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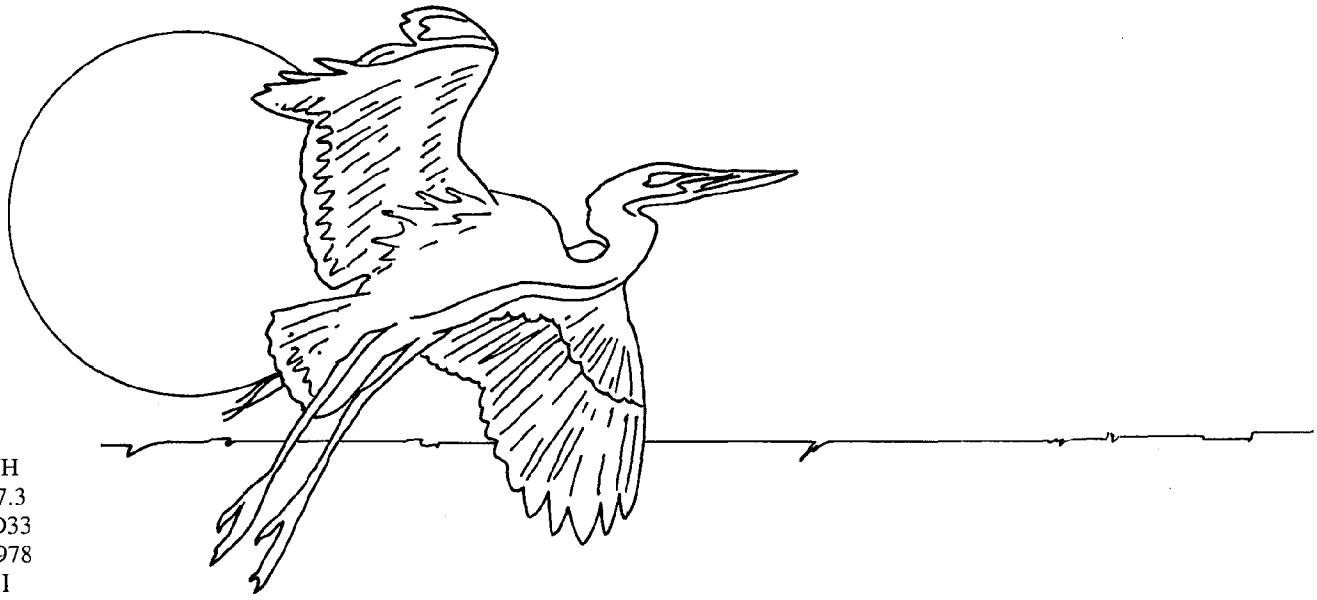
wetlands demonstration project

Volume I PROJECT REPORT



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Dade County Wetlands Demonstration Project

MAY 22 1978

Volume I
Project Report

Dade County Planning Department

In Conjunction with the Bureau of
Coastal Zone Management, Florida
Department of Environmental Regulation

February 1, 1978

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DADE COUNTY WETLANDS PLANNING/MANAGEMENT DEMONSTRATION PROJECT

1. INTRODUCTION

The Dade County Wetlands Planning/Management Demonstration Project was conducted by the Metropolitan Dade County Planning Department pursuant to a Federal Inter-agency Demonstration and Comprehensive Planning Grant. Federal agencies participating in the funding of the project for fiscal year 1976 included the U.S. Department of Housing and Urban Development and the Bureau of Coastal Zone Management. This report summarizes the project.

