LAKE & RESERVOIR ASSESSMENTS
BROAD RIVER BASIN

Lake Adger

Intensive Survey Unit
Environmental Sciences Section
Division of Water Quality
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TABLE OF CONTENTS

GLOSSARY

Algae	Small aquatic plants that occur as single cells, colonies, or filaments. May also be referred to as phytoplankton, although phytoplankton are a subset of algae.
Algal biovolume	The volume of all living algae in a unit area at a given point in time. To determine biovolume, individual cells in a known amount of sample are counted. Cells are measured to obtain their cell volume, which is used in calculating biovolume.
Algal density	The density of algae based on the number of units (single cells, filaments and/or colonies) present in a milliliter of water. The severity of an algae bloom is determined by the algal density as follows: Mild bloom = 10,000 to 20,000 units/ml Moderate 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) and are found in almost every aquatic environment including fresh and marine waters, soils, in fact almost anywhere moist. 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 concentration 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.
Dissolved oxygen	The range of surface 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 dissolved 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 elevated biological productivity and low water transparency.

Eutrophication	The process of physical, chemical, and biological changes in a lake associated with the presence of one or more of the following: excessive nutrients, organic matter, silt enrichment and sedimentation.
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 north 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). Values for total organic nitrogen, total phosphorus, chlorophyll *a* and Secchi depth are used to calculate a numeric score representing the lake's degree of 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. DWQ 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 Broad River Basin encompasses a 1,506 square mile watershed drained by 1,452 miles of streams. The three major tributaries to the Broad River are the Green, the Second Broad, and the First Broad Rivers. The headwaters of the Broad River and its major tributaries are located within the Mountains and flow towards the Foothills before entering the Piedmont ecoregion southeast and east of Lake Lure. From there, the Broad River flows through Rutherford and Cleveland counties, then into South Carolina. The basin encompasses most of Cleveland, Polk and Rutherford counties, and small portions of Buncombe, Henderson, Lincoln, and Gaston counties. Larger municipalities include the towns and cities of Forest City, Kings Mountain, Lake Lure, Rutherfordton, Shelby and Spindale. Many of these municipalities are concentrated along the US 74 corridor between the cities of Lake Lure and King's Mountain. Approximately one-half of the basin consists of forests and widespread agriculture while the other half is urbanized.

The Broad River (Rocky Broad River) originates upstream of Lake Lure. Flat, Hickory, and Reedypatch Creeks are the largest tributaries above the lake. Buffalo Creek forms a major arm of the lake and Cove Creek is a large tributary to the Broad River below the lake. Land use within the lake's watershed is predominantly forested with some urban and agricultural uses. The headwater reaches of the Green River are in Henderson County. The Green has been impounded at two locations to form Lakes Summit and Adger. Both reservoirs are used to produce hydroelectric power. Lake Summit is used extensively for primary and secondary recreational purposes. Tributary streams are often high gradient and are capable of supporting trout populations. Apple orchards are a significant land use in upper reaches of many tributary catchments, including the Hungry River. As the topography flattens, the lower reaches of many catchments are farmed. The First Broad River originates in Rutherford County and flows into the Broad River in Cleveland County, just above the South Carolina border. This geographic area is a transitional zone between ecoregions, with some streams exhibiting Mountain characteristics while other streams are more Piedmont in nature.

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 Broad River Basin which might support largemouth bass (http://www.epi.state.nc.us/epi/fish/current.html).

Assessment Methodology

For this report, data from January 1, 2006 through September 30, 2010 were reviewed. All lakes were sampled during the summer from May through September of 2010. 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.
Additional data considered as part of the use support assessment include historic DWQ 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 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.

For a more complete discussion of lake ecology and assessment, please go to http://www.esb.enr.state.nc.us/. The 1990 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.

