Alligator Lake

Surface Water improvement and Management Plan

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Water Management District
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The Surface Water Improvement and Management program is funded annually by the Florida Legislature, based in part on funding estimates made in this plan and by the Department of Environmental Protection. Project funding is split between the State (80%) and the Suwannee River Water Management District (20%). SWIM plans are implemented to the extent that funding is made available by the Legislature, DEP, and the SRWMD Governing Board.

Statutory authority and guidance for the Surface Water Improvement and Management program is provided in Sections 373.451 - 373.459, Florida Statutes.

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I. Executive Summary

Alligator Lake is one of the few truly degraded water bodies in the Suwannee River Water Management District (SRWMD). The lake's problems are well known and have been scientifically documented. These include degraded water quality, blooms of nuisance algae, periodic infestation with the exotic aquatic weed *Hydrilla*, and loss of valuable lake wetland habitat to diking and draining. Surface Water Improvement and Management (SWIM) planning for Alligator Lake began in 1988. Water quality and aquatic biological monitoring were conducted on the lake (under SWIM) between 1989-1991. Geographic Information System (GIS) databases have been developed for the region that provide information applicable to the lake; these include land cover, soils, topography, and roads/hydrography. These efforts contributed to a better understanding of the lake and its problems and indicate the need to undertake a comprehensive restoration and management effort in the lake and its watershed. Columbia County is now working with the Florida Communities Trust (FCT) Program to acquire the lands needed to restore the lake to a condition closer to its natural state. The SRWMD, under the SWIM Program, will be the lead agency in restoring the lake once this acquisition takes place. The steps to be taken in this restoration effort are outlined in this SWIM Plan.

Alligator Lake and its Watershed

The lake watershed encompasses about 15.4 square miles in Columbia County. It is one of the most heavily urbanized watersheds in the SRWMD. Major water bodies include Alligator Lake, Price Creek, and Montgomery Lake. Alligator Lake is noted for the occurrence of sinkholes in the lake bottom which perforate the confining geologic strata beneath the lake. These sinkholes periodically unplug, resulting in complete drainage of part or all of the lake. Historically, substantial areas of the eastern lake shore have been diked and drained for agricultural development. These areas were formerly wetlands and shallow lake bottom.

The most recent Florida Department of Environmental Protection (DEP) State Water Quality Assessment Report indicates a Trophic State Index in the fair to poor range. SRWMD monitoring shows periodic violations of one or more Class III water quality criteria, indicating that the lake only partially meets its designated use. The source of this water quality degradation is believed to be a combination of wetland habitat loss, sewage discharge, and ongoing nonpoint pollution from stormwater runoff. About two thirds of the watershed land cover is some type of developed use - residential, commercial, or agricultural. Most of this development occurred prior to the enactment of state stormwater management rules.

Priority Issues

Five priority issues are identified for the Alligator Lake SWIM Plan. These are:

1. Water Quality Restoration and Management

The lake was recognized as one of the 50 poorest water quality lakes in Florida *in* a 1983 DEP study. Class III water quality standards are periodically violated, resulting in adverse effects on the lake's biological communities. The lake experiences frequent algal blooms composed of species characteristic of hypereutrophic lakes. Benthic invertebrate communities are occasionally dominated by a phantom midge characteristic of hypereutrophic Florida lakes, but the community also includes invertebrate groups found in "clean" lakes. This indicates that, despite the known water quality problems, the lake would probably respond positively to efforts to restore water quality and habitat. Contingent upon the availability of SWIM funding and the acquisition of needed land, SRWMD will plan and implement water quality restoration efforts in the lake.

2. Aquatic Habitat Restoration and Natural Systems Protection

Substantial areas of wetlands and shallow lake bottom habitat on the eastern shore of the lake were diked and drained in the late 1950s through mid 1960s. These areas likely contributed to maintenance of lake water quality and are known to be good wildlife and fisheries habitat. Efforts to restore these areas must be an integral component of lake restoration. Contingent upon acquisition of these lands from private owners, the SRWMD will implement efforts to restore them to their historical condition.

3. Land Acquisition

Columbia County has been awarded a $1.5 million grant from the FCT Program to acquire the lands needed to restore the lake. The SRWMD will provide staff assistance as requested by county or FCT staff to implement this acquisition. No progress on lake restoration can be made until this acquisition takes place.

4. Local Government Coordination and Technical Assistance

The provision of data and technical assistance to city and county governments in the Alligator Lake watershed is an important need to link land and water planning, which must be done not only to restore the lake but to manage it properly. This is particularly relevant in this watershed, since stormwater planning and management efforts to "retrofit" older development will be an integral component of a water quality restoration effort in the watershed.

5. Public Information and Involvement

The support of local citizens in the watershed has been an impetus to lake restoration efforts. The public must be involved in the decision-making process during lake restoration planning and implementation. Beyond the need for public involvement in the lake's restoration and management, opportunities for

environmental education, freshwater fishing and other outdoor recreation need to be explored and implemented to encourage and facilitate public use of a restored Alligator Lake.

Management Strategies and Schedule

The primary thrust of this SWIM Plan is to put forth the framework by which a detailed lake restoration plan will be developed and implemented through a cooperative effort between the District, local governments, interest groups, citizens, and other state agencies. The need for the land acquisition described in "Priority Issues" has limited the extent to which planning efforts can begin. Once the land is acquired, a steering committee will be formed to guide the planning and implementation of lake restoration. The goals and objectives developed by this committee for management of the lake will dictate in large part the actual strategies implemented. General goals include:

- Improve lake water quality.
- Control growth of nuisance and exotic aquatic weeds.
- Protect and enhance lake fish production and increase public access to this resource through construction of fishing piers, fish attractors, etc.
- Provide other outdoor recreation opportunities, including facilities for picnicking, hiking, canoeing, bird watching, etc.
- Work with local school programs to incorporate environmental education elements into the restoration and management of the lake.

Five programs of work describe the overall framework for management of the Alligator Lake system: Resource Monitoring, Resource Planning, Program Implementation, Restoration Implementation, and Waterbody Planning. Each program includes projects and tasks that address the priority issues identified above. Major initiatives in each program include:

RESOURCE MONITORING

- Initiate water quality and aquatic biological monitoring to track the progress and success of lake restoration (begin in 1997).

RESOURCE PLANNING

- Develop a comprehensive restoration and management plan for the lake (by 1999).

• Implement necessary diagnostic studies to develop a lake restoration plan (begin in 1998).

- Develop plans to restore lost wetland acreage on acquired lands (by 1999).
- Develop Pollution Load Reduction Goals (PLRGs) to improve water quality (by 1999).
- Develop Stormwater Management Plans to meet the PLRGs (by 1999).

Describe the lake's hydrology and its relationships with ground water (begin in 1998).

PROGRAM IMPLEMENTATION

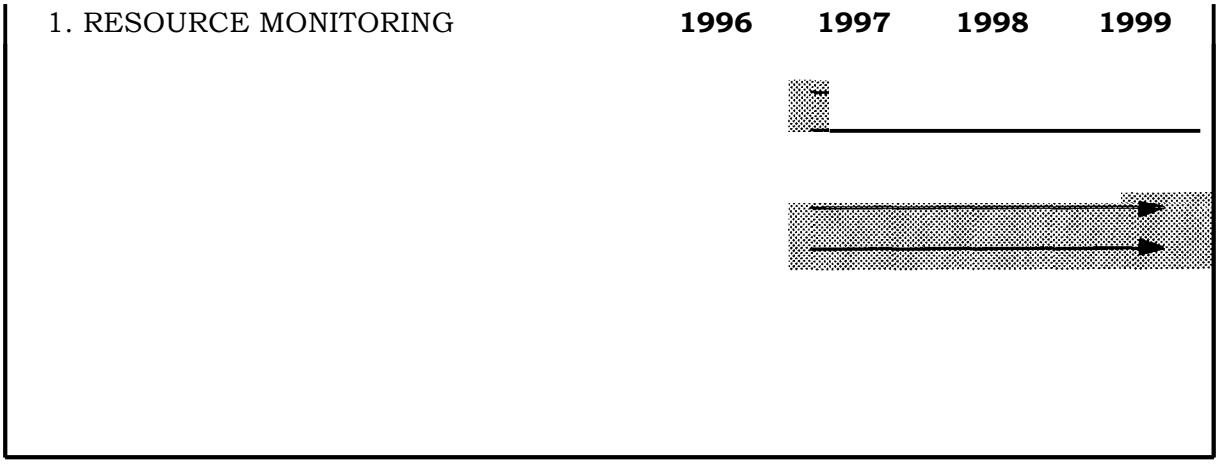
- Incorporate environmental education programs into the project through partnerships with local schools (make recommendations by 1998).
- Develop public outreach efforts to inform local citizens about important issues affecting the lake and involve them in its restoration and management.
- Develop plans for outdoor recreation uses of the project, including fisheries access enhancements (piers, fishing trails), a canoe trail, nature trails, and boardwalks (by 1999).

RESTORATION IMPLEMENTATION

- Assist Columbia County (as requested) to acquire needed lands (acquire by 1997).
- Implement wetland restoration efforts (begin in 1999).
- Implement stormwater management and retrofit (begin in 1999).

ALLIGATOR LAKE SWIM PROGRAM TIMELINE
(XX = begin and complete)

1.1 Water Quality Monitoring
1.1.1 - Quarterly Sampling
1.1.2 - Analysis and Reporting 1.2 Aquatic Biological Monitoring
1.2.1 - Quarterly Sampling
1.2.2 - Analysis and Reporting 1.3 Land Cover/Use Monitoring 1.4 Special Projects
1.4.1 - DEP Biology Coordination 1.5 Lake Hydrologic Monitoring 1.5.1 Lake Hydrology Gauging



2. RESOURCE PLANNING **1996** **1997** **1998** **1999**

2.1 Develop Restoration and
Management Steering Group
2.1.1 - Develop Steering Committee <
€< 2.1.2 - Meet with Committee and
develop recommendations
2.2 Lake gestoration Planning
2.2.1 - Select consultant
2.2.2 Data compilation and analysis 2.2.3 Diagnostic studies
::<<
2.2.4 - Develop restoration options,
scenarios, costs
2.3 Development of PLR .....
Gs
2.3.1 - Watershed Assessment
232 - Develop PL : .....
. RGs
2.4 Stormwater Planning
2.41 - Develop Stormwater Plan
2.5 Lake Hydrology Assessment
2.5.1 - Lake hydrology project
ect

3. PROGRAM IMPLEMENTATION **1996** **1997** **1998** **1999**

3.1 Environmental Education
3.1.1 Evaluate options and make
recommendations
3.2 Public Involvement and Use
32 1- Public awareness efforts
.....
3.2.2 - Fisheries a ..... :..... ::, ... ccess enhancement
- Canoe Trail planning
3.3
3 a
33.4 - Nature Trail planning 3.3 Long-term Management

3.3.1 - Lake management planning
3.4 Local Government Tech. Assistance
3 .4.1 - Land & Water Planning
Coordination
.
4.2 - Stormwater Plan implement. ::: .....
3 .....

