# *Total Maximum Daily Load for Aquatic Weeds for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena in North Carolina*

Final Report
August 2006

EPA Approved Date: September 25, 2006

*Yadkin-Pee-Dee River Basin, Roanoke River Basin, and Neuse River Basin*

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# INDEX OF TMDL SUBMITTAL

## 1. 303(d) Listed Water Body Information

**State:** North Carolina

**Counties:** Richmond, Halifax, Wake, and Wayne
**Major River Basins:** Yadkin-Pee-Dee, Roanoke, and Neuse
**Watersheds:** Falling Creek, Roanoke River, Sycamore Creek Reedy Creek, and Walnut Creek

**Impaired Water Body (2000 303(d) List):**

| Water Body Name - (Assessment Unit) | Water Quality Classification | Sub-basin | 8-digit HUC | Area (Acres) |
|---|---|---|---|---|
| Rockingham City Lake (13-Rockingham) | WS-III CA | 03-07-16 | 03040201 | 27 |
| Roanoke Rapids Lake (23-(22.5)) | WS-IV & B CA | 03-06-08 | 03010106 | 4893 |
| Big Lake (27-Big Lake_WA) | B-NSW | 03-04-02 | 03020201 | 62 |
| Reedy Creek Lake (27 Reedy Cree) | B-NSW | 03-04-02 | 03020201 | 20 |
| Lake Wackena (27 Lake Wacke) | C-NSW | 03-04-05 | 03020202 | 165 |

**Constituent(s) of Concern:** Aquatic Weeds

**Designated Uses:** Biological integrity, water supply, propagation of aquatic life, and recreation.

**Applicable Water Quality Standards:**

As defined by North Carolina Aquatic Weed Control Act of 1991, noxious aquatic weed is any plant organism which grows in or is closely associated with the aquatic environment, whether floating, emersed, submersed, or ditch-bank species, and including terrestrial phases of any such plant organism; exhibits characteristics of obstructive nature and either massive productivity or choking density; and is or may become a threat to public health or safety or to existing or new beneficial uses of the waters of the State. Noxious aquatic weed is any plant organism so designated under Article 15 of Chapter 113A of the General Statutes of North Carolina.

The North Carolina Aquatic Weed Control Act of 1991 empowers the State of North Carolina to control, eradicate, and regulate plants designated as noxious aquatic weeds. The Aquatic Weed Control Act and the existing powers of the Commissioner of

Agriculture prohibit importation, sale, use, culture, collection, transportation, and distribution of these plants in North Carolina. Permits for the movement of noxious aquatic weeds may be obtained from the Commissioner of Agriculture pursuant to 2 NCAC 48A .1705 and .1706, subject to the conditions stated therein. A detail of the definition and regulation of aquatic weeds in North Carolina is given in Appendix 12.2.

Following allocations for the aquatic weeds are identified in this TMDL.

- Non-noxious native aquatic plants along shoreline, which protect bank erosion and provide special habitat for aquatic animals and wildlife: **No Control.**
- Other non-noxious native aquatic plants: **Partial Control**
- Noxious native aquatic plants or exotic aquatic plants: **Extensive Control**

## 2. TMDL Development

Total Maximum Daily Load (TMDL) is defined as the total amount of pollutant that can be assimilated by a receiving lake while achieving water quality standards. Assimilative capacity of a lake is determined with regards to usefulness of aquatic weeds and management goals.

### Critical Conditions:

Critical conditions are determined by understanding growth patterns of aquatic weeds. Except for Brazilian elodea (*Egeria densa*), summer period is critical for many aquatic weeds. Winter period is critical for Brazilian elodea.

### Seasonal Variation:

No seasonal variation is studied due to insufficient measurement data.

**3. Control Level:**

| Lake/Watershed | Aquatic Weeds | | | Control Level |
|---|---|---|---|---|
| | Scientific Name | North Carolina Designation | Category | |
| Rockingham City Lake (Falling Creek) | *Eleocharis sp.* | Not Noxious | Native | No Control |
| | *Mayaca fluviatilis* | Not Noxious | Native | Partial Control |
| | *Myriophyllum heterophyllum* | Not Noxious | Native | Partial Control |
| | *Nymphae odorata.* | Not Noxious | Native | Partial Control |
| Roanoke Rapids Lake (Roanoke River) | *Hydrilla verticillata* | Noxious | Exotic | Extensive Control |
| | *Myriophyllum spicatum* | Noxious | Exotic | Extensive Control |
| | *Egeria densa* | Noxious | Exotic | Extensive Control |
| Big Lake (Sycamore Creek) | *Hydrilla sp.* | Noxious | Exotic | Extensive Control |
| Reedy Creek Lake (Reedy Creek) | *Hydrilla sp.* | Noxious | Exotic | Extensive Control |
| Lake Wackena (Walnut Creek) | Not known | Not known | Not known | Not known |

**4. Submittal Date: August 14, 2006**

**5. Establishment Date:**

**6. Public Notice Information:**

A draft of the Aquatic Weed TMDL for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena was publicly noticed through local newspapers, Richmond CO. Daily Journal, Daily Herald, The News and Observer, and Goldsboro News Argus on June 30, 2006. The TMDLs was also publicly noticed through DWQ web site at http://h20.enr.state.nc.us/tmdl/. A public comment period was through August 7, 2006.

- Did notification contain specific mention of TMDL proposals? **YES**
- Were comments received from the public? **NO**
- Was a responsiveness summary prepared? **NO**

**7. EPA Lead on TMDL (EPA or Blank):**
**8. DOT a Significant Contribution (Yes or Blank):**
**9. Endangered Species (Yes or Blank):**
**10. TMDL Considers Point Source, Nonpoint Source, or Both: NA**

# Table of Contents

# 1. Introduction

Section 303(d) of the Clean Water Act (CWA) requires States to develop a list of water bodies that do not meet water quality standards or have impaired uses. The list, referred to as the 303(d) list, is submitted biennially to the U.S. Environment Protection Agency (USEPA) for review. The 303(d) process requires that a Total Maximum Daily Load (TMDL) be developed for each of the waters appearing on Category 5 of the 303(d) list. This category consists of those waters that are impaired by a pollutant and the proper technical conditions exist to develop TMDLs.

As follow up of the CWA, this report presents the development of Total Maximum Daily Loads (TMDLs) for five different lakes in North Carolina: Big Lake, Reedy Creek Lake, Lake Wackena, Roanoke Rapid Lake, and Rockingham City Lake. The first three lakes are located in Neuse River Basin (NEU), while the remaining two lakes are respectively located in Roanoke River Basin (ROA), and Yadkin River Basin (YAD). As identified by the North Carolina Division of Water Quality (NC DWQ), the five lakes are impaired due to aquatic weeds and TMDLs are needed (NCDENR 2003).

The US EPA considers any aquatic plant growth in a lake to be a "pollutant" within the meaning of Section 502(6) of the Clean Water Act. In 1978, EPA decided that all pollutants, under proper technical conditions, are suitable for the calculation of TMDLs (43 Fed. Reg. 60662, December 28, 1978). EPA may reevaluate whether materials such as aquatic weeds are pollutants, generally or in individual situations, for Clean Water Act purposes.

Because of invasive nature of aquatic weed, a quantitative explanation of its reduction level is difficult and there is no clear instruction on how much control is needed for a particular weed problem. Therefore, this TMDL details types of aquatic weeds and qualitative options to control aquatic weeds in the following paragraphs.

## 1.1. Types of Aquatic Weeds

The staff of Division of Water Quality (DWQ) and Division of Water Resources (DWR) identified seven different aquatic plants in the following four lakes (Table 1.1): Rockingham City Lake, Roanoke Rapids Lake, Big Lake, and Reedy Creek Lake. The types of plants and the dates when the plants were identified are given in Tables 1.1 and 1. 2 respectively.

Table 1.1. Identified aquatic weeds and their classes in the North Carolina lakes

| **NC Lakes/Basin** | **Aquatic Weeds** | | **North Carolina Designation** | **Category** |
|---|---|---|---|---|
| | **Scientific Name** | **Common Name** | | |
| Rockingham City Lake (YAD) | *Eleocharis sp.* | Spike rush | Not Noxious | Native |
| | *Mayaca fluviatilis,* | Bog moss | Not Noxious | Native |
| | *Myriophyllum heterophyllum* | Watermilfoil | Not Noxious | Native |
| | *Nymphae odorata.* | Fragrant waterlily | Not Noxious | Native |
| Roanoke Rapids Lake (ROA) | *Hydrilla verticillata* | Hydrilla | Noxious | Exotic |
| | *Myriophyllum spicatum* | Eurasian milfoil | Noxious | Exotic |
| | *Egeria densa* | Brazilian elodea | Noxious | Exotic |
| Big Lake (NEU) | *Hydrilla sp* | Hydrilla | Noxious | Exotic |
| Reedy Creek Lake (NEU) | Hydrilla sp. | Hydrilla | Noxious | Exotic |
| Lake Wakena (NEU) | Not known | Not known | Not known | Not known |

Table 1.2. Field survey periods for identifying aquatic weeds in the North Carolina lakes

| NC Lakes | Data Collection Period |
|---|---|
| Rockingham City Lake | August 24, 1995 |
| Roanoke Rapids Lake | July 22, 1999, August 24, 2003 |
| Big Lake | July 12, 2000 |
| Reedy Creek Lake | July 12, 2000 and August 7, 2000 |
| Lake Wackena | July 25, 1995 |

A field study to identify specific aquatic weed type (macrophytes aqauatic plants) in Lake Wackena has not been performed yet. A field study is, therefore, urgent to identify exact types of weeds existed in order to determine specific management options for the lake. If aquatic weeds are not a problem, the lake can be delisted from the 303(d) list.

As shown in Table 1.1, Rockingham City Lake carried all native aquatic weeds: spike rush, bog moss, and watermilfoil. These plants naturally grow there and are integral part of the lake. The plants provide food and shelter to aquatic animals and protect shoreline from erosion. However, problems arise when the plants become so numerous that they impede recreational activities such as boating and swimming. When growth becomes very thick, they harm fisheries.

The three lakes -- Roanoke Lake, Big Lake, and Reedy Creek Lake -- carried exotic aquatic weeds. These species are sometimes available as ornamental water gardening or aquarium plants. Whether they were deliberately introduced or introduced by happenstance is unclear. Seeds of the species may have been brought to the lakes by the migratory birds. Once introduced the exotic weeds rapidly out compete native plants and form single-species stands. These monocultures reduce habitat for fish, waterfowl, aquatic mammals, and invertebrates.

North Carolina State has designated some of the identified aquatic weeds as noxious based on their invasive characteristics in NC lakes. Details of the NC Aquatic Weed Control Act of 1991 and Regulation and Designated noxious aquatic weeds are presented in Appendix 12.2. According to the Act, the plants identified in Roanoke Rapids Lake, Big Lake, and Reedy Creek Lake are noxious (Table 1.1).

## 1.2. Aquatic Weed Control Level

Some measures need to be implemented in order to control the identified aquatic weeds in the five lakes. There is, however, no clear instruction on how much control is needed for a particular weed problem. Based on usefulness and invasive types of weeds in the lakes, the following three levels of control are recommended for this study.

### 1.2.1. No Control:

Non-noxious native aquatic weeds along shoreline, which protect bank erosion and provide special habitat for aquatic animals and wildlife, should not be controlled. For instance, spikerush (*Eleocharis sp.*) is a native weed to North Carolina and grows individually or in clumps along shorelines. Seeds and stems of the plants are important food for waterfowl and mammals. Management actions targeting this species may cause more harm than good.

### 1.2.2. Partial Control:

Partial control of non-noxious native aquatic weeds is recommended in order to maintain lake management activities. For instance, fragrant or white water lily (*Nymphae odorata*), a native weed to NC, provides aesthetic value for the surrounding lake community. However, excessive spatial coverage on surface of lake would interfere with boating, fishing, and swimming.

Sometimes an extensive control of non-noxious aquatic weeds might be needed. Level of control depends on the nature of invasion in a lake. Therefore, selection of a control level should be done on a case by case basis.

### 1.2.3. Extensive Control:

Presence of noxious aquatic weeds or exotic aquatic weeds may justify extensive control. For instance, Hydrilla species (*Hydrilla verticillata*) is a very competitive exotic as well as noxious aquatic weed. This species adversely impacts aquatic ecosystems by forming dense canopies that often shade out native vegetation. Therefore, lake wide extensive control of these aquatic weeds is recommended.

## 1.3. Aquatic Weed Control Strategies

The identified aquatic weeds in Table 1.1 are generally characterized by rapid growth, ability to regenerate by fragmentation (production of new plants from small plant segments) or vegetative hibernating organs (tubers and turions). Factors that contribute to their rapid development are often connected with their normal pattern of succession. Therefore, if control measures are not carried out, the five lakes may eventually fill with aquatic weeds.

Normally, the following preventive measures are recommended to control aquatic weeds: Hand Pulling and Bottom Barrier Installation, Aquatic Herbicide Treatment, Triploid Grass Carp, Diver Dredging, and Water Level Drawdown. Intensity of these preventive measures, however, depends upon hydrologic characteristics of lakes and aquatic species.

When applying herbicide in a lake, one should follow the North Carolina Pesticide Law of 1971, G.S. 143-434, Article 52. The law establishes programs of pesticide management and control under the authority of the North Carolina Pesticide Board. The purpose of the Law is to protect the health, safety, and welfare of the people of this State, and to promote a more secure, healthy and safe environment for all people of the state. This is accomplished by regulation in the public interest of the use, application, sale, disposal, and registration of pesticides.

The North Carolina Pesticide Law of 1971 requires the registration of pesticide products in the state, the licensing and certification of commercial and private applicators and pest control consultants, the proper handling, transportation, storage and disposal of pesticides, and the licensing of dealers selling restricted use pesticides.

## 1.4. Characteristics of Lakes

The five lakes -- Roanoke Rapid Lakes, Rockingham City Lake, Big Lake, Reedy Creek Lake, and Lake Wackena -- are artificially created for water supply and recreation in North Carolina. Rivers and streams are the primary sources of water to the lakes. Water that runs off the land surface also enters the lakes. Water levels in the lakes fluctuate seasonally and annually. During summer season when rains are infrequent; run-off is

minimal; and sediment loads are insignificant; sunlight penetrates deeper into the water column. The depth light that is able to penetrate the water column is called the photic zone and is measured as twice the secchi depth (measure of transparency of water column). Increased light increases productivity and fosters plant growth, especially when it reaches nutrient rich sediments. Therefore, increased photic zone allows plants to grow at greater depths, which would be normally unattainable without the increased light. Photic zone is important for plant colonization and growth is coupled with the fact that shallow systems with large surface areas are more susceptible to weed infestations than deep systems with small surface areas. Average photic zones and surface areas of the five lakes during summer period are presented in Table 1.3.

