

# THE SURVEY OF COLLECTING WATER SAMPLES FROM VITAL WATER SOURCES FOR EVALUATION OF WATER POLLUTION AND CLEANLINESS

Water pollution is a serious issue. Our health and livelihood revolves around healthy water sources. Some ways water becomes polluted is through high levels of phosphates, nitrates, sulfates, chlorine, and other minerals. These pollutants cause excessive growth of algae, which has adverse effects on aquatic life. High concentrations of some pollutants also have the potential to become carcinogenic.

Daily examinations of physical and chemical factors suspected of playing a role in the establishment and proliferation of poor water quality in three lakes on Raleigh, NC were studied for two weeks. The parameters studied were pH, conductivity, turbidity, water and ambient temperatures, and salinity. The following chemical analyses were also tested: ammonia nitrogen, pH, chlorine, chromium, copper, iron, nitrate nitrogen, phosphorus, silica, and sulfide. Data review was confined to the last two weeks in July 2008 to provide the most recent assessment of the three lakes sampled.

During our survey, water samples were collected from three local lakes in Raleigh, NC. The lakes are: Lake Wheeler, Lake Johnson, and Yates Mill Pond. Correlation analysis revealed positive relationships between nutrient levels and chemical and physical parameters at each lake. The lake with the greatest impact on water quality was Yates Mill Pond due to the agricultural runoffs from nearby farms and research facilities. It also had the most concentration of nitrogen, phosphorus and potassium, which play critical roles in the quality of water.

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## INTRODUCTION

Lakes and reservoirs are integral features of the North Carolina landscape, supplying water for personal, industrial, and municipal users. Lakes provide recreational opportunities and aesthetic enjoyment for the public, and support rich communities of aquatic plants and animals. Public use of the state's lakes is high, and lake-related recreation provides significant revenues. The North Carolina Environmental Management Commission and Division of Water Quality are committed to protecting these valuable resources for public use.

Recognizing the importance of North Carolina's waters, the Legislature adopted the 2005 Drinking Water Reservoir Protection Act (SB981). Under Section 2(a) of this Act, the Environmental Management Commission is charged with studying the state's drinking water reservoirs, determining which reservoirs are not meeting surface water quality standards and reporting their findings and recommendations to the Environmental Review Commission.

The three lakes chosen for this study were Lake Wheeler, Lake Johnson, and Yates Mill Pond. Lake Wheeler was constructed in 1956 by the U.S Army Corps of Engineers as Raleigh's secondary auxiliary water supply lake. This 800-acre lake/park has 650 acres of lake and 150 acres of park and land buffer. Yates Mill Pond has a water-powered mill that was built around 1756. This four and a half foot deep, 20 acre, semi-rural historic landmark was halved due to sediment deposits. It was later restored. An impaired tributary caused

this erosion and sediment transportation. Lake Johnson is owned by the City of Raleigh. Its original use was as an auxiliary water supply for the City of Raleigh. It is now used solely for recreation.

The purpose of this research was to evaluate the pollution levels of water sources in the Raleigh area, and to evaluate the environmental effects on those levels. It was discovered that certain chemicals in water could disrupt the function of the endocrine system, resulting in reproductive, developmental, and behavioral problems. These problems increase the occurrence of stillbirths and birth defects. Chemicals could also become carcinogenic, causing kidney and bone cancers and hormonally dependant cancers such as breast, testicular, and prostate cancer.

It was expected that Yates Mill Pond would have the highest levels of phosphates and nitrates, Lake Johnson would have the highest levels of copper, and Lake Wheeler would have median levels between the two.

## METHODS/MATERIALS

### Field Sampling

Three water-sampling stations were established at each research site (Lake Wheeler, Lake Johnson and Yates Mill Pond). At each of the sites, measurements for water temperature, dissolved oxygen, conductivity, turbidity, salinity, and ambient temperature were taken for 10 consecutive days using the *Horiba Water Quality Checker Model U-10*.

**Table 1. Physical parameters**

	Air Temp. °C	H <sub>2</sub> O Temp. °C	Conductivity (umho/cm)	Mean Depth (ft.)	Watershed Area (mi <sup>2</sup> )	Volume (10 <sup>6</sup> m <sup>3</sup> )
<b>LJ</b>	32.1	28.6	165	5	65	12.02
<b>LW</b>	30.3	26.2	215	13	28	8.0
<b>YMP</b>	33.4	29.7	200	4.5	20	2.6

LJ=Lake Johnson.  
LW=Lake Wheeler.  
YMP=Yates Mill Pond.