4. RESTORATION IMPLEMENTATION 1996 **1997** **1998** **1999**

4.1 Land Acquisition
4 .1.1 .1.1 - Land acquisition technical
assistance

4.2 Lake Restoration Implementation 4.2.1 - Water quality improvement 4.2.2 - Aquatic habitat restoration 4.2.3 - Exotic aquatic plant control 4.2.4 - Funding

5. WATERBODY PLANNING **1996** **1997** **1998** **1999**
5.1 Annual SWIM Plan Review
1.1 - SWIM Plan Annual Review .....
5 .....
5.1.2 - SWIM Plan Triennial Revision
5.2 Annual SWIM Priority List Review 2.1 - Priority List

5 SWIM Review **II.**

Background Information SWIM Principles

and Concepts

Under the SWIM Program, the SRWMD advocates a regional approach to water resource management. The need for a regional approach is based on the fact that surfacewater bodies, groundwater aquifers, and their related natural systems are not confined to political jurisdictions. The lands that drain into a water body, defined as the watershed, are often comprised of the jurisdictions of many levels of government; a total of 13 agencies or units of government have some type of responsibility over Alligator Lake and/or its watershed lands. Effective management of the lake ecosystem must extend beyond political jurisdictions to include a "whole watershed" approach.

Land use appears to be the key determinant of water quality in Alligator Lake. Generally, local land use decisions govern the intensity of practices which occur on the land, including the type and density of development. Regional and state agencies can provide information to the local government entities in this watershed (Lake City and Columbia County) to assist in making local land use decisions that could affect the lake. It is through the assistance of regional and state agencies that regional protection of water resources can be addressed.

The SWIM Program in the Alligator Lake Watershed

Alligator Lake is the fourth-ranked priority water on the District's SWIM Priority List, and is the only water body on the list with a restoration emphasis, having known water quality and habitat degradation problems. A SWIM Plan for the lake

was approved in 1988 by the Governing Board and the DEP. The plan outlined the basic principles and concepts for the restoration and of Alligator Lake, focusing on:

- collecting and analyzing the data needed to better define and understand the Alligator Lake system.

- identifying priority issues which needed to be considered in restoration and management of the surfacewater resources of the watershed.

The initial SWIM Plan was intended to lead to a more detailed lake restoration and management plan. This revised SWIM Plan is an extensive revision of the first, providing a review of the activities which have been undertaken since adoption of the original plan and outlining future directions for restoration and management of the lake.

Alligator Lake Watershed Management Goals 1)

Restore water quality to Class III Standards.

2) Restore historic lake bottom and contiguous wetland and upland habitats to a more natural condition.

3) Put in place the management structure needed to implement these efforts and monitor and manage the lake in perpetuity as an ecosystem.

Objectives

The objectives of this plan revision are intended to serve as measurable benchmarks to provide guidance in achieving the above goals and to measure progress in doing so. These objectives are:

1) Acquire lands needed to implement lake restoration effort by 1997.

2) Continue to develop and promote community support for the project through public presentations, news releases, and formation of a lake restoration/management advisory committee by *1997.*

3) Quantify extent of loss of historic lacustrine wetland and lake bottom acreage by 1998 and develop plans to restore this acreage as part of a comprehensive lake restoration and management effort.

4) Define (by 1999) the PLRGs needed to meet Class III water quality standards.

5) Complete engineering and other necessary diagnostic evaluations and develop restoration plan by 1999, incorporating (2) and (3).

6) As part of the overall restoration and management effort, identify appropriate Operation and Maintenance entity and necessary funding sources to assume long-term management of the system;

SWIM Policies for the Alligator Lake System

1) The watershed management strategy for Alligator Lake shall seek to maintain a hydrology appropriate to support natural systems and native ecological communities.

2) The District shall promote the public acquisition of lands needed for the preservation of natural floodplains, the protection of water resources and/or restoration of the functioning of natural ecosystems.

3) The District will monitor surfacewater quality in the Alligator Lake watershed to determine seasonal and long-term trends in water quality.

4) The District will monitor aquatic biota, in conjunction with water quality monitoring, in order to determine long-term trends in biological integrity.

5) The District will coordinate with other governmental agencies to monitor aspects of the water and related natural resources of the Alligator Lake watershed which fall within their area of jurisdiction.

6) The District will monitor changes in regional land cover in order to define trends in vegetative cover and general land use.

7) The District will provide technical assistance to local units of government in the watershed, particularly in the implementation of local comprehensive plans as related to the water resources of the Alligator Lake watershed. This assistance will include the creation and interpretation of data, analyses, maps, and reports.

8) The District will continue to enforce rules and regulations regarding the use and management of surface waters and related ground waters of the Alligator Lake watershed.

9) Lands acquired by the District for the protection or restoration of water resources shall be open to the public and managed consistent with the need to protect water and related natural resources.

Other Management and Related Programs in the Watershed

The Alligator Lake watershed lies wholly within Columbia County. Portions of the lake and

watershed lie within the incorporated limits of Lake City. The

management of land use in the watershed is the primary responsibility of these two local units of government under their comprehensive plans, adopted per Chapter 163, Florida Statutes (F.S.). Both local governments have adopted Local Land Development Regulations to implement these comprehensive plans.

In January 1995, Columbia County was awarded a $1.5 million grant from the FCT Program to purchase areas of diked and drained farmlands which were historically lake bottom and wetland habitat. This ambitious effort resulted from earlier SWIM planning efforts which determined that acquisition and restoration of these diked lands was needed to ensure the widest range of options for restoration of the lake.

Other ongoing management programs in the watershed are:

1) Fish Management Efforts. The Florida Game and Fresh Water Fish Commission (FGFWFC) manages fishery resources in Alligator and Montgomery lakes. Efforts include production of an information brochure, periodic fish population assessments, installation and maintenance of fish attractors and feeders, providing information to the public, and boat ramp maintenance. Recently, the Commission has assisted with aquatic plant control efforts in the lake by stocking triploid grass carp.

2) Aquatic Plant Management. The Bureau of Aquatic Plant Management, DEP, conducts exotic and nuisance aquatic plant control efforts under a cooperative funding arrangement with Columbia County.

3) Ongoing Permitting Programs. These are listed in Appendix A and are the Resource Management Permitting programs of a variety of federal, state, regional, and local agencies.

Governmental Units with jurisdiction in the Watershed

A listing of government agencies and their authority is found in Appendix A. **General**

Overview of the Alligator Lake System

Watershed Characteristics

Alligator Lake is located in central Columbia County (Map 1), in southern Lake City. The lake's watershed encompasses a drainage area of about 15.4 square miles (Map 2). The lake has one principal inflowing stream, Price Creek, which drains the eastern half of the watershed, receiving drainage from the Lake City Airport, the city and county industrial parks, and adjacent residential subdivisions. Two small unnamed streams drain into the northeastern

part of the lake. Two other lakes are found in the watershed. One is a small unnamed pond located near the southcentral boundary of the watershed. The second is Lake Montgomery (Lake Hamburg

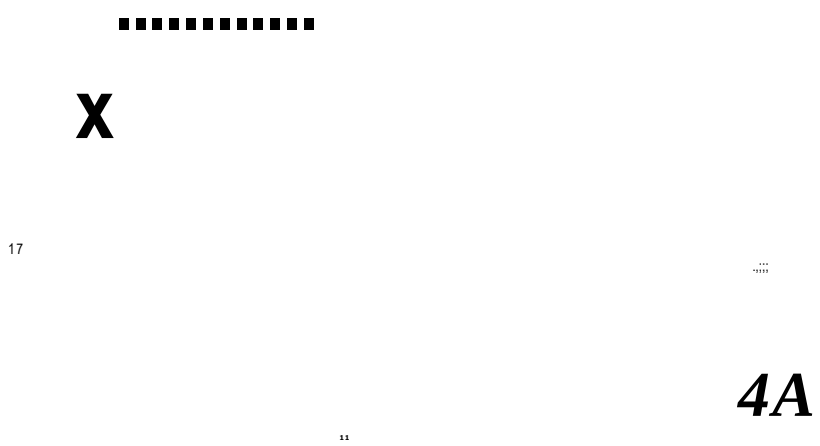
on older maps), a 36-acre lake located in the northwestern portion of the watershed. Portions of the most heavily urbanized area of Lake City are found in the northwest quarter of the lake's watershed. Most of this development was constructed prior to state requirements for stormwater treatment. Generalized watershed land cover is shown in Map 3. About 50 percent of the watershed area is classified as "urban" land cover; primarily commercial and residential development. Two small domestic waste facilities have, until recently, discharged treated sewage effluent into the lake, and waste water from a groundwater decontamination effort is discharged to one of the small unnamed streams draining to the north lake.

Lake Description

Alligator Lake consists of two interconnected basins; a north basin located within the corporate boundaries of Lake City, and a south basin located within unincorporated Columbia County. The surface area of the lake is listed as 338 acres in the "Gazetteer of Florida Lakes" (Florida Board of Conservation, 1969). However, this figure excludes about 500 acres of former lake bottom which had been diked. The lake is a doline lake; consisting of coalescing solution features (the north and south basins). The circular shape of each basin suggests origin by dissolution and collapse of the underlying limestone. The lake is embedded within the Hawthorn Group, composed of sandy clay (Meyer, 1962; Hunn and Slack, 1983), which generally functions as a confining unit. Sinkholes, which perforate the confining layer and provide direct connection to the Floridan Aquifer system, are located in both basins. The sinkholes are usually plugged with fine bottom sediments, which allows the lake to fill with surface water. When the water table is high in the Floridan Aquifer system, its back pressure keeps the sinkhole blockage in place. When the water table drops, pressure from the lake's surface waters becomes too great and the sinkhole blockage is dislodged, allowing lake water to drain quickly (within 24 hours) through permeable rock into the underlying aquifer.