Table 1.3. Physical and Chemical Properties of the studied lakes in NC

| NC Lakes | Surface Area (Acres) | Average Photic Zone During Summer Period (Meter) | Average Maximum Depth (Meter) | Average Depth (Meter) | Average Water Temperature ($^{O}$C) | Average Chlorophyl *a* (ug/L) | Average Turbidity (NTU) |
|---|---|---|---|---|---|---|---|
| Rockingham City Lake | 27 | 1.53 | 2 | 0.7 | 26 | 4.5 | 2.6 |
| Roanoke Rapids Lake | 4893 | 3.21 | 27 | 5 | 27 | 6.0 | 2.4 |
| Big Lake | 62 | 1.58 | 5 | 2 | 29 | 10.0 | 17.0 |
| Reedy Creek Lake | 20 | 2.29 | 4 | 2 | 29 | 6.0 | 16.0 |
| Lake Wackena | 165 | 1.95 | 5 | 2 | 32 | 15.0 | 4.2 |

The photic zones of the five lakes were considerably high compared to their average water depths during summer period. On average, the photic zones occupied 65% of the average depth in Roanoke Rapids Lake and 80% in Big Lake. The occupation was higher than 90% in the remaining three lakes. The result suggests that the five lakes facilitate the photosynthetic process, promoting rapid and dense growth during summer time.

Water temperature is another important factor that governs growth of plants. Although some plants can photosynthesize and grow at $2^{O}$ C, it is generally at higher temperatures (20 to 35 $^{O}$ C) that weed problems become most severe (Spencer and Bowes, 1990). Water temperature in the six lakes during summer time reached to more than 25 $^{O}$ C (Table 1.3). The result further suggests that the lakes provided good environment for the weeds to grow profusely during summer time.

Soil erosion and nutrient enriched runoff can also increase growth of aquatic plants. Eroded soil particles not only make a lake shallower and allow rooted plants to quickly invade, but soil particles also transport adsorbed nitrogen and phosphorus that stimulate plant growth. In addition, nutrient enriched runoff deposits nitrogen and phosphorus in the bottom soil of lake. The deposited nutrients further stimulate plant growth. However, the five lakes were not contaminated due to nutrient and sediment problems during the study periods; because the lakes did not exceed Chlorophyll *a* and turbidity values greater than the State's standard values, 40 ug/L and 50 NTU, respectively (Table 1.3 and Appendix 11.3). Therefore, a control strategy through reducing nutrient and sediment is not discussed in this aquatic weed TMDL study.

# 2. Rockingham City Lake

## 2.1. General Background

Rockingham City Lake is a secondary water supply reservoir for the City of Rockingham (Figure 2.1). The lake receives permanent water from Falling Creek and supplies water for approximately one-third of the total water use in the City. The volume of the lake is 0.02 x$10^6$ $m^3$, the mean depth is 0.7 meter (two feet) and the maximum depth is two meter (7 feet). The drainage area covers 52 $km^2$ (20 $mi^2$). Observed land uses in the watershed include forested areas, agricultural areas consisting of crop production, and slight residential and urban development (Figure 2.2).

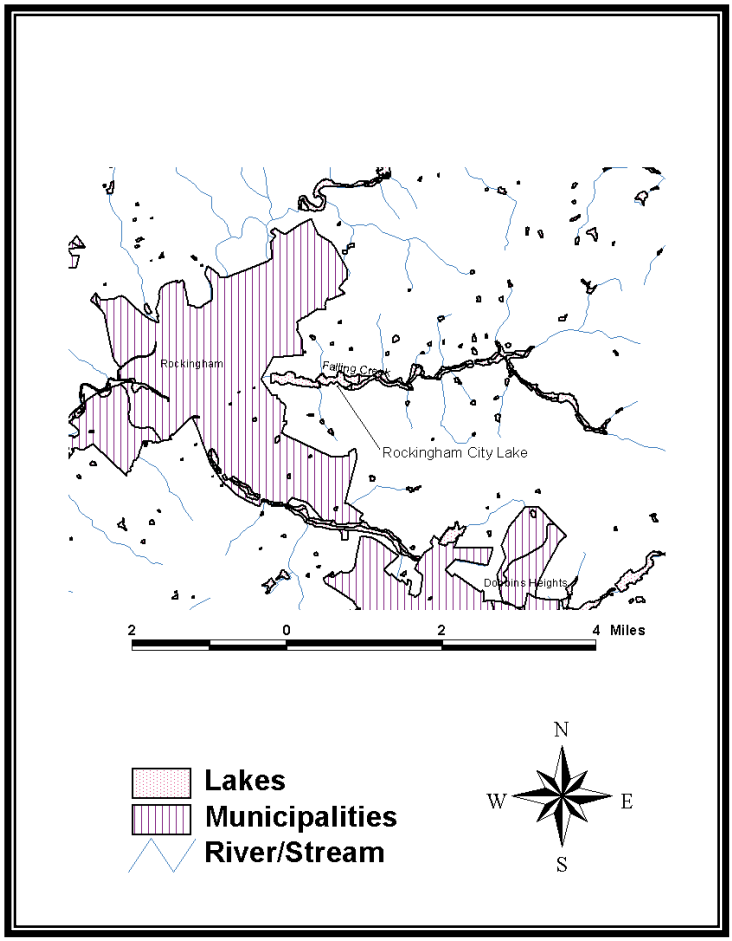


Figure 2.1. Location of the Rockingham City Lake in the Yadkin River Basin.


Figure 2.2. Aerial view of the Rockingham City Lake (USGS: January 30, 1993).

Rockingham City Lake is currently classified as WS-III CA. Class WS-III states that waters are used as sources of potable water where a more protective WS-I or II classification is not feasible. These waters are also protected for Class C uses. WS-III waters are generally in low to moderately developed watersheds. General discharge permits only are allowed near the water supply intake whereas domestic and nonprocess industrial discharges are allowed in the rest of the water supply watershed. The Class CA stands for critical area.

## 2.2. Aquatic Weed Problem

On August 24, 1995, the DWQ staff identified the following aquatic weeds in Rockingham Lake: spike rush (*Eleocharis sp.*), bog moss (*Mayaca fluviatilis*), two-leaf watermilfoil (*Myriophyllum heterophyllum*) and fragrant or white waterlily (*Nymphae odorata*). The identified plants are native to North Carolina (Godfrey and Wooten 1997 and 1981). These plants are not included on the federal or state noxious weed list (Table 1.1). However, excessive plants like watermilfoil and fragrant waterlily can limit swimming, fishing, boating, and aesthetic appreciation. Characteristics of the plants are as follows:

Spike rush (*Eleocharis sp.*): The plant can be recognized by the oval-shaped, brownish-flowering spikes at the tips of smooth, round stems. Spike-rush species grow individually or in clumps along shorelines or in shallow water, sometimes forming ankle-high turf-like mats (http://www.ecy.wa.gov/programs/wq/wqhome.html). Needle spike-rush often appears hair-like when growing underwater. Seeds and stems of the plants are important food sources for waterfowl and mammals. Spike-rushes provide habitat for amphibians and fish and help stabilize shorelines. Therefore, a TMDL to control the plant is not required.

Bog moss (*Mayaca fluviatilis*): This plant is a submersed plant (http://aquat1.ifas.ufl.edu/welcome.html). It may be found in water several feet deep. The stems of bog moss are typically several feet long. The stems are whitish-green. The leaves of bog moss are soft and mossy, like short pieces of fine thread. They are arranged spirally on the stem, and are densely crowded. Bog moss flowers are solitary, on stalks that are one to two inches long. Its massive growth can limit swimming, fishing, skiing, sailing, boating, and aesthetic appreciation. Therefore, its growth should be limited in lakes with secondary recreation uses.

Two-leaf watermilfoil (*Myriophyllum heterophyllum*): The plant is a submerged plant and flowers in the spring through the fall (http://aquat1.ifas.ufl.edu/welcome.html). Its massive growth can limit swimming, fishing, skiing, sailing, boating, and aesthetic appreciation. For this reason, management of the plant is needed.

Fragrant or white waterlily (*Nymphae odorata*): This plant is a rooted, emerged aquatic plant distinctive for its sweet-scented, white, or pink, showy flower (http://www.ecy.wa.gov/programs/wq/wqhome.html). The plant has floating leaves, which are nearly circular in shape. They are notched to the center. Leaves arise on stalks from long rhizomes in the mud. Generally, the plant is not a problem, but significant spatial coverage in the surface of the lake would interfere with boating, fishing, and swimming. Its surface covering would also physically prevent atmospheric oxygen from dissolving into the water. Although relatively slow-spreading, water lilies will eventually

colonize shallow water depths to six feet deep and can dominate shorelines of shallow lakes. For this reason, the plant needs to be controlled from spreading across the entire lake surface.

## 2.3. Control Strategies

The Rockingham Water Treatment Plant in Richmond County manages Rockingham City Lake. The plant releases triploid grass carps every ten years to control the aquatic plants in the lake. According to the plant supervisor, Mr. Gary Johnson, the last release was in March 2001 and total number of grass carps released was 150. Nevertheless, grass carps will not eat bog moss and watermilfoil. They will consume fragrant waterlily, but the effective control of the plant is not yet well documented. The University of Washington experimented with using triploid grass carp to remove fragrant and other species of waterlilies from Chambers Lake, Thurston County by stocking very high rates of fish (http://www.ecy.wa.gov/programs/wq/plants/weeds/). However, little or no impact of the fish on waterlilies was observed in that lake.

Some of the control strategies like bottom barriers and manual harvesting could be effective to control the aquatic plants in the lake. Some lake residents have indicated that extremely persistent "picking" of emerging waterlily leaves every other day during the growing season for two to three seasons will eventually kill the plants.

Herbicide application is not necessary, because the identified plants are not noxious for the lake (see section 1.2). Improper application of herbicide could cause toxicity in the lake. Furthermore, use of sophisticated machines to cut or drag the plants from the lake is not recommended. It can result in eroding soils from banks and bottom surface of the lake.

## 2.4. Control Level

Because the identified aquatic weeds in Rockingham City Lake are native to North Carolina and are not listed as noxious weeds (Appendix 12.2), a partial control of these plants might be needed to attain lake management goals. However, there is no need to control spike rush, because it provides good habitat for amphibians and fish and helps

stabilize shorelines of the lake. Different control levels are described in details in Section 1.2.

## 2.5. Critical condition

Growth patterns of the native weeds suggest summer as the critical period for the Rockingham City Lake. The identified native aquatic weeds are rooted perennial plants. Each spring new shoots appear from rhizomes and grow up through the water until they reach the surface. During summer time, their growths are further enhanced due to prolonged photosynthesis period. In Rockingham Lake, light can reach up to 1.5 meter in the lake (Table 1.3), which is a favorable condition for submerged photosynthesis.

Flowers of waterlily appear from June to September. Each blossom opens in the morning and closes in the early afternoon for two to five consecutive days. The plant senesces in fall and over winters as the rhizome.

# 3. Roanoke Rapids Lake

## 3.1. General Background

Roanoke Rapids Lake, located on the Roanoke River immediately downstream from Lake Gaston, is owned by the Virginia Electric and Power Company. This reservoir is used as a water supply and for recreation. Maximum depth is 27 meter (89 feet), mean depth is five meter (16 feet), and volume is 96 x $10^6$ $m^3$. The Roanoke River is the major tributary to the reservoir and drains nearly all of its 21,482 $km^2$ (8,294 $mi^2$) watershed. Releases from Lake Gaston located directly upstream account for almost all of the inflow into Roanoke Rapids Lake (Figure 3.1). The watershed is characterized by rolling hills where nearly three-fourths is forested and most of the remaining land is agricultural (Figure 3.2).

Roanoke Rapids Lake is currently classified as WS-IV & B CA. Class WS-IV states that waters are used as sources of potable water where a WS-I, II or III classification is not feasible. These waters are also protected for Class C uses. WS-IV waters are generally in moderately to highly developed watersheds or Protected Areas, and involve no categorical restrictions on discharges. Class B states that waters are used for primary recreation and other uses suitable for Class C. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. There are no restrictions on watershed development or types of discharges. Class CA stands for critical area, which is the area adjacent to a water supply intake or reservoir where risk associated with pollution is greater than from the remaining portions of the watershed. The critical area is defined as extending either 1/2 mile from the normal pool elevation of the reservoir in which the intake is located or to the ridge line of the watershed (whichever comes first); or 1/2 mile upstream from and draining to the intake (or other appropriate downstream location associated with the water supply) located directly in the stream or river (run-of-the-river), or to the ridge line of the watershed (whichever comes first).

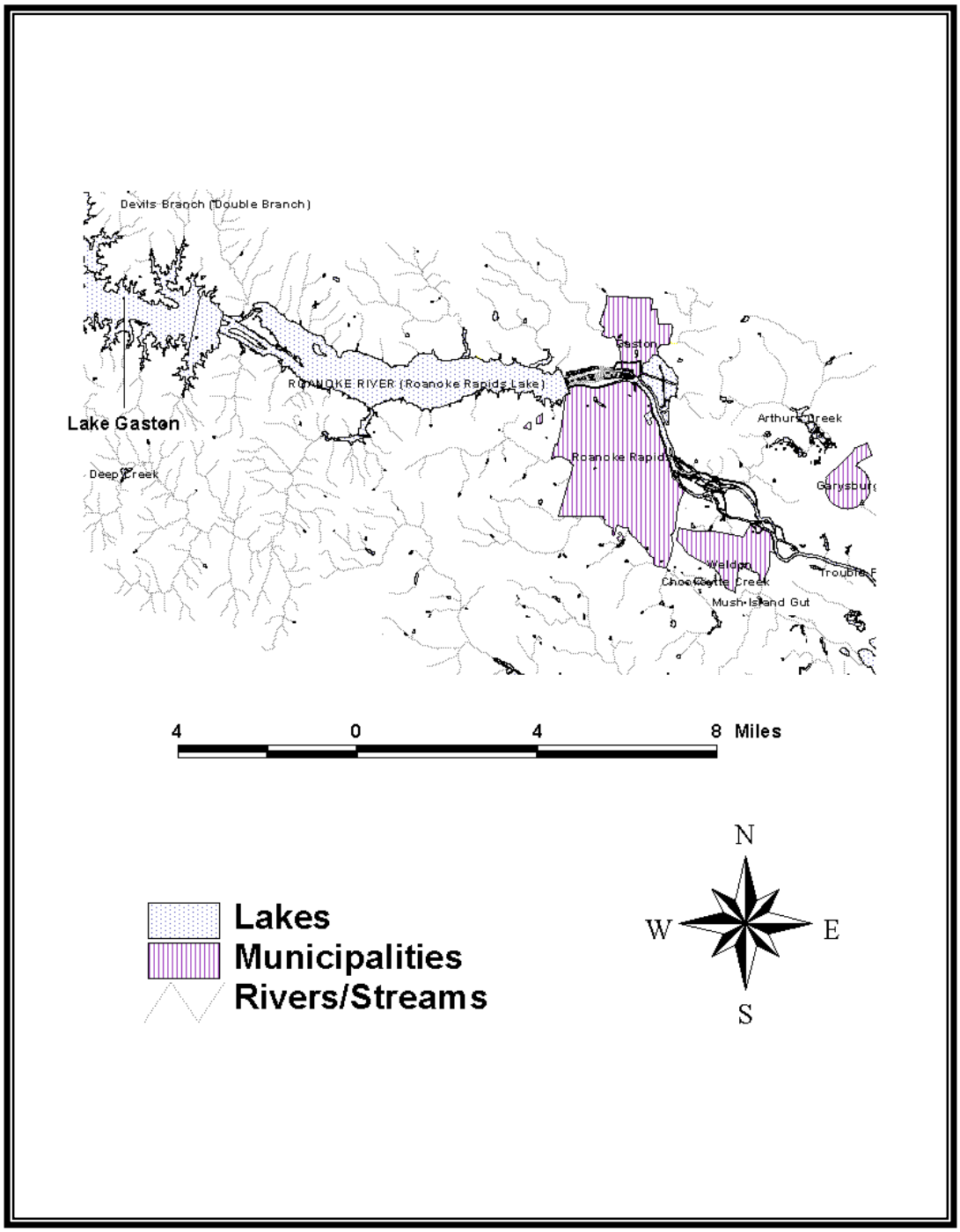


Figure 3.1. Location of the Roanoke Rapids Lake in the Roanoke River Basin.