**Table 2. Chemical parameters**

	pH	DO mg/L	Sal mg/L	Cl mg/L	NH <sup>3</sup> mg/L	NO <sup>3</sup> mg/L	Cr mg/L	Cu mg/L	Fe mg/L	P mg/L	S <sub>1</sub> mg/L	SO <sub>2</sub> mg/L	Turb. (NTU)
<b>LJ</b>	6.5	4.6	*	*	1.8	0.62	*	.2	1.72	0.25	23.9	*	12
<b>LW</b>	5.8	5.0	*	*	2.0	0.78	*	.6	1.85	0.3	27.9	*	15
<b>YMP</b>	6.6	3.2	*	*	3.32	0.84	*	1.2	1.96	0.5	26.7	*	8

LJ=Lake Johnson.  
LW=Lake Wheeler.  
YMP=Yates Mill Pond.

## Chemical Analysis of Water Samples

Water samples were also taken daily from each lake for the following chemical analysis: ammonia nitrogen, pH, chromium, chlorine, copper, iron, nitrate nitrogen, phosphorus, silica, and sulfate. These analyses were taken upon return to the lab. The chemical analysis was conducted using the US Environmental Protection Agency Protocol for *Methods for Chemical Analysis of Water and Waste*.

## Soil Sampling

Three soil samples were taken in the same vicinity as the collected water samples. These soil samples were tested in the lab for 4 factors: pH, potassium, phosphate, and nitrogen using the *Recommended Chemical Soil Test Procedures for North Central Region*.

## RESULTS

We found several factors that promoted and regulated water qualities in Lake Johnson (LJ), Lake Wheeler (LW) and Yates Mill Pond (YMP). Air and water temperatures followed the

seasonal pattern expected of both water and air temperature. Air temperature in West Wake County during the study periods fluctuated characteristically in accordance with normal seasonal variations. Conductivity, which measures the water's capacity to conduct an electric current, was highest in Lake Wheeler and lowest in Lake Johnson (Table 1). Our results suggest that Lake Johnson, with the lowest conductance, has the highest concentration of dissolved ionic matter in the water, which in turn is related to water fertility.

During the study, mean pH was nearly neutral in all of the lakes varying from low pH, 5.8 at Lake Wheeler, to pH of 6.5 at Lake Johnson. Dissolved Oxygen fluctuated from 3.2 mg/L at Yates Mill Pond to a high of 5.0 mg/L

at Lake Wheeler (Table 2). The fluctuation was due to the photosynthetic and respiratory activities of the Biota in the open water, the benthos; and (2) the diffusion gradient at the air-water interface and distribution by wind-driven mixing. Generally 3.0 mg/L of dissolved oxygen or less is stressful to aquatic vertebrates and most other aquatic life.

Water quality chemical parameters were not at dangerous levels. Nitrogen and phosphorus were the highest measured (Tables 2 and 3). The high concentrations of these nutrients are due to agricultural runoffs from nearby farms and research laboratories of North Carolina State University-College of Agriculture and Life Sciences. The college has poultry, cow pasture, and turf-grass science laboratories.

**Table 3. Chemical soil parameters**

	pH lb/acre	N lb/acre	P lb/acre	K lb/acre
<b>LJ</b>	6.5	10	10	550
<b>LW</b>	6.0	40	25	720
<b>YMP</b>	6.0	100	75	512

LJ=Lake Johnson.  
LW=Lake Wheeler.  
YMP=Yates Mill Pond.

Iron levels were slightly higher than the average in all of the lakes. This may be due to runoffs. Iron and manganese minerals were found in drinking water supplies. These minerals will not harm an individual but can cause reddish brown or black stains on household

fixtures and clothes. More research is needed to confirm our conclusions.

#### RESOURCES

Kolega, John J. Water Conductivity Treatment of Iron and Manganese. Fact Sheet 9. University of Connecticut Cooperative Extension Service. 1989.

Machmeier, Roger E. Iron in Drinking Water. University of Connecticut Cooperative Service. 1971.

*Methods for Chemical Analysis of Water and Waste.*

Recommended Chemical Soil Test Procedures for North Central Region, North Central Regional Research Publication Number 221.