

# INTERIM REPORT FOR PHASE I CLEAN LAKES STUDY: LAKE BLACKSHEAR

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## INTRODUCTION

### Lake Description

Lake Blackshear is a hydroelectric impoundment created in 1930 on the Flint River and owned by the Crisp County Power Commission. It is located primarily between Crisp and Sumter Counties, but also borders Dooley, Lee and Worth. Lake Blackshear has a surface area of 34.5 km<sup>2</sup> and a mean depth of 5.3 m. Mean hydraulic retention time is 16 days (USEPA, 1975). It is estimated that 88.7 percent of the annual mean flow into Lake Blackshear comes from upstream sources. Gum Creek, the drainage basin of which includes the City of Cordele, contributes 1.6 percent of the annual mean flow (Foth and Van Dyke, 1985).

In recent years Lake Blackshear has shown significant characteristics of eutrophication (USEPA, 1975). The lake has been infested with extensive growth of the bluegreen algae *Lyngbya wollei* in certain of the tributary embayments since at least the 1960's. Following the start-up in 1981 of a Proctor and Gamble Corporation pulp plant upriver from the lake, low river flow intensified some of the negative conditions leading to strong public concern about the health of the lake. This concern has led to a series of studies involving the lake and related nutrient sources.

### Lake Studies

One intensive study sponsored by Proctor and Gamble and directed by the Academy of Natural Sciences of Philadelphia, demonstrated that nutrient loading was sufficient in the spring and summer to classify the lake as eutrophic (ANSP, 1984).

A study (Foth and Van Dyke, 1985) funded by the Crisp County Power Commission applied the Vollenweider model (1978) to nutrient data gathered for a 1973 study (USEPA, 1975). This study stressed the importance of lake tributaries and local sources such as septic tanks as nutrient sources to the lake. The Gum Creek embayment was considered to be very important to the lake enrichment process.

The Foth and Van Dyke study (1985) recommended the establishment of a Watershed Association to oversee

evaluation of lake quality and related studies. The Lake Blackshear Watershed Association was formed with representatives of the Crisp County Power Commission, local county governments, state agencies, Proctor and Gamble, lake residents, and Georgia Southwestern College. Through funds raised by the Association several studies have investigated problems associated with the lake, including an extensive year long study of Gum Creek and a study evaluating the status of Lyngbya. The results of the Gum Creek study were reported at the previous Georgia Water Resources Conference (Cofer, et al., 1991).

The Lake Blackshear Watershed Association developed a proposal for a Phase I Clean Lakes Study and arranged to provide the necessary matching funding. The U.S. Environmental Protection Agency and the Georgia Environmental Protection Division have funded the study, and it is the preliminary results of this study that are described here.

The year long study of Gum Creek led to the estimation that 4.8 percent of the nitrogen and 5.5 percent of the phosphorus entering Lake Blackshear was provided through Gum Creek (Cofer, et al., 1989). The modeling study (Foth and Van Dyke, 1985) had predicted that greatest nutrient enrichment would be found associated with tributary embayments, a prediction confirmed by the Gum Creek study. The Gum Creek study included an initial study of land use in relation to nutrient sources, finding that the City of Cordele was the greatest source.

### Non-Point Sources Study

A current study involving several agencies, including the USDA Soil Conservation Service and the Georgia Environmental Protection Division, is providing a much more complete evaluation of nonpoint sources in the Gum Creek drainage basin. A major goal of this study is to develop recommendations for agricultural practices designed to reduce nutrient input from non-point sources.

The initial Gum Creek study calculated an annual nutrient flux for Gum Creek for 1987. Short term nutrient flux studies had been done on a larger part of the system in the 1973 Environmental Protection Agency Study (USEPA, 1975) and the 1983 Academy of Natural Sciences study (ASCP, 1984). A more complete nutrient

evaluation conducted along with other lake quality evaluations seemed needed. Thus, in April 1992, the current Phase I Clean Lakes evaluation of Lake Blackshear began.

## METHODS

**Major Scope of Study.** Biweekly (May - Oct.) and monthly sampling is done at three upriver, one down river, seven lake, twelve tributary embayment and twelve stream stations. Sampling protocol includes: nutrients, total organic carbon, alkalinity, suspended solids, chlorophyll a, 20 metals (plasma emission scan), dissolved oxygen, pH, conductivity, and temperature.