LAKE & RESERVOIR ASSESSMENTS

HUC 03050105

Lake Lure

Ambient Lakes Program Name	Lake Lure		
Trophic Status (NC TSI)	Oligotrophic		
Mean Depth (meters)	20.0		
Volume ($10^6 m^3$)	12.10		
Watershed Area (mi^2)	90.0		
Classification	B; Tr		
Stations	BRD001C	BRD001D1	BRD001F
Number of Times Sampled	5	5	5

Lake Lure is a large impoundment located in the mountains of southwestern North Carolina, adjacent to the Town of Lake Lure. The lake has a maximum depth of 34 meters. Major tributaries to the lake are the Broad River, Buffalo Creek, and Pool Creek. The watershed is predominantly forested with some urban and agricultural uses. Shoreline development consists of houses and vacation lodges. Lake Lure is owned and managed by the Town of Lake Lure.

DWQ field staff monitored Lake Lure five times in 2010. Surface physical measurements in 2010 (Appendix A) were similar to those measured on previous sampling trips. Surface dissolved oxygen in May ranged from 9.3 to 9.9 mg/L and surface water temperatures ranged from 21.1 to 22.1 °C. On July 6th, the greatest surface water temperatures were recorded (28.5 to 29.0 °C) and surface dissolved oxygen ranged from 8.1 to 8.9 mg/L. The lake became thermally stratified in July with a thermocline present at a depth of approximately eight meters from the surface near the center of the lake (BRD001D1). Dissolved oxygen in July was greater than 4.0 mg/L throughout the water column at this lake site in July, but became sharply stratified on August 2nd and 31st. On July 2nd, dissolved oxygen dropped to below 4.0 mg/L at a depth of 7.0 meters from the surface at sampling site BRD001D1, then at a depth of 5.0 meters from the surface on August 31st. In both instances, severe hypoxic conditions occurred below the depth of the photic zone, which ranged from 4.0 to 4.4 meters from the surface.

Lakewide Secchi depths ranged from 1.9 to 2.5 meters, indicating good water clarity. Very low turbidity and suspended solids values recorded in 2010 also suggest that the clarity of the lake is very good.

Nutrient concentrations in Lake Lure in 2010 were also similar to concentrations observed from previous DWQ sampling trips to the lake (Appendix A). Total phosphorous and ammonia were consistently at or below DWQ water quality laboratory detection levels. Total Kjeldahl nitrogen and total organic nitrogen concentrations were similar to those observed in other mountain lakes. Chlorophyll *a* values ranged from

1.6 ug/L to 14 µg/L. Algae concentrations in Lake Lure were below bloom densities with the exception of a mild bloom during early August. Algal assemblages were dominated by centric diatoms during May to June and by the filamentous blue-greens *Planktolyngbya sp.* and *Aphanizomenon sp.* during July to August. The euglenoid *Trachelomonas* was also prevalent during June and late August.

An Algal Growth Potential Test run on a water sample collected on July 6, 2010 at BRD001D1 determined that algae productivity at this sampling site is limited by the availability of nitrogen in the lake water (Table 1).

Table 1. Algal Growth Potential Test Results for Lake Lure, July 6, 2010.

Station	Control (mg/L)	C + N (mg/L)	C +P (mg/L)	Limiting Nutrient
BRD001D1	0.58	6.46	0.37	**Nitrogen**

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

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

Based on the calculated NCTSI scores, Lake Lure was determined to exhibit very low biological productivity (oligotrophic). Lake Lure has been predominantly oligotrophic since it was first monitored by DWQ in 1981.

Lake Summit

Ambient Lakes Program Name	Lake Summit		
Trophic Status (NC TSI)	Oligotrophic		
Mean Depth (meters)	10.0		
Volume ($10^6 m^3$)	11.50		
Watershed Area (mi^2)	41.0		
Classification	C; Tr		
Stations	BRD005Q	BRD005R	BRD005T
Number of Times Sampled	1	1	0

Lake Summit is a 322-acre impoundment located in Henderson County in the mountains of southwestern North Carolina. The dam was built and the lake filled in 1920. The average retention time for this reservoir is 75 days and the maximum depth is 24 meters. The major tributary to the lake is the Green River. Many homes and several camps encircle the lake. Lake Summit, which is owned by Duke Energy and used to produce hydroelectric power, is leased to the Lake Summit Property Owners Association (LSPOA). The LSPOA manages lakeshore construction activities as well as access to the lake boat ramp.

