# EVALUATION OF WATER QUALITY MANAGEMENT ALTERNATIVES FOR LAKE LANIER FEASIBILITY STUDY

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**Abstract.** The feasibility study portion of the clean lakes study combines the research results, proposed BMPs, and regulations to assist in protecting the water quality of Lake Lanier. In this paper, an effort is made to express the current status of alternative development and evaluation.

## INTRODUCTION

The feasibility/management phase of this study is an effort to combine the results of the other studies done on Lake Lanier into action plans and to evaluate possible courses of action that will enhance or protect the overall water quality of Lake Lanier. The actions to be proposed in the plan are dependent on the assumed level of effectiveness of the management alternatives on the problems that have been defined. Due to the size and complexity of the watershed variables, this Phase I feasibility study is very preliminary and is incomplete at this time. The Georgia Mountain Regional Development Commission (GMRDC) and the US Geological Survey (USGS) have proposed that a GIS be developed that will be useful for indicating potential problem areas. Members of the Chestatee-Chattahoochee Resources Conservation and Development Council, Inc. (RC&D) along with members of the Soil Conservation Service (SCS) are in the process of developing a GIS (GRASS) for the Mossey and White Creek areas of Hall and White counties. Several other studies are underway or proposed that should supply valuable information. Several BMPs are being evaluated and certain land use practices have been or are being related to water quality for site specific application in the watershed. The results of these studies will be coordinated with water quality sampling to relate land use to water quality for developing a total resource management feasibility plan but will not be completed until well into the Phase II portion of the study. Part of the finished management plan must be the evaluation of alternative courses of action both in effectiveness and in financial and economic consequences. When these areas have been established, coordination of interest groups and agencies involved in managing and using the lake must be assured. As in all management efforts there will be some groups that are influenced more by one course of action than another and the benefits and costs of any course of action are seldom uniform in application.

The procedure appears quite simple-determine desired objectives; identify existing and potential problems; determine possible courses of action for dealing with the problems; and evaluating the proposed courses of actions under the criteria of legal, economic, and physical limits. One of the major problems is determining statistically the relationships between courses of action, water quality of streams and the effects on lake water quality. In general, it is agreed that conservation practices that include preventing erosion and nutrient flushing from agricultural land will have positive benefits on water quality. The exact relationship of land use and water quality may not be known for the Lake Lanier area but there are general statements that can be made and practices that can be followed based upon recommendations from studies done by the USDA Soil Conservation Service (SCS)[1] and other governmental agencies. Several of the other probable sources of nutrients and pollutants are discussed briefly below.

## GENERAL DESCRIPTION OF THE STUDY AREA

Located: North Georgia - USGS Hydrologic Unit No. 03130001.

Physical Characteristics: (1) 2000 miles of streams draining into Lake Lanier; (2) 665,600 acres in parts of Dawson, Forsyth, Habersham, Hall, Lumpkin and White counties; (3) 38,540 acres in Lake Lanier; (4) 4,190 acres of surface water are stored in some 430 small lakes or ponds; (5) 18,610 acres of cropland; (6) 81,200 acres of pasture; (7) 58,690 acres of urban and other uses; (8) the remaining acres in woodland; (9) approximately 62,600 head of cattle; (10) 735 horses; (11) 75 sheep; (12) 38,600 hogs and pigs; (13) 21 dairies with 3,340 milk cows; (14) an estimated 274,600,000 birds (SCS estimates). Usages of the river system: (1) water supply; (2) hydroelectric power; (3) navigation and, (4) recreation. Lake Lanier ranks highest in the nation in recreational use. Last year's estimate of users is 18 million visitor days.

The population in upstream watershed influence area:

1990: 200,000; projected 2000: 235,000 yielding a 17% growth in 10 years. These numbers are for the counties surrounding Lake Lanier and do no reflect the projected population increases downstream that have exceeded the national average for growth for many years nor does this include the total affected populations of the counties not adjacent to the lake.