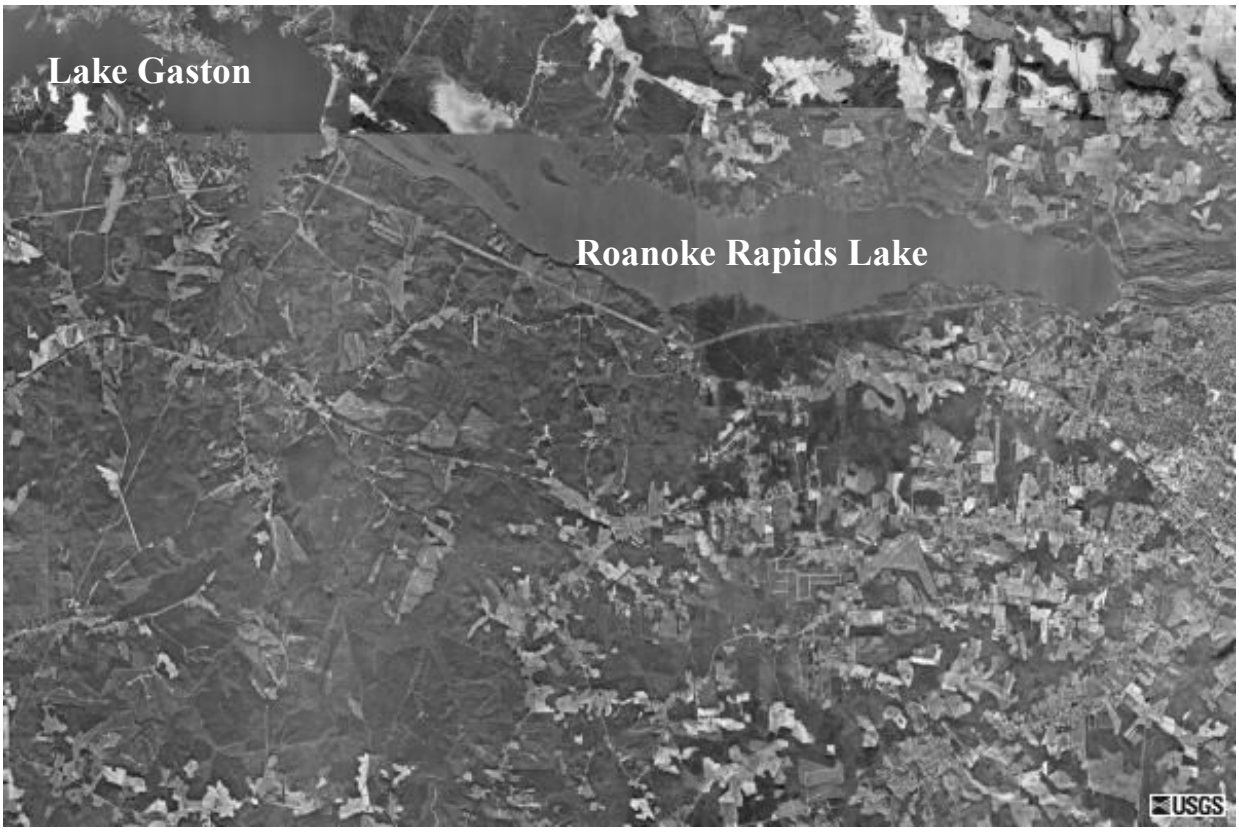


Figure 3.2. Aerial view of Roanoke Rapids Lake (USGS: February, 1994).

## 3.2. Aquatic Weed Problem

In 1994, aerial surveys conducted by North Carolina State University found the following composition of invasive aquatic weeds in Roanoke Rapids Lake: 90% *Myriophyllum spicatum*, 9% *Egeria densa*, and 1% *Hydrilla verticillata*. Nine years later, in August 2003, the DWR-Aquatic Weed Control program surveyed the lake to estimate the composition of invasive aquatic weeds. The program found water milfoil being dominated by hydrilla profoundly. The composition was 1% *Myriophyllum spicatum* and 99% *Hydrilla verticillata*.

All the identified aquatic weeds in Roanoke Rapids Lake were noxious to the North Carolina lakes (Appendix 12.2). Their physiological characteristics and control methods are well documented in http://www.ecy.wa.gov/programs/wq/plants/weeds/.

Hydrilla (*Hydrilla verticillata*): Hydrilla is the most competitive exotic aquatic weed identified in Roanoke Rapids Lake. The plant is a much- ranched perennial, submerged, rooted, vascular plant. It needs just a little light to grow.

Hydrilla adversely impacts aquatic ecosystems by forming dense canopies that often shade out native vegetation. Extensive monospecific stands of hydrilla can provide poor habitat for fish and other wildlife. Hydrilla mats provide good breeding grounds for mosquitoes. Hydrilla interferes with recreational activities such as swimming, boating, fishing and water skiing.

Eurasian watermilfoil (*Myriophyllum specatum*): Eurasian milfoil is a submerged, invasive, and non-native plant. It has feather-like underwater leaves and emergent floral spikes. Its stem sometimes emerges 2 to 4 inches above water; usually, the stem will have no leaves. The plant spreads rapidly, crowding out native species, clogging waterways, and blocking sunlight and oxygen from underlying waters.

Brazilian elodea (*Egeria densa*): Brazilian elodea is also a submerged, invasive, and non-native weed. The plant makes good aquarium plant and is commonly sold as in the United States and Canada. The plant can be a nuisance plant out of its native habitat. It is an underwater and sometimes floating perennial that can form tangled masses near the water surface. Dense masses interfere with recreational uses of a lake by interfering with navigation, fishing, swimming, and water skiing.

## 3.3. Control Strategies

The Aquatic Nuisance Plant Control Program in Halifax County manages Roanoke Rapids Lake. The program applied the herbicides, Copper and Diquat, to control the aquatic plants in the lake (from personal communication with the program manager Mr. Skip Wiegersma).

Effectiveness of herbicide application indeed varies with types of aquatic plants. There are three EPA-registered herbicides effective against hydrilla growth: Fluridone

(Sonar®), endothall (Aquathal®), and copper compounds. Fluridone is a systemic herbicide that has proven effective against hydrilla in Florida and other states. Endothall, a fast-acting contact herbicide, is used when immediate control of vegetation is needed. Copper compounds are often used in conjunction with endothall applications, although copper by itself exhibits herbicidal action against hydrilla. These herbicides do not affect hydrilla seeds, tubers, and turions and repeated applications are needed to control hydrilla regrowth.

Westerdahl and Getsinger (1988) report excellent control of Eurasian watermilfoil with 2,4-D, diquat, endothall dipotassium salt, and endothall and complexed copper. They report good control with fluridone. Westerdahl and Getsinger (1988) also report excellent control of Brazilian elodea with diquat and complexed copper, endothall dipotassium salt, and endothall and complexed copper. However, enodthall is considered by general knowledge of aquatic plant managers to be less than effective against Brazilian elodea. Good control was obtained with fluridone.

However, improper application of these herbicides can contaminate ground water and surface water. It is, therefore, important that only herbicides that are EPA approved for aquatic use are selected, and that applications strictly adhere to label specifications. It is also important that herbicides are applied only when following strategies fail to control the aquatic plants.

Drawdown can be an effective cultural method to control the aquatic weeds. The Tennessee Valley Authority (TVA) uses both winter and summer water level drawdown as an effective way of reducing Eurasian watermilfoil biomass. Poovey (1997) suggested that hydrilla in NC lakes could be managed by a short-term summer drawdown. Manning and Johnson (1975) reported that water level drawdown, in combination with 2,4-D treatment of Hydrilla on exposed substrates, plus diquat application to weed beds in areas still covered by water, formed an effective integrated approach to submerged weed control in a Louisiana reservoir. Goldsby and Sanders (1977) reported that

consecutive drawdowns in Black Lake, Louisiana eradicated Brazilian elodea. They noted that consecutive drawdowns might be more effective than an individual drawdown.

Localized control of the aquatic weeds (in swimming areas and around docks) can be achieved by covering the sediment with an opaque fabric which blocks light from the plants (bottom barriers or screens).

Manual harvesting can also be an effective method to control the aquatic plants in the lake. However, a major disadvantage of harvesting Hydrilla is that the underground material is left behind. The tubers of the plant are particularly troublesome, since they serve as a source of regrowth in areas where the hydrilla shoots have been controlled by chemical or mechanical methods.

Biological control of Hydrilla by means of grass carp (Ctenopharyngodon idella) is one of the most successful methods of controlling Hydrilla in NC lakes. Species like silver carp (*Hypophthalmichthys molitrix*) and big head carp (*Aristichthys nobilis*) that consume phyto- and zooplankton, and the polyphagous Tilapia species are sometimes used in combination with grass carp for weed control. Their role in aquaculture in combination with grass carp is found to be much more effective (Zweerde, 1990).

Like Hydrilla, Brazilian elodea is highly palatable to grass carp. The crap has been successfully employed as a management tool in Devils Lake, Oregon to control plant populations (http://www.ecy.wa.gov/programs/wq/plants/weeds/). In practice, grass carp often remove the entire native aquatic community; therefore grass carp should be used with great care.

However, grass carp prefers less to eat Eurasian watermilfoil, because the plant is not a highly palatable. In situations where Eurasian watermilfoil is the only aquatic weed species in a lake, grass carp may be a management solution.

Insects can be used to control Eurasian watermilfoil. The North American weevil, *Euhyrchiopsis lecontei* (Dietz), has been found associated with declining populations of Eurasian watermilfoil in northeastern North America. A researcher at the University of Washington is conducting an evaluation of whether the milfoil weevil will be a suitable control for Eurasian watermilfoil in Washington.

The plant pathogenic fungus *Mycoleptodiscus terrestris* has been shown to significantly reduce Eurasian water milfoil biomass in laboratory studies, but not in field settings. The US Army Corps of Engineers is continuing research on plant pathogens. Similarly, recent research in Brazil has identified a fungus (*Fusarium* sp.), which damaged Brazilian elodea in laboratory tests. This may have potential as a biological control agent for Brazilian elodea.

## 3.4. Control Level

Because the identified aquatic weeds in the lake are noxious and non-native to North Carolina (Table 1.1), these plants should be removed to the best extent possible. Complete removal is the ultimate goal, but may not be realized due to the limited sources and methods available to combat the weeds. Different control levels are described in details in Section 1.2.

## 3.5. Critical Condition

Growth patterns of hydrilla and Eurasian watermilfoil suggest summer as the critical period for Roanoke Rapids Lake. Light and temperature are the key environmental factors that enhance growth of plants through photosynthesis. In the Roanoke Rapid Lake, light could penetrate to a depth of 3.2 meters (Table 1.3). The defined zone covered approximately 64 % of the mean depth of the lake. Therefore, the lake provides a favorable condition for photosynthesis to occur. In addition, water temperature during summer remained $27^{O}$ C on average, the temperature at which hydrilla and Eurasian watermilfoil grow profusely (Spencer and Bowes, 1990).

Hydrilla is able to survive and spread readily due to its ability to produce structures called turions and tubers. Turions are compact "buds" produced along the leafy stems. They

break free of the parent plant and drift or settle to the bottom to start new plants. They are 1/4 inch long, dark green, and appear spiny. Tubers develop in the hydrosoil and form at the end of roots. They are small, potato-like, and are usually white or yellowish. Hydrilla produces an abundance of tubers and turions in the fall. Tubers may remain dormant for several years in the sediment. Hydrilla also makes tubers in the spring and will produce nondormant turions throughout the growing season.

In the spring, Eurasian watermilfoil begins to grow rapidly as water temperatures approach $15^{O}$ C. When the plant near the surface, shoots branch profusely, forming a dense canopy. Typically, plants flower upon reaching the surface (usually in mid to late July). After flowering, plant biomass declines as the result of the fragmentation of stems. Where flowering occurs early, plant biomass may increase again later in the growing season and a second flowering may occur. During fall, plants die back to the root crowns, which sprout again in the spring.

In contrast, Brazilian elodea behaves differently in its growth. The plant begins to deteriorate when the temperature reaches $30^{O}$ C (Spencer and Bowes, 1990). Its growth appears to be increased when water temperature declines to $10^{O}$ C. Therefore, the growth pattern of Brazilian elodea suggests winter as the critical period for Roanoke Rapids Lake.

# 4. Big Lake

## 4.1. General Background

Big Lake is located at Umstead State Park in Raleigh (northwestern Wake County), adjacent to the Raleigh-Durham International Airport. Sycamore Creek is impounded twice within the park, first forming Big Lake and then Sycamore Lake (Figure 4.1). Big Lake has a drainage basin of seven square miles (18 $km^2$). Land use in the watershed is primarily forest and agriculture; however, development has increased considerably over the past years (Figure 4.2). Big Lake has a maximum depth of five meters (16 feet), a mean depth of two meters (six and a half feet), a mean hydraulic retention time of 25 days and a volume of 0.05 $x10^6 m^3$. .