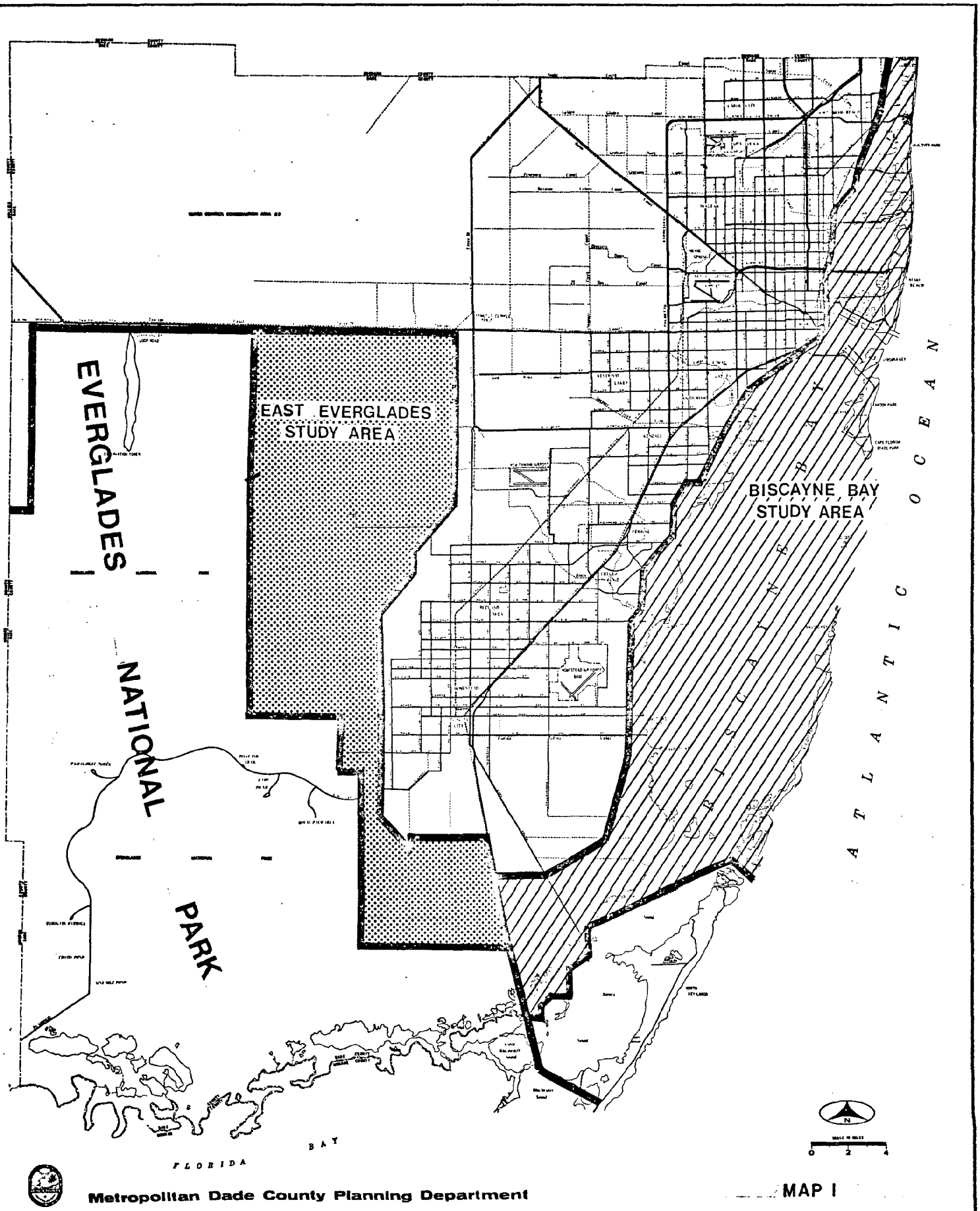
1.1 PURPOSE

The overall purpose of the project was to demonstrate techniques of coordination and socio-economic/environmental analysis of land use and resource allocations in a multi-jurisdictional, multi-programatic geographic area of critical natural environmental, agricultural and urban development interfaces - the wetlands of Dade County, Florida. These wetlands are of two distinct, though related types; the waters and adjacent shores of Biscayne Bay and the marshes and sloughs of the eastern edge of the Everglades. Both of these areas have histories of land use conflicts and misuses. Both rest within Federal, State, regional and local governmental jurisdictions with resource planning/management responsibilities. Also, both share an absence of effective comprehensive resource management policy at all levels of government. The Biscayne Bay coastal fringe and the East Everglades are arenas within which divergencies among the economic, social and environmental goals of the metropolitan area come into focus (see Map 1). Along the Bay fringe, these divergencies are most obviously represented by market place competition among residential, marine and non-marine essential recreation, industrial, and commercial land and water uses, as well as natural areas required for the maintenance of environmental values. These latter areas include Biscayne National Monument and the Biscayne Bay Aquatic Preserve. In the glades area to the west, land use issues relate to agriculture retention and expansion, limerock mining, suburban expansion and east Everglades National Park protection.

The goal of the project is to define management responsibilities in these wetlands areas, identify resource management gaps and duplications, and recommend immediate means of improving planning and management in these areas. A special focus of the study was to develop methods for economic analysis of resource conflicts.

1.2 METHODOLOGY

Upon approval of the project, the first tasks to be undertaken were to refine the study proposal and to prepare a work plan. This involved identifying the planning/management conflicts more



Metropolitan Dade County Planning Department

MAP I

precisely and organizing the study into discrete components to deal with each of these situations.

The resources for conducting the study were identified as primarily staff with assistance from consultants. Staff was hired and the need for two types of consulting assistance was identified. The firm of Wallace, McHarg, Roberts and Todd of Philadelphia, Pennsylvania was selected as general advisory counsel with broad experience in planning and Dr. Daniel Bromley, a professor from the University of Wisconsin, was selected as the consultant with special experience in economic analysis of environmental resources.

Staff and consultant capabilities were supplemented with technical advisory committee assistance. An overall advisory commitee was created comprised of staff representatives from the following:

Dade County

Planning Department
Park and Recreation Dept.
Development Impact Committee
Dept. of Environmental Resources Mgmt.
Cooperative Extension Department

Region

South Fla. Regional Planning Council
Central and South Fla. Water Mgmt. District

State

Dept. of Environmental Regulations
Dept. of Administration
Division of State Planning

Federal

Environmental Protection Agency
Fish and Wildlife Service
Army Corps of Engineers
U.S. Geological Survey
National Park Service

In addition to the overall group, four technical advisory sub-groups were formed to deal with the Biscayne Bay sub-area, the East Everglades sub-area, legal aspects and economic/social considerations. The membership in the sub-groups was augmented with legal, scientific and economic expertise from throughout the Dade County community.