In the Lake Lanier Tributary and NonPoint Source Assessment Study done as part of the Clean Lakes Study, following conditions were noted. Of the 202,300 acres of land below where the Chattahoochee and Chestatee Rivers enter the lake, 63% is forested, 25% is pasture, 13% residential and urban and 1% cropland. Along the streams there are two major land-application systems for waste water. One located on Squirrel Creek (2300 acre watershed) and one on Six Mile Creek on the north side of Lake Lanier. The land application system on Squirrel Creek is used by a poultry processing plant and the one on Six Mile Creek by a rendering plant. A waste treatment plant for the City of Gainesville is located on South Flat Creek. According to the results of this study, S. Flat Creek is the tributary with the highest measured pollutant concentration for the lake. These three streams were excluded from the nonpoint analysis due to the fact that the pollution loads were extreme, may be related to a single activity in the watershed and, therefore, should be treated as a point sources. In the case of S. Flatt Creek, water sampling done by the City of Gainesville indicates that the sources of pollutants may be upstream of the treatment plant. In this phase of the study, no attempt was made to directly evaluate point source problems for the lake but these problems must be addressed in the second phase. Data indicated in the case of both export coefficients and July and September concentrations that agricultural activity is a significant source of nutrient loads to Lake Lanier. In general, nonpoint source loads account for 80 to 90% of the total loadings of nutrients to the lake.

If the limiting factor for excessive plant growth in Lake Lanier is phosphorus, as indicated in this study, measures should be taken to limit the amount of the nutrient entering the streams and the lake proper. Since the majority of phosphorus enters the systems attached to sediment, procedures that limit soil erosion should limit the unwanted growth. Nitrogen management could be enhanced by this process and with correct timing and application procedures of animal waste and other fertilizers.

At this stage considerable emphasis is placed on the nonpoint source reduction procedures and studies done under the various Federal and state efforts to address agricultural nonpoint source reductions because much work has been done in this area, financing and cost data are available for accepted Best Management Practices (BMPs), and an education program implemented by the University of Georgia's Cooperative Extension Service (CES) is underway. The same type of analysis must be done for all the present and potential water quality problem areas.

Considerable work and effort has been done on management procedures for Lake Lanier such as the ongoing efforts of the Corps of Engineers (COE), Georgia Department of Natural Resources (DNR), Soil Conservation Service (SCS) and other USDA agencies, the US Geological Survey (USGS), and members of this study team. Coordination of interest group efforts and goals are essential for an effective management program. The responsibility areas and authorization for management must be defined and understood before a management procedure can be developed. One of the major outputs of this study should be the development of a process for decision making for water resources management that: can be done; is cost effective; and is in the spirit as well as legal limits of current environmental legislation.

The potential water quality problems and some possible sources of pollutants for the Lake Lanier area are outlined in Table 1. At this stage the general problem areas and possibly courses of action are stated in very broad terms. A more precise analysis and summary will be developed once the Phase II process is completed and the results of other on-going research is available.

## PROPOSED MANAGEMENT PLAN PROCESS

A procedure for developing a management planning process for water quality management is proposed below. First the overall goals of the plan must be stated and the objectives developed that if satisfied could make achieving the goals a possibility. Once the objectives have been defined, courses of action (alternatives that will enhance or maintain water quality) must be evaluated based on effectiveness, economic/financial considerations and acceptability to the majority of the members of the affected population. When alternatives are developed and selected, they must be implemented and evaluated. A management plan for any natural resources must be one based on process rather than set alternatives.