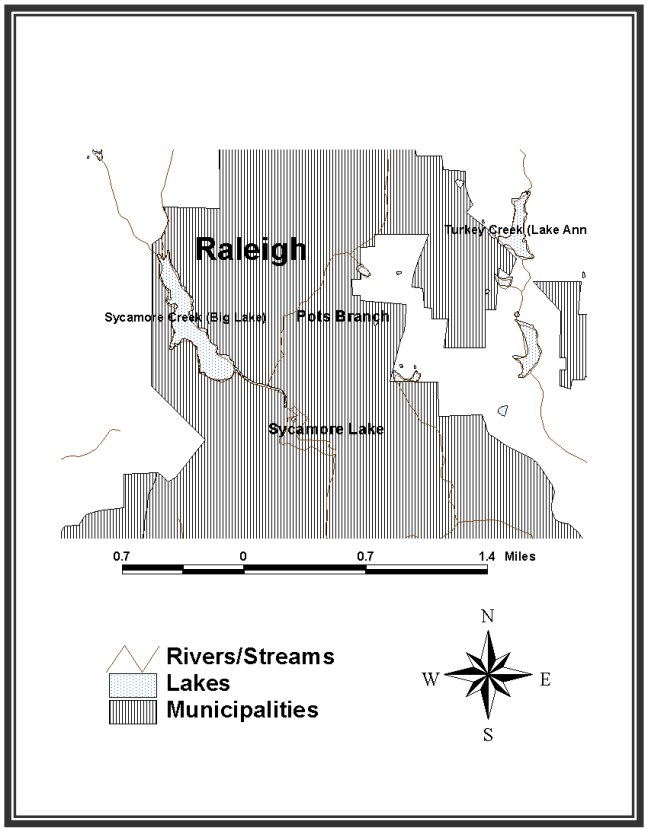


Figure 4.1 Location of Big Lake in Neuse River Basin

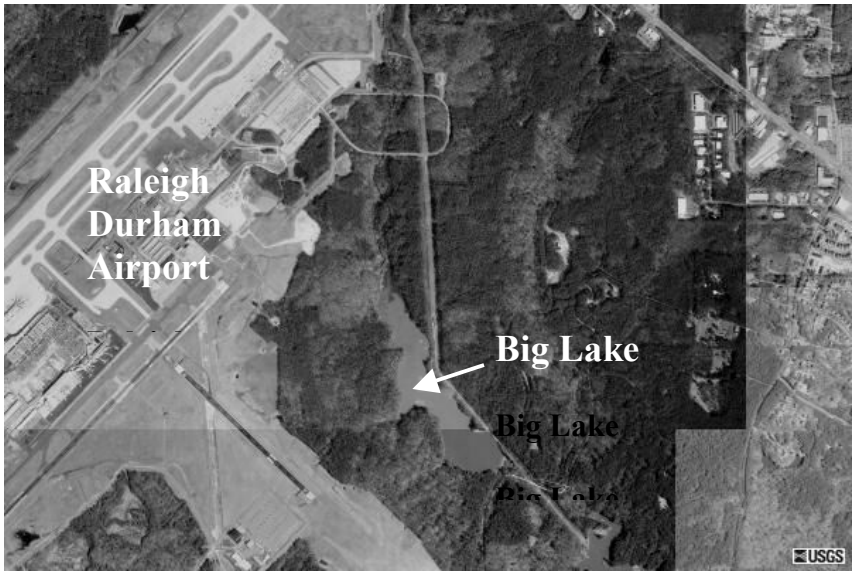


Figure 4.2. Aerial view of the Big Lake (USGS: March 29, 1998).

Big Lake is currently classified as B NSW. Class B states that water is used for primary recreation and other uses suitable for class C. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. The supplemental class NSW (Nutrient Sensitive Waters) states that water is needed for additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. This supplemental classification is associated with all waters in the Neuse River Basin. In general, management strategies for point and nonpoint source pollution control require limitation of nutrients such that excessive growths of vegetation are reduced or prevented and there is no increase in nutrients over target levels. There are no restrictions on watershed development or discharge types.

## 4.2. Aquatic Weed Problem

Staff of NC Division of Water Resources, noticed hydrilla covering 90 to 100% of the shoreline in Big Lake on July 18, 2000. Characteristics of the plant are described in detail in Section 3.2, above.

## 4.3. Control Strategies

The Umstead State Park in Wake County manages Big Lake. The park applied the herbicide Sonar to control Hydrilla. However, improper application of herbicides can contaminate ground water and surface water. It is, therefore, important that only herbicides that are EPA approved for aquatic use are selected, and that applications strictly adhere to label specifications. It is also important that herbicides are applied only when other possible strategies fail to control the aquatic plants. The possible strategies are discussed in detail in Section 3.3, above.

The park also releases grass carps every three to four years to control the plant. The total estimated grass carp released from April 1985 through April 1999 was about 2,700 (from personal communication with Mr. Rob Emens, Aqautic Weed Control, Division of Water Resources).

## 4.4. Control Level

Because the identified aquatic weeds in the lake are noxious and non-native to North Carolina (Appendix 12.2), these plants should be removed to the best extent possible. Complete removal is the ultimate goal, but may not be realized due to an extensive and persistent tuber bank that has developed over the last two decades. Different control levels are described in details in Section 1.2.

## 4.5. Critical Condition

Growth pattern of hydrilla suggests summer as the critical period for Big Lake. Light and temperature are the key environmental factors that enhance growth of the plant through photosynthesis. In Big Lake, light could penetrate up to 1.6 meter, on average (Table 1.3). The zone covered approximately 80 % of the mean depth of the lake. Furthermore, water temperature during summer remained $29^{O}$ C on average in Big Lake. Hydrilla grows profusely between 28 to $37^{O}$ C (Spencer and Bowes, 1990). Therefore, the lake provides a favorable condition for hydrilla during the summer period.

# 5. Reedy Creek Lake

## 5.1. General Background

Reedy Creek Lake is located in Umstead State Park, which is adjacent to the Raleigh Durham International Airport (Figure 5.1). The lake is relatively small with a surface area of 20 acres (eight hectares) and a volume of 0.14 x$10^6$$m^3$. The maximum and average depths are four meter (13 feet) and two meters (seven feet), respectively. The lake's watershed is approximately 11 $km^2$ (4 $mi^2$). Land use in the watershed is primarily forest and agriculture (Figure 5.2). Retention time for the lake is eleven days. Reedy Creek is one of three lakes (Big Lake, Reedy Creek and Sycamore) located within the park.

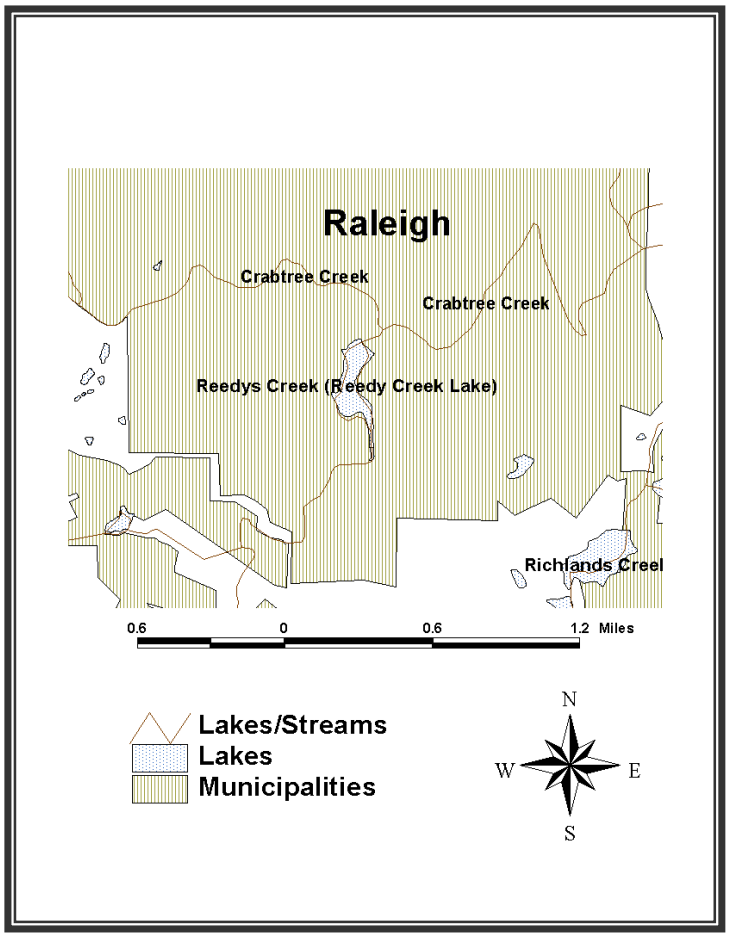


Figure 5.1 Location of Reedy Creek Lake in Neuse River Basin

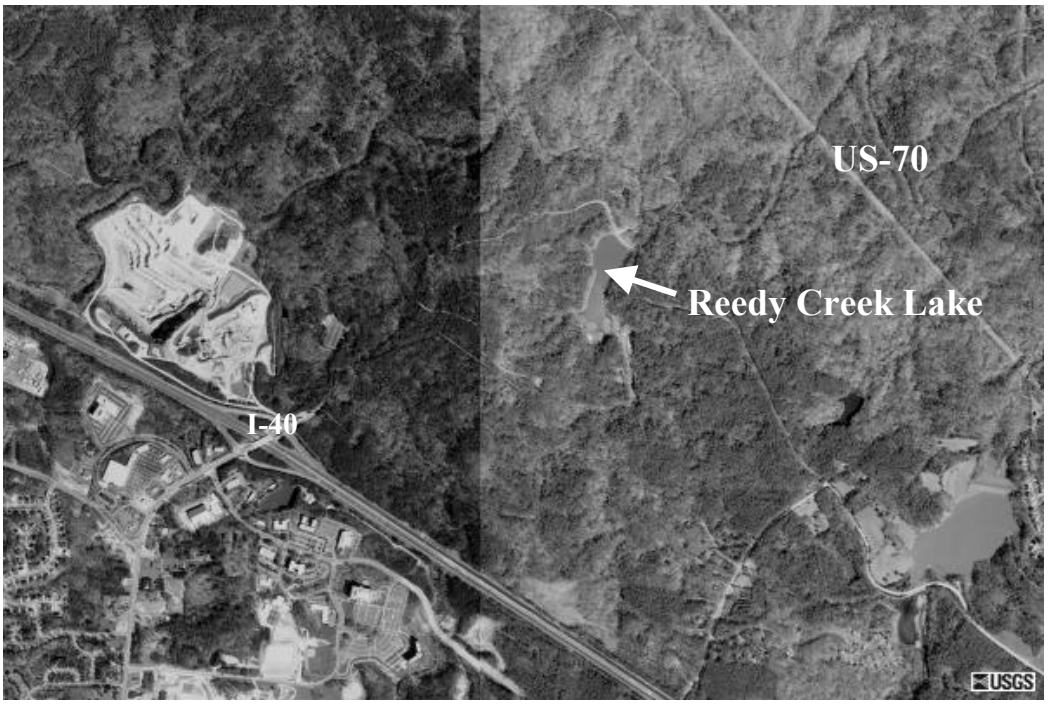


Figure 5.2. Aerial view of Reedy Creek Lake (USGS: March 29, 1998).

Reedy Creek Lake is classified as B NSW and is used primarily for educational and recreational purposes. Class B states that water is used for primary recreation and other uses suitable for Class C. Primary recreational activities include swimming, skin diving, water skiing, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. The supplemental class NSW (Nutrient Sensitive Waters) states that water is needed for additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. This supplemental classification is associated with all waters in the Neuse River Basin. In general, management strategies for point and nonpoint source pollution control require limitation of nutrients such that excessive growths of vegetation are reduced or prevented and there is no increase in nutrients over target levels.

## 5.2. Aquatic Weed Problem

Staff of NC Division of Water Resources identified the noxious aquatic weed, *Hydrilla verticillata*, in Reedy Creek Lake along the shoreline on July 14, 2000. Characteristics of the plant are described in Section 3.2, above.

## 5.3. Control Strategies

The Umstead State Park manages Reedy Creek Lake. The park applied herbicides like Diquat, Cutrine Plus, Aquathol, and Sonar to control Hydrilla. However, improper application of herbicides can contaminate ground water and surface water. It is, therefore, important that only herbicides that are EPA approved for aquatic use are selected, and that applications strictly adhere to label specifications. It is also important that herbicides are applied only when other possible strategies fail to control the aquatic plants. The possible strategies are discussed in detail in Section 3.3, above.

The park also releases grass carps every three to four years to control the plant. The total estimated grass carp released from September 1986 through April 1999 was about 1,650 (from personal communication with Mr. Rob Emens, Aqautic Weed Control, Division of Water Resources).

## 5.4. Control Level

Because the identified aquatic weeds in the lake are noxious and non-native to North Carolina (Table 1.1 and Appendix 1), these plants should be removed to the best extent possible. Complete removal is the ultimate goal, but may not be realized due to an extensive and persistent tuber bank that has developed over the last two decades. Different control levels are described in details in Section 1.2.

## 5.5. Critical Condition

Growth pattern of hydrilla suggests summer as the critical period for Reedy Creek Lake. Light and temperature are the key environmental factors that enhance growth of the plant through photosynthesis. In this lake, light will penetrate up to 2.3 meters (Table 1.3) promoting photosynthesis. Furthermore, water temperature during summer remained $29^{O}$ C on average in the Lake. Hydrilla grows profusely between 28 to $37^{O}$ C (Spencer and Bowes, 1990). Therefore, the lake provides a favorable condition for hydrilla to grow during the summer period.

# 6. Lake Wackena

## 6.1. General Background

Lake Wackena is a privately owned lake located near Goldsboro in Wayne County. The shoreline of the lake is comprised of a residential development (Walnut Creek Estates) and a golf course. The lake has a surface area of 165 acres (67 hectares) with a maximum depth of five meters and a mean depth of two meters. The lake's watershed is approximately 16 $mi^2$ (41.4 $km^2$), consisting mostly of forested and agricultural land.