During the course of the study, the inter-agency groups met on three occasions and the technical sub-groups met numerous times to respond to the preliminary work of the staff and consultants.

The format of the final document followed revision of the study into the two sub-areas, Biscayne Bay and East Everglades. The final reports of the project are divided into two volumes. Volume I presents a summary of the total study effort and Volumes II and III contain special technical information developed from the economic analysis and environmental performance standards aspects of the project.

1.3 CONCLUSIONS

The conclusions of the study reflected in the findings and recommendations are found in Sections 2.33 and 3.33. However, the overall conclusions can be summarized as follows:

1.31 Study Approach

The benefits of having inter-agency and government consideration of common problems associated with planning/management were demonstrated by the study. A significant level of cooperation was demonstrated by the numerous participants to the study in their commitment to attend the various meetings and review and comment on the study preliminary and final product. However, difficulties were also identified. Some of the basic difficulties of local government conducting demonstration/research activities came to the forefront when problems of dealing with previously established positions were encountered and the demand for locally applicable products was stressed. There was on several occasions reminders that participation by representatives of some of the entities does not constitute any commitment on the part of that agency to the product. Endorsements from the several agencies must be obtained on an individual basis in utilizing their operating procedures. Although inter-agency communication and cooperation was just beginning to materialize in the demonstration study, it laid an important predicate for continuing follow-up study efforts that have had a higher degree of coordination and particiation out of multi/jurisdictional entities.

1.32 Study Findings

Water quantity and quality remain the central concern in the wetlands area. A complex set of physical relationships are united around a common dependency on this medium. Because of the wetlands areas remoteness and vastness, little is known of the details of the physical environmental complex relationships of these areas. This lack of data renders it difficult to establish the social and economic parameters of the area as well. The several levels of government with planning/management responsibilities in the wetlands areas have elected either to proceed to enforce, or not enforce, their responsibilities on the basis of the information available. Their

independent actions have led to inconsistencies in their approach to their planning/management responsibilities. Also, considerable confusion exists between the delineation of responsibility between the several levels of government involved in wetland planning/management. Some agencies have been required to take the initiative to properly prepare for the decisions they face, others have been able to take a passive role. Often one government jurisdiction is waiting for another to act. Once these passive and active roles have been established it is difficult to change the pattern. Considerable improvement in planning/management in the wetlands areas could be achieved from better coordination of the responsibilities and resources currently applicable to the several governmental jurisdictions involved.

1.33 Study Recommendations

The specific to the recommended actions for the two study areas are as follows:

1.331 East Everglades

1) Designate East Everglades as an area of critical environmental concern, utilizing local and State procedures, as a means of full and coordinated commitment for preserving the natural functions of the area.

2) Develop and adopt interim environmental regulation performance standards in permitting processes that will provide for a site alteration permit and a review by a County committee, augmented by State and Federal agency representatives.

1.332 Biscayne Bay

1) Establish suitable planning/management organization including a planning council and staff with the objective or preparing a comprehensive Bay fringe/water plan.

2) Structure a comprehensive/planning management program addressing the problems and concerns and developing solutions to bay considerations.

3) Secure planning/management funding giving special consideration to Coastal Zone Management Grant programs.

2. EAST EVERGLADES

The East Everglades area is an integral part of the Everglades basin which occupies an irregularly defined area of about 4,000 square miles extending from slightly north of Lake Okeechobee to the salt water and mangrove swamps which border Florida Bay on the south. The unique features of this broad fresh water land has been recognized in the designation of a major portion as the Everglades National Park. More recently, an additional portion has been designated as the Big Cypress Swamp Preserve. The delineation of these wetlands is imprecise and the designation of the Park boundary left out what has been found to be increasingly important buffer lands to the east of the Park and west of the spreading agricultural and urbanization areas of metropolitan Miami.

Over the years, the natural wetlands functions and developmental potential of this area has increasingly come into conflict. As urbanization has expanded westward from suburban Miami, agricultural activities have had to move further west ahead of subdivision development. Both of these activities have increased the pressure for drainage of the East Everglade area to accommodate their needs for water control. The water quantity and quality alteration of urban and agricultural activities have produced heightened concern for the preservation of the Everglades Park which is impacted by the surface water flows out of the East Everglades area. A situation that might normally be characterized as a classic wetlands management problem is made unusual by the multi-jurisdictional involvement of the Federal, State, Regional, and County governments in dealing with this national resource. Following the discussion of the setting and problems and issues, planning/management approaches for this wetlands resource management problem are suggested.

