCTSI scores for 2012, 2013 and 2014, 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)	Oligotrophic		
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 3.8 meters (Appendix A). Surface dissolved oxygen ranged from 7.2 to 9.7 mg/L and surface water temperatures ranged from 24.9 C° to 29.2 C°. Surface pH values varied from 7.2 to 7.9 s.u. and surface conductivity ranged from 182 to 293 µmhos/cm.

Total phosphorus in Mayo Reservoir was predominantly below the DWR Laboratory detection level (Appendix A). Total Kjeldahl nitrogen ranged from 0.20 to 0.62 mg/L and total organic nitrogen ranged from 0.19 to 0.61 mg/L. Chlorophyll *a* ranged from 2.6 to 30.0 µg/L. Overall, Mayo Reservoir was determined to exhibit very low biological productivity or oligotrophic conditions in 2014 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 2014. Surface dissolved oxygen ranged from 6.9 to 9.5 mg/L and surface water temperatures ranged from 25.1 C° to 29.0 C° (Appendix A). Surface pH values ranged from 7.2 to 9.5 s.u. The greatest pH values were observed in July at the mid-lake (ROA031E) and lower lake (ROA031H) sampling sites and these values were greater than the state water quality standard of 9.00 s.u. These measurements also coincided with increased surface dissolved oxygen values at the two sampling sites, suggesting the likely occurrence of elevated algal photosynthetic activity. Field observations by DWR staff noted that the color of the lake water ranged from brown-green to green. Secchi depths in Lake Isaac Walton ranged from 0.6 to 1.2 meters.

Total phosphorus ranged from 0.02 to 0.06 mg/L and total Kjeldahl nitrogen ranged from 0.50 to 0.95 mg/L. Total organic nitrogen ranged from 0.49 to 0.94 mg/L. Chlorophyll *a* in Lake Isaac Walton ranged from 5.7 to 161.0 µg/L. For each sampling date, the highest chlorophyll *a* value was observed at the most upstream lake sampling site (ROA031C). Two chlorophyll *a* values out of 12 observations (17%) were greater than the state water quality standard of 40 µg/L. Based on the calculated NCTSI scores, Lake Isaac Walton was determined to have elevated biological productivity or eutrophic conditions. This reservoir has consistently been found to be eutrophic since it was first monitored by DWR staff in 1986.

LAKE & RESERVOIR ASSESSMENTS

HUC 03010106

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 2014. Secchi depths ranged from 1.0 to 3.1 meters (Appendix A). Surface dissolved oxygen concentrations ranged from 3.4 mg/L at the upper end of the reservoir to 8.8 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 (3.4 mg/L) was less than the state water quality standard of 4.0 mg/L for an instantaneous dissolved oxygen reading. The lake water was described in field notes as appearing brown and clear with floating clumps of Hydrilla, an invasive aquatic weed. Surface water temperatures ranged from 15.5 C° in May at the upper end of the reservoir to 28.7 C° near the dam (ROA039B) in July. Surface pH values in 2014 ranged from 7.2 to 8.1 s.u.

Total phosphorus concentrations ranged from <0.02 to 0.03 mg/L and total Kjeldahl nitrogen ranged from 0.30 to 0.44 mg/L. Total organic nitrogen ranged from 0.26 to 0.43 mg/L. Chlorophyll *a* values ranged from 1.8 to 20.0 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 2014, 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 2014. Secchi depths ranged from 1.5 to 2.0 meters (Appendix A). Surface dissolved oxygen ranged from 7.0 to 8.7 mg/L and surface water temperature ranged from 20.7 C° to 30.1 C°. Surface pH values were within state water quality standards and ranged from 7.5 to 8.9 s.u.

The concentration of total phosphorus in Roanoke Rapids Lake was consistently 0.02 mg/L (Appendix A). Total Kjeldahl nitrogen ranged from 0.29 to 0.53 mg/L and total organic nitrogen ranged from 0.28 to 0.52 mg/L. Chlorophyll *a* values ranged from 3.5 µg/L in May to 22.0 µg/L in September. 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.