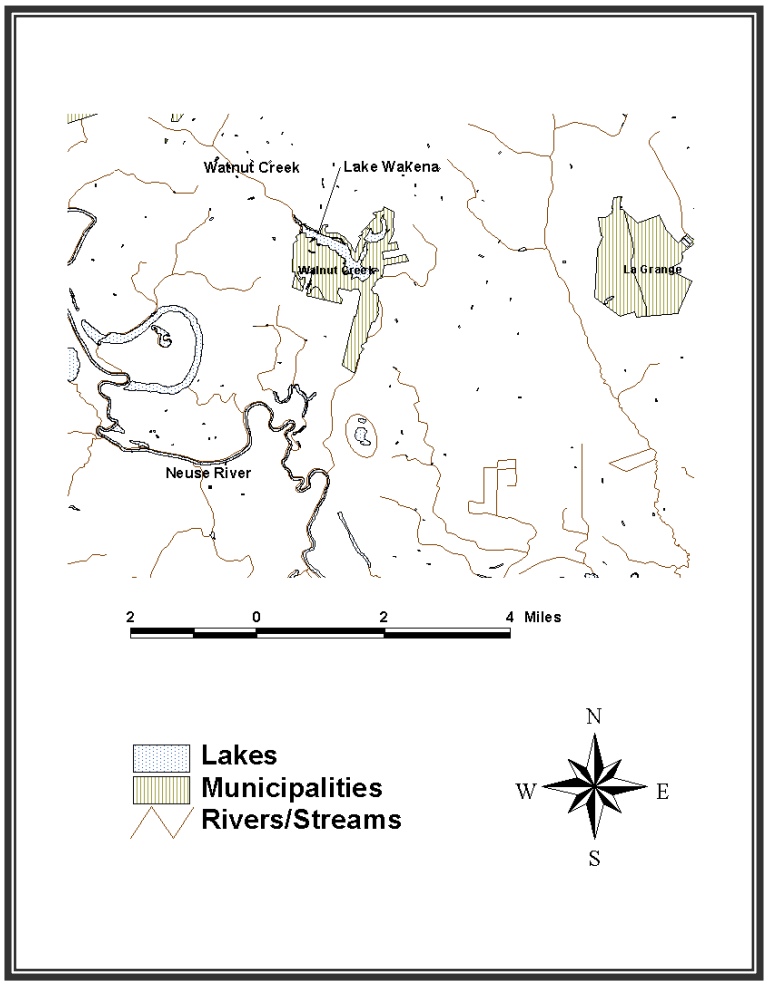


Figure 6.1 Location of Lake Wakena in Neuse River Basin

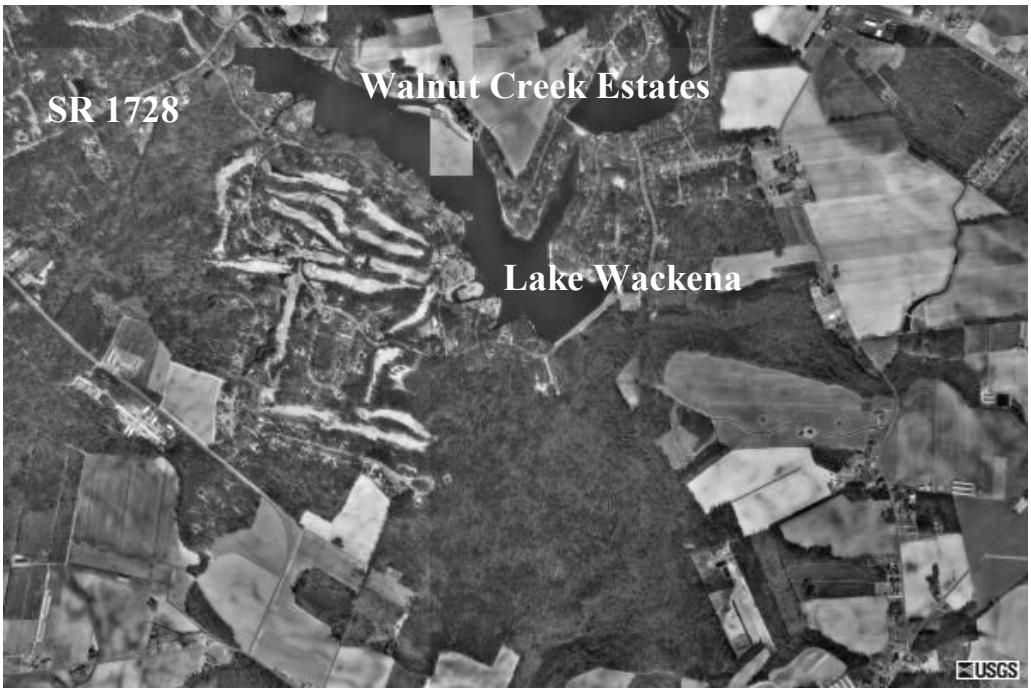


Figure 6.2. Aerial view of Lake Wackena (USGS: February 3, 1993).

Lake Wackena is currently classified as C-NSW and is used primarily for recreational purposes. Class C states that water is protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, agriculture and other uses suitable for Class C. Secondary recreation includes wading, boating, and other uses involving human body contact with water where such activities take place in an infrequent, unorganized or incidental manner. The supplemental Class NSW (Nutrient Sensitive Waters) states that water is needed for additional nutrient management due to it being subject to excessive growth of microscopic or macroscopic vegetation. This supplemental classification is associated with all waters in the Neuse River Basin. In general, management strategies for point and nonpoint source pollution control require limitation of nutrients such that excessive growths of vegetation are reduced or prevented and there is no increase in nutrients over target levels.

## 6.2. Aquatic Weed Problem

In 303(d) list, Lake Wackena is listed as an impaired waterbody due to aquatic weeds. However, neither field record indicated that the lake was impaired due to aquatic weeds,

nor the 303(d) list suggested any types of aquatic weeds existed in the lake. It is, therefore, recommended to delist Lake Wackena since there is no basis for any impairment decision.

# 7. Summary and Future Consideration

This report presents the development of Total Maximum Daily Loads (TMDLs) for the following five lakes in North Carolina: Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena. The first two lakes are located in Yadkin River Basin and Roanoke River Basin respectively. The last three lakes are located in Neuse River Basin. All the five lakes were identified impaired due to aquatic weeds in the 303(d) list.

Available field reports on the aquatic weed types in the five lakes are reviewed and TMDLs are determined to control the aquatic weeds. Growth and development of the aquatic weeds are examined to conclude the critical periods. The necessary reduction levels of the plants to meet the TMDL requirement was then qualitatively determined based on utility of the plants in the respective lakes. The summary of the results is as follows:

- Rockingham City Lake was identified impaired due to four different native and non-noxious aquatic weeds: *Eleocharis sp. Mayaca fluviatilis, Myriophyllum heterophyllum,* and *Nymphae odorata.* The species of *Eleocharis* protects lake shorelines and provides food for aquatic animals; therefore removal of this plant is not recommended. The remaining three native plants require partial control. Use of opaque fabric for bottom screens and manual harvesting can be used to control these plants.

- Roanoke Rapids Lake was identified impaired due to three exotic and noxious aquatic weeds: *Hydrilla verticillata, Myriophyllum spicatum,* and *Egeria densa*. These plants need to be removed 100% from the lake. Different cultural practices such as herbicide application, use of opaque fabric for bottom screens, and manual harvesting can be used successfully for the plants like *Hydrilla verticillata and Myriophyllum spicatum*. Biocontrol method should be considered as an alternative, or in conjunction with methods stated above. The stocking of sterile grass carp has successfully eradicated hydrilla from some lakes in NC.

- Big Lake was identified impaired due to *Hydrilla verticillata*. The identified species is an exotic and noxious aquatic weed. It needs to be removed 100% from the lake. Different cultural practices such as herbicide application, use of opaque fabric for bottom screens, and manual harvesting can be used successfully for the plants like *Hydrilla verticillata and Myriophyllum spicatum*. Biocontrol method (i.e. stocking grass carp) should be considered as an alternative, or in conjunction with methods stated above.

- Reedy Creek Lake was identified impaired due to the exotic and noxious aquatic weed *Hydrilla verticillata*. It needs to be removed 100% from the lake. Different cultural practices such as herbicide application, use of opaque fabric for bottom screens, and manual harvesting can be used successfully for the plants like *Hydrilla verticillata and Myriophyllum spicatum*. Biocontrol method (i.e. stocking grass carp) should be considered as an alternative, or in conjunction with methods stated above.

- Lake Wackena was identified impaired due to aquatic weeds in the 303(d) list, but no specific types of plants were recorded. There is no basis for any impairment decision. It is therefore recommended to delist the lake from the 303(d) list.

## 7.1. Lake Monitoring

Lake monitoring for aquatic weed identification should continue on a quarterly interval. While monitoring, the following additional information should be collected for evaluation of progress towards reaching water quality standards:

- Identify types of aquatic weeds.
- Draw map of aquatic weed locations in a lake, showing distribution.
- Estimation of relative abundance of weeds, % surface area.
- Growth and development of weeds.
- Collection of sample of weed species.
- Identification of substrate types.
- Identification of sediment types
- Identification of problem areas and beneficial weed zones.

## 7.2. Implementation Plan

Development of a successful implementation plan to control aquatic weeds is an ongoing concern that requires long-term commitment from multiple state, federal agencies, and public participation. The plan should focus on monitoring and determining efficacy of

control measures and allowing for modification as conditions change. Integration of control methods and best management practices should be implemented. The development of funding strategies and implementation of public outreach program for noxious and invasive weeds are necessary.

# 8. Public Participation

Many local government officials have been notified of DWQ's intention to develop the Aquatic Weeds TMDL for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena. The TMDL was publicly noticed through local newspapers, Richmond CO. Daily Journal, Daily Herald, The News and Observer, and Goldsboro News Argus on June 30, 2006 (Appendix 11.4). The TMDLs was also publicly noticed through DWQ web site at http://h20.enr.state.nc.us/tmdl/.

A public comment period was through August 7, 2006. No written comments were received.

# 9. Further Information

Technical questions regarding this report should be directed to the following members of the DWQ Modeling/TMDL Unit:
Narayan Rajbhandari, Environmental Modeler, (narayan.rajbhandari@ncmail.net), and Michelle Woolfolk, Supervisor (michelle.woolfolk@ncmail.net).

Further information concerning North Carolina's water quality program can be found on the Internet at the Division of Water Quality website**:** http://h2o.enr.state.nc.us/.

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# 11. Appendices

## 11.1. Physical parameters of lakes

| Lake Name | Date (m/d/yr) | Water Temp ( C ) | Secchi Depth (meters) | Lake Name | Date (m/d/yr) | Water Temp ( C ) | Secchi Depth (meters) |
|---|---|---|---|---|---|---|---|
| Pittsboro | 11-Aug-03 | 25.4 | 0.5 | Rockingham City | 17-Aug-00 | 26.8 | 0.7 |
| Pittsboro | 11-Aug-03 | 23.5 | 0.6 | Rockingham City | 8-Jun-00 | 25.5 | 0.7 |
| Pittsboro | 16-Jul-03 | 27.6 | 0.8 | Rockingham City | 24-Aug-95 | 28.6 | 0.5 |
| Pittsboro | 16-Jul-03 | 28.4 | 0.8 | Rockingham City | 19-Aug-92 | 23.7 | 1.1 |
| Pittsboro | 17-Jun-03 | 24.4 | 0.6 | Roanoke Rapids | 26-Aug-04 | 25.6 | 3.2 |
| Pittsboro | 17-Jun-03 | 24.5 | 0.6 | Roanoke Rapids | 26-Aug-04 | 27.2 | 2.1 |
| Pittsboro | 6-Aug-98 | 25.8 | 0.4 | Roanoke Rapids | 26-Aug-04 | 26.9 | 2.1 |
| Pittsboro | 6-Aug-98 | 25.6 | 0.4 | Roanoke Rapids | 29-Jul-04 | 25.9 | 2.6 |
| Pittsboro | 8-Jul-98 | 28.7 | 0.6 | Roanoke Rapids | 29-Jul-04 | 27.6 | 1.6 |
| Pittsboro | 8-Jul-98 | 29.1 | 0.4 | Roanoke Rapids | 29-Jul-04 | 28.2 | 2.1 |
| Pittsboro | 3-Jun-98 | 27.4 | 0.7 | Roanoke Rapids | 24-Jun-04 | 24.9 | 2.8 |
| Pittsboro | 29-Jul-93 | 33.4 | 0.4 | Roanoke Rapids | 24-Jun-04 | 26.2 | 2.2 |
| Pittsboro | 4-Aug-87 | 31.0 | 0.5 | Roanoke Rapids | 24-Jun-04 | 27.0 | 2.0 |
| Pittsboro | 4-Aug-87 | 31.0 | 0.9 | Roanoke Rapids | 5-Aug-99 | 27.2 | 1.7 |
| Pittsboro | 19-Aug-81 | 24.4 | 0.9 | Roanoke Rapids | 5-Aug-99 | 30.6 | 1.4 |
| Pittsboro | 19-Aug-81 | 24.3 | 0.9 | Roanoke Rapids | 5-Aug-99 | 30.8 | 1.8 |
| Big | 7-Aug-00 | 31.3 | 0.3 | Roanoke Rapids | 22-Jul-99 | 27.8 | 2.2 |
| Big | 7-Aug-00 | 30.4 | 0.3 | Roanoke Rapids | 22-Jul-99 | 30.0 | 2.2 |
| Big | 12-Jul-00 | 29.5 | 0.7 | Roanoke Rapids | 22-Jul-99 | 29.9 | 2.1 |
| Big | 12-Jul-00 | 29.7 | 1.3 | Roanoke Rapids | 2-Jun-99 | 23.3 | 2.0 |
| Big | 27-Jun-00 | 29.5 | 0.3 | Roanoke Rapids | 2-Jun-99 | 23.8 | 1.6 |
| Big | 27-Jun-00 | 29.4 | 1.0 | Roanoke Rapids | 2-Jun-99 | 24.1 | 1.5 |
| Big | 21-Aug-96 | 27.8 | 0.7 | Roanoke Rapids | 9-Aug-94 | 26.2 | 2.2 |
| Big | 21-Aug-96 | 27.7 | 0.7 | Roanoke Rapids | 9-Aug-94 | 26.8 | 1.7 |
| Big | 3-Jul-95 | 26.1 | 0.8 | Roanoke Rapids | 9-Aug-94 | 27.7 | 1.6 |
| Big | 3-Jul-95 | 25.9 | 0.8 | Roanoke Rapids | 30-Jul-87 | 25.6 | 1.4 |
| Big | 3-Jul-91 | 29.5 | 0.2 | Roanoke Rapids | 30-Jul-87 | 29.0 | 0.9 |
| Big | 3-Jul-91 | 29.7 | 0.6 | Roanoke Rapids | 30-Jul-87 | 29.4 | 1.5 |
| Big | 31-Jul-87 | 28.9 | 0.6 | Roanoke Rapids | 30-Jul-85 | 25.1 | 1.8 |
| Big | 31-Jul-87 | 29.2 | 0.6 | Roanoke Rapids | 30-Jul-85 | 25.0 | 1.6 |
| Big | 13-Aug-81 | 29.5 | -- | Roanoke Rapids | 30-Jul-85 | 25.6 | 2.6 |
| Big | 13-Aug-81 | 29.7 | 1.6 | Roanoke Rapids | 29-Aug-84 | 25.8 | 2.0 |
| Reedy Creek | 7-Aug-00 | 29.8 | 0.2 | Roanoke Rapids | 29-Aug-84 | 25.2 | 1.3 |
| Reedy Creek | 12-Jul-00 | 29.7 | 0.8 | Roanoke Rapids | 29-Aug-84 | 25.7 | 1.0 |
| Reedy Creek | 27-Jun-00 | 29.4 | 1.2 | Roanoke Rapids | 12-Jul-83 | 25.3 | 1.4 |
| Reedy Creek | 10-Aug-95 | 26.6 | 0.7 | Roanoke Rapids | 12-Jul-83 | 26.0 | 2.0 |
| Reedy Creek | 12-Aug-91 | 28.0 | 2.0 | Roanoke Rapids | 12-Jul-83 | 26.8 | 1.9 |
| Wackena | 25-Jul-95 | 33.0 | 0.5 | Roanoke Rapids | 16-Jul-82 | 24.5 | 0.9 |
| Wackena | 25-Jul-95 | 32.7 | 1.5 | Roanoke Rapids | 16-Jul-82 | 24.5 | 1.1 |
| Wackena | 14-Jul-88 | 30.2 | 0.6 | Roanoke Rapids | 16-Jul-82 | 25.9 | 1.4 |
| Wackena | 14-Jul-88 | 30.4 | 1.3 | Roanoke Rapids | 6-Aug-81 | 27.5 | 1.3 |
| | | | | Roanoke Rapids | 6-Aug-81 | 27.7 | 0.5 |

## 11.2. North Carolina Aquatic Weed Control Act of 1991

North Carolina Aquatic Weed Control Act of 1991

&

Aquatic Weed Control Regulations

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(Article 15 of Chapter 113A of the General Statutes of North Carolina)

§**113A-220. Short title.**
This Article shall be known as the Aquatic Weed Control Act of 1991.