2.1 SETTING

The East Everglades study area is located in southwest Dade County, Florida. The area is bounded on the north by the Tamiami Trail (US 41), on the west and south by the Everglades National Park and on the east by Levee 31 (L-31). The southern part of the study area (the Canal 111 area) extends east to US-1 and north to an unnumbered canal (see Figure 2). This area is approximately 300 square miles in size and lies wholly within unincorporated portions of Dade County.

2.11 The Biophysical Environment

Like all of southern Florida, the East Everglades is characterized by a sub-tropical marine climate, distinguished by a long, warm summer with abundant rainfall ($\pm$ 60" per year) and a mild, dry winter. The area is comprised of low lying gladelands west and south of the urbanized Atlantic coastal ridge and upstream from the

Everglades National Park. The environmental significance of the study area is largely due to the direct flow of the surface waters into the National Park and the water storage and ground water recharge functions essential to public and private water supplies of Dade and Monroe Counties.

The geology of the study area is marked by highly transmissive water-bearing limestone known as the Biscayne Aquifer. This aquifer underlies nearly all of Dade and Broward Counties and is the only source of fresh water supply for the two counties. The rock surface of the aquifer is exposed in much of the study area or is covered by only a thin mantle of soil and plant material (see Figure 3).

The ground water under the study area moves downgradient to the southeast from a high in northwest Dade County. Thus, the rains that fall within the East Everglades act to replenish the waters pumped out of the Biscayne Aquifer for drinking and irrigation uses in southern Dade County. In addition, the fresh water head developed by the recharge of ground water in the study area prevents further intrusion of salt water at the base of the aquifer (see Figure 3).

Within the East Everglades three physiographic areas are identifiable. From north to south they are: the Shark River Slough, the Rocky Glades, and the Southern Coastal Prairie (see Figure 4).

1) Shark River Slough. This is the headwater area for the major watercourse in the Everglades National Park. The area is a shallow basin approximately six feet above sea level with a northeast - southwest orientation. Most of the area is wet nearly year-round. During the rainy season the water table rises in excess of two feet above much of the land surface.

Soils in this basin are primarily accumulations of peat and muck which grade into rockland and outcrops of limestone in the south and southeast confines of the basin. Characteristic of the Shark River Slough is the periphyton or algal mat; a complex biotic community consisting primarily of bluegreen and green algae, as well as diatoms, desmids and other microscopic plants and animals. This periphyton community is the foundation of the Everglades food web.

Within the slough, aquatic plants grow profusely, especially the bladderworts, coontail moss, spider lily, bonnets, and a few grasses. Sawgrass usually grows along the slough borders. Many tree islands

of various sizes are found in the basin. Their vegetation is mainly whitebay and sweetbay, wax myrtle, and dahoon holly, with an undergrowth of royal fern, cinnamon fern, and swamp fern.

Wildlife species which nest or feecd in the slough include the Wood Ibis, Snowy and American Egrets, Everglades Kite, Everglades Mink, Round-tailed Muskrat, White-tailed Deer, and American Alligator. These species which include rare and endangered wildlife, migrate freely from the Everglades National Park into the Slough. This area is especially valuable as a feeding area for a large population of wading birds during the early part of the dry season.

2) Rocky Glades. This area lies between the Shark River coastal prairie of Everglades National Park to the south. Land elevation in the rocky glades approaches seven feet above mean sea level. The land is characterized by rough, rocky outcropping of limestone eroded into landforms known as pinnacle rock.

The primary value of the rocky glades is as a ground water recharge and storage area. Precipitation collects in depressions in the eroded limestone and percolates downward to the water table where it adds to the freshwater head. This supports the characteristic surface flow of Taylor Slough into the Everglades National Park. It also helps maintain ground water flow toward the public wellfields in the vicinity of Homestead and Florida City.

Vegetation in the area is mainly sawgrass, switchgrass, beardgrass, sedges and rushes, with some bayheads and hammocks interspersed throughout. Hammocks are slightly above water most of the year. Bayheads and swamp plants exist in the sloughs and on the lower elevations. A striking scarcity of tree islands is noticeable in the eastern third of this province within the study area.

Wildlife common to the Everglades National Park and Shark River Slough inhabit this area. In addition, portions of the area has been designated as critical habitat for the Cape Sable Sparrow.

3) Southern Coastal Glades. Historically, fresh water flowed during the wet season as a vast sheet from the vicinity of Florida City southward through this marl gladeland to the coastal estuaries. Today, partially as a result of the construction of flood control works, the remaining flow into the coastal area from the north is intercepted. The levee on the north side of Canal-111 (C-111) causes a considerable ponding of water in the

southeastern corner of the study area where C-111 intersects US 1.

Hydrologically, this sub-area is similar to Shark River Slough in that the area is wet most of the year. The persistence of inundation is the primary causal factor in the formation of peat and marl soils. Elevations for this sub-area average one to two feet above sea level.