DWQ field staff sampled two sites on Lake Summit; one site located near the center of the lake (BRD005R) and the other site near the dam (BRD005Q), on June 1, 2010. Surface dissolve oxygen at the two sites ranged from 8.0 to 8.2 mg/L and surface water temperature ranged from 24.4 °C to 25.1 °C. Surface pH values ranged from 7.7 to 7.8 s.u. and conductivity ranged from 29 to 30 μmhos/cm. All of these values are similar to those previously recorded from previous sampling trips by DWQ. Secchi depths, an indicator of water clarity, ranged from 2.0 to 2.7 meters, indicating very good light penetration into the water column.

Nutrient concentrations at the two lake sampling sites were also similar to those previously recorded by DWQ field staff. Total phosphorous ranged from less than DWQ Laboratory detection levels to 0.03 mg/L(Appendix A). Concentrations of nitrogen were similar to those observed in other NC mountain lakes monitored by DWQ. Chlorophyll *a* values ranged from 1.3 μg/L near the dam to 3.8 μg/L near the center of the lake. These values suggest that the algal productivity on the day this lake was sampled in June was very low. Based on the calculated NCTSI score, Lake Summit has very low biological productivity (oligotrophic). This lake was previously determined to be oligotrophic in 1989 and 1995.

Future monitoring of the water quality of Lake Summit by DWQ will be curtailed due to restricted public access.

Lake Adger

Ambient Lakes Program Name	Lake Adger		
Trophic Status (NC TSI)	Oligotrophic		
Mean Depth (meters)	8.0		
Volume ($10^6 m^3$)	14.40		
Watershed Area (mi^2)	134.0		
Classification	C		
Stations	BRD007J	BRD007L	BRD007P
Number of Times Sampled	5	5	5

Lake Adger dam constructed in 1925 created a 460-acre impoundment located in the mountains of southwestern North Carolina. The maximum depth of Lake Adger is 22 meters and the average retention time is 21 days. The Green River is the primary tributary to this reservoir. Fishing and boating are common recreational activities at Lake Adger. The hydroelectric facility at the dam is operated by Northbrook Power Management LLC. In June, 2008, Polk County agreed to purchase the reservoir, water and dam from Duke Energy, the previous owner. Northbrook Power Management will continue to operate the hydropower facility as a part of this purchase agreement.

Lake Adger was sampled six times from May through September 2010 by DWQ field staff. On May 19th, only surface metals were sampled (Appendix A). Surface dissolved oxygen ranged from 7.2 mg/L on August 3rd to 9.7 mg/L on June 2nd. Both of these measurements were taken at the sampling site located at the lower end of the lake (BRD007P). Surface water temperatures ranged from 23.7 °C to 28.3 °C and surface pH values ranged from 7.2 to 8.5 C. Surface conductivity values were low and ranged from 35 to 38 µmhos/cm, which was similar to previous conductivity values recorded by DWQ for this lake. Secchi depths in Lake Adger ranged from 1.1 meters in May to 2.8 meters in July and August, indicating that the clarity of the lake water was good. The Secchi depths of 2.8 meters were also the greatest Secchi depth measurements recorded for this lake since 1989 when it was first monitored by DWQ.

Photic zone total phosphorus was below the DWQ laboratory detection level with the exception of a single measurement at the upper end of the lake (0.04 mg/L at BRD007J) on May 4th (Appendix A). Total Kjeldahl nitrogen and ammonia concentrations were frequently below DWQ laboratory detection levels. Nitrite plus nitrate concentrations were greatest in May and decreased as the growing season progressed over the summer (Appendix A). Total suspended solids were below DWQ laboratory detection level and turbidity measurements ranged from 2.1 to 7.4 NTU. Surface metals and hardness were within the applicable state water quality standards from May through September 2010.

Chlorophyll *a* values in Lake Adger ranged 1.4 to 9.5 µg/L and algal assemblages remained below bloom densities with the exception of a mild bloom in June at Station BRD007P. Assemblages were dominated by pennate diatoms, the diatom *Aulacoseira sp.*, the dinoflagellate *Peridinium sp.*, and the chrysophyte *Dinobryon sp*.during May. June assemblages were dominated by the green alga *Coelastrum sp.* The filamentous blue-green *Planktolyngbya sp.* was dominant July to September, and *Aulacoseira* sp. was again dominant during August to September.