**§113A-221. Definitions.**
Unless a different meaning is required by the context, the following definitions shall apply throughout this Article:
(1) "Department" means the Department of Environment, Health, and Natural Resources.
(2) "Secretary" means the Secretary of Environment, Health, and Natural Resources or his designee.
(3) "Noxious aquatic weed" means any plant organism so designated under this Article.
(4) "Waters of the State" means any surface body or accumulation of water, whether publicly or privately owned and whether naturally occurring or artificially created, which is contained within, flows through, or borders upon any part of this State.

**§113A-222. Designation of noxious aquatic weeds.**
(a) The Secretary, after consultation with the Director of the North Carolina Agricultural Extension Service, the Wildlife Resources Commission, and the Marine Fisheries Commission, and with the concurrence of the Commissioner of Agriculture, may designate as a noxious aquatic weed any plant organism which:

> (1) Grows in or is closely associated with the aquatic environment, whether floating, emersed, submersed, or ditch-bank species, and including terrestrial phases of any such plant organism;
> (2) Exhibits characteristics of obstructive nature and either massive productivity or choking density; and
> (3) Is or may become a threat to public health or safety or to existing or new beneficial uses of the waters of the State.

(b) A plant organism may be designated as being a noxious aquatic weed either throughout the State or within specified areas within the State.
(c) The Secretary shall designate a plant organism as a noxious aquatic weed by rules adopted pursuant to Chapter 150B of the General Statutes.
(d) The Secretary may modify or withdraw any designation of a plant organism as a noxious aquatic weed made previously under this section. Any modification or withdrawal of such designation shall be made following the procedures for designation set out in this section.

NC Aquatic Weed Control Act of 1991 continued:

**§113A-223. Powers and duties of the Secretary.**
(a) The Secretary shall direct the control, Control, and regulation of noxious aquatic weeds so as to protect and preserve human health, safety, and the beneficial uses of the waters of the State and to prevent injury to property and beneficial plant and animal life. The Secretary shall have the power to:

(1) Conduct research and planning related to the control of noxious aquatic weeds;
(2) Coordinate activities of all public bodies, authorities, agencies, and units of local government in the control and Control of noxious aquatic weeds;
(3) Delegate to any public body, authority, agency, or unit of local government any power or duty under this Article, except that the Secretary may not delegate the designation of noxious aquatic weeds;
(4) Accept donations, grants, and services from both public and private sources;
(5) Enter into contracts or agreements, including cost-sharing agreements, with public or private agencies for research and development of methods of control of noxious aquatic weeds or for the performance of noxious aquatic weed control activities;
(6) Construct, acquire, operate, and maintain facilities and equipment necessary for the control of noxious aquatic weeds; and
(7) Enter upon private property for purposes of conducting investigations and engaging in aquatic weed control activities.

(b) The Secretary may control, remove, or destroy any noxious aquatic weed located in the waters of the State or in areas adjacent to such waters wherever such weeds threaten to invade such waters. The Secretary may employ any appropriate control technology which is consistent with federal and State law, regulations, and rules. Control technologies may include, but are not limited to drawdown of waters, application of chemicals to shoreline and surface waters, mechanical controls, physical removal from transport mechanisms, quarantine of transport mechanisms, and biological controls. Any biological control technology may be implemented only after the environmental review provisions of the State Environmental Policy Act have been satisfied.
(c) In determining the appropriate strategies and technologies, the Secretary shall consider their relative short-term and long-term cost-efficiency and effectiveness, consistent with a margin of safety adequate to protect public health and the resources of the State.
(d) All activities carried out by the Secretary, his designees, and others authorized to perform any function under this Article shall be consistent with all applicable federal and State law, regulations, and rules.

**§113A-224. Powers of the Commissioner of Agriculture.**
(a) The Commissioner of Agriculture may regulate the importation, sale, use, culture, collection, transportation, and distribution of a noxious aquatic weed as a plant pest under Article 36 of Chapter 106 of the General Statutes.
(b) This Article shall not be construed to limit any power of the Commissioner of Agriculture, the Department of Agriculture, or the Board of Agriculture under any other provision of law.

**§113A-225. Responsibilities of other State agencies.**
All State agencies shall cooperate with the Secretary to assist in the implementation of this Article.

**§113A-226. Enforcement.**
(a) Any person who violates this Article or any rule adopted pursuant to this Article shall be guilty of a misdemeanor and, upon conviction, shall be fined not less than fifty dollars ($50.00) or more than one thousand dollars ($1000), or imprisoned for not less than 10 days nor more than 180 days, or both, for each offense.

NC Aquatic Weed Control Act of 1991 continued:

(b) Whenever there exists reasonable cause to believe that any person has violated this Article or

rules adopted pursuant to this Article, the Secretary may request the Attorney General to institute a civil action for injunctive relief to restrain the violation. The Attorney General may institute such action in the name of the State upon relation of the Department in the superior court of the county in which the violation occurred. Upon a determination by the court that the alleged violation of the provisions of this Article or of rules adopted pursuant to this Article has occurred or is threatened, the court shall grant the relief necessary to prevent or abate the violation or threatened violation. Neither the institution of the action, nor any of the proceedings thereon shall relieve any party to such proceedings from any penalty otherwise prescribed for violations of this Article.

**§113A-227. Adoption of rules.**
The Secretary may adopt rules necessary to implement the provisions of this Article pursuant to Chapter 150B of the General Statutes.

## AQUATIC WEED CONTROL REGULATIONS

(Title 15A, Chapter 2, Subchapter 2G

of the North Carolina Administrative Code)

SECTION .0600 - AQUATIC WEED CONTROL

**SECTION .0601 THE AQUATIC WEED CONTROL ACT**
The North Carolina Aquatic Weed Control Act of 1991 empowers the State of North Carolina to control, eradicate, and regulate plants designated as noxious aquatic weeds. The Aquatic Weed Control Act and the existing powers of the Commissioner of Agriculture prohibit importation, sale, use, culture, collection, transportation, and distribution of these plants in North Carolina. Permits for the movement of noxious aquatic weeds may be obtained from the Commissioner of Agriculture pursuant to 2 NCAC 48A .1705 and .1706, subject to the conditions stated therein.
*History Note: Statutory Authority G.S. 106-420; 113A-222; 113A-223; 113A-224; Eff. September 1, 1992.*

NC Aquatic Weed Control Act of 1991 continued:

**SECTION .0602 NOXIOUS AQUATIC WEED LIST**
The Secretary of the Department of Environment, Health, and Natural Resources has determined that the following aquatic plants exhibit characteristics which threaten or may threaten the health or safety of the people of North Carolina or beneficial uses of the waters of North Carolina:
(1) Aquatic Species Listed on the Federal Noxious Weed List.

| | |
|---|---|
| *Azolla pinnata* R. Brown | Pinnate mosquitofern |
| *Eichhornia azurea* (Sw.) Kunth | Anchored waterhyacinth |
| *Hydrilla verticillata* (L. f.) Royle | Hydrilla |
| *Hygrophila polysperma* (Roxb.) T. Anderson | Indian hygrophila |
| *Ipomoea aquatica* Forsk. | Swamp morningglory, water spinach |
| *Lagarosiphon major* (Ridley) Moss | African Elodea |
| *Limnophila sessiliflora* (Vahl) Blume | Limnophila |
| *Melaleuca quinquenervia* (Cav.) Blake | Melaleuca |
| *Monochoria hastata* (L.) Solms | Arrowleaved monochoria |
| *Monochoria vaginalis* (Burm. f.) Kunth | Monochoria |
| *Sagittaria sagittifolia L.* | Arrowhead |
| *Salvinia auriculata* Aubl. | Giant salvinia |
| *Salvinia biloba* Raddi | Giant salvinia |
| *Salvinia herzogii* de la Sota | Giant salvinia |
| *Salvinia molesta* Mitch. | Giant salvinia |
| *Sparganium erectum* L. | Branched burreed |
| *Stratiotes aloides* L. | Crab's-claw |

(2) Additional Noxious Aquatic Weeds.

| | |
|---|---|
| *Crassula helmsii* R. Brown | Swamp stonecrop |
| *Lagarosiphon* spp. (All species) | African elodea |
| *Salvinia* spp. (All except *S. rotundifolia*) | Water fern |
| *Trapa* spp. (All species) | Water Chestnut |
| *Ludwigia uruguayensis* (Camb.) Hara | Uruguay waterprimrose |
| *Lythrum salicaria* L. | Purple loosestrife |
| *Phragmites australis* (Cav.) Trin. ex Steud. | Common reed |
| *Alternanthera philoxeroides* (Mart.) Griseb | Alligatorweed |
| *Egeria densa* Planch. | Brazilian elodea |
| *Myriophyllum spicatum* L. | Eurasian watermilfoil |
| *Najas minor* All. | Brittleleaf naiad |

*History Note: Statutory Authority G.S. 113A-222; Eff. September 1, 1992.*

# 11.3. Lake Chemistry Data

## 1. Surface data:

| | | | Water | | | Secchi | |
|---|---|---|---|---|---|---|---|
| Lake Name | Date | DO | Temp | pH | Cond. | Depth | Percent |
| | m/d/yr | mg/L | C | s.u. | µmhos/cm | meters | SAT |
| BIG LAKE | 7-Aug-00 | 10.9 | 31.3 | 8.5 | 86 | 0.3 | 147.5% |
| BIG LAKE | 7-Aug-00 | 10.1 | 30.4 | 7.8 | 91 | 0.3 | 134.4% |
| BIG LAKE | 12-Jul-00 | 7.4 | 29.5 | 7.6 | 132 | 0.7 | 97.1% |
| BIG LAKE | 12-Jul-00 | 8.2 | 29.7 | 8.2 | 132 | 1.3 | 108.0% |
| BIG LAKE | 27-Jun-00 | 6.1 | 29.5 | 7.3 | 127 | 0.3 | 80.2% |
| BIG LAKE | 27-Jun-00 | 7.3 | 29.4 | 7.7 | 125 | 1.0 | 96.0% |
| BIG LAKE | 21-Aug-96 | 8.7 | 27.8 | 8.5 | 101 | 0.7 | 110.8% |
| BIG LAKE | 21-Aug-96 | 9.1 | 27.7 | 8.2 | 99 | 0.7 | 115.7% |
| BIG LAKE | 3-Jul-95 | 5.3 | 26.1 | 6.2 | 83 | 0.8 | 65.5% |
| BIG LAKE | 3-Jul-95 | 4.9 | 25.9 | 6.4 | 84 | 0.8 | 60.3% |
| BIG LAKE | 3-Jul-91 | 7.4 | 29.5 | 6.8 | 98 | 0.2 | 97.1% |
| BIG LAKE | 3-Jul-91 | 7.2 | 29.7 | 7.1 | 98 | 0.6 | 94.8% |
| BIG LAKE | 31-Jul-87 | 7.2 | 29.3 | 7.6 | 112 | 1.0 | 94.1% |
| BIG LAKE | 31-Jul-87 | 7.5 | 28.9 | 7.9 | 114 | 0.6 | 97.4% |
| BIG LAKE | 31-Jul-87 | 7.4 | 29.2 | 7.7 | 113 | 0.6 | 96.6% |
| BIG LAKE | 13-Aug-81 | 5.1 | 29.5 | 7.5 | 81 | | 66.9% |
| BIG LAKE | 13-Aug-81 | 5.3 | 29.7 | 7.2 | 79 | 1.6 | 69.8% |
| LAKE WACKENA | 25-Jul-95 | 8.5 | 33 | 6.3 | 98 | 0.5 | 118.4% |
| LAKE WACKENA | 25-Jul-95 | 9 | 32.7 | 8.2 | 95 | 1.5 | 124.7% |
| LAKE WACKENA | 14-Jul-88 | 7.6 | 30.2 | 7.1 | 87 | 0.6 | 100.9% |
| LAKE WACKENA | 14-Jul-88 | 8 | 30.4 | 7.2 | 88 | 1.3 | 106.6% |
| REEDY CREEK LAKE | 7-Aug-00 | 10.4 | 29.8 | 8.2 | 61 | 0.2 | 136.5% |
| REEDY CREEK LAKE | 12-Jul-00 | 7.3 | 29.7 | 7.4 | 119 | 0.8 | 96.1% |
| REEDY CREEK LAKE | 27-Jun-00 | 7.6 | 29.4 | 7.7 | 109 | 1.2 | 99.3% |
| REEDY CREEK LAKE | 10-Aug-95 | 7.3 | 26.6 | 6.6 | 70 | 0.7 | 91.0% |
| REEDY CREEK LAKE | 12-Aug-91 | 5.8 | 28 | 6.4 | 62 | 2.0 | 74.1% |