**Additional Studies.** Dissolved oxygen, pH, conductivity, and temperature diel profiles were made at weekly intervals from mid-June through mid-September at nine stations on a transect across the lake using an abandoned bridge. Measurements were taken at two meter depth intervals every four hours at each of the transect stations.

Other protocols used in this study are sediment samples taken twice at each of the lake and embayment stations for total carbon, phosphorus, nitrogen and metals analysis being done on samples from each station and pesticide analysis is being done on several selected stations. Additionally, fecal coliform samples are taken at each of the lake and embayment stations and samples for planktonic algae and for algal growth potential have been taken at selected stations. Sediment oxygen demand studies were conducted during the summer season. An extensive evaluation of the bluegreen *Lyngbya* is being done in one of the tributary embayments. The evaluation includes productivity estimates and nutrient enrichment effects.

## RESULTS AND CONCLUSIONS

Much data has been collected to date. Dissolved oxygen distribution will be used to illustrate results.

Table 1 gives the surface water and bottom temperatures and dissolved oxygen content at six lake stations and at five embayment stations on three dates selected to illustrate the temperature and oxygen distribution. Data in Table 1 support the following conclusions: (1) summer stratification increases as one progresses downstream, with the water well mixed at the uplake station at Georgia Highway 27 bridge; (2) stratification decreases in the fall; and (3) these data should be expected for a reservoir of this type. These data also show oxygen variability to be greater in tributary embayments, suggesting greater primary production, which is in keeping with the conclusion of Foth and Van Dyke (1985).

Table 2 diel oxygen data show limited variation in surface dissolved oxygen over the summer and between the

two locations having the greatest depth. Station 3A, with a depth of 7 meters, is located at the flooded river channel. Station 7 is likely a flooded oxbow river meander and has a depth of 4.7 meters. The variation in oxygen over a twenty four hour period at the station surface was always less than 3 ppm and usually less than 2 ppm. Variation at the bottom was always less than 2 ppm and usually less than 1 ppm. Figure 1 shows diel variations at Station 3A on two different days. Variation over the course of the summer at a station was appreciable. Further, variation between stations on the bottom was also appreciable on some days. The dates when the least oxygen was present on the bottom were days when extensive die-off of the Asian Clam (*Crobcicula*) occurred. Presumably the die-off resulted from viral disease and caused the oxygen loss. Time of greatest surface dissolved oxygen was most often around 1800 hours, in some cases around 1400 hours. This suggests photosynthetic production of oxygen. Maximal temperature was typically around 1400 hours. Correlation of these data with chlorophyll a will be evaluated following conclusion of field studies.

Preliminary nutrient data support the idea that the greatest eutrophication problems are in the embayments. Conductivity and alkalinity values tend to be greater in the embayments. The higher alkalinity results from the extensive limestone presence in a large part of the local drainage basin. This contributes to the extensive blue-green *Lyngbya* population, which has high calcium requirements (Dyck, 1990, personal communication).

This study upon completion should provide information to delineate the following:

- (a) nutrient sources for the lake;
- (b) fecal coliform sources;
- (c) *Lyngbya* problem.

Recommendations will then be developed to:

- (a) reduce nutrient enrichment;
- (b) correct fecal coliform sources;
- (c) reduce *Lyngbya* population.