Based on the calculated NCTSI scores, Lake Adger was determined to exhibit very low biological productivity (oligotrophic conditions) in 2010. This lake has been oligotrophic since it was first monitored by DWQ in 1989.

In 2008, Polk County sent a request to the to the Planning Section of DWQ for a reclassification of a portion of the Green River in Polk and Henderson Counties from B Tr HQW, B Tr, C Tr, and C to WS-III B Tr HQW, WS-III B Tr, WS-III Tr and WS-III CA. Lake Adger had recently been purchased by Polk County for the purpose of utilizing the lake as a public water supply resource for the county and the new proposed reclassification would be from C to WS-III CA. In response to this request, the Intensive Survey Unit (ISU) of DWQ was requested to conduct a special study to determine if the water quality of Lake Adger meets or exceeds the state water quality standards for a WS-III CA designation. Monitoring was conducted during the summer of 2010 (May through September) and the results of that study were presented to DWQ's Planning Section in the Spring of 2011.

Kings Mountain Reservoir

Ambient Lakes Program Name	Kings Mountain Reservoir			
Trophic Status (NC TSI)	Mesotrophic			
Mean Depth (meters)	14.0			
Volume ($10^6 m^3$)	7.50			
Watershed Area (mi^2)	65.0			
Classification	WS-III; CA			
Stations	BRD056C	BRD056E	BRD056G	BRD056J
Number of Times Sampled	5	5	5	5

Kings Mountain Reservoir (also known as Moss Lake) is the water supply for the City of Kings Mountain. The reservoir, built in 1963, has a maximum depth of 24 meters. Major tributaries include Buffalo Creek and White Oak Creek. The watershed consists of rolling hills and rural land with approximately 50 to 70 percent of the shoreline developed.

This reservoir was monitored by DWQ staff monthly from May through September, 2010. Lakewide mean Secchi depths ranged from 1.2 to 2.5 meters, suggesting good water clarity in this lake (Appendix A). This is supported by the suspended solids and turbidity values collected in 2010, which were very low.

Surface dissolved oxygen concentrations in 2010 were greatest in May (range = 8.9 to 9.5 mg/L) and lowest (range = 6.8 to 8.0 mg/L) on August 2nd. Kings Mountain Reservoir became thermally stratified in June with a thermocline present at a depth of 5.0 meters from the surface near the dam (BRD056J). In August, a very strong thermocline was present at a depth of 7.0 meters at this sampling site. Near the dam, dissolved oxygen concentrations decreased to hypoxic levels at a depth of 5.0 to 6.0 meters in August. This depth was below the extent of the photic zone, which ranged from 4.0 to 4.4 meters (Appendix A).

Total phosphorus concentrations ranged from 0.03 mg/L in May to at or below DWQ laboratory detection levels from June through August (Appendix A). Concentrations of total Kjeldahl nitrogen, nitrite plus nitrate and total organic nitrogen were also greatest in May as compared with June through August. Rain occurred in the reservoir's watershed within 48 hours of monitoring in May and may have contributed to an increase in nutrients via runoff and suspension of bottom sediments, especially along the shoreline and upper end of the lake. Chlorophyll *a* values for Kings Mountain Reservoir in 2010 ranged from 1.8 *µ*g/L to 11 *µ*g/L.

An Algal Growth Potential Test run on a water sample collected on July 6, 2010 at BRD056J and BRD056G determined that algae productivity at these sampling sites is limited by the availability of phosphorus in the lake water (Table 2).

Table 2. Algal Growth Potential Test Results for Kings Mountain Reservoir, July 6, 2010.

Station	Control (mg/L)	C + N (mg/L)	C +P (mg/L)	Limiting Nutrient
BRD056J	0.58	0.45	6.99	**Phosphorus**
BRD056G	0.49	0.45	5.14	**Phosphorus**

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

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

Based on the calculated NCTSI scores for 2010, Kings Mountain Reservoir was determined to have very low biological productivity (oligotrophic) with the exception of the scores for May, which indicated that the reservoir at that time exhibited elevated biological productivity (eutrophic). The increase in chlorophyll *a* and nutrient concentrations contributed to this score. Previous NCTSI scores for Kings Mountain Reservoir indicated that the lake ranged from oligotrophic to mesotrophic (moderate biological productivity).