An overview of aquatic ecology of the lake was provided in an SRWMD staff report (Mattson, 1993). The lake is an alkaline, hardwater lake of moderate color (Canfield, 1981). It is currently in an advanced eutrophic state due in part to years of municipal sewage discharge. High phosphorus levels in lake water are probably derived partly from leaching from the phosphate-rich Hawthorn Group in which the lake is embedded, as well as from watershed loading. Biological conditions indicate a eutrophic to hypereutrophic state. The lake's phytoplankton community is dominated by blue-green and green algae, with periodic blooms of the nitrogenfixing blue-green alga *Anabaena.* Water quality data indicate hypoxic conditions in the summer. The south basin suffers from excessive growth of the exotic aquatic weed *Hydrilla verticillata.* Despite these water quality problems, benthic invertebrate communities remain fairly diverse and productive; however, the phantom midge *Chaoborus* (characteristic of hypereutrophic lakes) dominates the benthic community in the summer. The lake supports a productive sport fishery; the FGFWFC notes that "fish growth and reproduction are excellent in this natural lake." (FGFWFC pamphlet - "Alligator, Montgomery, Watertown Lakes. Lake

Map 1. Alligator Lake Watershed



.Alligator Lake Basin

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/ \ / Major Roads

NCounty Boundary

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Map 3. Alligator Lake Watershed, Landcover

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This landcover map is based on 1988 Landsat TM satellite imagery. The images were classified according to a modified form of the Flonda Land Use, Cover and Forms Classification System.

This map was prepared for informational purposes and does not conform to National Map Accuracy Standards
Department of Water Resources

Urban

K" Water

Agricultural

Wetlands

Rangeland

Barren Land

Upland Forest

■ Transportation

Scale: 1:50,000
Miles

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City"). Use of the lake by wildlife, particularly wading birds and waterfowl, is regarded as high. The FGFWFC has identified the lake as a "Strategic Habitat Conservation Area."

Population Profile

Columbia County experienced a 20 percent growth in population from 1980 to 1990, adding about 7,200 residents. Ninety-one percent of this increase occurred in unincorporated areas. Most new development in the county is occurring in the western and southern portions. An estimate of the 1990 population in the watershed is 9,000 persons, or about 21 percent of the county population. The county is projected to experience a 42 percent increase in population by 2010, with a total of about 60,000 residents (an increase of 18,000). If the Alligator Lake watershed maintains the same proportion of total population, an additional 3,800 people will live in the watershed. However, since the areas in Lake City and surrounding subdivisions are approaching buildout, and large areas are proposed for public acquisition, this should be considered a high estimate. Considering the trends in population growth (i.e., in unincorporated areas outside the watershed), it is likely that the watershed's population growth would be less.

Population growth in the watershed increases the potential for adverse impacts to the lake system. Much of the watershed is served by individual wells and septic tanks. Without extending the service area of Lake City's public facilities, any significant increase in the watershed's population could pose a threat to the lake's water quality. However, since Lake City has recently annexed many urbanized areas, it is likely that more of the watershed will be served by centralized wastewater treatment.

Land Cover and Land Use

Most of the urbanized development around the lake has taken place over the past 40 years. For many years, Lake City discharged treated sewage effluent into the lake from its municipal sewage treatment plant (STP) until 1987, when spray field disposal was initiated at a location several miles south of town (and outside of the lake's watershed). Today, the major source of lake water pollution is believed to be urban and agricultural stormwater runoff, which runs directly into the lake without benefit of any treatment. This runoff comes from the above-described older development, constructed prior to enactment of stormwater management rules in 1986.

Portions of the south basin were diked in the 1950s and much of the north basin was diked in the early 1960s by private landowners (Figure 1). Land use in these diked areas has alternated between more intensive crop production (soybeans, corn, and

other crops) and less intensive pasture. Historically the diked areas appear to have been intermittently submerged lake bottom and emergent wetland habitat (both forested swamp and marsh). It is likely the lake has been adversely impacted by the construction of these two dikes and conversion of these areas into farmland. The landowner who constructed the north basin dike was challenged in court by other lake-front property owners in the mid-1960s, in a case which went to the Florida Supreme Court. The Court ruled, among other things, that the property was land, not lake, based upon historical records which indicated the area was not permanently inundated, and therefore not owned by the state under Florida's submerged lands act. The SRWMD was involved in legal action against the owner of the north dike in the late 1980's for alleged violation of the District's Surfacewater Management Rules (Chapter 40B-4, Florida Administrative Code [F.A.C.]). The court ruled that the defendant was exempt from District regulation because the work in question was conducted on an existing facility. This ruling was upheld by the appellate court. During this time the District was involved in discussions with the owners to acquire the diked lands but was unable to reach an agreement which satisfied all parties.

As one of its initial SWIM efforts, the District conducted a regional land cover mapping project using LANDSAT Thematic Mapper imagery (from 1988) classified according to the Florida Land Use, Cover and Forms Classification System. Although best applied at a more regional level, these mapping data are the most current and most accurate which exist. According to these data, 50 percent of the watershed area of the lake is classified as "urban" (Table 1 and Figure 3); 31 percent as "Residential" (subdivisions of low- and medium-density housing), and 19 percent as "Commercial and Services." An additional 15 percent of the watershed land area is classified as agricultural (FLUCFCS category 210) or rangeland (category 320). Thus, a total of 65 percent (nearly two thirds) of the lake watershed is in some type of developed state. Because much of this development occurred prior to enactment of the state's stormwater management rules, it is likely that runoff from these land uses receives minimal or no treatment and is a source of nonpoint pollution to the lake.

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Figure 1. Aerial photographs of Alligator Lake in 1939 (left) and 1974 (right), showing changes to the lake and surrounding environs. Source: Lake City Reporter, 29 July 1993.

Table 1. Tabulation of land cover in the Alligator Lake watershed, mapped according to the Florida Land Use, Cover and Forms Classification System (FLUCFCS). Data derived from 1988 LANDSAT Thematic Mapper imagery. Source: SRWMD files.

FLUCFCS Code	Description	Acres	Percent
110	Residential	3,063	31
140	Commercial and Services	1,823	19
210	Cropland and Pasture	986	10
320	Shrub and Brushland	522	5
425	Temperate Hardwood	381	4
427	Live Oak Forest	4	<
434	Hardwood-Conifer Mixed	517	5
441	Coniferous Plantation	586	6
520	Water - Lake	802	8
613	Gum Swamp	14	< 1
615	Stream and Lake Swamp	5	<
617	Mixed Wetland Hardwoods	209	2
621	Cypress Swamp	52	< 1
630	Wetland Forested Mixed	*702*	*7*
641	Freshwater Marsh	62	< 1
700	Barren Land	10	< 1
810	Transportation	93	1

III. Priority Issues and Analysis

Water Quality Restoration and Management

Alligator Lake was recognized as one of the 50 poorest water quality lakes in the state by the Florida Department of Environmental Regulation in a survey published in 1983 (Myers and Edmiston, 1983); primarily due to high nutrient levels and chronic, intense algal blooms. Recent SRWMD monitoring data (collected 1989-1991) show nitrogen, phosphorus, and chlorophyll a levels in the lake exceed the 90th percentile of a statewide distribution. This means that over 90 percent of the lakes sampled for water quality have levels lower than Alligator Lake. The most recent Florida Water Quality Assessment Report (DEP, 1994) lists a Trophic State Index of 67 for the lake, which indicates fair water quality tending toward poor (= a value of 70 or higher). Figure 2 shows one manifestation of these water quality problems. In summer, hypoxic conditions (dissolved oxygen levels of 3 mg/L or less) occur. Note in the figure how dissolved oxygen is depressed during summer (June-September), when water temperatures are higher. This creates stressful conditions for lake biota and contributes to reduced benthic faunal diversity (Mattson, 1993). The lake also suffers from exotic aquatic weed infestation *(Hydrilla verticillata).* The 1992 Florida Aquatic Plant Survey Report (DEP, 1992) lists 110 acres of *Hydrilla* in the lake, which is about one-third of the total existing lake acreage. Table 2 summarizes water quality in the lake compared with existing Class III water quality standards.

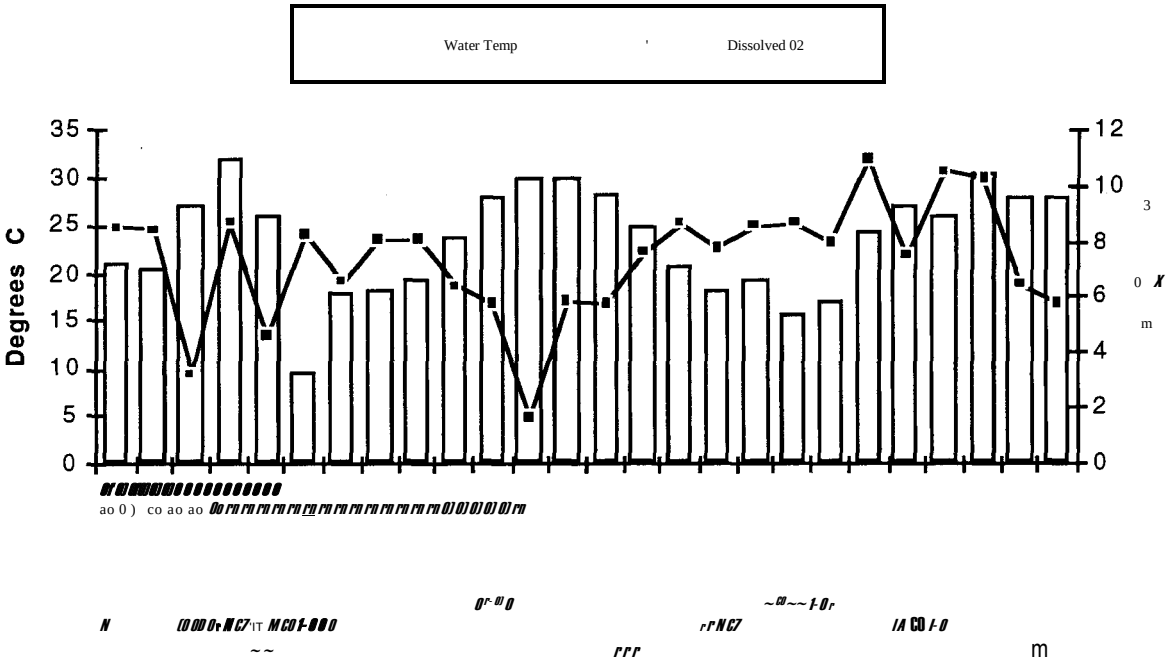


Figure 2. Graph showing surfacewater temperature and dissolved oxygen concentration at a sampling site in the south basin of Alligator Lake. Source: SRWMD files.

Table 2. Comparison of Alligator Lake water quality with state Class III standards (Chapter 17-302, FA.C.).