The southern coastal gladeland is critically linked to the functioning of the brackish water estuaries -- the nurseries for infant shrimp and fish. Basic to the immense productivity of South Florida's estuaries is the terrestrial inflow of fresh water from the coastal glades which seasonally moderates estuarine salinities and transports detrital and other food sources for the juvenile marine organisms. Maintenance of a broad brackish zone and a gradual salinity gradient is a critically important function of the sheet flow from this part of the study area to the coastal estuaries.

Perrine marl is the dominant soil of the southern coastal area. The Perrine marl is derived from unconsolidated finely divided calcareous sediments. Various depths of the marls can be found within this physiographic area, with the deepest phases approaching six feet. Some marls have a peat substratum. All of these marls drain slowly, even when influenced by canals.

Vegetation in the coastal gladelands is characterized by sawgrass and various other sedges and rushes. Elevated tree islands are present here also, and are occasionally distiniguished by the occurrence of cypress trees. In addition, a number of mangrove strands extend into the study area from the coastal area to the south.

Wildlife in the southern coastal gladelands is characteristic of the Everglades Park species, including the Bald Eagle, Osprey, and numerous wading birds. The southern half of this subarea has been designated critical habitat of the American Crocodile, and the receiving waters in Florida Bay are part of the critical habitat for the Manatee.

In summary, the East Everglades is of particular significance to the County, State and Nation as a large element in a unique ecological system. Several of the most important characteristics of this environment are summarized below:

- Very subtle changes in land elevations produce dramatic changes in vegetation;

- The Everglades is a semi-aquatic habitat, similar to lakes and rivers inasmuch as the base of the food web is a community of algae, desmids, diatoms and similar life forms;

- Plant and animal life cycles are intimately keyed to the annual cycle of wet and dry seasons;

- The broad zone of brackish water where the Everglades intermingle with Florida Bay is critical to the health of the fisheries and rookeries of the marine, bird, and other life forms that migrate from their origins in the Everglades to many parts of the continent and oceans;

- The Everglades, including the study area, provides a habitat for numerous rare and endangered wildlife populations; and,

- The limestone strata which outcrops in the study area is one of the most permeable aquifers in the world.

2.12 Land Use and Economic Conditions

Historically, land uses in the study area have been quite limited. Seasonal flooding and highly fissured limestone topography have restricted almost all human activity from the area other than hunting and similar recreational activities. The recent placement of roads within the area (frequently without permit) combined with innovations in agricultural technology, have facilitated an increase in development. Now, in addition to a few remote hunting cabins, there are several homes, numerous agricultural operations, and abundant trash dumps within the study area. A sailplane airport with a grass runway is located just south of Chekika Hammock State Park.

Almost all of the land in the East Everglades is zoned General Use (GU) by Dade County. Under that classification one dwelling unit per five acres is the maximum allowable residential density. Agriculture use generally requires a zoning change, and mining requires a special use permit. Most of the study area is designated Environmentally Sensitive by the adopted Dade County Comprehensive Development Master Plan.

Mining uses have not occurred on a significant scale within the area. The abundance of existing mining sites outside the study area operating far below capacity (due to current economic conditions), combined with dredge and fill restrictions in wetlands, make mineral extraction of limited concern at the present. Recreation uses, including hunting, wildlife observation and off-road vehicle (ORV) use have historically occurred in the East Everglades. The amount of use is unmeasured. There are clearly visible destructive effects from ORV and firearm use. Camping, swimming and picnicking facilities are available at Chekika State Park.

Within the East Everglades, only the central rockland area (Figure 4) can be farmed with existing technology and under the current hydrologic regime. The enforced absence of water control by the South Florida Water Management District prevents growing sugar cane or other crops in the peat soils of northeast Shark Slough, and the salinity and low elevations in the coastal glades below Ingraham Highway prevent farming there. Only within the central rockland area where the average annual high water table has been lowered by the L-31 project has farming occurred. The lower water table is caused by the highly transmissive limestone. Water levels are lower closer to the canal, and farming is presently confined largely to this area abutting L-31. Technological development in recent years has allowed the breaking up of the rockland (exposed limestone bedrock) and the building of elevated planting beds of small (1" to 2" diameter) rocks. This plowing and bedding technique has reduced the flood risk for crops grown during the dry winter months to a level low enough to generate agricultural operations along the levee in the rockland area, and even farther west on slightly elevated rockland near Chekika Hammock State Park. The rockland is generally conceded as too wet for groves. However some groves exist west of the levee, including an "experimental" grove of mangos, the most flood-tolerant fruit trees.

The two conditions critical to the success of commercial agriculture in the East Everglades are 1) sufficient period free from flooding and 2) absence of severe microclimatic conditions. Generally, virgin land cannot be profitably farmed by rockplowing and bedding unless a high-value crop such as tomatoes can be raised. However this crop requires a minimum 120 days of dry soil. Furthermore, the increased distance from the warm Bay, the lack of protective vegetation, and the low elevation downslope

from the coastal ridge all serve to create temperature extremes, increasing the risk of frost damage. The experience of these growers over a period of several years should provide evidence of the viability of large scale agricultural operations west of L-31.