Appendix A - Broad River Basin Lakes Data
October 1, 2006 through September 31, 2010

			SURFACE PHYSICAL DATA						PHOTIC ZONE DATA										
Lake	Date	Sampling Station	DO mg/L	Temp Water C	pH s.u.	Cond. µmhos/cm	Depth Secchi meters	Percent SAT	TP mg/L	TKN mg/L	NH3 mg/L	NOx mg/L	TN mg/L	TON mg/L	TIN mg/L	Chla µg/L	Solids Total mg/L	Total Solids Suspended mg/L	Turbidity NTU	COMMENTS
LAKE LURE	August 31, 2010	BRD001C	8.4	28.1	7.9	38	2.1	114.7%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	6.4	44	<6.2	3.1	
	August 31, 2010	BRD001D1	8.0	29.1	8.0	38	2.2	106.6%	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	8.3	46	<6.2	2.5	
	August 31, 2010	BRD001F	8.1	28.9	7.6	38	2.0	110.6%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	7.4	45	<6.2	2.2	
	August 2, 2010	BRD001C	7.4	28.1	7.3	38	1.7	94.7%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	8.5	44	<6.2	2.9	
	August 2, 2010	BRD001D1	7.8	28.2	7.3	37	2.0	100.0%	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	4.0	41	<6.2	4.3	
	August 2, 2010	BRD001F	7.6	28.2	7.3	38	1.9	97.5%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	7.5	46	<6.2	3.3	
	July 6, 2010	BRD001C	8.9	28.5	7.3	39	1.9	114.7%	0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	7.3	44	<6.2		No sample collected for turbidity
	July 6, 2010	BRD001D1	8.1	29.7	7.3	38	2.4	106.6%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	2.5	43	<6.2		No sample collected for turbidity
	July 6, 2010	BRD001F	8.5	29.0	7.6	37	2.2	110.6%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	2.1	40	<6.2		No sample collected for turbidity
	June 2, 2010	BRD001C	8.5	25.2	7.2	35	1.7	103.3%	0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	14.0	38	<6.2	3.1	
	June 2, 2010	BRD001D1	8.1	25.2	7.1	35	2.6	98.4%	<0.02	<0.20	<0.02	0.03	0.13	0.09	0.04	3.4	34	<6.2	2.5	
	June 2, 2010	BRD001F	8.2	25.1	7.0	34	3.2	99.4%	<0.02	<0.20	<0.02	0.02	0.12	0.09	0.03	1.6	35	<6.2	1.9	
	May 4, 2010	BRD001C	9.9	21.1	8.2	34	1.3	111.3%	0.02	<0.20	<0.02	0.02	0.12	0.09	0.03	5.1	39	<6.2	5.1	
	May 4, 2010	BRD001D1	9.5	21.3	7.7	32	2.8	107.2%	<0.02	<0.20	0.02	<0.02	0.11	0.08	0.03	6.3	40	<6.2	2.9	
	May 4, 2010	BRD001F	9.3	22.1	7.8	32	3.2	106.6%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	5.3	50	<6.2	2.8	