PARAMETER	Class III Standard	Alligator Lake Medians	NOTES
Alkalinity	>_ 20 mg/L	29-50 mg/L	in compliance
Ammonia (unionized)	<_ 0.02 mg/L	0.03-0.04 mg/L total ammonia	total ammonia > 0.10 mg/L 18 times between 1989-1991 - may exceed stan dard under certain conditions
Bacteria - Fecal colif.	ave. < 200/100 ml	1/100 ml	in compliance - no exeedences
Biological Integrity	> 75% of establish-ed "background"	Mean Diversity Index: 1.67-2.31	depressed diversity during summer - an established 'background" has not been determined; < 2 indicates stress
Specific conductance	<_ 1275 micromhos	90-142.5	in compliance
Dissolved Oxygen	z 5 mg/L	6.25-7.63 mg/L	periodic violations, particularly in summer - 19 violations during 1989-91 < 3 mg/L 8 times during this period
Nuisance species			Hydrilla present in lake at nuisance levels
Nutrients	concentrations shall not be altered so as to cause an "imba-lance " in natural populations of fauna and flora		blue-green algae blooms characteristic of hypereutrophication and periodic dominance of Chaoborus in benthos indicates this standard may be vio lated
pH	range from 6.0-8.5	7.5-8.5	upper limit exceeded 30 times during 1989-1991
Total Dissolved Gases	<_ 110% saturation		exceedences during algal blooms?
Turbidity	<_ 29 NTU above natural background	3.2-7.8 NTU	11 readings between 38-240 NTU during 1989-1991

Lake Montgomery also shows signs of eutrophication. The lake was sampled by the District in 1990 as part of a one-time regional assessment of lake water quality. The data from this effort determined a Trophic State Index of 58.3 for the lake, which is in the upper end of the good range (0-59), bordering on fair water quality (60-69). The lake does experience blue-green algal blooms and is experiencing increased growth of *Hydrilla.* As part of their Fish Management Area efforts, the FGFWFC installed an aerator in the lake to attempt to improve water quality and also treated the lake with "Aquashade," a non-toxic dye intended to reduce light penetration and inhibit growth of aquatic plants and algae. This lake receives stormwater drainage from the surrounding, urbanized area. The FGFWFC Lake Restoration Section has proposed a stormwater detention facility in one of the storm drains into the lake, but is still attempting to secure funding for this project.

Because the lake is drained by sinkholes, there is concern for potential groundwater impacts. The lake and its watershed appear to be the headwater portion of an ancestral river valley which was drained by the Ichetucknee River (Meyer, 1962). The lake is described as "a collapse feature at the intersection of two joint systems" (Lawrence and Upchurch, 1976). Elevated phosphorus concentrations in the upper Floridan Aquifer system south of Alligator Lake have been attributed to surfacewater drainage to ground water (Lawrence and Upchurch, 1976). Additionally, the public water supply wells serving Lake City used to be located next to the lake. In the early 1960s, these were closed and relocated due to high bacteria levels (Meyer, 1962). These observations help substantiate the linkages between surface and ground water in the Alligator Lake watershed. Within the corporate limits of Lake City, homes and businesses are served by the municipal water system; however, outside of the city limits, ground water from self-supplied wells is the principal source of potable water for residences and businesses.

Wastewater treatment facilities

Wastewater treatment facilities are regulated by the DEP under the National Pollutant Discharge Elimination System (NPDES) Program, which was recently delegated to the state by the U. S. Environmental Protection Agency. Six facilities providing wastewater treatment are known to exist in the watershed based on field reconnaissance and information from DEP files. Four of these are small domestic waste treatment plants, one is a municipal sewage treatment facility, and one is an industrial site undergoing a groundwater decontamination effort. These are listed below:

(1) Pondview Mobile Home Park. This park is served by a package treatment plant (extended aeration, chlorinated effluent) with a design capacity of 9,000 gallons/day. Effluent from the plant is discharged to two percolation/evaporation ponds, with no discharge to surface waters specified in the permit. A field inspection on January 27, 1995, did note a pipe from this facility leading into a ditch leading to Alligator Lake, and recently the facility was cited by the DEP for illegal discharge onto adjacent property (F. Watkins, DEP Northeast District, personal communication).

(2) Lakeside Mobile Home Park. This park is located on Marion Street next to the south lake boat ramp. It is served by a community septic system with an unknown design capacity. Effluent has been observed in the past discharging to the south basin of Alligator Lake via a small ditch. According to
local residents, recently the facility has been upgraded and improved at the direction of the County Public Health Unit.

(3) Paradise Village Mobile Home Park. This mobile home park has a package treatment plant (extended aeration, activated sludge) with a design capacity of 7,500 gallons /day). The facility has discharged illegally to Price Creek (see below), but is now in the process of being permitted to discharge to two newly constructed rapid infiltration ponds.

(4) WESTVACO Corp. This facility has an NPDES permit to discharge waste water from a groundwater decontamination effort to a small, unnamed tributary which discharges to the lake. This discharge consists of ground water which has been pumped from recovery wells and treated to remove aromatic hydrocarbons such as benzene, toluene, xylene, and others.

(5) The City of Lake City. The city operates a municipal wastewater treatment plant (activated sludge treatment) with a design capacity of 3.0 million gallons/day (mgd). Effluent is pumped to a 600acre land application site (spray irrigation) located outside of the watershed, south of Lake City.
Since initiation of land application (in September 1987), the facility has experienced one documented instance (January 3, 1989) of treatment problems which led to discharge of raw effluent to Alligator Lake via the historic discharge canal (F. Watkins, DEP Northeast District, personal communication).

(6) Eastside Village Subdivision. This residential community is served by a package treatment plant (extended aeration, chlorinated effluent) with a design capacity of 25,000 gallons/day. Effluent is discharged to two percolation/evaporation ponds with no surface discharge.

There was one facility in the watershed operating without a permit until recently; the sewer plant serving the Paradise Village Mobile Home Park. This facility previously discharged minimally treated sewage effluent illegally into Price Creek (which drains to Alligator Lake). The DEP Northeast District office in Jacksonville initiated enforcement action against the owner of this facility. The Department has now issued a permit (DEP Permit No. 011398, dated August 14, 1995) for the facility which involved construction of new rapid infiltration ponds for the effluent from the existing wastewater treatment plant.

The Pondview Mobile Home Park is presently operating its wastewater treatment plant under a temporary operating permit from the DEP. The permit is issued temporarily to ".. allow time for the facility to demonstrate full compliance with department rules, demonstrate satisfactory pond performance and investigate alternate land application methods, if necessary" (source: DEP Permit No. DT12222062, issued March 17, 1994). The park owner has noted to SRWMD staff that a major constraining factor for land application is the ability to acquire the needed land. The owner has been unable to negotiate agreements with adjacent land owners to acquire the land. Recently, DEP initiated enforcement action against the owner of this facility for illegal discharges to surface waters and onto adjacent property.

Nonpoint Sources of Pollution

It is currently believed that urban stormwater runoff represents the greatest existing contributor to degraded water quality in Alligator Lake. A previous study of Florida lakes (Huber, et al., 1983) conducted an evaluation of watershed land uses and pollutant loadings to the lake. The results of that effort are shown in Table 3. Lake nitrogen loading was estimated as 28,865 kg/ year; phosphorus loading was estimated as 2,440 kg/yr. The preponderance of "developed" land cover types (urban and agricultural) in the watershed, which represent older development constructed prior to requirements for stormwater treatment, suggests that nonpoint pollution from stormwater runoff is a major source of these nutrient loadings. Updated estimates of nitrogen and phosphorus loadings to the lake, along with estimates of loadings of metals and toxics and their ecological effects, are needed.

Table 3. Watershed land cover and pollutant loading estimates for Alligator Lake from an earlier statewide study of Florida lakes. From Huber, et al., 1983.

LAKE DRAINAGE AREA	11, 789 acres	POINT SOURCES	Municipal Agricultural Small domestic
DRAINAGE AREA DEVELOPED (urban or agricultural)	43.3%		
NITROGEN LOADING 20.5 g/m^2 - yr		PHOSPHORUS LOADING 1.73 g/m^2 - yr	28,865 kg/yr 2,440 kg/yr

State Water Policy (Chapter 62-40, F.A.C.) requires SWIM Plans to include strategies to reduce pollution from older stormwater systems (constructed prior to enactment of stormwater management rules). This will be accomplished by the development of PLRGs. These are defined in the Water Policy as "estimated numeric reductions in pollutant loadings needed to preserve or restore designated uses of receiving bodies of water and maintain water quality consistent with applicable state standards." Drainage improvements or land management practices needed to meet the PLRGs are developed in the lake restoration planning effort.

Aquatic Habitat Restoration and Natural Systems Protection

Previous discussion and Figure 1 show that extensive areas of fringing wetlands on the lake's eastern shore have been diked and converted to agricultural use. These

types of lake wetland areas are known to provide shallow water aquatic habitat for a diverse assortment of lake biota (Williams, et al., 1985) and contribute to fisheries production in the lake by providing physical habitat and food resources in the form of plant production. A major issue for the restoration and protection of the lake will be the restoration of these wetland areas to their former state.

Despite its water quality problems, Alligator Lake supports a relatively diverse population of benthic invertebrates, which includes representatives of taxonomic groups regarded as indicative of "clean" lakes with good water quality (Mattson, 1993), such as mayflies, caddisflies, and odonates (dragonflies and damselflies). This indicates the degree of water quality degradation is not too severe, and that the system would probably respond positively to restoration.

Use of the lake by wading birds (herons, wood stork, etc.) and water fowl (duck, coot, etc.) is high, particularly as the lake dries down during low water periods. An active rookery is found on the east side of the lake which has supported Great blue heron, Anhinga, Double-crested cormorant, and Tri-colored heron. An active Bald eagle nest is on the eastern shore of the southern basin of the lake (FGFWFC personal communication). These observations indicate the lake is important for wildlife and is suitable for use as a wildlife conservation area. This will be one component of a multiple use management strategy for the lake.

Land Acquisition

Every lake management professional interviewed to date who has evaluated Alligator Lake believes that restoration of the diked areas on the east shore of the lake to their historic condition must be an integral part of any overall lake restoration effort. Legal precedents described in previous sections indicate that implementation of lake restoration will require public acquisition of the diked and adjacent lands on the lake's eastern shore.

As discussed earlier, Columbia County has been awarded a grant from the FCT Program to purchase the diked land areas on the east shore of the lake The role of the SWIM program in this process has been to provide technical assistance as requested during the grant application process and as needed or requested during the acquisition process. Because land acquisition is a key component of restoration, it is listed as a "priority issue."