Roanoke Rapids Lake was determine to have moderate biological productivity (mesotrophic conditions) in 2014. 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	September 3, 2014	ROA037A	7.4	27.6	8.3	104	0.7	93.9%	0.03	0.51	<0.02	<0.02	0.52	0.50	0.02	19.0	96	<6.2	5.1	
RESERVOIR	September 3, 2014	ROA037E	6.7	28.0	7.5	99	1.1	85.6%	0.02	0.42	<0.02	<0.02	0.43	0.41	0.02	13.0	71	<6.2	5.1	
	September 3, 2014	ROA037I	7.5	28.5	7.6	97	1.8	96.7%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	8.0	69		4.1	
	September 3, 2014	ROA037IJ	7.7	28.5	7.6	96	3.6	99.3%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	6.3	76	<6.2	3.0	
	August 13, 2014	ROA037A	7.6	26.6	7.7	93	1.3	94.7%	0.02	0.40	<0.02	<0.02	0.41	0.39	0.02	16.0	86	<6.2	3.5	
	August 13, 2014	ROA037E	7.6	26.9	7.5	93	1.8	95.2%	0.02	0.41	<0.02	<0.02	0.42	0.40	0.02	9.1	68	<6.2	2.2	
	August 13, 2014	ROA037I	7.8	26.7	7.4	91	2.0	97.4%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	7.8	66	<6.2	1.9	
	August 13, 2014	ROA037IJ	7.0	26.2	7.5	95	2.6	86.6%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	4.7	72	<6.2	1.5	
	July 14, 2014	ROA037A	8.9	29.0	8.8	116	0.9	115.8%	0.03	0.41	<0.02	<0.02	0.42	0.40	0.02	15.0			3.8	
	July 14, 2014	ROA037E	7.4	28.0	7.6	103	1.4	94.6%	0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	7.0	73	<6.2	3.1	
	July 14, 2014	ROA037I	7.6	28.5	7.7	100	2.0	98.0%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	4.0	90	<6.2	2.3	
	July 14, 2014	ROA037IJ	7.6	29.4	7.7	99	2.1	99.5%	<0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	6.6	101		2.2	
	June 19, 2014	ROA037A	9.1	29.8	9.1	115	1.0	120.0%	0.03	0.52	<0.02	<0.02	0.53	0.51	0.02	17.0	73		3.7	
	June 19, 2014	ROA037E	8.2	28.8	8.3	104	1.5	106.3%	0.02	0.42	<0.02	<0.02	0.43	0.41	0.02	10.0	72		3.1	
	June 19, 2014	ROA037I	7.9	29.2	8.1	101	1.8	103.1%	0.02	0.32	<0.02	<0.02	0.33	0.31	0.02	6.5	69		2.3	
	June 19, 2014	ROA037IJ	8.0	29.3	8.1	100	1.9	104.6%	0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	6.4	67		2.4	
	May 21, 2014	ROA037A	9.3	21.2	7.8	102	1.6	104.8%	0.02	0.35	<0.02	0.06	0.41	0.34	0.07	9.0	78	<6.2	3.6	
	May 21, 2014	ROA037E	9.3	21.0	7.7	101	1.8	104.4%	0.02	0.35	<0.02	0.07	0.42	0.34	0.08	9.5	78	<6.2	3.3	
	May 21, 2014	ROA037I	8.9	20.7	7.6	100	1.7	99.3%	0.02	0.30	<0.02	0.08	0.38	0.29	0.09	8.1	76	<6.2	3.5	
	May 21, 2014	ROA037IJ	9.0	20.8	7.6	102	1.7	100.6%	0.02	0.41	<0.02	0.09	0.50	0.40	0.10	9.1	78	<6.2	4.0	
HUC 03010103																				
HANGING ROCK	September 9, 2013	ROA003A	7.4	24.7	7.8	13	3.5	89.1%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	8.2	19	<6.2	1.7	
LAKE	August 1, 2013	ROA003A	7.4	24.5	6.7	13	2.3	88.8%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	7.2	20	<6.2	2.7	
	July 8, 2013	ROA003A	7.2	25.8	7.3	13	1.3	88.4%	0.02	0.37	<0.02	<0.02	0.38	0.36	0.02	18.0	28	6.2	5.4	
	June 13, 2013	ROA003A	7.8	24.9	7.0	14	2.5	94.2%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	4.9	19	<6.2	2.4	
	May 14, 2013	ROA003A	8.2	10.9	5.7	15	3.2	74.2%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.9	26	<6.2	2.5	
KERNERSVILLE	September 9, 2013	ROA0092A	7.3	26.4	7.9	132	0.6	90.7%	0.03	0.91	<0.02	<0.02	0.92	0.90	0.02	26.0	106	<6.2	6.9	38.0
RESERVOIR	August 1, 2013	ROA0092A	6.5	27.0	7.5	132	0.6	81.6%	0.04	0.72	<0.02	<0.02	0.73	0.71	0.02	24.0	100	6.5	8.9	38.0
	July 8, 2013	ROA0092A	6.3	28.3	7.6	127	0.9	80.9%	0.03	0.52	<0.02	<0.02	0.53	0.51	0.02	21.0	96	<6.2	6.8	37.0
	June 13, 2013	ROA0092A	7.8	28.0	8.1	121	0.8	99.7%	0.03	0.58	<0.02	<0.02	0.59	0.57	0.02	14.0	90	<6.2	8.2	35.0
	May 14, 2013	ROA0092A	8.3	20.4	7.7	108	0.6	92.0%	0.04	0.54	<0.02	<0.02	0.55	0.53	0.02	15.0	92	<6.2	11.0	32.0
BELEWS	September 15, 2014	ROA009E	6.5	29.8	7.4	120	4.5	85.7%	<0.02	0.20	<0.02	<0.02	0.28	0.26	0.02	2.7	82	<6.2	1.6	