LAKE SUMMIT	June 1, 2010	BRD005Q	8.2	24.4	7.7	29	2.7	98.2%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	1.3	17	<6.2	3.1	
	June 1, 2010	BRD005R	8.0	25.1	7.8	30	2.0	97.0%	0.03	0.20	<0.02	0.05	0.25	0.19	0.06	3.8	34	11.0	14.0	
LAKE ADGER	September 1, 2010	BRD007J	8.2	26.8	7.9	36	1.8	102.6%	0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	5.4	44	<6.2	4.0	Hg Field Blank = <1.00 ng/L
	September 1, 2010	BRD007L	8.8	27.1	8.4	35	2.3	110.7%	<0.02	<0.20	0.02	0.04	0.14	0.08	0.06	9.5	43	<6.2	3.3	Hg Field Blank = <1.00 ng/L
	September 1, 2010	BRD007P	8.1	27.4	8.5	35	2.3	102.4%	<0.02	<0.20	<0.02	0.05	0.15	0.09	0.06	4.7	41	<6.2	2.3	Hg Field Blank = <1.00 ng/L
	August 3, 2010	BRD007J	7.3	28.1	7.2	37	1.8	93.5%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	6.2	41	<6.2	3.8	Hg Field Blank = <1.00 ng/L
	August 3, 2010	BRD007L	7.3	28.3	7.5	37	2.2	93.8%	<0.02	<0.20	0.03	0.04	0.14	0.07	0.07	4.1	34	<6.2	4.2	Hg Field Blank = <1.00 ng/L
	August 3, 2010	BRD007P	7.2	28.0	7.4	37	2.8	92.0%	<0.02	<0.20	0.03	0.05	0.15	0.07	0.08	3.2	41	<6.2	2.1	Hg Field Blank = <1.00 ng/L
	July 7, 2010	BRD007J	8.4	28.2	8.2	38	1.4	107.7%	<0.02	<0.20	<0.02	<0.02	0.11	0.09	0.02	7.6	38	<6.2	3.4	Hg Field Blank = <1.00 ng/L
	July 7, 2010	BRD007L	8.2	28.1	8.0	38	2.0	105.0%	<0.02	<0.20	<0.02	0.02	0.12	0.09	0.03	7.4	42	<6.2	4.6	Hg Field Blank = <1.00 ng/L
	July 7, 2010	BRD007P	7.8	28.1	8.0	37	2.8	99.9%	<0.02	0.22	<0.02	<0.02	0.22	0.21	0.01	2.5	41	<6.2	2.8	Hg Field Blank = <1.00 ng/L
	June 2, 2010	BRD007J	8.9	23.7	7.3	36	1.1	105.2%	0.02	<0.20	<0.02	0.10	0.20	0.09	0.11	1.4	36	<6.2	7.4	Hg Field Blank = <1.00 ng/L
	June 2, 2010	BRD007L	9.4	25.8	8.5	35	1.3	115.5%	0.02	<0.20	<0.02	0.08	0.18	0.09	0.09	6.9	35	<6.2	6.5	Hg Field Blank = <1.00 ng/L
	June 2, 2010	BRD007P	9.7	26.3	8.5	35	1.5	120.2%	<0.02	0.20	<0.02	0.02	0.22	0.19	0.03	7.1	35	<6.2	5.6	Hg Field Blank = <1.00 ng/L
	May 19, 2010	BRD007J																		Hg Field Blank = <1.00 ng/L
	May 19, 2010	BRD007L																		Hg Field Blank = <1.00 ng/L
	May 19, 2010	BRD007P																		Hg Field Blank = <1.00 ng/L
	May 4, 2010	BRD007J	8.3	18.5	7.1	36	0.6	88.6%	0.04	0.20	<0.02	0.15	0.35	0.19	0.16	2.1	56	10.0	19.0	
	May 4, 2010	BRD007L	8.9	20.6	7.6	35	1.9	99.1%	<0.02	<0.20	<0.02	0.12	0.22	0.09	0.13	3.8	50	<6.2	3.7	
	May 4, 2010	BRD007P	8.6	20.8	7.6	36	2.3	96.1%	<0.02	<0.20	<0.02	0.12	0.22	0.09	0.13	5.8	54	<12	3.5	