Local Government Coordination and Technical Assistance

Three related issues point to the key role played by local government in the protection and long-term management of Alligator Lake:

(1) Nonpoint pollution appears to be a significant contributor to water quality and related problems in the lake.

(2) This nonpoint pollution is directly tied to land use and development. (3) Local

government has direct responsibility for controlling land use.

Watershed management efforts by state and regional resource management agencies must coordinate with land use management by local government. One form this may take is through the provision of technical data to local governments. Review of proposed local plan amendments and land development regulations may provide a means for integrating land use and watershed planning; however, this would apply only for future land use changes and would be primarily reactive rather than proactive. Additional focus must be on older, "pre-stormwater management" development, which appears to be a principal cause of water quality problems in the lake.

Public Information and Involvement

The most fundamental need for a resource protection effort of the magnitude of this project is the support of the local public. A major factor driving the Alligator Lake effort has been, and will continue to be, the support of an interested public in the Lake City/Columbia County area. Throughout the process of developing a restoration and management plan for the lake, the public must be kept informed through the media and special events, and they must be involved as partners in development and implementation of the plan.

Encouraging public use and enjoyment of the lake will be an important part of this effort. The lake and surrounding lands which may be acquired and restored must be used and enjoyed by the people who live in the area to foster a sense of value for the resource. This creates support for expending money and resources on restoration and management of the lake. For these reasons, public education, environmental education, and outdoor recreation planning are important aspects of the Alligator Lake SWIM planning process.

IV. Management Strategies for the Alligator Lake System Goals and Objectives for Management

The goals and objectives for management of Alligator Lake will dictate the types of strategies implemented to restore and manage the system. General goals for management of the lake were stated on pp. 6-7. Refining these into more specific goals will require an interactive process between local, regional, and state governments, citizens, and interest groups. It is the purpose of this SWIM Plan to create the framework for development of specific restoration and management goals and the strategies to implement them. Ideally, management of the lake will emphasize a "multi-use" approach which will address:

• water quality improvement and management.

- recreational fisheries.
- other water-based recreation (e.g., water skiing, canoeing, etc.).
- wildlife and habitat conservation.
- environmental education.

Strategies for Management

Management strategies for the Alligator Lake system are divided into five program categories: Resource Monitoring, Resource Planning, Program Implementation, Restoration Implementation, and Waterbody Planning. Each of these programs consists of a series of projects and related tasks to address the priority issues identified in the preceding section.

Two key prerequisites will determine the extent to which the projects and tasks outlined below will be implemented:

1) Land Acquisition. Columbia County is currently working with the FCT Program to purchase lands needed to successfully restore the lake. Implementation of many of the following projects is contingent upon this acquisition project.

2) Funding. Continued funding of the SWIM Program will be necessary to fully implement this SWIM Plan. Neither the District nor the local governments in the watershed have the financial resources to implement the projects and tasks in this plan without SWIM funding from the state.

1. Resource Monitoring

Program Definition: Monitoring is the collection of data at regular, specified intervals of time. Monitoring is a key feature of SWIM because it provides the means for assessing the success or failure of watershed management efforts. A recent report by the federal Intergovernmental Task Force on Monitoring Water Quality (ITFM, 1992) notes that over $500 billion have been spent on water pollution abatement in the U.S. since the 1970s, yet the data do not exist to evaluate the efficacy of this expense. This is relevant for Alligator Lake, since several million dollars (from local, state, and federal sources) were probably spent to remove the sewage discharge from the lake and pump the effluent to a land disposal site south of the city, yet the data do not exist to document any improvements due to this action. This section describes the types of monitoring which will be conducted in Alligator Lake to track the progress of

restoration and management efforts.

Project 1.1: Water Ouality Monitoring

Project Goal: Reinstitute and maintain the monitoring network begun in 1989 (and discontinued in 1991) in order to provide the data needed to track the progress and results of lake restoration efforts.

In 1989, bimonthly water chemistry monitoring was initiated at three sites on Alligator Lake (Map 4) to generate baseline data to assess the current condition of the lake and provide a starting point from which to evaluate changes due to restoration efforts. Monitoring was discontinued by SRWMD in 1991 because of lack of progress on implementing lake restoration. At the request of DEP Tallahassee SWIM staff, the DEP District Office in Jacksonville continued monitoring two of these sites 3-4 times per year, which continues to the current day. However, DEP may have to discontinue these sites due to expanding program responsibilities.

Task 1.1.1: Resume Water Quality Monitoring 1996-1999

With the impending resumption of more active restoration efforts in the watershed, the SRWMD will resume monitoring the three sites begun in 1989 and shown in Map 4. Water quality monitoring will be conducted on at least a quarterly schedule at these three sites.

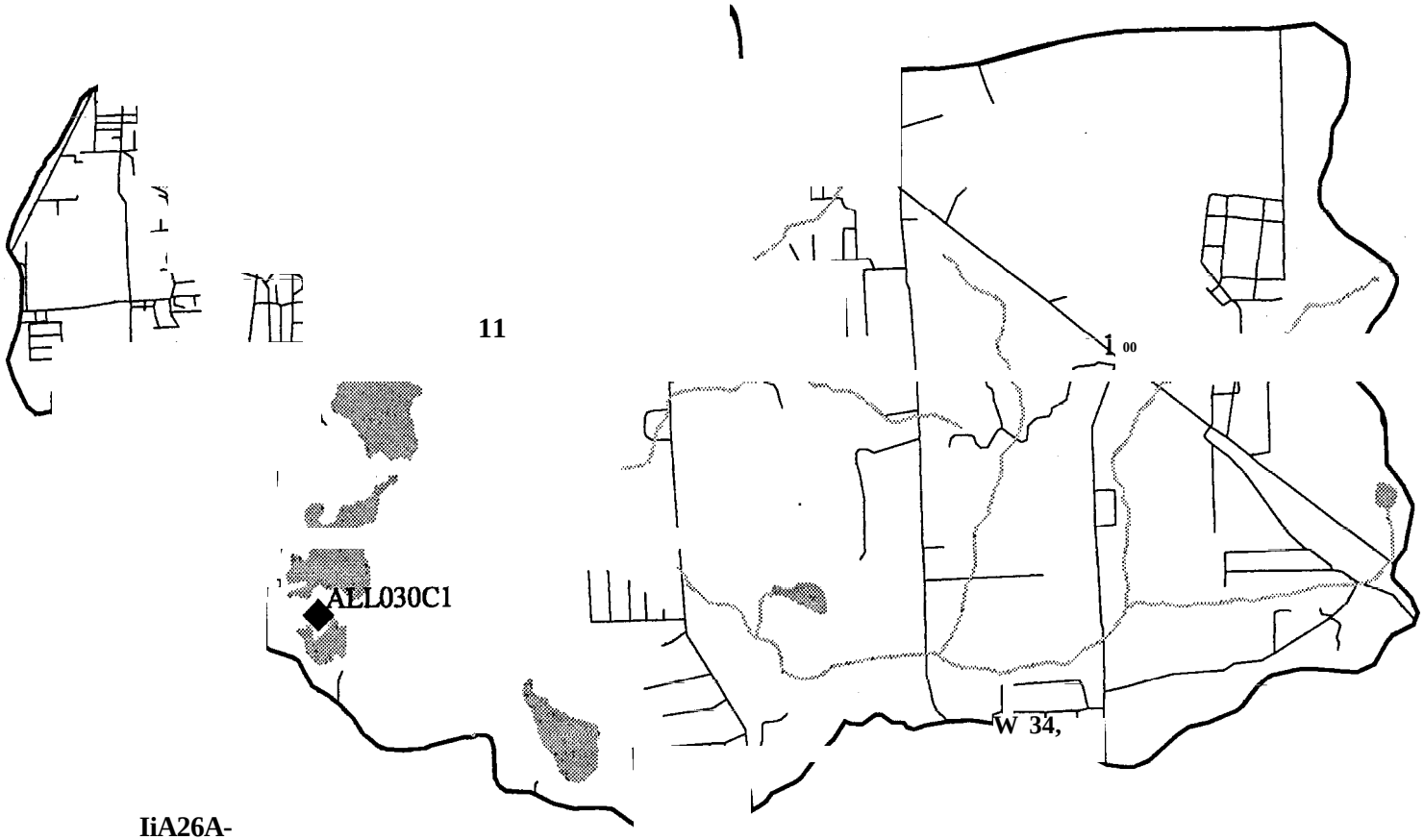
Water quality monitoring will involve subsurface grab samples (taken approximately 0.5 meter below the water surface). The proposed list of variables and analytes to be measured is shown in Table 4. As done previously, sample collection and laboratory analysis will be conducted by a contractor for SRWMD. The sampling effort will be conducted under a DEP-approved Project Quality Assurance Plan.

Task 1.1.2: Data Analysis and Reporting 1996-1999

The water quality data collected in the District's ambient surfacewater monitoring effort are archived in the SRWMD database "SWN-SWIM" and are also uploaded to the STORET database for use by DEP staff and other interested parties. Periodic review and analysis of the data collected in Alligator Lake are conducted by SRWMD technical staff using graphical and statistical techniques.

The water quality data collected in Alligator Lake will be reported in several ways. Periodic technical reports may be issued describing the data. The District is also planning the production of a Water Quality Assessment Report oriented toward the public. Verbal reports may be given at various public meetings and to the District Governing Board.

Map 4. Alligator Lake Watershed Monitoring Stations (1989-91)



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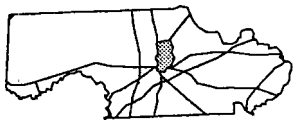

Table 4. Water quality variables and analytes proposed for sampling in Alligator Lake Resource Monitoring Program.

Water Column (Field Measurements)

Sample and total depth (meters)
Water temperature (degrees C) pH (standard units)
Dissolved oxygen (mg/L)
Conductivity (field and lab; micromhos/cm)
Secchi depth (meters)
Lake stage (feet above NGVD)

Basic Physical/Chemical

Color (PCU)
Turbidity (NTU)
Residue, total nonfilterable (mg/L)
Residue, fixed nonfilterable (mg/L)
Total dissolved solids (mg/L)
Alkalinity (mg/L as $CaCO_3$) Total Organic Carbon (mg/L)

Major Ions (Total; all in mg/L)

Potassium
Sodium
Magnesium
Calcium
Chloride
Fluoride
Sulfate

Nutrients (all in mg/L)

Nitrate plus nitrite N
Ammonia N
Total Kjeldahl nitrogen
Total phosphorus
Soluble reactive phosphorus

Microbiological

Total coliform bacteria (colonies/100 ml) Fecal coliform bacterial (colonies/100 ml) Fecal streptococcus bacteria (units)

Sediment

Granular composition (Wentworth scale)
Sediment metals (arsenic, cadmium, chromium, lead, mercury, zinc; all in mg/kg)
Total phosphorus (mg/L)

Aquatic Biological

Phytoplankton (chlorophyll a, # taxa, density as # cells/L, biovolume as mm^3/L) Benthic macroinvertebrates (petite ponar grab; # taxa, density as $\#/m^2$) Benthic macroinvertebrates (dip net in littoral marshes; qualitative as # taxa)

Project 1.2: Aquatic Biological Monitoring

Project Goal: Reinstitute and maintain aquatic biological monitoring at the two sites begun in 1989 (and discontinued in 1991) in order to provide ecological data to supplement the water chemistry monitoring and to track the progress and results of lake restoration efforts.