LAKE	September 15, 2014	ROA009G	6.8	28.2	7.9	119	5.5	87.2%	<0.02	0.20	<0.02	<0.02	0.28	0.26	0.02	2.4	79	<6.2	1.4	
	September 15, 2014	ROA009H	6.7	28.4	7.7	120	5.0	86.2%	<0.02	0.26	<0.02	<0.02	0.28	0.26	0.02	2.9	80	<6.2	1.6	34.0
	September 15, 2014	ROA009J	6.5	30.8	7.6	120	4.5	87.2%	<0.02	0.24	<0.02	<0.02	0.28	0.26	0.02	2.4	82	<6.2	2.1	
	August 18, 2014	ROA009E		31.6	7.3	120	4.0		<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	2.3	76	<6.2	1.8	
	August 18, 2014	ROA009G		30.6	7.4	120	3.5		<0.02	0.29	<0.02	<0.02	0.30	0.28	0.02	2.3	78	<6.2	1.4	
	August 18, 2014	ROA009H		30.7	7.4	120	4.5		<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02	1.9	80	<6.2	1.8	36.0
	August 18, 2014	ROA009J		32.7	7.6	120	3.5		<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	2.5		<6.2	2.1	
	July 29, 2014	ROA009E	6.7	32.7	7.8	118	4.0	92.8%	<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	2.2	80	<6.2	1.0	
	July 29, 2014	ROA009G	6.7	30.7	8.0	119	4.0	89.7%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02	2.5	80	<6.2	1.0	
	July 29, 2014	ROA009H	6.9	30.5	7.7	120	4.5	92.1%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	2.2	142	<6.2	<1.0	36.0
	July 29, 2014	ROA009J	6.6	34.4	7.8	120	4.0	94.1%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	3.4	80	<6.2	1.0	
	June 16, 2014	ROA009E	7.3	33.1	7.9	117	3.0	101.8%	<0.02	0.34	<0.02	<0.02	0.35	0.33	0.02	4.2	83	<6.2	2.7	
	June 16, 2014	ROA009G	7.5	30.8	8.2	118	3.0	100.6%	<0.02	0.34	<0.02	<0.02	0.35	0.33	0.02	3.6	80	<6.2	2.9	
	June 16, 2014	ROA009H	7.6	31.3	8.1	119	2.5	102.8%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02	3.5	80	<6.2	2.7	33.0
	June 16, 2014	ROA009J	7.1	34.8	7.9	119	3.0	101.9%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	4.4	82		2.9	
	May 27, 2014	ROA009E	7.6	29.7	7.8	116	3.0	100.1%	<0.02	0.28	<0.02	0.03	0.31	0.27	0.04	3.0	78	<6.2	1.8	
	May 27, 2014	ROA009G	7.5	27.7	7.9	114	3.8	95.3%	<0.02	0.28	<0.02	0.03	0.31	0.27	0.04	2.8		<6.2	1.4	
	May 27, 2014	ROA009H	7.7	28.1	7.8	116	3.0	98.6%	<0.02	0.30	<0.02	0.03	0.33	0.29	0.04	2.8	78	<6.2	1.7	33.0
	May 27, 2014	ROA009J	7.2	31.4	7.8	115	3.0	97.6%	<0.02	0.32	<0.02	0.03	0.35	0.31	0.04	2.4	82	<6.2	1.9	
	September 5, 2012	ROA009E	6.9	32.6	7.6	122	3.2	95.4%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.6	84	<6.2	1.6	
	September 5, 2012	ROA009G	7.3	31.2	7.8	122	3.1	98.6%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	2.7	86	<6.2	1.1	
	September 5, 2012	ROA009H	7.1	31.2	7.8	122	2.8	95.9%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	2.7	84	<6.2	1.0	
	September 5, 2012	ROA009J	6.7	34.5	7.7	123	3.1	95.7%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	2.9	88	<6.2	1.4	34.0
	August 21, 2012	ROA009E	6.3	32.8	7.6	118	3.7	87.4%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	3.0	83	<6.2	<1.0	
	August 21, 2012	ROA009G	6.6	30.8	7.7	118	3.6	88.6%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	2.6	84	<6.2	<1.0	
	August 21, 2012	ROA009H	6.6	30.9	7.7	118	3.5	88.7%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.7	80	<6.2	<1.0	
	August 21, 2012	ROA009J	6.1	34.0	7.8	116	3.5	86.4%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	3.6	84	<6.2	1.0	34.0
	July 31, 2012	ROA009E	6.3	35.0	7.7	116	3.2	90.7%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	3.0	82		<1.0	
	July 31, 2012	ROA009G	6.6	33.2	7.8	118	3.6	92.2%	<0.02	0.29	<0.02	<0.02	0.30	0.28	0.02	2.5	82	<6.2	<1.0	
	July 31, 2012	ROA009H	6.7	32.7	7.8	117	4.1	92.8%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	2.1	81	<12	<1.0	
	July 31, 2012	ROA009J	6.0	36.9	7.9	116	3.9	89.1%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	3.4	83	<6.2	<1.0	32.0
	June 20, 2012	ROA009E	7.0	32.7	7.6	117	4.0	97.0%	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02		77	<6.2	1.0	
	June 20, 2012	ROA009G	7.2	31.3	7.7	117	4.0	97.4%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02		80	<6.2	1.3	