Residential development has been and continues to be quite limited in the area. Structures range from shacks to several modern CBS homes. Few homebuilders, roadbuilders, or even farmers have bothered to obtain necessary permits or zoning changes. Recently, roads and structures are being discovered at more frequent intervals and the number of permit applications and inquiries about regulations has been increasing.

The movement of agriculture into the marginal East Everglades lands is a phenomenon that is not completely understood. However, two sources of pressure causing the agricultural conversion are evident. Most often cited was the residential displacement of agriculture from the better drained ridgelands east of L-31. A sequence of events frequently described by those interviewed begins with the conversion of coastal ridge grovelands to residential use. The grove owners in turn purchase cropland east of the levee and convert the land to groves. At the same time, residential use is displacing crop use directly. The result is a serious squeeze on the South Dade cropland and agricultural business. This sequence of events often leaves the vegetable farmer at the mercy of the developer. The farmer (who is nearly always not the owner), in effect does the site preparation for the developer and provides for reduced agricultural tax assessment until the owner is ready to develop the site. The farmer irreversibly alters the natural environment, which in turn provides the developer with the argument that the land is already committed to development. The developer sells the land for residential or other higher value use, and the farmer seeks new land.

The second reason cited for agricultural activity west of L-31 is the desire to get as close as possible to the favorable hydrologic and microclimatic conditions found in the lands within the Everglades National Park from which the agriculturalists were recently displaced. However, the general information available indicates that the favorable flood and frost-free conditions of these lands cannot be duplicated in the study area.

Additional pressures exist on the East Everglades in the form of speculative investment in real estate. This activity has generated land values that appear to have little, if any, relationship to potential use of the property, both in the study area as a whole and in lands

west of the levee that are currently in low intensity uses and designated to remain so by the CDMP. Selling prices apparently presume a more intensive use in the future through zoning changes and/or modification of the environment.

2.13 Management and Legal Structures.

Several governmental jurisdictions have responsibilities related to the East Everglades area. The Federal government, in addition to having responsibility for the operation and protection of the Everglades National Park is concerned for the enforcement of Federal water quality regulations in the wetlands encompassed by the study area. The State of Florida is responsible for enforcement of State, and some of the Federal environmental regulations, often working through regional entities such as the South Florida Water Management District and the South Florida Regional Planning Council. The County government has responsibility for enforcing County environmental regulations and for land use regulation within the study area. The specific responsibilities of the various levels of government, and their implementing agencies, are discussed below.

2.131 Federal Legislation Which Controls the East Everglades.

Federal government responsibilities related to the study area are administered by several key agencies. These agencies are the Army Corps of Engineers, Environmental Protection Agency and the Department of the Interior.

1) Army Corps of Engineers. Unless pre-empted in the future by Congress, the role of the Corps in the East Everglades began on July 1,1977, with the implementation of Phase 3 of Section 404 of the Federal Water Pollution Control Act of 1972 (FWPCA). Under Section 404, Corps permits are required for the discharge of dredged or fill material into the waters of the United States. Almost any construction activity in the East Everglades will require fill material and thus a Corps permit. The applicability of the permit requirement to rock "plowing" is still in question at the time of this writing. However, preliminary information from the Corps indicates that rock "plowing" will not require a permit.

2) Environmental Protection Agency. The EPA has extensive jurisdiction over activities that may result in the discharge of pollutants into the waters of the United States under and pursuant to the Federal Water Pollution Control Act, Amendments of 1972, supra.

This jurisdiction is similar to, but more stringent than, that previously noted for the United States Army Corps of Engineers in that the Corps is restricted in its review to dredging and filling operations while the Environmental Protection Agency's jurisdiction goes to any discharge of a pollutant into the waters of the United States. For purposes of the Act "pollutant" is defined as:

> ...dredged, spoiled, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water... 502 (sic), FWPCA

An elaborate system for the permitting of such discharges is contained within the Federal Water Pollution Act and includes initial State approval through a National Pollutant Discharge Elimination System as a prerequisite for EPA review of same (refer to Section 2.34 of this report).

3) Department of the Interior. Under its obligations to protect the Everglades National Park from adverse effects due to activities outside the Park boundaries, the Department of the Interior has a legal obligation to take actions to avoid degradation of the Park. One such action with specific relevance to the East Everglades might be legal proceedings to prevent the degradation of high quality surface water flowing into the Park.

The Department of the Interior also has the responsibility for enforcement of the Endangered Species Act. Under said Act, the Secretary of Interior is required to determine endangered and threatened species and provide rules and regulations for their protection and conservation. Portions of the Taylor Slough area of the East Everglades are natural habitat for the Cape Sable Sparrow, and a part of the southern C-111 area is a natural habitat for the American Crocodile (see Figure 4), an endangered species under the Act. Florida Bay has been designated as critical habitat for the Manatee.

Department of the Interior actions in the East Everglades to date have been limited to data collection programs, testimony in recent County hearings on the construction of a road and a tree clearing permit application by a Park-bordering property owner and to participation in this study.