Concurrent with the water quality monitoring begun in 1989, biological monitoring was conducted in the lake. Benthic invertebrates and phytoplankton were sampled quarterly at two of the three water quality sites (Map 4). This provided data on the ecological condition of the lake. Biological monitoring efforts were discontinued in 1991 along with cessation of water quality monitoring. No routine monitoring of benthos or phytoplankton has been conducted since stoppage of SWIM sampling. Currently the only regular biological sampling done is an annual survey of the aquatic plant community by the Bureau of Aquatic Plant Management, DEP.

Task 1.2.1: Resume Aquatic Biological Monitoring 1996-1999

Concurrent with resumption of water quality monitoring, resume quarterly monitoring of benthic macroinvertebrate and phytoplankton communities at the two sites previously monitored to generate additional data to evaluate water quality and the success of restoration efforts. These two groups of organisms are routinely used in water quality assessment.

Task 1.2.2: Data Analysis and Reporting 1996-1999

Biological data collected in the District's SWIM monitoring program are stored in the SRWMD database "AQBIO." Periodic review and analysis of the data are conducted by SRWMD technical staff using graphical and statistical techniques.

As with the water quality data, biological data will be reported via Technical publications, a publicly-oriented water quality assessment report, and verbal presentations on an "as needed" or "as requested" basis.

Project 1.3: Sediment Monitoring

Project Goal: Reinstitute a sediment quality monitoring program in the lake to evaluate the extent and degree of contamination of lake sediments.

Existing data indicate some degree of enrichment of the bottom sediments of Alligator Lake with the heavy metals cadmium, copper, zinc, and lead (SRWMD internal memorandum). Information developed in this program will be useful for evaluating lake dredging, potential for biological recovery, and levels of contaminant and nutrient reserves in the lake bottom.

Task 1.3.1: Sediment sampling and monitoring 1996-1999

In conjunction with resumption of water quality and biological sampling, the District will incorporate a sediment monitoring program. Sediments will be monitored at least annually at proposed water quality/biological stations, and additional sediment sites (e.g., at or adjacent to stormwater outfalls and tributary inflow areas) may be sampled on a one-time basis to obtain a broader understanding of the distribution and concentrations of metals, nutrients, and, if feasible, other contaminants in the lake bottom.

Project 1.4: Land Cover /Use Monitoring

Project Goal: Develop and maintain an accurate, current database on watershed land cover and land use.

As part of any type of assessment of nonpoint pollutant loading, accurate land use data will be critical. This project will generate and provide these geographic data in a form usable for watershed assessments.

Task 1.4.1: Land Use/Cover Monitoring Project 1995-1996

The District is presently conducting a more detailed mapping of land cover and land use within SRWMD. This project will generate more detailed data for use in watershed pollutant loading assessments. Mapping data will be derived from photo interpretation of 1994-95 aerial photography from the National Aerial Photography Program, followed by digitization into an ARC-INFO geographic database. The data will be updated every 5 years.

Project 1.5: Special Projects

Project Goal: Conduct or coordinate with special studies designed to generate data needed to answer specific questions or problems (includes using data from studies conducted by other agencies or groups).

Task 1.5.1: DEP Biology Section Special Project Coordination 1996-1999

The DEP Biology Section in Tallahassee conducted sampling of water quality and aquatic biota in Alligator Lake in the summer of 1994 as part of:

a) initiation of a statewide ambient lake monitoring program. b) development of lake bioassessment techniques for purposes of assessing status and condition.
c) development of biological criteria for lakes.

Along with monitoring in Alligator Lake, DEP staff also monitored Lake Jeffrey (northwest of Alligator Lake) as a "reference condition" lake. This information will

be useful for understanding potential biological and water quality targets for the lake restoration effort, and the results of this DEP sampling effort will be incorporated into the SWIM planning process.

Project 1.6: Lake Hydrologic Monitoring

Project Goal: Monitor lake hydrology to quantify variation in lake stage.

Monitoring the hydrology of Alligator Lake (the annual changes in the stage, or level, of the lake) will be an important part of the overall management effort, particularly because of the unique characteristics of this lake's hydrology. Collection of adequate data on stage fluctuation in the lake will be needed to develop a hydrologic budget for the lake and to better understand the relationships between lake stage and groundwater levels.

Task 1.6.1: Lake hydrologic monitoring 1996-1999

The SRWMD maintained a continuous stage recorder for several years on the north basin of Alligator Lake, but this unit has been inactive for the past four years. SRWMD also had an observer reading a staff gauge on the south lake for a number of years but this effort is also now inactive. The SRWMD will reactivate stage monitoring in both north and south basins, beginning in 1996. Efforts in the first year will focus on determining which type of gauge to use (continuous recording or observer-read staff gauges) and the best locations to place gauges in each basin.

2. Resource Planning

Program Definition: The Resource Planning element of the SWIM Program encompasses those activities related to the development of plans and strategies for watershed management, and includes activities such as watershed assessments and GIS database development. Included are digital database development, special studies aimed at specific geographic areas (e.g., subwatersheds), conducting specific analyses for the provision of technical assistance to other agencies, and the further identification of management needs and issues.

Project 2.1: Lake Restoration and Management Advisory Group

Project Goal: Develop an ongoing mechanism for coordination with and input from the public and other agencies into the restoration and management process.

As part of the restoration planning process, the District will be the lead agency in forming a working group of state and regional agency staff, local officials and staff, and "stakeholder" groups (e.g. bass clubs, environmental organizations). This group will provide input to the planning process and will review work products produced by the SRWMD consultant developing the lake restoration plan.

Task 2.1.1: Develop a Lake Restoration Steering Committee/Advisory Group 1996-1997

In cooperation with Columbia County, the District will develop (by 1997) an Advisory Committee to provide direction in lake restoration and management.

Task 2.1.2: Meet with the Committee and develop recommendations for lake restoration 1997-1999

The committee will meet as needed during the course of lake restoration. All meetings will be public meetings and will be announced and noticed in local media.

Project 2.2: Lake Restoration Strategy Development

Project Goal: Develop a comprehensive list of feasible scenarios for lake restoration and begin to develop long-term management strategies for the lake.

Contingent upon the acquisition of lands along the lake's eastern shoreline by Columbia County through the FCT Program, the District, through the SWIM Program, will take a lead role in the development of a lake restoration plan.

Task 2.2.1: Select consultant and cooperating agencies 1997

The services of a consultant with expertise in lake restoration and management will be sought to provide analytical services and assist with development of a lake restoration plan. District staff will develop a Request for Proposals to solicit and evaluate potential contractors. District staff will also develop arrangements with cooperating agencies to provide services and assistance in development of restoration strategies.

Task 2.2.2: Data compilation and analysis 1997-1998

One of the tasks of the consultant will be to procure and compile all existing data on the lake, including GIS data from the District's watershed assessment project. Results of this effort should include loadings from point and nonpoint pollution sources, quantification of wetland habitat losses and trend analysis of water quality data.

Task 2.2.3: Engineering and restoration design evaluation 1997-1998

As part of the restoration design process, necessary engineering and diagnostic evaluations will be conducted. For instance, a program to sample runoff from selected storm events will be implemented in order to refine nonpoint loading estimates. Other diagnostic activities will involve assessment of the seed bank potential of the drained lake bottom and wetland areas; diurnal water quality

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studies, topographic mapping of the diked areas, bathymetric mapping of the lake bottom, and sediment contaminant assessments.

Task 2.2.4: Restoration options, strategies and costs 1998

Based on the results of Tasks 2 and 3, a plan will be developed detailing restoration options, scenarios, strategies, and costs. This report will provide the "menu" of choices which can be used by District and state agency staff and local officials to develop a course of action for lake restoration.

Project 2.3: Development of PLRGs

Project Goal: Develop PLRGs per State Water Policy (Chapter 62-40, F.A.C.) which will achieve Class III water quality standards.

Based on the data compilation and diagnostic efforts undertaken in the above project, PLRGs will be developed for the Alligator Lake watershed. This will be done within the context of developing a stormwater management master plan for the watershed.

Task 2.3.1: Watershed Assessment (presently ongoing) 1996-1997

The District is presently conducting a District-wide GIS assessment project to quantify pollutant loadings from each watershed in the SRWMD. The results of this effort for the Alligator Lake watershed will be incorporated into a PLRG effort for the lake.

Task 2.3.2: Pollution Load Reduction Goal Development 1998

As part of the lake restoration planning, the consultant selected to do the work will be tasked with the development of PLRGs for the watershed using results of the District's watershed assessment project, supplemented by additional work (e.g., storm event sampling to refine loading estimates).

Project 2.4: Stormwater Management Plan Development

Project Goal: Develop a stormwater management plan for the Alligator Lake watershed for use in construction of works to retrofit and treat urban runoff from older development constructed prior to implementation of the SRWMD stormwater permitting program.

Based on the discussions presented in the previous section on Priority Issues and Analysis, adequate treatment of storm water from older development in the watershed will need to be a major component of restoration efforts. This will entail development of a stormwater master plan for the watershed.

Task 2.4.1: Stormwater Master Plan 1999

As part of the restoration planning described in Project 2.2, the consultant will be tasked with development of a Stormwater Management Plan for the watershed. This will include plans to "retrofit" development constructed prior to the District's stormwater rules.

Project 2.5: Lake Hydrologic Assessment

Project Goal: Define the hydrology of the lake, including maximum and minimum lake levels, related frequency and duration criteria, lake level fluctuation cycles, and interrelationships between lake level and groundwater levels.

The lake's hydrology influences a variety of ecosystem processes as well as lake characteristics regarded as of value to people (e.g., fishing, recreational use). A better understanding of the lake's hydrology will be of direct management value, particularly if decisions need to be made about stabilizing the lake level.