	June 20, 2012	ROA009H	7.2	31.5	7.7	117	4.0	97.8%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02		80	<6.2	1.0	
	June 20, 2012	ROA009J	6.9	34.5	7.8	118	4.0	98.5%	<0.02	0.22	<0.02	<0.02	0.23	0.21	0.02		82	<6.2	1.1	79.0
	May 31, 2012	ROA009E	7.3	32.6	8.1	111	2.7	101.0%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	3.6	80	<6.2	1.7	
	May 31, 2012	ROA009G	7.2	30.8	8.2	111	2.4	96.6%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	3.5	79	<6.2	1.5	
	May 31, 2012	ROA009H	7.3	30.7	8.2	111	2.5	97.8%	<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	3.5	77	<6.2	1.4	
	May 31, 2012	ROA009J	7.0	34.6	8.0	111	2.6	100.1%	<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	3.9	80		1.3	33.0
HUC 03010104																				
FARMER	September 18, 2014	ROA027G	9.2	25.8	8.4	98	0.6	113.0%	0.08	0.76	<0.02	<0.02	0.77	0.75	0.02	39.0		114.0	31.0	
LAKE	September 18, 2014	ROA027J	7.9	24.5	7.5	88	1.0	94.8%	0.03	0.55	<0.02	<0.02	0.56	0.54	0.02	29.0	79	<6.2	7.2	
	September 18, 2014	ROA027L	7.4	24.8	7.7	84	1.0	89.3%	0.02	0.59	<0.02	<0.02	0.60	0.58	0.02	20.0	78	<6.2	5.8	28.0
	August 26, 2014	ROA027G	8.3	26.4	8.2	95	0.5	103.1%	0.16	0.86	<0.02	<0.02	0.87	0.85	0.02	63.0	250	168.0	60.0	
	August 26, 2014	ROA027J	7.9	26.8	7.5	87	0.6	98.8%	0.03	0.54	<0.02	<0.02	0.55	0.53	0.02	26.0	88	8.5	18.0	
	August 26, 2014	ROA027L	7.5	26.2	7.7	84	0.8	92.8%	0.02	0.63	<0.02	<0.02	0.64	0.62	0.02	21.0	88		20.0	29.0
	July 30, 2014	ROA027G	9.8	28.6	8.7	100	0.5	126.6%	0.12	0.98	<0.02	<0.02	0.99	0.97	0.02	85.0	152	46.0	31.0	
	July 30, 2014	ROA027J	8.1	28.2	8.4	88	1.0	103.9%	0.02	0.66	<0.02	<0.02	0.67	0.65	0.02	20.0	101	<6.2	6.2	
	July 30, 2014	ROA027L	7.8	28.1	8.3	81	1.2	99.9%	<0.02	0.54	<0.02	<0.02	0.55	0.53	0.02	17.0	92	<6.2	3.9	28.0

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
FARMER	June 25, 2014	ROA027G	10.1	31.5	8.6	106	0.5	137.1%	0.09	0.80	<0.02	<0.02	0.81	0.79	0.02	30.0	123	36.0	23.0	
LAKE	June 25, 2014	ROA027J	8.8	31.6	8.4	95	0.6	119.7%	0.04	0.58	<0.02	<0.02	0.59	0.57	0.02	15.0	92	7.5	7.2	
	June 25, 2014	ROA027L	7.4	31.1	7.7	79	1.0	99.8%	0.03	0.49	<0.02	<0.02	0.50	0.48	0.02	5.1	127	<6.2	5.3	26.0
	May 21, 2014	ROA027G	8.2	22.2	7.4	86	0.2	94.2%	0.13	0.91	<0.02	0.02	0.93	0.90	0.03	79.0	129	34.0	65.0	
	May 21, 2014	ROA027J	9.5	23.1	7.6	69	0.3	111.0%	0.10	0.84	<0.02	<0.02	0.85	0.83	0.02	49.0	110	15.0	55.0	
	May 21, 2014	ROA027L	8.7	23.5	7.6	79	0.8	102.4%	0.04	0.50	<0.02	<0.02	0.51	0.49	0.02	14.0	78	<6.2	13.0	27.0
	September 10, 2013	ROA027G	7.4	27.0	7.9	104	0.4	92.9%	0.08	0.65	<0.02	<0.02	0.66	0.64	0.02		149	34.0		
	September 10, 2013	ROA027J	7.9	27.2	8.3	82	0.7	99.5%	0.03	0.61	<0.02	<0.02	0.62	0.60	0.02	23.0	84	<6.2	5.1	
	September 10, 2013	ROA027L	8.1	27.4	8.2	76	0.8	102.4%	0.02	0.65	<0.02	<0.02	0.66	0.64	0.02	18.0	79		4.6	25.0
	August 22, 2013	ROA027G	8.9	25.3	8.5	88	0.5	108.3%	0.07	0.66	<0.02	<0.02	0.67	0.65	0.02	25.0	87	9.5	21.0	
	August 22, 2013	ROA027J	8.2	25.6	8.2	81	0.6	100.4%	0.03	0.66	<0.02	<0.02	0.67	0.65	0.02	24.0	76	<6.2	7.0	
	August 22, 2013	ROA027L	8.4	26.3	8.3	72	0.7	104.1%	0.03	0.70	<0.02	<0.02	0.71	0.69	0.02	23.0	76	<6.2	7.5	25.0
	July 16, 2013	ROA027G	8.5	28.7	7.8	80	0.3	110.0%	0.07	0.72	<0.02	<0.02	0.73	0.71	0.02	29.0	111	16.0	30.0	
	July 16, 2013	ROA027J	8.8	29.5	8.5	80	0.5	115.5%	0.40	0.68	<0.02	<0.02	0.69	0.67	0.02	14.0	98	7.5	21.0	
	July 16, 2013	ROA027L	8.5	29.9	8.4	82	0.6	112.3%	0.03	0.60	<0.02	<0.02	0.61	0.59	0.02	14.0	91	6.8	12.0	29.0
	June 12, 2013	ROA027G	8.6	26.5	7.9	82	0.4	107.0%	0.10	0.68	<0.02	<0.02	0.69	0.67	0.02	28.0	133	32.0	45.0	
	June 12, 2013	ROA027J	8.1	26.6	8.2	93	1.0	101.0%	0.03	0.39	<0.02	<0.02	0.40	0.38	0.02	14.0	80	<6.2	6.3	
	June 12, 2013	ROA027L	7.4	27.0	7.9	90	1.6	92.9%	0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	5.4	72	<6.2	3.0	30.0
	May 15, 2013	ROA027G	8.9	19.9	8.0	97	0.5	97.7%	0.07	0.51	<0.02	<0.02	0.52	0.50	0.02	22.0	90	9.0	13.0	