2.132 State Laws which Control the East Everglades.

State legislation regulating activities in the East Everglades area include enforcement of Federal laws but also special State environmental regulations. This legislation can best be described in terms of the activities of the State agencies having responsibility for its enforcement -- the Department of Environmental Regulation, the South Florida Water Management District, and the South Florida Regional Planning Council.

1) Florida Department of Environmental Regulation. The Florida DER was created under and pursuant to the authority of the "Florida Air and Water Pollution Control Act of 1967" (Chapter 403, Florida Statutes). This and subsequent acts have given the Department broad powers and duties to control and prohibit water pollution including but not limited to rule-making, planning, permitting and enforcement. The Department maintains jurisdiction over the rivers, lakes, streams, impoundments, canals, ditches, underground waters, coastal waters and all other waters or bodies of waters, including fresh, brackish, saline, tidal and surface waters of the State of Florida.

It is a violation of Chapter 403 to discharge or emit pollutants in quantities that are harmful or injurious to human health or welfare, animal, plant or aquatic life or property.

Of particular importance to the Everglades Study Area is the requirement for a permit prior to the construction of any stationary installation which may reasonably be expected to be a source of water pollution and for the discharge of any waste which, by itself or in combination with the wastes of other sources, reduces the quality of the receiving waters below the classification established for them in the Act and the rules arising out of the Act. Such installations and discharges would include domestic and industrial waste facilities, drainage systems and dredge and fill activities. Any or all of these activities would most probably be required for any construction or development within the East Everglades area.

Actions by DER in the East Everglades have been quite limited to date. Communication from DER has cited inadequate staff resources as the reason for absence of enforcement of permit requirements in the area.

2) South Florida Water Management District. The South Florida Water Management District (SFWMD) was created pursuant to the enactment of the Florida Water Resource Act of 1972, Chapter 373, Florida Statutes. The act provides for the comprehensive management of all waters, including those on or beneath the surface of the ground or in the atmosphere, and related land resources, fish, and wildlife within the jurisdiction of the State.

Particularly of concern in the East Everglades study area are the permitting and licensing provisions that are contained within the Act. The Act requires a permit or license for the following activities: the artificial recharge or intentional introduction of water into any underground formation; the withdrawal, diversion, impoundment or consumptive use of water (except for the domestic consumption of water by individual users) and the construction, alteration, operation, abandonment or removal of a dam, impoundment, reservoir, appurtenant work or works designed to divert or impound water, subject to certain exemptions and limitations.

The Act provides for its enforcement through administrative orders, permits, or regulations and the issuance of a complaint or notice and order followed by a hearing, if requested, and eventual judicial review. In addition, remedial alteration or repaired dams, reservoirs, impoundments and appurtenant works may also be ordered by the District.

In viewing the authority of the Water Management District in the study area it should be noted that Chapter 373 is not merely directed to water management and distribution alone. The District is required and is capable of environmental review of such applications. Moreover, the District is required to establish minimum flows for all surface water courses in the area. Minimum flow is defined as the limit at which further withdrawals could be significantly harmful to the water resources or ecology of the area.

Actions by the District to enforce regulations, in particular regulation for environmental reasons have been absent in the East Everglades. Minimum flows are also undetermined. Communication from the District through their participation in this project indicates a willingness to cooperate to the limit of their abilities with a comprehensive resource management program in the East Everglades. At present, such a program is lacking.

3) South Florida Regional Planning Council. The South Florida Regional Planning Council (SFRPC) is a Local Planning Agency within the meaning of the Environmental Land and Water Management Act of 1972 (Chapter 380, Florida Statutes). The Council was created by an interlocal agreement of July 1, 1974 as noted within Chapter 29J-1 of the Florida administrative Code.

Under the Act, any development as defined in Section 380.04(1) that would take place within the East Everglades study area and which would meet the threshold requirements for a Development of Regional Impact, pursuant to Chapter 22F-2, Florida Administrative Code, would have to apply to the County for approval. The County would, in turn, notify the Regional Planning Council of the nature of the application. The Council would, thereupon, prepare and submit to the local government a report of recommendations on the regional impact of the proposed development. The decision of the local governmental entity based upon these recommendations is, thereafter, appealable to the Florida Land and Water Adjudicatory Commission and is subject to judicial review.

2.133 County Legislation Which Controls the East Everglades.

Since the East Everglades study area lies entirely within the boundaries of Dade County, it is subject to the broad powers and responsibilities of metropolitan county government. Since the study area is within the unincorporated portion of Dade County, it is also subject to the local land use control and service provision regulations of the County government. As with the previous description of Federal and State regulations, Dade County's responsibilities in the East Everglades area can best be described in terms of the agencies having responsibility for their administration -- the Office of the County Manager, the Planning Department, the Building and Zoning Department, the Development Impact Committee, the Department of Environmental Resources Management and the Public Works Department.