| Surface data Continued | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Water | | | Secchi | |
| Lake Name | Date | DO | Temp | pH | Cond. | Depth | Percent |
| | m/d/yr | mg/L | C | s.u. | µmhos/cm | meters | SAT |
| ROANOKE RAPIDS LAKE | 26-Aug-04 | 5.6 | 25.6 | 7.2 | 101 | 3.2 | 68.5% |
| ROANOKE RAPIDS LAKE | 26-Aug-04 | 7.9 | 27.2 | 7.6 | 100 | 2.1 | 99.5% |
| ROANOKE RAPIDS LAKE | 26-Aug-04 | 7.8 | 26.9 | 7.5 | 100 | 2.1 | 97.7% |
| ROANOKE RAPIDS LAKE | 29-Jul-04 | 4.4 | 25.9 | 7.3 | 106 | 2.6 | 54.1% |
| ROANOKE RAPIDS LAKE | 29-Jul-04 | 7.1 | 27.6 | 7.4 | 103 | 1.6 | 90.1% |
| ROANOKE RAPIDS LAKE | 29-Jul-04 | 8 | 28.2 | 7.7 | 103 | 2.1 | 102.6% |
| ROANOKE RAPIDS LAKE | 24-Jun-04 | 6.5 | 24.9 | 7.3 | 96 | 2.8 | 78.5% |
| ROANOKE RAPIDS LAKE | 24-Jun-04 | 8.3 | 26.2 | 7.7 | 96 | 2.2 | 102.7% |
| ROANOKE RAPIDS LAKE | 24-Jun-04 | 8.4 | 27 | 7.9 | 95 | 2.0 | 105.5% |
| ROANOKE RAPIDS LAKE | 5-Aug-99 | 6.4 | 27.2 | 6.9 | 114 | 1.7 | 80.6% |
| ROANOKE RAPIDS LAKE | 5-Aug-99 | 8.2 | 30.6 | 8 | 113 | 1.4 | 109.6% |
| ROANOKE RAPIDS LAKE | 5-Aug-99 | 7.9 | 30.8 | 7.8 | 113 | 1.8 | 106.0% |
| ROANOKE RAPIDS LAKE | 22-Jul-99 | 6.7 | 27.8 | 7.1 | 110 | 2.2 | 85.3% |
| ROANOKE RAPIDS LAKE | 22-Jul-99 | 8.4 | 30 | 7.8 | 109 | 2.2 | 111.2% |
| ROANOKE RAPIDS LAKE | 22-Jul-99 | 8.4 | 29.9 | 7.9 | 109 | 2.1 | 111.0% |
| ROANOKE RAPIDS LAKE | 2-Jun-99 | 8.4 | 23.3 | 8.4 | 108 | 2.0 | 98.5% |
| ROANOKE RAPIDS LAKE | 2-Jun-99 | 8.6 | 23.8 | 8.6 | 108 | 1.6 | 101.8% |
| ROANOKE RAPIDS LAKE | 2-Jun-99 | 9.1 | 24.1 | 9 | 109 | 1.5 | 108.3% |
| ROANOKE RAPIDS LAKE | 9-Aug-94 | 5.3 | 26.2 | 7 | 101 | 2.2 | 65.6% |
| ROANOKE RAPIDS LAKE | 9-Aug-94 | 7.5 | 26.8 | 7.1 | 98 | 1.7 | 93.8% |
| ROANOKE RAPIDS LAKE | 9-Aug-94 | 7.5 | 27.7 | 7.1 | 97 | 1.6 | 95.3% |
| ROANOKE RAPIDS LAKE | 30-Jul-87 | 3.8 | 25.6 | 6 | 103 | 1.4 | 46.5% |
| ROANOKE RAPIDS LAKE | 30-Jul-87 | 7.5 | 29 | 6.8 | 100 | 0.9 | 97.5% |
| ROANOKE RAPIDS LAKE | 30-Jul-87 | 8.1 | 29.4 | 7.1 | 102 | 1.5 | 106.1% |
| ROANOKE RAPIDS LAKE | 30-Jul-85 | 6.6 | 25.1 | 6.9 | 107 | 1.8 | 80.0% |
| ROANOKE RAPIDS LAKE | 30-Jul-85 | 7.8 | 25 | 6.3 | 108 | 1.6 | 94.4% |
| ROANOKE RAPIDS LAKE | 30-Jul-85 | 8.2 | 25.6 | 7.6 | 105 | 2.6 | 100.4% |
| ROANOKE RAPIDS LAKE | 29-Aug-84 | 5.2 | 25.8 | 6.3 | 99 | 2.0 | 63.9% |
| ROANOKE RAPIDS LAKE | 29-Aug-84 | 5.8 | 25.2 | 6.4 | 96 | 1.3 | 70.5% |
| ROANOKE RAPIDS LAKE | 29-Aug-84 | 7.4 | 25.7 | 6.5 | 97 | 1.0 | 90.7% |
| ROANOKE RAPIDS LAKE | 12-Jul-83 | 7.3 | 25.3 | 6.2 | 96 | 1.4 | 88.9% |
| ROANOKE RAPIDS LAKE | 12-Jul-83 | 7.8 | 26 | 6.6 | 97 | 2.0 | 96.2% |
| ROANOKE RAPIDS LAKE | 12-Jul-83 | 7.6 | 26.8 | 6.6 | 100 | 1.9 | 95.1% |
| ROANOKE RAPIDS LAKE | 16-Jul-82 | 4.7 | 24.5 | 6.2 | 142 | 0.9 | 56.4% |
| ROANOKE RAPIDS LAKE | 16-Jul-82 | 4.7 | 24.5 | 6.2 | 141 | 1.1 | 56.4% |
| ROANOKE RAPIDS LAKE | 16-Jul-82 | 7.1 | 25.9 | 7.2 | 135 | 1.4 | 87.4% |
| ROANOKE RAPIDS LAKE | 6-Aug-81 | 6.2 | 27.5 | 7.1 | 109 | 1.3 | 78.5% |
| ROANOKE RAPIDS LAKE | 6-Aug-81 | 8.3 | 27.7 | 7.7 | 112 | 0.5 | 105.5% |
| ROCKINGHAM CITY LAKE | 17-Aug-00 | 3.2 | 26.8 | 5.3 | 28 | 0.7 | 40.0% |
| ROCKINGHAM CITY LAKE | 8-Jun-00 | 3.9 | 25.5 | 5.7 | 27 | 0.7 | 47.6% |
| ROCKINGHAM CITY LAKE | 24-Aug-95 | 3 | 28.6 | 5.1 | 32 | 0.5 | 38.7% |
| ROCKINGHAM CITY LAKE | 19-Aug-92 | 2.6 | 23.7 | 4.1 | 21 | 1.1 | 30.7% |

## 2. Photoc Zone Data

| Lake Name | Date | TP | TN | TON | TIN | CHL a | T. Solids | TSS | Turbidity |
|---|---|---|---|---|---|---|---|---|---|
| | m/d/yr | mg/L | mg/L | mg/L | mg/L | µg/L | mg/L | mg/L | NTU |
| BIG LAKE | 7-Aug-00 | 0.08 | 0.77 | 0.50 | 0.27 | | 100 | 22 | 45 |
| BIG LAKE | 7-Aug-00 | 0.07 | 0.75 | 0.48 | 0.27 | | 100 | 15 | 40 |
| BIG LAKE | 12-Jul-00 | 0.05 | 0.41 | 0.39 | 0.02 | | 110 | 11 | 7.4 |
| BIG LAKE | 12-Jul-00 | 0.03 | 0.51 | 0.50 | 0.01 | | 100 | 20 | 3.9 |
| BIG LAKE | 27-Jun-00 | 0.03 | 0.91 | 0.87 | 0.04 | | 95 | 20 | 11 |
| BIG LAKE | 27-Jun-00 | <0.01 | 0.71 | 0.68 | 0.03 | | 70 | 12 | 2.9 |
| BIG LAKE | 21-Aug-96 | 0.01 | 0.41 | 0.40 | 0.01 | | 100 | 13 | |
| BIG LAKE | 21-Aug-96 | 0.03 | 0.51 | 0.49 | 0.02 | | 94 | 10 | 5.6 |
| BIG LAKE | 3-Jul-95 | 0.03 | 0.41 | 0.39 | 0.02 | 9 | 80 | 2 | 6.4 |
| BIG LAKE | 3-Jul-95 | 0.03 | 0.41 | 0.39 | 0.02 | 10 | 82 | 2 | 5 |
| BIG LAKE | 3-Jul-91 | 0.05 | 0.41 | 0.27 | 0.14 | 11 | 100 | 2 | 35 |
| BIG LAKE | 3-Jul-91 | 0.03 | 0.21 | 0.17 | 0.04 | 5 | 89 | <1.0 | 24 |
| BIG LAKE | 31-Jul-87 | 0.20 | 0.41 | 0.36 | 0.05 | 11 | | | |
| BIG LAKE | 31-Jul-87 | 0.30 | 0.41 | 0.38 | 0.03 | 11 | | | |
| BIG LAKE | 31-Jul-87 | 0.30 | 0.51 | 0.47 | 0.04 | 13 | | | |
| BIG LAKE | 13-Aug-81 | 0.03 | 0.51 | 0.50 | 0.01 | 11 | | | |
| BIG LAKE | 13-Aug-81 | 0.03 | 0.41 | 0.40 | 0.01 | 9 | | | |
| LAKE WACKENA | 25-Jul-95 | 0.18 | 0.61 | 0.55 | 0.06 | 11 | 150 | 22 | 6.6 |
| LAKE WACKENA | 25-Jul-95 | 0.02 | 0.41 | 0.35 | 0.06 | 4 | 110 | 4 | 1.8 |
| LAKE WACKENA | 14-Jul-88 | 0.13 | 0.72 | 0.67 | 0.05 | 27 | 83 | 9 | 4.6 |
| LAKE WACKENA | 14-Jul-88 | 0.05 | 0.51 | 0.48 | 0.03 | 18 | 83 | 8 | 3.8 |
| REEDY CREEK LAKE | 7-Aug-00 | 0.08 | 0.61 | 0.55 | 0.06 | | 150 | 18 | 50 |
| REEDY CREEK LAKE | 12-Jul-00 | 0.04 | 0.31 | 0.14 | 0.17 | | 99 | 11 | 5.3 |
| REEDY CREEK LAKE | 27-Jun-00 | 0.01 | 0.41 | 0.32 | 0.09 | | 76 | 2 | 2.7 |
| REEDY CREEK LAKE | 10-Aug-95 | 0.04 | 0.41 | 0.40 | 0.01 | 6 | 68 | 5 | 7.8 |
| REEDY CREEK LAKE | 12-Aug-91 | 0.05 | 0.42 | 0.34 | 0.08 | 6 | 83 | 20 | 13 |
| ROANOKE RAPIDS LAKE | 26-Aug-04 | 0.02 | 0.34 | 0.24 | 0.10 | 3 | 86 | <2.5 | 1.6 |
| ROANOKE RAPIDS LAKE | 26-Aug-04 | 0.02 | 0.29 | 0.26 | 0.03 | 6 | 78 | <2.5 | 2.2 |
| ROANOKE RAPIDS LAKE | 26-Aug-04 | 0.02 | 0.31 | 0.27 | 0.04 | 8 | 82 | 2.5 | 2.1 |
| ROANOKE RAPIDS LAKE | 29-Jul-04 | 0.02 | 0.36 | 0.23 | 0.13 | 3 | 80 | <2.5 | 1.3 |
| ROANOKE RAPIDS LAKE | 29-Jul-04 | 0.02 | 0.32 | 0.26 | 0.06 | 5 | 74 | <2.5 | 1.7 |
| ROANOKE RAPIDS LAKE | 29-Jul-04 | 0.02 | 0.30 | 0.25 | 0.05 | 7 | 72 | <2.5 | 1.8 |
| ROANOKE RAPIDS LAKE | 24-Jun-04 | 0.02 | 0.37 | 0.23 | 0.14 | 3 | 74 | <2.5 | 4 |
| ROANOKE RAPIDS LAKE | 24-Jun-04 | 0.02 | 0.36 | 0.25 | 0.11 | 4 | 74 | <2.5 | 3.1 |
| ROANOKE RAPIDS LAKE | 24-Jun-04 | 0.02 | 0.33 | 0.24 | 0.09 | 5 | 70 | <2.5 | 2.4 |
| ROANOKE RAPIDS LAKE | 5-Aug-99 | 0.01 | 0.31 | 0.30 | 0.01 | | 90 | 7 | 2.6 |
| ROANOKE RAPIDS LAKE | 5-Aug-99 | 0.01 | 0.41 | 0.40 | 0.01 | | 81 | 6 | 2.6 |
| ROANOKE RAPIDS LAKE | 5-Aug-99 | 0.01 | 0.21 | 0.20 | 0.01 | | 79 | 4 | 2.3 |
| ROANOKE RAPIDS LAKE | 22-Jul-99 | 0.01 | 0.35 | 0.26 | 0.09 | | 81 | 5 | 1.7 |
| ROANOKE RAPIDS LAKE | 22-Jul-99 | 0.01 | 0.22 | 0.16 | 0.06 | | 71 | 3 | 1.9 |
| ROANOKE RAPIDS LAKE | 22-Jul-99 | 0.01 | 0.21 | 0.16 | 0.05 | | 76 | 2 | 2.3 |
| ROANOKE RAPIDS LAKE | 2-Jun-99 | 0.01 | 0.30 | 0.20 | 0.11 | | 77 | 3 | 2.8 |
| ROANOKE RAPIDS LAKE | 2-Jun-99 | <0.01 | 0.31 | 0.20 | 0.12 | | 88 | 3 | 3 |

| Photoc Zone Data Continued | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lake Name | Date | TP | TN | TON | TIN | CHL a | T. Solids | TSS | Turbidity |
| | m/d/yr | mg/L | mg/L | mg/L | mg/L | µg/L | mg/L | mg/L | NTU |
| ROANOKE RAPIDS LAKE | 2-Jun-99 | 0.03 | 0.37 | 0.28 | 0.09 | | 85 | 2 | 3 |
| ROANOKE RAPIDS LAKE | 9-Aug-94 | 0.02 | 0.27 | 0.18 | 0.09 | 1 | 79 | 3 | 1.7 |
| ROANOKE RAPIDS LAKE | 9-Aug-94 | 0.02 | 0.24 | 0.19 | 0.05 | 2 | 96 | 4 | 2.4 |
| ROANOKE RAPIDS LAKE | 9-Aug-94 | 0.02 | 0.24 | 0.18 | 0.06 | 2 | 88 | 3 | 2.2 |
| ROANOKE RAPIDS LAKE | 30-Jul-87 | 0.02 | 0.38 | 0.27 | 0.11 | 7 | 68 | 2 | 3.1 |
| ROANOKE RAPIDS LAKE | 30-Jul-87 | 0.02 | 0.31 | 0.29 | 0.02 | 13 | 76 | 4 | 4.3 |
| ROANOKE RAPIDS LAKE | 30-Jul-87 | 0.02 | 0.32 | 0.29 | 0.03 | 13 | 62 | 2 | 3 |
| ROANOKE RAPIDS LAKE | 30-Jul-85 | 0.01 | 0.36 | 0.27 | 0.09 | 1 | 110 | 2 | 2.3 |
| ROANOKE RAPIDS LAKE | 30-Jul-85 | 0.01 | 0.23 | 0.19 | 0.04 | 5 | 130 | 6 | 1.6 |
| ROANOKE RAPIDS LAKE | 30-Jul-85 | 0.43 | 0.31 | 0.05 | 0.26 | 4 | 110 | 3 | 1.1 |
| ROANOKE RAPIDS LAKE | 29-Aug-84 | 0.01 | 0.32 | 0.19 | 0.13 | 4 | 65 | 4 | 2 |
| ROANOKE RAPIDS LAKE | 29-Aug-84 | 0.02 | 0.42 | 0.29 | 0.13 | 6 | 67 | 4 | 2.9 |
| ROANOKE RAPIDS LAKE | 29-Aug-84 | 0.02 | 0.35 | 0.18 | 0.17 | 1 | 78 | 3 | 3.6 |
| ROANOKE RAPIDS LAKE | 12-Jul-83 | 0.03 | 0.25 | 0.19 | 0.06 | 3 | 75 | 6 | 2.8 |
| ROANOKE RAPIDS LAKE | 12-Jul-83 | 0.03 | 0.21 | 0.18 | 0.03 | 3 | 75 | 1 | 2.3 |
| ROANOKE RAPIDS LAKE | 12-Jul-83 | 0.02 | 0.31 | 0.29 | 0.02 | 6 | 80 | 3 | 2.3 |
| ROANOKE RAPIDS LAKE | 16-Jul-82 | 0.03 | 1.58 | 0.23 | 1.35 | 7 | 133 | 11 | |
| ROANOKE RAPIDS LAKE | 16-Jul-82 | 0.03 | 1.24 | 0.37 | 0.87 | 13 | 118 | 6 | |
| ROANOKE RAPIDS LAKE | 16-Jul-82 | 0.03 | 3.00 | 0.40 | 2.60 | 13 | 134 | 9 | |
| ROANOKE RAPIDS LAKE | 6-Aug-81 | 0.02 | 0.31 | 0.29 | 0.02 | | | | |
| ROANOKE RAPIDS LAKE | 6-Aug-81 | 0.04 | 0.41 | 0.38 | 0.03 | 17 | | | |
| ROCKINGHAM CITY LAKE | 17-Aug-00 | 0.03 | 0.51 | 0.39 | 0.12 | | 65 | 10 | 2 |
| ROCKINGHAM CITY LAKE | 8-Jun-00 | 0.02 | 0.31 | 0.17 | 0.14 | | 46 | 7 | 2.5 |
| ROCKINGHAM CITY LAKE | 24-Aug-95 | 0.03 | 0.51 | 0.47 | 0.04 | 8 | 48 | 4 | 2.3 |
| ROCKINGHAM CITY LAKE | 19-Aug-92 | 0.02 | 0.41 | 0.36 | 0.05 | 1 | 55 | 2 | 3.6 |