	May 15, 2013	ROA027J	8.9	20.4	8.1	95	1.1	98.7%	0.03	0.35	<0.02	<0.02	0.36	0.34	0.02	11.0	75	<12.0	4.8	
	May 15, 2013	ROA027L	8.5	20.1	8.1	89	1.4	93.7%	0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	6.5	69	<6.2	4.4	29.0
	September 12, 2012	ROA027G	8.2	24.6	7.8	89	0.3	98.5%	0.09	0.91	<0.02	<0.02	0.92	0.90	0.02	41.0				
	September 12, 2012	ROA027J	5.1	25.3	7.0	90	0.4	62.1%	0.05	0.67	<0.02	<0.02	0.68	0.66	0.02	19.0	96	12.0	17.0	
	September 12, 2012	ROA027L	7.2	25.6	7.6	95	0.8	88.1%	0.02	0.63	<0.02	<0.02	0.64	0.62	0.02	17.0	90	<6.2	4.0	31.0
	August 29, 2012	ROA027G	6.9	27.2	8.1	96	0.4	86.9%	0.10	0.83	<0.02	<0.02	0.84	0.82	0.02	29.0	127	26.0	34.0	
	August 29, 2012	ROA027J	8.3	27.7	8.4	98	0.7	105.5%	0.03	0.69	<0.02	<0.02	0.70	0.68	0.02	26.0	92	<6.2	5.6	
	August 29, 2012	ROA027L	7.4	27.7	8.0	97	1.0	94.1%	<0.02	0.54	<0.02	<0.02	0.55	0.53	0.02	11.0	172	<6.2	2.7	31.0
	July 25, 2012	ROA027G	5.8	28.7	8.2	95	0.3	75.0%	0.10	0.92	<0.02	<0.02	0.93	0.91	0.02	44.0	120	29.0	34.0	
	July 25, 2012	ROA027J	7.4	29.5	8.6	92	0.6	97.1%	0.04	0.70	<0.02	<0.02	0.71	0.69	0.02	27.0	91	<6.2	5.9	
	July 25, 2012	ROA027L	7.7	29.4	8.6	92	1.0	100.8%	0.02	0.53	<0.02	<0.02	0.54	0.52	0.02	11.0	85	<6.2	2.6	30.0
	May 17, 2012	ROA027G	9.3	24.4	8.3	95	0.8	111.3%	0.06	0.48	<0.02	<0.02	0.49	0.47	0.02	17.0	120	32.0	26.0	
	May 17, 2012	ROA027J	8.8	23.5	8.2	93	1.1	103.6%	0.03	0.43	<0.02	<0.02	0.44	0.42	0.02	11.0	93	<6.2	4.8	
	May 17, 2012	ROA027L	8.3	24.2	8.0	89	1.9	99.0%	0.02	0.39	<0.02	<0.02	0.40	0.38	0.02	12.0	86	<6.2	3.0	29.0
HYCO	September 9, 2014	ROA030C	5.9	31.3	7.5	282	2.0	79.8%	<0.02	0.33	0.02	<0.02	0.34	0.31	0.03	4.5	200		2.2	
LAKE	September 9, 2014	ROA030E	6.3	28.2	7.5	259	1.6	80.8%	0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	8.9	184	<6.2	3.2	
	September 9, 2014	ROA030F	7.6	29.9	7.5	274	2.4	100.4%	<0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	4.4	205	<6.2	1.7	
	September 9, 2014	ROA030G	6.3	29.2	7.6	274	2.4	82.2%	<0.02	0.28	<0.02	<0.02	0.29	0.27	0.02	4.3	204	<6.2	1.5	
	August 12, 2014	ROA030C	5.7	29.8	7.6	249	1.7	75.2%	<0.02	0.36	0.05	0.04	0.40	0.31	0.09	3.6		<6.2	2.2	
	August 12, 2014	ROA030E	6.3	28.8	7.3	244	2.1	81.7%	0.02	0.40	<0.02	0.01	0.41	0.39	0.02	8.2	176	<6.2	2.8	
	August 12, 2014	ROA030F	5.9	29.2	7.2	248	1.8	77.0%	<0.02	0.46	0.04	0.04	0.50	0.42	0.08	4.1	204	<6.2	2.1	
	August 12, 2014	ROA030G	6.1	28.4	7.3	245	2.4	78.5%	<0.02	0.33	0.02	0.03	0.36	0.31	0.05	4.0	202	<12 P	1.3	
	July 15, 2014	ROA030C	6.5	32.9	7.5	245	2.2	90.4%	<0.02	0.37	<0.02	0.02	0.39	0.36	0.03	7.5	210	<6.2	1.9	
	July 15, 2014	ROA030E	7.2	32.1	7.8	243	2.7	98.8%	0.02	0.43	<0.02	<0.02	0.44	0.42	0.02	7.9	158	<6.2	2.8	
	July 15, 2014	ROA030F	7.0	31.5	7.6	237	2.8	95.0%	0.02	0.37	<0.02	0.02	0.39	0.36	0.03	4.7	198	<6.2	1.8	
	July 15, 2014	ROA030G	6.5	32.6	7.5	245	2.4	89.9%	<0.02	0.42	<0.02	0.02	0.44	0.41	0.03	4.6	208	<6.2	1.5	
	June 30, 2014	ROA030C	5.4	32.1	7.3	223	1.8	74.1%	0.02	0.45	0.03	0.03	0.48	0.42	0.06	3.0	197		2.4	
	June 30, 2014	ROA030E	6.9	30.6	7.7	212	1.7	92.3%	0.02	0.48	<0.02	<0.02	0.49	0.47	0.02	5.0	164		2.5	
	June 30, 2014	ROA030F	6.1	31.8	7.3	219	1.8	83.3%	0.02	0.43	<0.02	0.03	0.46	0.42	0.04	2.7	172		2.0	
	June 30, 2014	ROA030G	6.7	31.5	7.5	218	2.2	91.0%	<0.02	0.39	<0.02	0.03	0.42	0.38	0.04	1.1	215		1.5	
	May 28, 2014	ROA030C	6.9	26.8	7.3	178	1.0	86.3%	0.03	0.49	<0.02	0.06	0.55	0.48	0.07	13.0	170	5.9	7.6	
	May 28, 2014	ROA030E	8.6	26.7	7.8	132	0.9	107.4%	0.03	0.56	<0.02	<0.02	0.57	0.55	0.02	18.0	130	<6.2	6.2	
	May 28, 2014	ROA030F	7.0	26.6	7.5	182	1.0	87.2%	0.02	0.48	0.02	0.06	0.54	0.46	0.08	9.2	154	<6.2	5.8	
	May 28, 2014	ROA030G	8.3	27.6	7.6	182	1.3	105.3%	0.02	0.44	<0.02	0.04	0.48	0.43	0.05	9.8	165	<6.2	3.7	
LAKE	September 18, 2014	ROA030DA	7.6	25.0	7.2	86	0.6	92.0%	0.08	0.97	<0.02	<0.02	0.98	0.96	0.02	58.0	84	12.0	16.0	
ROXBORO	September 18, 2014	ROA030DC	7.8	24.7	7.1	80	1.0	93.9%	0.03	0.80	<0.02	<0.02	0.81	0.79	0.02	34.0	72	<6.2	5.3	