Task 2.5.1: Lake Hydrologic Assessment 1997-1999

This task will develop a quantitative description of the lake's hydrology, including stage/frequency and duration curves. This effort will include analysis of groundwater level data to better understand the relationship between lake stage and groundwater level. Based on the availability of data to calculate these distributions, one recommendation of this effort may be to conduct additional hydrologic monitoring in the lake before these curves can be developed. This monitoring would be conducted under the Resource Monitoring Program, as described in Project 1.5.

3. Program Implementation

Program Definition: Program Implementation is the action component of the SWIM process, encompassing activities related to carrying out the policies and tasks identified in this SWIM Plan. Included are certain kinds of analyses, presenting results of analyses and special studies, providing products of monitoring or planning programs, such as maps and reports, recommending or instituting rule changes based on special studies or analyses, undertaking specific enforcement activities, intergovernmental or interagency coordination efforts, environmental education efforts, and providing ongoing technical assistance to members of the public, other agencies, or local government. Related implementation activities undertaken by the District include administration of regulatory programs, land acquisition, and land management activities. These are not SWIM programs, but through assistance from and coordination with SWIM, they fulfill goals, objectives, and policies presented in this SWIM Plan.

Project 3.1: Environmental Education

Project Goal: Incorporate environmental education elements into the overall restoration and management of Alligator Lake.

As a large, aquatic conservation area within an urban setting, the project will provide many opportunities for environmental education efforts, involving cooperative efforts with local school systems (which may include Columbia, Union, Baker, and Hamilton counties) and environmental organizations. The Columbia County School Board and Superintendent of Schools have expressed interest in exploring ways to incorporate and develop environmental education programs using the lake and the acquired land areas. The Columbia County School System has already hired two staff positions to implement a comprehensive environmental education program in the county school system.

Task 3.1.1: Coordination with Columbia High School Environmental Academy 1997-1999

The recent establishment of an Environmental Academy at the Columbia High School South campus, adjacent to the lake, creates a myriad of opportunities for environmental education and service. These may include using the students and faculty of the academy to assist in establishment of a Regional Nature Study Center on the acquired lands, use of students to assist with planting and monitoring of restored wetlands, use of students to assist with other monitoring (water quality, biological, bird census, etc.), and using school programs to help develop nature trails (including building interpretive exhibits). An SRWMD staff member sits on' the Advisory Council for the academy. Through continued coordination with this program, efforts will be made to link restoration needs and efforts with the academy programs.

Task 3.1.2: Other Environmental Education Initiatives 1997-1999

In conjunction with the Lake Restoration Steering Committee and the SRWMD Environmental Education Coordinator, an ongoing program of environmental education oriented toward various age groups will be developed. Embedded within the overall efforts to restore and manage the lake, this education effort will convey concepts associated with water quality protection, aquatic ecology, fisheries management, stormwater management, and watershed management. Tools used may include newspaper and radio spots, videos, brochures and pamphlets, public presentations, and special events.

Project 3.2: Public Involvement and Use

Project Goal: Inform the public about the lake's restoration, call attention to lake management needs, and enlist public participation in management and protection

of surfacewater resources in the watershed.

A key feature for the protection of the lake will be to enlist the help of the public in its management and, to the greatest extent possible consistent with protection of its natural communities and wildlife, encourage public use of the area. When the people who live in the area use and enjoy the lake and surrounding lands and feel they are partners in its protection, they will value those resources much more and support local and regional government expenditures of personnel and money to protect and maintain the area. To this end, a key component of the restoration and management of the lake will be the design and construction of public access features and development of features to attract public use and attention. These will include design of boardwalks/trails for walking access and a canoe trail in the lake. SWIM cannot fund the construction of any recreation facilities, but the program can incorporate the design of recreation facilities into the overall project design, and other, more appropriate funding sources could then be secured to actually construct the facilities.

Task 3.2.1: Public awareness efforts 1996-1999

Public awareness efforts may be undertaken to call attention to lake management and protection. These may include trash cleanups, painting signs on storm drains to the lake to discourage dumping of oils or chemicals into them, news features in local papers, and production of informational brochures about the lake and the restoration project.

Task 3.2.2: Fisheries Enhancement 1998-1999

Lake fisheries production should be improved by lake restoration. The objective of this task will be to work with the FGFWFC to improve public access to and use of the fishery resource. Efforts to meet this objective may include contouring/shaping of the lake bottom for fish habitat improvement, in conjunction with use of portions of the existing dikes for land-based fishing access, construction of access boardwalks and fishing piers, and improved fishery management (e.g., stocking, installation of fish attractors and feeders, etc.). Design efforts for this will be a component of the overall restoration plan for the lake and will be conducted in close cooperation with the FGFWFC. Some of the funding for implementation may come from SWIM, since activities such as lake bottom recontouring are regarded as habitat restoration. Other funding may come from FGFWFC sources for specific fisheries-related improvements.

Task 3.2.3: Canoe Trail Planning 1999

During lake restoration planning, a self-guided, scenic canoe trail will be designed. This trail will wind through the natural areas in the lake and also through some of the restoration sites. The trail may provide access for

monitoring of the restoration, either by District staff, consultants or by citizen volunteers or students. Signposts would guide paddlers on the route and educational signage would explain natural features on the route.

Task 3.2.4: Nature Trail Planning 1999

An upland nature trail/wetland boardwalk complex will be designed as an additional outdoor recreation/environmental education feature of the site. As with the canoe trail, SWIM can fund the design of the facility but funds for actual development and construction will come from other sources.

Project 3.3: Long-term Management

Project Goal: Develop plans, and identify responsible entities for long-term management and protection of the lake and its natural systems.

A mechanism to manage the lake in perpetuity will need to be developed to protect the investments made in habitat restoration, outdoor recreation development, and water quality improvement.

Task 3.3.1: Lake Management Planning 1999-2002

Working with the advisory group described in Project 2.1, a long-term lake management plan will be prepared. This plan will include identification of Operation and Maintenance entities and funding mechanisms.

Project 3.4: Local Government Technical Assistance

Project Goal: Provide technical assistance to support local and regional land use planning and regulation in the Alligator Lake watershed. Coordinate planning activities with local governments and the Regional Planning Council to better integrate land and water planning.

It has been stressed in this SWIM Plan that local land use decisions have a great influence on water quality and habitat in Alligator Lake. Because of a limited tax base, both Lake City and Columbia County lack technical staffs able to develop and implement the level of land planning found in more highly urbanized counties and cities. A key component of the SRWMD SWIM Program is the provision of data, analysis, and technical assistance to local governments to assist in making sound land use decisions which prevent harm to water and related natural resources.

Task 3.4.1: Land and Water Planning Coordination 1996-1999

As requested or required, provide location-specific technical assistance to Columbia County and Lake City relating to land use planning, impact analyses, development review, facility development or siting, water quality problems or

issues, ecological analyses, or other issues or problems. **Task 3.4.2:**

Stormwater Master Plan Implementation 1999

Because of the necessity for stormwater planning and retrofit in the lake restoration effort, and because this will heavily involve the City and the County, the District will provide ongoing assistance to these two local governments in the implementation of the stormwater plan developed in Project 2.4.

4. Restoration Implementation

Program Definition: This program includes activities related to restoring or improving degraded water quality, habitat restoration, or activities to provide mitigating or compensatory actions. Problems identified due to violations of permit terms or rules will be referred to other District programs or agencies for appropriate compliance and enforcement. Problems not related to regulatory compliance and enforcement are addressed in this section. Activities may include assisting local governments in planning and designing stormwater retrofit projects and master plans, designing and implementing erosion control or shoreline stabilization projects, wetland restoration efforts, etc.

The National Research Council (1992) has identified several key concepts for lake restoration projects that need to be considered in the development of the Alligator Lake program:

- Lake restoration must be conducted within a watershed context. From a technical standpoint, the watershed is the most logical scale at which to undertake restoration.

- Effective lake restoration demands an "ecosystem" perspective. It often depends on land use in the surrounding watershed and interacts with the management of connecting streams and wetlands. Additionally, restoration of processes as well as habitats should allow development of a "selfmaintaining" system which will be cheaper for long-term operation and management.

- Goals for lake restoration need to be realistic and based on the concept of "expected conditions" for the region the lake is located in.

- Lake restoration is still a developing science. Every project is an opportunity to learn; monitoring is an important component of this process.

- Public education and involvement must be components of lake restorations.

Wherever feasible in the restoration effort, short-term, smaller scale restoration projects will be implemented to provide "demonstration projects" to show what types of restoration efforts will be happening and to demonstrate that these will work as intended.

Project 4.1: Land Acquisition

Project Goal: Provide technical assistance, as requested, to acquire lands needed to implement lake restoration.

A crucial aspect of an overall lake restoration and management program for the lake is acquisition of the privately owned, diked lands on the lake's eastern shore. This will be achieved by working with staff from Columbia County and the FCT Program to implement acquisition under the FCT Grant awarded to the county.

Task 4.1.1: Land Acquisition Technical Assistance 1996-1997

Columbia County has been awarded a grant from the FCT Program to purchase the diked lands on the east shore of the lake. The proposed project is shown in Map 5. The county was assisted in preparing the grant application by the North Central Florida Regional Planning Council (NCFRPC) and SRWMD. SRWMD will continue to provide technical assistance as requested to the county, the NCFRPC, and the FCT staff to assist in the acquisition process.

Project 4.2: Lake Restoration Implementation

Project Goal: Restore lake water quality to Class III standards and restore historic lake bottom and fringing wetland habitat to historic conditions.

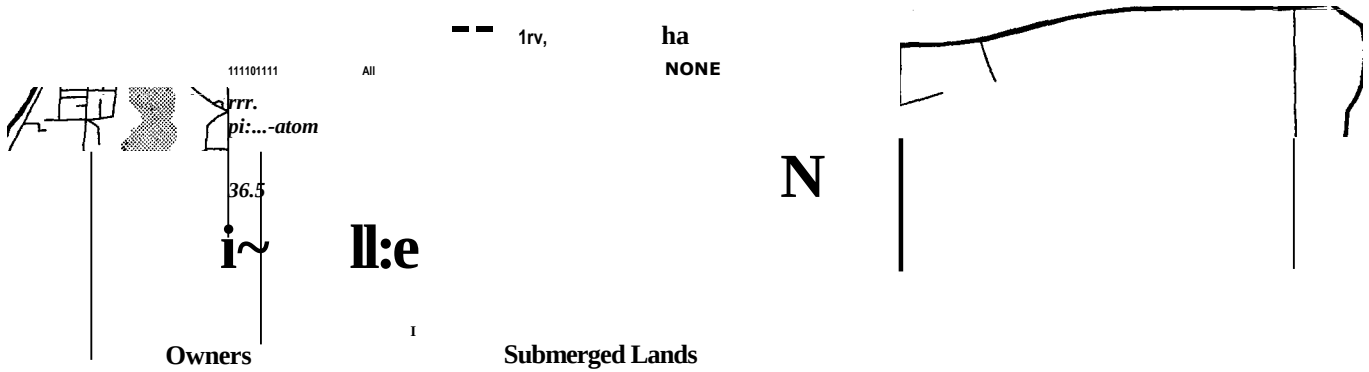
Contingent upon the acquisition of the lands on the lake's eastern shore, and the availability of SWIM funding, the District will oversee the implementation of the restoration plan developed in Project 2.2. SWIM funds, if available, may be used as "seed money" to begin restoration efforts, but because of the anticipated magnitude of the project it is believed that additional funding sources will need to be sought.