KINGS MOUNTAIN RESERVOIR	August 31, 2010	BRD056C	8.2	29.7	8.0	60	1.4	108.0%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	11.0	52	<6.2	3.1	
	August 31, 2010	BRD056E	8.1	29.6	7.9	59	1.3	106.5%	<0.02	0.29	<0.02	<0.02	0.30	0.28	0.02	6.9	50	<6.2	3.5	
	August 31, 2010	BRD056G	8.2	29.6	7.7	60	1.9	107.8%	<0.02	0.25	<0.02	<0.02	0.26	0.24	0.02	5.6	50	<6.2	2.5	
	August 31, 2010	BRD056J	7.8	29.5	8.6	61	2.2	102.3%	<0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	5.6	50	<6.2	2.1	
	August 2, 2010	BRD056C	6.8	28.5	7.6	58	1.8	87.7%	<0.02	0.32	0.02	0.06	0.38	0.30	0.08	8.2	49	<6.2	5.1	
	August 2, 2010	BRD056E	7.1	28.4	7.5	60	1.9	91.4%	<0.02	0.30	<0.02	0.03	0.33	0.29	0.04	7.3	49	<6.2	3.8	
	August 2, 2010	BRD056G	7.2	28.6	8.2	59	1.9	93.0%	<0.02	0.27	<0.02	<0.02	0.28	0.26	0.02	5.4	50	<6.2	3.6	
	August 2, 2010	BRD056J	8.0	28.7	7.9	60	2.0	103.5%	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	6.3	49	<6.2	2.4	
	July 6, 2010	BRD056C	8.7	30.1	8.4	60	2.4	115.3%	<0.02	0.28	<0.02	0.12	0.40	0.27	0.13	6.2	50	<6.2		No sample collected for turbidity
	July 6, 2010	BRD056E	8.6	30.1	8.4	61	2.1	114.0%	<0.02	0.27	<0.02	0.10	0.37	0.26	0.11	5.4	45	<6.2		No sample collected for turbidity
	July 6, 2010	BRD056G	8.8	29.7	8.4	61	2.5	115.9%	<0.02	0.26	<0.02	0.13	0.39	0.25	0.14	5.2	44	<6.2		No sample collected for turbidity
	July 6, 2010	BRD056J	8.8	29.6	8.5	60	2.9	115.7%	<0.02	0.32	<0.02	0.17	0.49	0.31	0.18	4.3	46	<12		No sample collected for turbidity
	June 1, 2010	BRD056C	7.5	26.5	7.7	59	2.3	93.3%	0.02	0.27	0.02	0.42	0.69	0.25	0.44	2.1	44	<6.2	5.1	
	June 1, 2010	BRD056E	7.3	26.2	7.7	58	2.0	90.3%	0.02	0.31	0.02	0.36	0.67	0.29	0.38	4.2	43	<6.2	4.0	
	June 1, 2010	BRD056G	7.5	26.1	7.7	57	2.4	92.6%	0.02	0.32	<0.02	0.43	0.75	0.31	0.44	3.2	44	<6.2	3.4	
	June 1, 2010	BRD056J	7.4	25.9	7.7	57	2.1	91.1%	<0.02	0.29	<0.02	0.35	0.64	0.28	0.36	5.2	45	<6.2	3.2	
	May 3, 2010	BRD056C	9.5	21.5	7.9	57	1.2	107.6%	0.02	0.40	<0.02	0.42	0.82	0.39	0.43	10.0	52	<6.2	7.3	
	May 3, 2010	BRD056E	9.1	21.4	7.6	58	1.1	102.9%	0.03	0.43	<0.02	0.42	0.85	0.42	0.43	9.4	70	6.5	8.3	
	May 3, 2010	BRD056G	9.3	20.4	7.3	58	1.2	103.1%	0.03	0.38	<0.02	0.46	0.84	0.37	0.47	1.8	73	<6.2	8.7	
	May 3, 2010	BRD056J	8.9	19.4	7.1	57	1.1	96.8%	0.03	0.43	<0.02	0.48	0.91	0.42	0.49	8.7	62	6.2	9.7	