	September 18, 2014	ROA030DE	6.6	24.1	7.6	80	0.8	78.6%	0.03	0.80	<0.02	<0.02	0.81	0.79	0.02	25.0	69	<6.2	5.0	26.0
	August 26, 2014	ROA030DA	7.1	27.2	7.6	87	0.6	89.5%	0.07	0.86	<0.02	<0.02	0.87	0.85	0.02	43.0	87	10.0	19.0	
	August 26, 2014	ROA030DC	7.4	26.7	8.0	78	0.8	92.4%	0.03	0.80	<0.02	<0.02	0.81	0.79	0.02	33.0	71	<6.2	6.1	
	August 26, 2014	ROA030DE	6.6	25.8	7.6	77	0.8	81.1%	0.03	0.79	<0.02	<0.02	0.80	0.78	0.02	42.0	74	<6.2	6.0	25.0
	July 30, 2014	ROA030DA	8.5	28.0	8.5	84	0.8	108.6%	0.08	0.98	<0.02	<0.02	0.99	0.97	0.02	77.0	86	7.8	8.3	
	July 30, 2014	ROA030DC	7.6	27.6	8.4	81	1.3	96.4%	0.03	0.71	<0.02	<0.02	0.72	0.70	0.02	26.0	69	<6.2	4.0	
	July 30, 2014	ROA030DE	7.5	27.5	8.3	80	1.5	95.0%	0.02	0.70	<0.02	<0.02	0.71	0.69	0.02	20.0	66	<6.2	3.2	27.0
	June 25, 2014	ROA030DA	8.6	29.4	8.1	94	0.7	112.6%	0.09	1.00	<0.02	<0.02	1.01	0.99	0.02	110.0	110		10.0	
	June 25, 2014	ROA030DC	8.3	29.3	8.4	83	0.9	108.5%	0.04	0.79	<0.02	<0.02	0.80	0.78	0.02	31.0	82	6.2	7.6	
	June 25, 2014	ROA030DE	8.0	29.4	8.4	80	1.0	104.8%	0.03	0.81	<0.02	<0.02	0.82	0.80	0.02	24.0	74	<6.2	7.0	27.0
	May 21, 2014	ROA030DA	10.6	25.4	8.4	80	0.7	129.3%	0.07	0.82	<0.02	<0.02	0.83	0.81	0.02	37.0	84	9.2	11.0	
	May 21, 2014	ROA030DC	10.7	24.0	8.2	75	0.8	127.1%	0.06	0.76	<0.02	<0.02	0.77	0.75	0.02	29.0	77	7.2	8.6	
	May 21, 2014	ROA030DE	10.5	24.1	8.2	76	0.8	125.0%	0.05	0.74	<0.02	<0.02	0.75	0.73	0.02	25.0	74	<6.2	7.5	26.0
	September 10, 2013	ROA030DA	8.9	28.2	8.5	91	0.7	114.1%	0.05	0.82	<0.02	<0.02	0.83	0.81	0.02	42.0	86	<6.2	5.8	
	September 10, 2013	ROA030DC	8.1	28.6	8.4	83	1.1	104.6%	0.04	0.70	<0.02	<0.02	0.71	0.69	0.02	25.0	81	<6.2	3.4	
	September 10, 2013	ROA030DE	7.6	27.9	8.1	81	1.3	97.0%	0.03	0.74	<0.02	<0.02	0.75	0.73	0.02	25.0	78	<6.2	3.1	26.0
	August 22, 2013	ROA030DA	9.9	26.3	8.8	8.8	0.6	122.7%	0.08	0.97	<0.02	<0.02	0.98	0.96	0.02	58.0	84	6.5	7.6	
	August 22, 2013	ROA030DC	8.5	27.2	8.5	82	0.8	107.1%	0.05	0.92	<0.02	<0.02	0.93	0.91	0.02	57.0	70		4.4	
	August 22, 2013	ROA030DE	8.4	26.5	8.7	79	0.8	104.5%	0.04	0.71	<0.02	<0.02	0.72	0.70	0.02	23.0	71	<6.2	3.5	25.0
	July 16, 2013	ROA030DA	11.0	30.0	8.9	92	0.7	145.6%	0.06	0.87	<0.02	<0.02	0.88	0.86	0.02	40.0	85		7.6	
	July 16, 2013	ROA030DC	9.8	31.3	8.8	92	0.7	132.6%	0.04	0.83	<0.02	<0.02	0.84	0.82	0.02	31.0	92	<6.2	6.6	
	July 16, 2013	ROA030DE	9.6	31.3	8.8	92	0.8	129.9%	0.03	0.74	<0.02	<0.02	0.75	0.73	0.02	23.0	86	<6.2	5.2	31.0
	June 12, 2013	ROA030DA	9.2	27.8	8.7	97	0.7	117.2%	0.07	0.79	<0.02	<0.02	0.80	0.78	0.02	24.0	80	7.0	6.4	
	June 12, 2013	ROA030DC	8.7	27.3	8.6	97	1.0	109.8%	0.04	0.61	<0.02	<0.02	0.62	0.60	0.02	18.0	75	<6.2	4.3	
	June 12, 2013	ROA030DE	8.3	27.6	8.5	95	1.1	105.3%	0.02	0.56	<0.02	<0.02	0.57	0.55	0.02	9.4	74	<6.2	3.4	32.0
	May 15, 2013	ROA030DA	9.4	20.6	8.3	101	0.7	104.7%	0.04	0.60	<0.02	<0.02	0.61	0.59	0.02	27.0	80	<6.2	6.3	
	May 15, 2013	ROA030DC	9.4	21.0	8.4	97	1.2	105.5%	0.03	0.49	<0.02	<0.02	0.50	0.48	0.02	14.0	78	<6.2	3.4	
	May 15, 2013	ROA030DE	8.9	20.7	8.2	95	1.4	99.3%	0.02	0.44	<0.02	<0.02	0.45	0.43	0.02	12.0	76	<6.2	3.4	31.0

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
LAKE ROXBORO	September 12, 2012	ROA030DA	8.4	27.2	7.5	92	0.6	105.8%	0.05	0.80	<0.02	<0.02	0.81	0.79	0.02	28.0	88	12.0	9.2	
	September 12, 2012	ROA030DC	6.7	26.3	6.9	88	0.8	83.1%	0.03	0.70	<0.02	<0.02	0.71	0.69	0.02	23.0	85	<6.2	4.7	
	September 12, 2012	ROA030DE	6.8	26.8	7.1	89	1.0	85.1%	0.02	0.74	<0.02	<0.02	0.75	0.73	0.02	16.0	80	<12.0	3.7	29.0
	August 29, 2012	ROA030DA	7.1	27.8	7.7	91	0.7	90.4%	0.05	0.78	<0.02	<0.02	0.79	0.77	0.02	22.0	86	<12.0	5.8	
	August 29, 2012	ROA030DC	7.1	27.2	7.7	89	1.0	89.5%	0.02	0.70	<0.02	<0.02	0.71	0.69	0.02	14.0	160	<6.2	3.2	
	August 29, 2012	ROA030DE	6.6	28.4	7.6	89	1.0	84.9%	0.02	0.64	<0.02	<0.02	0.65	0.63	0.02	13.0	157	<6.2	3.5	29.0
	July 25, 2012	ROA030DA	6.8	30.6	8.6	97	0.7	90.9%	0.04	0.82	<0.02	<0.02	0.83	0.81	0.02	27.0	88	6.5	6.8	