Task 4.2.1: Water Quality Improvement 1999-2003

The lake currently does not meet state Class III water quality standards (Table 2). The objective of this task is to restore lake water quality to meet these standards. One means of water quality improvement will be restoring historic wetlands. By restoring wetlands, a large "nutrient sink" will be created which may help reduce nutrient and chlorophyll a levels in the lake. In addition, a component of the lake restoration planning process will be development and implementation of a master stormwater plan for the areas draining to the lake. Implementation of drainage retrofit projects may result in routing of storm

water through the restored wetland, providing treatment of this runoff.

Map 5
Alligator Lake Land Parcels In F.C.T. Purchase



-- 1rv, ha

NONE

Owners

Everett Rogers

11 El Rancho No Tengo

Jeffrey Hill Leonard P Hill

Submerged Lands

Everett Rogers

El Rancho No Tengo

This map was prepared for informational purposes and does not conform to National Map Accurancy Standards.

Department of Water Resources

NO

N

Alligator Lake

Hydrography

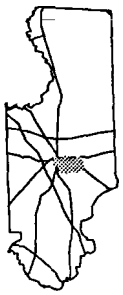
N Major Roads Lakes

& Swamps

Scale: 1:50,000

Miles

0 .5 1



Task 4.2.2: Aquatic Habitat Restoration/Protection 1999-2003

Another major objective of restoration implementation will be the restoration of the diked lands on the lake's eastern shore to their historic condition as wetlands and submerged lake bottom. Other components of habitat protection will be habitat management to improve wildlife value (e.g., controlled burning in marshes), improved management of exotic/nuisance aquatic plants, and educational efforts for lakefront property owners for the management and protection of lake shoreline vegetation. It is anticipated that cost effective wetland restoration in the diked areas may be achieved by restoring hydrology to these areas; breaching the existing dikes to allow natural flooding and draining of the lands. Growth of wetland vegetation would proceed from a natural "seed bank" in the existing soils on the site. The existence and potential of this seed bank can be done easily and will be evaluated during the restoration planning process. Additional restoration focused on restoring forested wetland systems may involve planting of wetland trees.

Task 4.2.3: Exotic Aquatic Plant Control 1999-2003

Alligator Lake (particularly the south basin of the lake) is periodically infested with the exotic aquatic weed *Hydrilla*. Staff with the DEP Bureau of Aquatic Plant Management have noted that a major constraining factor for control efforts is limited funding. As part of the overall restoration effort, an increased level of funding will be sought to provide adequate control of exotic and nuisance aquatic plant growth. These efforts will be conducted in conjunction with the DEP regional aquatic plant biologist and the FGFWFC.

Task 4.2.4: Funding 1999-2003

It is anticipated that a major need to implement lake restoration will be the dollars to do the work. For this reason, this topic is identified as a distinct task in the restoration implementation effort. Funding sources include SWIM, the Pollution Recovery Trust Fund, existing state programs (e.g., FGFWFC Lake Restoration Program) or grants from federal programs (319 Program grants, "Clean Lakes" Program, 205(j) Program grants). For many of these, detailed applications will have to be prepared. The SRWMD will provide assistance to agencies applying for these grants or may be the lead agency in applying for one or more of these grants to implement lake restoration.

5. Waterbody Planning

Program Definition: Waterbody planning includes activities involved with the ongoing SWIM planning process as it affects Alligator Lake. Specifically, such plan administration tasks as annual plan review, evaluation of implementation progress, minor revisions, program administration (budget development, quarterly reports and requests to. DEP for reimbursement from the SWIM Trust Fund), and

ongoing planning fall within this category.

Recognizing that the SWIM planning and management process for Alligator Lake is an ongoing one, this program provides for periodic review and analysis of the overall program, the projects conducted to accomplish management objectives, and the individual tasks that comprise the projects. As tasks are implemented and the SWIM program progresses, it becomes necessary to redefine aspects of the program in order to meet the management needs of the lake and the agencies and governments involved with its protection and management.

Project 5.1: Annual SWIM Plan Review and Evaluation

The Alligator Lake SWIM Program is an ongoing one - it must respond to the changing needs of the lake system and the management issues associated with it. In order for the program to be successful and an effective use of the public's resources, SWIM Plans must be periodically reviewed, appraised, and modified as needed. The periodic, systematic evaluation of the plan by SRWMD, DEP staff, and other agencies will help ensure that the program can respond to changing conditions and needs.

Task 5.1.1: Alligator Lake SWIM Plan Review and Evaluation 1996-1999

An annual review and evaluation of the Alligator Lake SWIM Plan and the implementation of its programs, projects, and tasks will be conducted. Annual evaluation reports will be prepared for the SRWMD Governing Board, DEP, and involved agencies and local governments.

Task 5.1.2: Alligator Lake SWIM Plan Revision - 1999

Update or revise Alligator Lake SWIM Plan according to the degree of successful implementation of the projects and tasks identified in this plan. This task may result in a substantially revised plan or a minor update.

Project 5.2: Annual SWIM Priority List Review,

The SWIM Priority List should be reviewed and evaluated each year to ascertain the priority ranking of the Alligator Lake system or the need for additional priority waters within the District.

Task 5.2.1: Annual Priority List Review 1996-1999

The District's SWIM Priority List will be reviewed annually and evaluated for the need for revisions to the Alligator Lake priority ranking.

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APPENDIX A

Governmental Units with jurisdiction in the Alligator Lake Watershed

GOVERNMENTAL UNITS WITH JURISDICTION IN THE ALLIGATOR LAKE WATERSHED

FEDERAL AGENCIES

U. S. Army Corps of Engineers

Responsibilities include wetlands dredge and fill permitting and navigation channels.

U. S. Environmental Protection Agency

Responsibilities include permitting point sources of pollution and overseeing state water quality programs consistent with the Clean Water Act.

U. S. Fish and Wildlife Service

Responsibilities include National Wildlife Refuge management and Endangered Species Act administration and enforcement.

STATE AGENCIES

Department of Environmental Protection

Responsibilities include permitting point sources of pollution, landfills, and linear transmission facilities, water quality classifications and monitoring, aquatic plant control and permitting, State land acquisition and management, SWIM program administration, and oversight of water management districts.

Department of Transportation

Responsibilities include state roads and associated stormwater management systems.

Department of Agriculture and Consumer Services, and Division of Forestry *Responsibilities include pesticide and herbicide management, consumer affairs, State Forest management, and biennial review of forestry Best Management Practices compliance.*

Department of Community Affairs

Responsibilities include local comprehensive plan review administration, Developments of Regional Impact, and the State Land Development Plan, Florida Communities Trust.

Department of Health and Rehabilitative Services

Responsibilities include administration of onsite sewage treatment and disposal systems regulations in conjunction with county public health units, health advisories on fish consumption.

Game and Fresh Water Fish Commission

Responsibilities include Fish and Wildlife Management Areas, fisheries research, and administering and enforcing game and fish regulations.

REGIONAL AGENCIES

Suwannee River Water Management District

Responsibilities include stormwater, water use, well construction, and wetlands regulations, SWIM plan development and implementation, water quality and quantity monitoring, land acquisition and management, and environmental education.

North Central Florida Regional Planning Council

Responsibilities include Strategic Regional Policy Plan development and implementation, Developments of Regional Impact, review of Federal projects (A-95 review), and providing technical planning assistance to local governments.

LOCAL GOVERNMENTS

Responsibilities include local comprehensive plan development and implementation, administering land development regulations, and the operation and maintenance of public facilities.

COUNTIES	*CITIES*
Columbia County	Lake City

APPENDIX B

Proposed Budget for Alligator Lake
SWIM Program 1996-1999

ALLIGATOR LAKE PROPOSED BUDGET: 1996-1999

PROGRAM	1996	1997	1998	1999
Resource Monitoring				
Salaries, Benefits, Expenses, and	$1,000	$6,000	$6,000	$6,000
Equipment				
Contracts		$29,000	$29,000	$29,000
SWIM Trust Fund (80%)	*$0*	$29,000	$29,000	$29,000
SRWMDMatch (20%)	*$1,000*	$6,000	$6,000	$6,000
Total	$1,000	$35,000	$35,000	$35,000
Resource Planning				
Salaries, Benefits, Expenses, and	$1,000	$12,000	$62,500	$62,500
Equipment				
Contracts	$0	$0	$250,000	$250,000
SWIM Trust Fund (80%)	*$0*	*$0*	$250,000	$250,000
SRWMD Match (20%)	*$1,000*	$12,000	$62,500	$62,500
Total	$1,000	$12,000	$312,500	$312,500
Program Implementation				
Salaries, Benefits, Expenses, and	$0	$1,000	$2,500	$6,250
Equipment				
Contracts	$0	$0	$10,000	$25,000
SWIM Trust Fund (80%)	*$0*	*$0*	*$10,000*	$25,000
SRWMD Match (20%)	*$0*	*$1,000*	$2,500	$6,250
Total	*$0*	*$1,000*	$12,500	$31,250
Restoration Implementation				
Salaries, Benefits, Expenses, and	$0	$0	$5,000	$12,500
Equipment				
Contracts	$0	$0	$0	$50,000
SWIM Trust Fund (80%)	*$0*	*$0*	*$0*	$50,000
SR WMD Match (20%)	*$0*	*$0*	*$0*	$12,500
Total	*$0*	*$0*	*$0*	$62,500
Waterbody Planning				
Salaries, Benefits, Expenses, and	$1,000	$1,000	$5,000	$5,000
Equipment				
Contracts	$0	$0	$0	$2,500
SWIM Trust Fund (80%)	*$0*	*$0*	*$0*	$2,500
SRWMD Match (20%)	*$0*	*$0*	*$0*	$5,000
Total	$0	$0	$0	$7,500