Appendix A - Broad River Basin Lakes Data
October 1, 2006 through September 31, 2010

Lake	Date	Sampling Station	SURFACE METALS DATA Hg 1631 ng/L	Zn µg/L	Pb µg/L	Ni µg/L	Cu µg/L	Cr µg/L	Cd µg/L	As µg/L	Mn mg/L	Mg mg/L	Fe µg/L	Al µg/L	Ca mg/L	Fluoride mg/L	Sulfate mg/L	Cl mg/L	Coliform Fecal per 100 ml	Total Hardness mg/L
LAKE LURE	August 31, 2010	BRD001C																		
	August 31, 2010	BRD001D1																		
	August 31, 2010	BRD001F																		
	August 2, 2010	BRD001C																		
	August 2, 2010	BRD001D1																		
	August 2, 2010	BRD001F																		
	July 6, 2010	BRD001C																		
	July 6, 2010	BRD001D1																		
	July 6, 2010	BRD001F																		
	June 2, 2010	BRD001C																		
	June 2, 2010	BRD001D1																		
	June 2, 2010	BRD001F																		
	May 4, 2010	BRD001C																		
	May 4, 2010	BRD001D1																		
	May 4, 2010	BRD001F																		
LAKE SUMMIT	June 1, 2010	BRD005Q																		
	June 1, 2010	BRD005R																		
LAKE ADGER	September 1, 2010	BRD007J	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	23	1.10	180	93	2.7	<0.4	<2.0	1.9		11.3
	September 1, 2010	BRD007L	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	12	1.00	120	87	2.6	<0.4	<2.0	1.8		10.6
	September 1, 2010	BRD007P	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	<10	1.00	95	69	2.5	<0.4	<2.0	1.9	3	10.4
	August 3, 2010	BRD007J	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	19	1.10	130	<50	2.8	<0.4	<2.0	2.0		11.5
	August 3, 2010	BRD007L	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	13	1.10	130	<50	2.8	<0.4	<2.0	2.0		11.5
	August 3, 2010	BRD007P	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	<10	1.10	120	63	2.7	<0.4	<2.0	2.0	1	11.3
	July 7, 2010	BRD007J	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	19	1.10	150	66	2.7	<0.4	<2.0	1.8		11.3
	July 7, 2010	BRD007L	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	11	1.10	140	84	2.8	<0.4	<2.0	1.8		11.5
	July 7, 2010	BRD007P	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	<10	1.10	120	81	2.7	<0.4	<2.0	1.7		11.3
	June 2, 2010	BRD007J	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	27	1.10	280	200	2.6	<0.4	<2.0	1.9		11.0
	June 2, 2010	BRD007L	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	15	1.00	240	150	2.6	<0.4	<2.0	1.9		10.6
	June 2, 2010	BRD007P	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	12	1.00	200	130	2.6	<0.4	<2.0	1.9	1	10.6
	May 19, 2010	BRD007J	1.08	<10	<10	<10	<2.0	<10	<1.0	<2.0	16	1.00	200	120	2.6	<0.4	<2.0	1.9		10.6
	May 19, 2010	BRD007L	1.02	<10	<10	<10	<2.0	<10	<1.0	<2.0	17	1.00	210	150	2.6	<0.4	<2.0	1.9		10.6
	May 19, 2010	BRD007P	<1.00	<10	<10	<10	<2.0	<10	<1.0	<2.0	16	1.10	180	92	2.7	<0.4	<2.0	1.9		11.3
	May 4, 2010	BRD007J																		
	May 4, 2010	BRD007L																		
	May 4, 2010	BRD007P		10	<10	<10	<2.0	<10	<1.0	<2.0		1.00	140		2.6				5	10.6
KINGS MOUNTAIN RESERVOIR	August 31, 2010	BRD056C																		
	August 31, 2010	BRD056E																		
	August 31, 2010	BRD056G																		
	August 31, 2010	BRD056J														<0.4	2.9	3.3		18.0
	August 2, 2010	BRD056C																		
	August 2, 2010	BRD056E																		
	August 2, 2010	BRD056G																		
	August 2, 2010	BRD056J														<0.4	3.1	3.6		18.0
	July 6, 2010	BRD056C																		
	July 6, 2010	BRD056E																		
	July 6, 2010	BRD056G																		
	July 6, 2010	BRD056J														<0.4	3.1	3.2		17.0
	June 1, 2010	BRD056C																		
	June 1, 2010	BRD056E																		
	June 1, 2010	BRD056G																		
	June 1, 2010	BRD056J										2.00			4.5	<0.4	3.4	3.1		19.5
	May 3, 2010	BRD056C																		
	May 3, 2010	BRD056E																		
	May 3, 2010	BRD056G																		
	May 3, 2010	BRD056J										1.8			4.3	<0.4	4.0	3.5		18.0