	July 25, 2012	ROA030DC	7.7	30.5	8.7	95	1.0	102.8%	0.03	0.88	<0.02	<0.02	0.89	0.87	0.02	21.0	82	<6.2	3.5	
	July 25, 2012	ROA030DE	7.4	30.3	8.8	95	1.2	98.4%	0.02	0.67	<0.02	<0.02	0.68	0.66	0.02	16.0	87	<6.2	3.0	30.0
	May 17, 2012	ROA030DA	10.2	24.6	8.6	99	1.2	122.6%	0.06	0.70	<0.02	<0.02	0.71	0.69	0.02	60.0	99	7.2	7.0	
	May 17, 2012	ROA030DC	9.2	24.4	8.4	94	1.5	110.1%	0.03	0.61	<0.02	<0.02	0.62	0.60	0.02	15.0	89	<6.2	3.1	
	May 17, 2012	ROA030DE	9.7	24.0	8.6	93	1.4	115.3%	0.03	0.59	<0.02	<0.02	0.60	0.58	0.02	15.0	92	<12.0	3.6	29.0
MAYO RESERVOIR	September 9, 2014	ROA0341A	6.6	26.8	7.2	247	2.0	82.6%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	3.5	182	<6.2	2.6	
	September 9, 2014	ROA0342A	7.2	26.1	7.2	260	2.8	88.9%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	2.7	176		1.3	
	September 9, 2014	ROA0343A	7.3	26.3	7.3	293	3.5	90.5%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	3.1	206		1.3	
	August 12, 2014	ROA0341A	7.7	26.6	7.4	224	2.5	96.0%	<0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	6.0	186	<6.2	2.1	
	August 12, 2014	ROA0342A	7.6	26.5	7.2	244	3.4	94.6%	<0.02	0.24	<0.02	<0.02	0.25	0.23	0.02	2.6	208	<6.2	1.1	
	August 12, 2014	ROA0343A	7.5	26.1	7.3	279	3.7	92.6%	<0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	3.4	248	<6.2	<1.0	
	July 23, 2014	ROA0341A	7.3	28.4	7.5	230	2.2	93.9%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	6.7	194	<6.2	2.4	
	July 23, 2014	ROA0342A	7.4	28.4	7.5	252	3.0	95.2%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	3.9	175	<6.2	1.7	
	July 23, 2014	ROA0343A	7.5	28.5	7.6	279	3.8	96.7%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	4.0	221	<6.2	1.0	
	June 18, 2014	ROA0341A	8.0	29.2	7.9	202	1.2	104.4%	0.02	0.45	<0.02	<0.02	0.46	0.44	0.02	15.0	169		4.1	
	June 18, 2014	ROA0342A	7.6	29.1	7.8	229	1.9	99.0%	<0.02	0.38	<0.02	<0.02	0.39	0.37	0.02	8.5	192		2.8	
	June 18, 2014	ROA0343A	7.7	29.1	7.6	262	3.4	100.3%	<0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	5.0	211		1.7	
	May 27, 2014	ROA0341A	9.7	24.9	7.8	182	0.9	117.2%	0.03	0.62	<0.02	<0.02	0.63	0.61	0.02	30.0	177	<12.0	7.2	
	May 27, 2014	ROA0342A	8.7	25.1	7.7	214	1.5	105.5%	<0.02	0.39	0.02	<0.02	0.40	0.37	0.03	10.0		<6.2	3.4	
	May 27, 2014	ROA0343A	8.0	25.6	7.6	263	2.5	97.9%	<0.02	0.42	<0.02	<0.02	0.43	0.41	0.02	5.9	289	<6.2	1.6	
LAKE ISAAC WALTON	September 18. 2014	ROA031C	7.1	25.1	7.7	91	0.6	86.1%	0.04	0.75	0.02	<0.02	0.76	0.73	0.03	39.0	81	7.8	12.0	
	September 18. 2014	ROA031E	7.1	25.3	7.6	71	0.8	86.4%	0.03	0.81	<0.02	<0.02	0.82	0.80	0.02	19.0	79	6.5	7.6	
	September 18. 2014	ROA031H	6.9	26.0	7.2	70	1.0	85.1%	0.03	0.86	<0.02	<0.02	0.87	0.85	0.02	19.0	77	<6.2	7.1	
	August 26, 2014	ROA031C	7.6	27.8	7.3	87	0.6	96.8%	0.04	0.72	<0.02	<0.02	0.73	0.71	0.02	43.0	88	7.8	20.0	30.0
	August 26, 2014	ROA031E	8.3	27.1	8.3	8.9	0.6	104.4%	0.04	0.94	<0.02	<0.02	0.95	0.93	0.02	27.0	86	7.5	19.0	
	August 26, 2014	ROA031H	8.6	26.9	8.8	69	0.6	107.8%	0.04	0.90	<0.02	<0.02	0.91	0.89	0.02	25.0	82	<6.2	9.3	
	July 30, 2014	ROA031C	8.2	29.0	8.2	83	0.6	106.6%	0.05	0.82	<0.02	<0.02	0.83	0.81	0.02	35.0	82		14.0	26.0
	July 30, 2014	ROA031E	9.5	28.8	9.5	77	0.6	123.1%	0.03	0.92	<0.02	<0.02	0.93	0.91	0.02	5.7	79	<6.2	7.2	
	July 30, 2014	ROA031H	9.4	28.7	9.5	76	0.8	121.6%	0.03	0.95	<0.02	<0.02	0.96	0.94	0.02	7.3	78	<6.2	7.2	
	June 25, 2014	ROA031C	7.8	28.7	8.0	80	0.9	100.9%	0.06	0.78	<0.02	<0.02	0.79	0.77	0.02	24.0	90	9.0	12.0	24.0
	June 25, 2014	ROA031E	7.7	28.4	8.1	71	1.1	99.1%	0.03	0.52	<0.02	<0.02	0.53	0.51	0.02	13.0	74	<6.2	4.9	
	June 25, 2014	ROA031H	7.4	28.9	8.0	72	1.1	96.1%	0.03	0.50	<0.02	<0.02	0.51	0.49	0.02	13.0	72	<6.2	5.0	
	May 29, 2014	ROA031C	8.6	25.4	8.0	72	0.9	104.9%	0.06	0.92	<0.02	0.09	1.01	0.91	0.10	161.0	68	12.0	13.0	23.0
	May 29, 2014	ROA031E	8.1	26.5	8.0	68	1.2	100.8%	0.02	0.52	<0.02	<0.02	0.53	0.51	0.02	16.0	103	<6.2	5.2	
	May 29, 2014	ROA031H	8.1	26.5	8.1	69	1.2	100.8%	0.02	0.51	<0.02	<0.02	0.52	0.50	0.02	13.0	93		4.8	