## 3. Bottom Data

| Lake Name | Region/Type | Date | Sampling | TP | NH3 | TKN | NOx | TON |
|---|---|---|---|---|---|---|---|---|
| | | m/d/yr | Station | mg/L | mg/L | mg/L | mg/L | mg/L |
| BIG LAKE | PIEDMONT | 7-Aug-00 | NEU035G | | | | | |
| BIG LAKE | PIEDMONT | 7-Aug-00 | NEU035H | 0.10 | 0.87 | 2 | 0.07 | 1.13 |
| BIG LAKE | PIEDMONT | 12-Jul-00 | NEU035G | | | | | |
| BIG LAKE | PIEDMONT | 12-Jul-00 | NEU035H | | | | | |
| BIG LAKE | PIEDMONT | 27-Jun-00 | NEU035G | | | | | |
| BIG LAKE | PIEDMONT | 27-Jun-00 | NEU035H | 0.03 | 0.19 | 0.5 | <0.01 | 0.31 |
| BIG LAKE | PIEDMONT | 21-Aug-96 | NEU035G | | | | | |
| BIG LAKE | PIEDMONT | 21-Aug-96 | NEU035H | 0.06 | 0.13 | 0.8 | 0.03 | 0.67 |
| BIG LAKE | PIEDMONT | 3-Jul-95 | NEU035G | 0.03 | 0.02 | 0.4 | <0.01 | 0.38 |
| BIG LAKE | PIEDMONT | 3-Jul-95 | NEU035H | 0.03 | 0.10 | 0.5 | <0.01 | 0.40 |
| BIG LAKE | PIEDMONT | 3-Jul-91 | NEU035G | 0.21 | 0.06 | 0.5 | 0.16 | 0.44 |
| BIG LAKE | PIEDMONT | 3-Jul-91 | NEU035H | 0.14 | 0.60 | 0.9 | 0.01 | 0.30 |
| BIG LAKE | PIEDMONT | 31-Jul-87 | BL3 | | | | | |
| BIG LAKE | PIEDMONT | 31-Jul-87 | NEU035G | | | | | |
| BIG LAKE | PIEDMONT | 31-Jul-87 | NEU035H | | | | | |
| BIG LAKE | PIEDMONT | 13-Aug-81 | NEU035G | | | | | |
| BIG LAKE | PIEDMONT | 13-Aug-81 | NEU035H | | | | | |
| LAKE WACKENA | PIEDMONT | 25-Jul-95 | NEU0714A | | | | | |
| LAKE WACKENA | PIEDMONT | 25-Jul-95 | NEU0717A | 0.06 | 0.15 | 0.6 | <0.01 | 0.45 |
| LAKE WACKENA | PIEDMONT | 14-Jul-88 | NEU0714A | | | | | |
| LAKE WACKENA | PIEDMONT | 14-Jul-88 | NEU0717A | 0.05 | 0.03 | 0.6 | <0.01 | 0.57 |
| REEDY CREEK LAKE | PIEDMONT | 7-Aug-00 | NEU035A7 | | | | | |
| REEDY CREEK LAKE | PIEDMONT | 12-Jul-00 | NEU035A7 | | | | | |
| REEDY CREEK LAKE | PIEDMONT | 27-Jun-00 | NEU035A7 | 0.02 | 0.40 | 0.6 | <0.01 | 0.20 |
| REEDY CREEK LAKE | PIEDMONT | 10-Aug-95 | NEU035A7 | 0.04 | 0.02 | 0.4 | <0.01 | 0.38 |
| REEDY CREEK LAKE | PIEDMONT | 12-Aug-91 | NEU035A7 | 0.04 | 0.04 | 0.4 | 0.02 | 0.36 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 26-Aug-04 | ROA039C | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 26-Aug-04 | ROA039D | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 26-Aug-04 | ROA039E | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 29-Jul-04 | ROA039C | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 29-Jul-04 | ROA039D | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 29-Jul-04 | ROA039E | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 24-Jun-04 | ROA039C | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 24-Jun-04 | ROA039D | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 24-Jun-04 | ROA039E | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 5-Aug-99 | ROA039C | <0.01 | 0.01 | 0.2 | <0.01 | 0.20 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 5-Aug-99 | ROA039D | 0.01 | 0.01 | 0.3 | <0.01 | 0.30 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 5-Aug-99 | ROA039E | 0.01 | 0.01 | 0.3 | 0.01 | 0.30 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 22-Jul-99 | ROA039C | 0.01 | 0.08 | 0.2 | 0.06 | 0.12 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 22-Jul-99 | ROA039D | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 22-Jul-99 | ROA039E | 0.02 | 0.22 | 0.4 | 0.05 | 0.18 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 2-Jun-99 | ROA039C | 0.01 | 0.01 | 0.1 | 0.11 | 0.10 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 2-Jun-99 | ROA039D | <0.01 | 0.04 | 0.1 | 0.09 | 0.06 |

| Bottom Data Continued | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Lake Name | Region/Type | Date | Sampling | TP | NH3 | TKN | NOx | TON |
| | | m/d/yr | Station | mg/L | mg/L | mg/L | mg/L | mg/L |
| ROANOKE RAPIDS LAKE | PIEDMONT | 2-Jun-99 | ROA039E | 0.04 | 0.04 | 0.2 | 0.11 | 0.16 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 9-Aug-94 | ROA039C | 0.02 | 0.01 | 0.2 | 0.08 | 0.20 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 9-Aug-94 | ROA039D | 0.02 | 0.01 | 0.2 | 0.03 | 0.19 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 9-Aug-94 | ROA039E | 0.02 | 0.17 | 0.3 | 0.03 | 0.13 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 30-Jul-87 | ROA039C | 0.02 | 0.04 | 0.3 | 0.08 | 0.26 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 30-Jul-87 | ROA039D | 0.03 | 0.08 | 0.3 | 0.08 | 0.22 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 30-Jul-87 | ROA039E | 0.02 | 0.06 | 0.3 | 0.08 | 0.24 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 30-Jul-85 | ROA039C | 0.02 | 0.07 | 0.3 | 0.07 | 0.23 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 30-Jul-85 | ROA039D | 0.02 | 0.02 | 0.3 | 0.04 | 0.28 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 30-Jul-85 | ROA039E | 0.04 | 0.47 | 0.7 | <0.01 | 0.23 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 29-Aug-84 | ROA039C | 0.02 | 0.01 | 0.2 | 0.12 | 0.19 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 29-Aug-84 | ROA039D | 0.02 | 0.01 | 0.2 | 0.12 | 0.19 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 29-Aug-84 | ROA039E | 0.02 | 0.01 | 0.2 | 0.09 | 0.19 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 12-Jul-83 | ROA039C | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 12-Jul-83 | ROA039D | 0.04 | 0.05 | 0.2 | 0.08 | 0.15 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 12-Jul-83 | ROA039E | 0.05 | 0.13 | 0.4 | 0.2 | 0.27 |
| ROANOKE RAPIDS LAKE | PIEDMONT | 16-Jul-82 | ROA039C | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 16-Jul-82 | ROA039D | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 16-Jul-82 | ROA039E | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 6-Aug-81 | ROA039C | | | | | |
| ROANOKE RAPIDS LAKE | PIEDMONT | 6-Aug-81 | ROA039E | | | | | |
| ROCKINGHAM CITY LAKE | SANDHILLS | 17-Aug-00 | YAD265C | | | | | |
| ROCKINGHAM CITY LAKE | SANDHILLS | 8-Jun-00 | YAD265C | | | | | |
| ROCKINGHAM CITY LAKE | SANDHILLS | 24-Aug-95 | YAD265C | 0.06 | 0.56 | 1.3 | <0.01 | 0.74 |
| ROCKINGHAM CITY LAKE | SANDHILLS | 19-Aug-92 | YAD265C | | | | | |

# 11.4. Public Notice of draft Aquatic Weed TMDL for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena.

## AFFIDAVIT OF PUBLICATION

NORTH CAROLINA.
Wake County. ) Ss.

**Public Notice**
**State of North Carolina**
**Division of Water Quality**

Availability of the Total Maximum Daily Load for Aquatic Weeds for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena in North Carolina.

You are requested to review the TMDL and mail your comments to NC DWQ-Planning Branch, attn: Ms. Linda Chavis, 1617 Mail Service Center, Raleigh, NC 27699-1617. Copies of the TMDL may be obtained by calling Ms. Linda Chavis at (919)733-5083, ext. 558 or on the internet at http://h2o.enr.state.nc.us/tmdl/. Written comments regarding the TMDL will be accepted until August 7, 2006.

N&O: June 30, 2006

Before the undersigned, a Notary Public of Chatham County North Carolina, duly commissioned and authorized to administer oaths, affirmations, etc., personally appeared Deborah McCullers, who, being duly sworn or affirmed, according to law, doth depose and say that she is Billing Manager-Legal Advertising of The News and Observer a corporation organized and doing business under the Laws of the State of North Carolina, and publishing a newspaper known as The News and Observer, in the City of Raleigh , Wake County and State aforesaid, the said newspaper in which such notice, paper, document, or legal advertisement was published was, at the time of each and every such publication, a newspaper meeting all of the requirements and qualifications of Section 1-597 of the General Statutes of North Carolina and was a qualified newspaper within the meaning of Section 1-597 of the General Statutes of North Carolina, and that as such she makes this affidavit; that she is familiar with the books, files and business of said corporation and by reference to the files of said publication the attached advertisement for NC DIVISION OF WATER QUALITY was inserted in the aforesaid newspaper on dates as follows: 06/30/06

Account Number: 73350831

The above is correctly copied from the books and files of the aforesaid Corporation and publication

Deborah McCullers

Deborah McCullers, Billing Manager-Legal Advertising
Wake County, North Carolina

Janet Scroggs Notary Public Chatham County, NC

Sworn or affirmed to, and subscribed before me, this 03 day of JULY , 2006 AD, by Deborah McCullers.

In Testimony Whereof, I have hereunto set my hand and affixed my official seal, the day and year aforesaid.

Janet Scroggs

Janet Scroggs, Notary Public

My commission expires 14th of March 2009

DENR - WATER QUALITY Wetlands & Stormwater Branch JUL 12 2006

**PUBLIC NOTICE**
**STATE of NORTH CAROLINA**
**DIVISION of WATER QUALITY**

Availability of the Total Maximum Daily Load for Aquatic Weeds for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek, and Lake Wackena in North Carolina.

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June 30, 2006

08/14/2006 11:33 FAX 19109974321 RICHMOND CO DAILY JOURNA

**PUBLIC NOTI E**
**STATE OF NORTH C JRO_INA**
**DIVISION OF WATER 2U:LITY**

Availability of the Total M ximum Daily Load for Aquatic Wee ls for Rockingham City Lake, Roa oke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena in Nc th Carolina.

You are requested to review the TMDL and mail your com nents to NC DWQ-Planning Branch, a t: Ms.Linda Chavis, 1617 Mail Se ice Center, Raleigh, NC 27699-161 . Copies of the TMDL may be obtai ed by calling Ms. Linda Chavis at (91 ) 733-5083, ext. 558 or on the interne at http://h2o.enr.state.nc.us mdl/. Written comments re arding the TMDL will be accepted unti August 7,2006.

June29,2006

ROCKIN HAM NEWSPAPERS, LLC
DBA Ric mond County Daily Journal
105 E. W shington Street
PO Box 838
Rockingl am, NC 28380

KEEP THIS AFFIDAVIT OF PUBLICATION with the [illegible]

NORTH CAROLINA
WAYNE COUNTY.

**AFFIDAVIT OF PUBLICATION**

Before the undersigned, a Notary Public of said County and State, duly commissioned, qualified, and authorized by law to administer oaths,

personally appeared Teresa Bozeman

who being first duly sworn, deposes and says: that he (she) is

Legal Clerk

(Publisher, or other officer or employee authorized to make affidavit) of WAYNE PRINTING COMPANY, INC., engaged in the publication of a newspaper known as GOLDSBORO NEWS-ARGUS, published, issued, and entered as second class mail in the city of Goldsboro in said County and State; that he (she) is authorized to make this affidavit and sworn statement; that the notice or other legal advertisement, a true copy of which is attached hereto, was published in GOLDSBORO NEWS-ARGUS on the following dates:

June 30, 2006

and that the said newspaper in which such notice, paper, document, or legal advertisement was published was, at the time of each, and every such publication, a newspaper meeting all of the requirements and qualifications of Section 1-597 of the General Statutes of North Carolina and was a qualified newspaper within the meaning of Section 1-597 of the General Statutes of North Carolina.

This 14 day of August, 20 06

Teresa Bozeman
(Signature of person making affidavit)

Sworn to and subscribed before me, this 14th day of August, 2006.

Notary Public

My Commission expires April 24, 2007

**CLIPPING OF LEGAL ADVERTISEMENT ATTACHED HERE**

[redacted]

STATE OF NORTH CAROLINA
DIVISION OF WATER QUALITY

Availability of the Total Maximum Daily Load for Aquatic Weeds for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena in North Carolina.

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Legal #568
June 30, 2006

08/14/06 16:40 FAX 919 739 7773 NEWS ARGUS ACCT.

## 11.5. The US EPA's Approval Letter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

SEP 25 2006

Mr. Alan W. Klimek, P.E., Director
Division of Water Quality
North Carolina Department of Environment and
Natural Resources
1617 Mail Service Center
512 N. Salisbury Street
Raleigh, NC 27699-1617

Dear Mr. Klimek:

The United States Environmental Protection Agency (EPA) has concluded a review of the "TMDL for Aquatic Weeds for Rockingham City Lake, Roanoke Rapids Lake, Big Lake, Reedy Creek Lake, and Lake Wackena in North Carolina" in Yadkin-Pee Dee River Basin, Roanoke River Basin, and Neuse River Basin as submitted by letter on August 14, 2006, by the North Carolina Department of Environment and Natural Resources (NCDENR). Based upon our review, we have determined that the statutory requirements of the Clean Water Act (CWA), Section 303(d) have been met and hereby approve the aquatic weed TMDLs for the impaired lakes listed above.

The enclosed Decision Document summarizes the elements of the review which were found to support EPA's approval of the TMDL. If you have any comments or questions relating to the approval of this TMDL or the enclosed Decision Document, please contact Bill Melville of my staff at (404) 562-9266.

Sincerely,

Gail Mitchell for

James D. Giattina, Director
Water management Division

Enclosure

cc: Michelle Woolfolk