## ACKNOWLEDGMENTS

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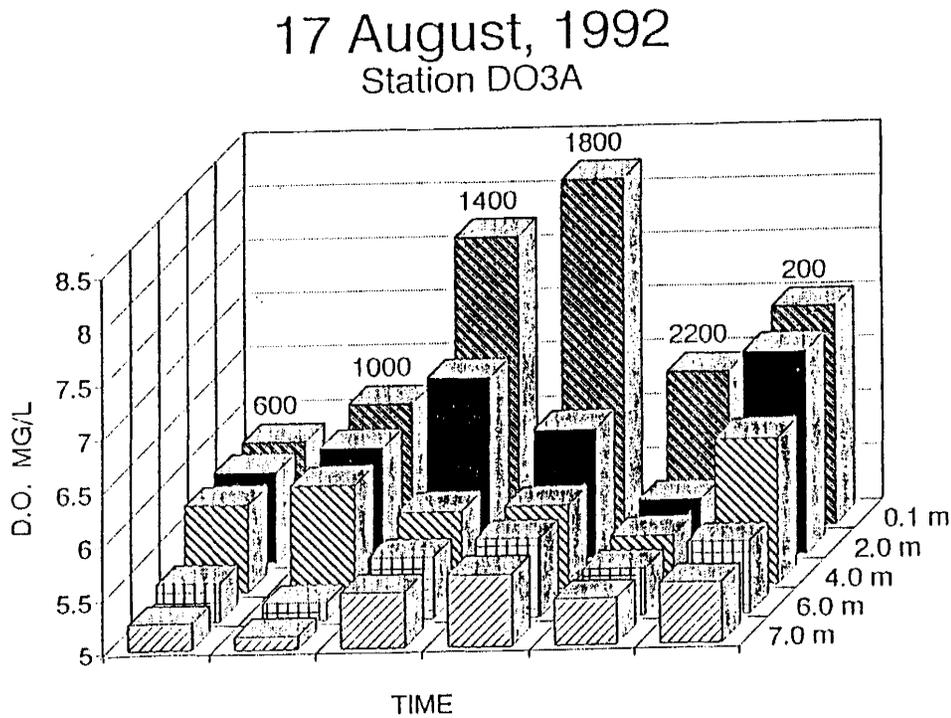
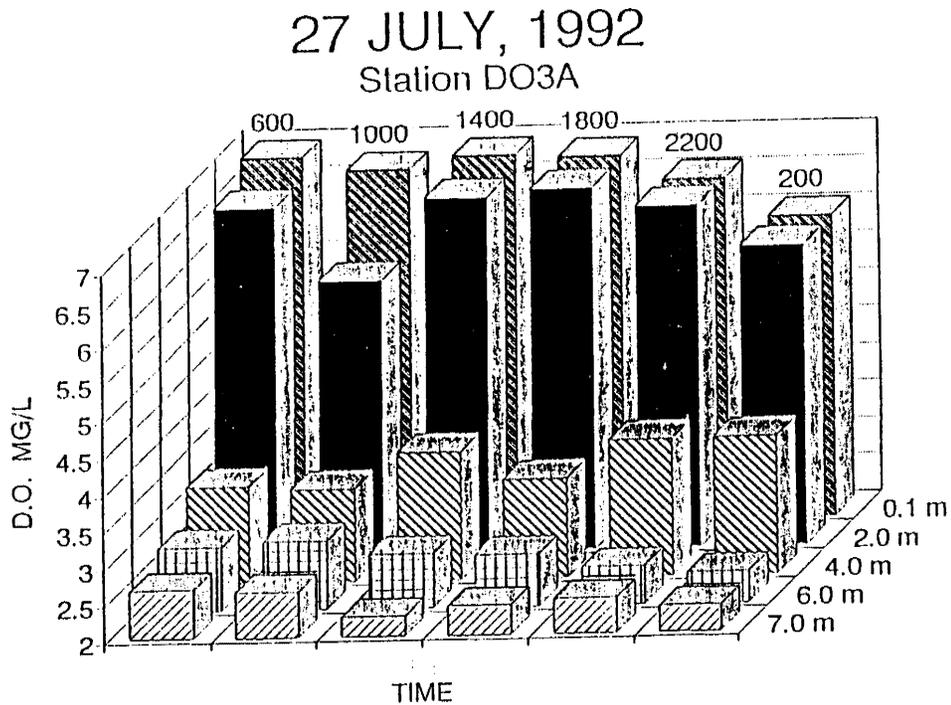
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**Table 2. Diel Study: Dissolved Oxygen at Stations 3A and 7; Twenty Four Hour Means at Surface and Bottom.**

DATE	Station 3A		Station 7	
	Surface	Bottom	Surface	Bottom
15 June	7.66	5.20	7.90	4.90
22 June	6.51	1.73	7.28	1.05
29 June	6.96	1.11	7.03	0.12
6 July	6.93	3.27	7.05	4.22
13 July	6.54	0.92	6.83	1.28
20 July	6.79	5.00	6.81	5.19
27 July	6.68	2.46	6.64	0.60
4 Aug	7.40	3.24	6.87	2.17
10 Aug	7.48	3.44	7.41	1.68
17 Aug	6.91	5.42	7.56	5.44
24 Aug	6.90	4.75	6.22	4.35
31 Aug	8.18	4.68	8.45	4.23
7 Sept	7.08	4.91	6.52	4.07
14 Sept	6.15	4.18	6.08	4.65



**Figure 1. Dissolved oxygen concentrations at Lake Transect Station 3A at two meter vertical intervals over twenty four hours on two dates during the summer of 1992.**