HUC 03010106																				
ROANOKE RAPIDS LAKE	September 11, 2014	ROA039C	7.3	27.1	7.6	101	1.5	91.8%	0.04	0.44	<0.02	0.03	0.47	0.43	0.04	12.0	122	26.0	12.0	
	September 11, 2014	ROA039D	7.1	26.2	7.5	98	1.8	87.9%	0.02	0.32	<0.02	0.02	0.34	0.31	0.03	8.4	70	<6.2	4.2	
	September 11, 2014	ROA039E	7.1	26.6	7.6	99	1.5	88.5%	0.02	0.29	<0.02	<0.02	0.30	0.28	0.02	12.0	74	<6.2	5.2	33.0
	August 19, 2014	ROA039C	8.1	27.8	8.4	97	1.5	103.1%	0.04	0.53	<0.02	<0.02	0.54	0.52	0.02	22.0	85	18.0	15.0	
	August 19, 2014	ROA039D	7.6	27.6	7.8	97	2.0	96.4%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	10.0	69	<6.2	3.3	
	August 19, 2014	ROA039E	8.1	28.2	7.9	98	2.0	103.9%								10.0	70	<6.2	3.3	33.0
	July 17, 2014	ROA039C	8.7	29.8	8.9	102	2.0	114.7%	0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	3.5	70	6.2	3.6	
	July 17, 2014	ROA039D	8.0	30.6	8.1	104	1.8	107.0%	0.02	0.35	<0.02	0.02	0.37	0.34	0.03	7.3	78		2.9	
	July 17, 2014	ROA039E	8.0	30.0	8.2	103	1.8	105.9%	0.02	0.34	<0.02	<0.02	0.35	0.33	0.02	5.6	88	<6.2	2.8	34.0
	June 26, 2014	ROA039C	7.0	26.9	7.5	104	1.5	87.7%	0.02	0.42	<0.02	0.09	0.51	0.41	0.10	3.5	77	6.2	4.2	
	June 26, 2014	ROA039D	7.7	29.7	7.7	104	1.5	101.4%	0.02	0.37	<0.02	0.05	0.42	0.36	0.06	4.6	97	<6.2	5.5	
	June 26, 2014	ROA039E	8.0	30.1	7.9	104	1.8	106.1%	0.02	0.39	<0.02	0.03	0.42	0.38	0.04	5.5	72	<6.2	3.6	34.0
	May 13, 2014	ROA039C	8.7	20.7	7.6	102	1.5	97.0%	0.02	0.30	<0.02	0.12	0.42	0.29	0.13	7.0	78	8.5	5.6	
	May 13, 2014	ROA039D	8.4	27.6	8.0	103	1.6	106.6%	0.02	0.32	<0.02	0.10	0.42	0.31	0.11	5.6	98	<6.2	4.4	
	May 13, 2014	ROA039E	8.0	28.5	8.0	103	2.0	103.1%	0.02	0.36	<0.02	0.10	0.46	0.35	0.11	6.6	75	<6.2	3.6	35.0
LAKE GASTON	September 11, 2014	ROA0382A	3.4	24.9	7.4	110	1.3	41.1%	0.03	0.40	0.17	0.06	0.46	0.23	0.23	3.0	80	<6.2	8.4	37.0
	September 11, 2014	ROA038A	7.0	25.9	7.4	102	1.0	86.1%	0.02	0.32	0.05	0.03	0.35	0.27	0.08	11.0	76		6.3	36.0
	September 11, 2014	ROA039	7.1	25.8	7.5	101	1.0	87.2%	0.02	0.28	0.02	0.02	0.30	0.26	0.04	20.0	78	<6.2	4.9	34.0
	September 11, 2014	ROA039B	6.7	26.1	7.5	101	1.5	82.8%	0.02	0.40	<0.02	0.03	0.43	0.39	0.04	14.0	78	<6.2	3.2	33.0
	August 19, 2014	ROA0382A	4.2	23.7	7.2	103	2.0	49.6%												37.0
	August 19, 2014	ROA038A	7.1	26.5	7.8	95	1.5	88.3%	0.02	0.40	<0.02	<0.02	0.41	0.39	0.02	18.0	68	<6.2	5.0	33.0
	August 19, 2014	ROA039	7.4	26.5	7.8	95	2.0	92.1%	0.02	0.33	<0.02	<0.02	0.34	0.32	0.02	18.0	68	<6.2	3.4	33.0
	August 19, 2014	ROA039B	7.7	26.8	7.8	98	2.5	96.3%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	13.0		<6.2	2.6	33.0
	July 17, 2014	ROA0382A	4.7	23.8	7.7	101	1.5	55.6%	0.02	0.38	0.05	0.09	0.47	0.33	0.14	2.6	77	<6.2	6.6	35.0
	July 17, 2014	ROA038A	8.1	28.6	7.8	100	1.5	104.6%	0.02	0.39	<0.02	<0.02	0.40	0.38	0.02	14.0	70	<6.2	4.5	33.0
	July 17, 2014	ROA039	7.9	27.8	7.9	101	2.0	100.6%	0.02	0.40	<0.02	<0.02	0.41	0.39	0.02	11.0	70	<6.2	3.5	34.0
	July 17, 2014	ROA039B	7.9	28.7	8.1	102	1.5	102.2%	<0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	8.1	70	<6.2	2.3	33.0
	June 26, 2014	ROA0382A	6.2	24.2	7.4	103	1.2	73.9%	0.03	0.44	<0.02	0.18	0.62	0.43	0.19	4.3	101		7.7	34.0
	June 26, 2014	ROA038A	8.0	28.4	7.8	100	1.5	103.0%	0.02	0.38	<0.02	0.03	0.41	0.37	0.04	9.5	76	<6.2	4.7	32.0
	June 26, 2014	ROA039	8.3	28.3	8.0	102	2.0	106.6%	0.02	0.40	<0.02	0.03	0.43	0.39	0.04	6.8	77	<6.2	4.7	33.0
	June 26, 2014	ROA039B	8.0	28.2	7.9	104	3.1	102.6%	0.02	0.40	<0.02	0.03	0.43	0.39	0.04	5.8	77	<6.2	3.5	33.0
	May 13, 2014	ROA0382A	7.6	15.5	7.7	103	1.5	76.2%	0.02	0.30	0.04	0.19	0.49	0.26	0.23	1.8	108	<6.2	6.5	37.0
	May 13, 2014	ROA038A	8.8	24.8	8.0	102	1.5	106.1%	0.02	0.30	<0.02	0.12	0.42	0.29	0.13	10.0	78	<6.2	5.5	36.0
	May 13, 2014	ROA039	8.8	24.4	8.0	103	2.0	105.4%	0.02	0.35	<0.02	0.12	0.47	0.34	0.13	6.8	78	<6.2	4.4	36.0
	May 13, 2014	ROA039B	8.6	24.7	8.1	102	2.0	103.5%	0.02	0.36	<0.02	0.10	0.46	0.35	0.11	6.7	114	<6.2	3.3	35.0