**Goals of the Water Quality Management Plan for Lake Lanier.** The major goals of the management plan are to maintain water quality for recreational use within the lake, to minimize downstream negative impacts and to support Federal and state legislation on environmental management and protection. This legislation includes, but not necessarily limited to, the Clean Water Act, the Wellhead Protection Act, the Comprehensive Environmental Response, Compensation Liability Act, the Resource Conservation and Recovery Act, the Flood Hazard Program, the Wetlands Program and the Storm Water Management Program. The most restrictive design purposes of Lake Lanier affecting water quality are

recreational and water supply usages[2]. Since most of the water supply uses of the stored lake water is downstream of Buford Dam, there must be some consideration of the water quality being discharged. The Chattahoochee River system is the major water supply source for the Greater Atlanta area and is important also in the economic and environmental systems of Georgia, Alabama, and Florida. The watershed begins near the northern most point of Georgia and extends across and south to form the border of Georgia and Alabama eventually emptying into the Gulf of Mexico at Appalachicola, Florida.

To properly manage the water quality of Lake Lanier, an integrated total watershed approach must be used. Cooperation with local, state and federal efforts relating to zoning, best management practices, and education are most essential. Table 2 contains several of the management objectives and procedures that should be considered in water quality management for Lake Lanier and the surrounding area. This listing is not all inclusive and will change as the studies progress. Any management plan based upon research done so far should include significant continued research. Lake Lanier is quite large compared to most lakes studied under the Clean Lakes Program. Due to the size of the lake and the many inflows, limited sampling has been done during the current study, but sufficient data have been collected to provide for the establishment of general guidelines for a lake management plan.

**Alternative Selection.** One serious problem in developing and evaluating management plans is being able to predict with some degree of certainty the positive and negative outcomes on lake water quality of selected courses of action. At the present, several BMPs have been approved for reducing pollution from NPS for agricultural as well as forestry land uses. The problems that remain, from a management point of view, are to be able to identify areas that need treatment and then selecting BMPs to apply. The area selection is being assisted by SCS and others but specific effects of BMPs on lake water quality are difficult to evaluate to the extent needed to determine what practices will give the most "Bang" for the "Buck". These problems become even more difficult when the practices are applied at locations more remote from the lake proper. Land uses and practices must then be related to runoff - runoff to stream water quality then to lake water quality. Information is available in the literature and from agencies charged with managing water resources that will assist in the final development of a proposed set of alternative action plans.

At this stage, NPS programs and practices for the agricultural land uses have been emphasized but by no means are these uses the sole causes of water quality problems for Lake Lanier but have been stated here to demonstrate the magnitude of one of the proposed action plans outlined in Table 2. In a study done for Georgia Department of Natural Resources published in 1991 called "We all live Downstream", the problems of urban NPS pollution and the relationship between land use and water quality has been very clearly stated. We realize that each problem area will be expanded as time goes on; each solution set multiplied; and, each selection of courses of action changed over time but we are at a stage now where we can begin an evaluation process that can lead to an acceptable management plan for Lake Lanier's water quality.

**General Management Procedure.** Several management evaluation structures have been suggested for dealing with water quality studies and with management of the water and land resources for water quality[3]. General guidelines are established in laws, rules, and regulations of both state and federal regulatory agencies. In the case for developing the management alternatives for Lake Lanier, these accepted procedures will serve as a guide but specific research that is being conducted by the various agencies and influence groups must be combined into case specific applications. Once the results are available on the effectiveness of the presently assumed BMPs and critical areas are identified, a decision making process must be developed. This may include the establishment of a decision making panel composed of the groups and individuals that can affect the implementation of management decisions. This process can be assisted by the development of an "expert system" that contains information on alternatives for assisting in water quality enhancement as well as the associated costs and legal restraints. These types of systems have been developed for a large portion of real world decisions and for certain applications in water resources[4].

The objectives for water quality management for Lake Lanier must be established-assumed to be recreation and drinking water standards. Problems with water quality must be identified; causes of these problems must be established (within reason); and courses of action for addressing the problems must be developed and evaluated. At this stage, potential problems with sediment, nutrients and metals have been identified. Efforts must be made at identifying the most critical areas for short term treatments and regulations. Continued study is needed to identify sources and alternative treatments as well as management coordination efforts. An evaluation of the various alternatives implemented must be made to serve as input into future decision making processes. It may be necessary to suggest specific rules and regulations for the overall watershed due to the interdependence of all the systems in the basin. Management planning processes are never finished but are a continuing process. To this stage, most management alternatives suggested are those recommended for nonpoint sources and particularly those

**Table 1. Potential Water Quality Problem Areas and Possible Sources of Pollutants**

| Problems | Possible Sources |
|---|---|
| A. Nutrients<br>Excessive algal growth and oxygen depletion | 1. Animal Waste<br>2. Chemical Fertilizer Applications<br>3. Septic systems<br>4. Waste treatment facilities |
| B. Sediment | 1. Agricultural Cropland<br>2. Road Bank erosion<br>3. Stream bank erosion<br>4. Construction site erosion |
| C. Fecal Coliform<br>(Disease potential) | 1. Animal waste (domestic and wild)<br>2. Septic Systems<br>3. Waste treatment facilities |
| D. Heavy Metals<br>(Human consumption of water and fish) | 1. Industrial wastes<br>2. Chicken waste (copper-arsenic)<br>3. Atmospheric (mercury)<br>4. Old mining operations<br>5. Hazardous wastes sites and landfills |

**Table 2. Objectives, Suggested Procedures, and Agencies Responsible for Implementation for Water Quality Management**

| OBJECTIVES | PROCEDURES |
|---|---|
| Reduce potential pollution of surface and groundwater from agricultural land usages | 1. Proper handling of animal wastes<br>2. Implementing approved BMPs |
| Reduce potential pollution of surface and ground water from septic tank and drain fields | 1. Proper zoning, planning, construction and operation<br>2. Extension of sewer lines |
| Reduce point source pollution | 1. Include in sampling in Phase II<br>2. Expand present collection facilities |
| Reduce urban runoff pollution potential | 1. Enforcement of existing rules and regulations<br>2. Implement recommendations of special task force |
| Determine sources of heavy metals | 1. More intensive sampling of suspected trouble sites |
| Provide adequate stream bank protection | 1. Establishing buffer zones<br>2. Stream bank fencing |
| Reduce boat and auto repair pollutants in streams, as well as boat discharges | 1. Require adequate collection and disposal of all waste materials |
| Reduce road bank erosion potential | 1. Enforcement of current standards |

relating to agricultural activities. The other areas must be addressed as well but there is ongoing research in the agriculture nonpoint source area and some funds are available. What is needed at this stage are validated results of the BMPs influence on water quality (hopefully to come from the RC&D study as well as others) and the identification of areas most needing treatment. For instance, road banks are assumed to be large contributors to sediment loads. These loadings and the cost per ton of sediment for prevention must be combined with an estimate of water quality benefits. Sources of funds such as the Water Quality Incentive Program administered through ASCS and other programs will be helpful in encouraging favorable actions from potential pollutant sources.

The development of the final management plan will depend upon the establishment of reliable estimates of causes of potential water quality problems. Some problems have been identified but the extent and sources of these problems have not been clearly established, in all cases. When this is done, the complete management process can be developed. It may be necessary to establish an "umbrella organization" to function similar to the one for Chesapeake Bay to provide technical assistance and management follow up. Without some direct oversight organization, coordination of proposed management plans may be impossible or at least difficult.

## ENDNOTES

1. United States Department of Agriculture, 1989. *Upper Chattahoochee River Basin Study: Main Report*, USDA Soil Conservation Service, State Office, Athens, GA and other state and federal studies as well as those studies done by private groups.

2. Georgia Department of Natural Resources, Environmental Protection Division, 1990. *Rules and Regulations for Water Quality Control*, Chapter 391-3-6, revised July 26, 1990.

3. Ryding, S.O. and W Rast, 1989. *The Control of Eutrophication of Lakes and Reservoirs: UNESCO*; Carnforth, UK for example.

4. Collins *et. al.*, 1990. "The Potential of Expert Systems in Water Utility Operations and Management," *Journal* AWWA, Vol. 82, #9, Sept. pp. 44-51 and many other modeling for decision making in water management including a project for all of North China being done at the present time.