1) Office of the County Manager. The County Manager is the chief administrative officer of Dade County and as such has primary responsibility for administering the Dade County Code and certain State regulations. However, in addition to these general mandates, the County Manager has two specific responsibilities applicable to

the East Everglades area--making recommendations to the Board of County Commissioners regarding requests for building and zoning moratoria in this and other areas of the County, and administering the County Development Impact Committee charged with reviewing large scale developmental proposals and other development applications with particular County significance. This latter responsibility will be described in detail below.

2) The Planning Department. The Planning Department, through its director, is charged with the responsibility of preparing County-wide and local plans for land use, community facilities, and public services within Dade County. In the exercise of this responsibility, the Department has prepared two general land use plans for Dade County and several sub-area plans and regulations for the East Everglades area. Within the current Dade County Comprehensive Development Master Plan, adopted in March, 1975, the East Everglades study area is designated as an "Area of Environmental Sensitivity". Included in the Plan are guidelines for regulating the type of development that should occur within the study area boundaries.

Concurrent with the preparation of the special environment analysis of the Comprehensive Development Master Plan (CDMP), a special East Everglades Area Study was prepared by the Planning Department to provide more detailed examination of the land use conflicts within the area. This study was adopted by the Board of County Commissioners and one of the major implementation actions, the "roll-back" of non-rural zoning in the area, was implemented (see discussion of zoning under Building and Zoning Department below). The second major implementation proposal for the East Everglades Area Study, the preparation and adoption of special environmental regulations for the area, was initiated though not completed. The continuing concerns identified in the CDMP and East Everglades Area Study have led to the initiation of this demonstration study.

3) Building and Zoning Department. The administration of the zoning ordinance is the responsibility of the Dade County Building and Zoning Department. This agency accepts application for amendments for zoning district boundaries within the East Everglades area and the unincorporated areas of Dade County. The requests are reviewed by this department, and by the Planning Department, and recommendations are made to the Board of County Commissioners for their final action. The Director of the Building and Zoning Department, together with the Planning Director, may initiate zoning changes within the East Everglades area, and other areas, in imple-

mentation of planning studies. Through this process, more than 7,000 acres of urban (commercial and industrial) zoning was rolled-back to rural classifications within the study area as part of the initial implementation of the East Everglades Area Study.

Dade County also prohibits the removal, destruction or moving of any tree within the County, subject to certain limitations, without application and receipt of a Tree Removal Permit from the Building and Zoning Department pursuant to Chapter 26B of the County Code. This provision defines "tree" as a woody or fibrous perennial plant with an upright trunk of either nine or more inches circumference, measured at the narrowest point below 4 1/2 feet above ground level, or 12 or more feet in height. The Chapter is applicable to all vacant and developed sites, all land currently zoned for agricultural use, all rights-of-way, and all developed sites except that the removal of less than five trees within a six month period on single family and duplex sites are exempt from the provisions of the ordinance.

Chapter 11C of the Code of Dade County governs standards of development where land is subject to flooding or erosion from abnormally high tidal waters resulting from severe storms or hurricanes or complete inundation of normally dry land areas from the overflow of streams, rivers, or other inland waters. The Chapter defines Coastal High Flood Hazard and Coastal General Flood Hazard Districts and requires application for building permits from the Building and Zoning Department for proposed construction, improvements or repairs within such zones with primary emphasis on whether or not the construction materials, methods and practices are designed to resist potential flood conditions from the above-noted sources.

No new construction or substantial improvement of any residential structure is permitted in Coastal General Flood Hazard Districts unless the new construction or substantial improvement has the lowest floor, including its basement, elevated to or above the level of the regulatory flood level, based on an average of a 100 year period of floor measurements. Most of the area falls within the Coastal General Flood Hazard District.

4) County Development Impact Committee. Pursuant to Sections 33-302-4 of the Code of Metropolitan Dade County, the County Manager's Office administers a Development Impact Committee. This committee, chaired

by an Assistant County Manager, is comprised of 14 members representing an inter-disciplinary cross-section of County departments with development review responsibilities, has jurisdiction to review and make recommendations on developments of "County Impact" and other development proposals which have a significant impact on the natural and human environment of the County. The Committee reviews approximately five percent of the rezoning requests and makes their recommendations to the County Commission for consideration in their final action.

5) Department of Environmental Resources Management. Chapter 24 of the Code of Metropolitan Dade County, designated as the Pollution Control Ordinance, is administered by the Department of Environmental Resources Management. Section 24-2 of the code, in part declares:

> ...It is the intent and purpose of this chapter to provide and maintain for the citizens and visitors of Dade County standards which will insure the purity of all waters consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life,...

In effectuating this intent, Chapter 24 prohibits water pollution and the operation of any facility or activity which would result in a nuisance. The Code defines nuisance, in part, as:

> (b) The discharge into any of the waters of this county of any organic or inorganic matter or deleterious substance or chemical compounds, or any effluent containing the foregoing, in such quantities, proportions or accumulations as to be detectable at any point beyond the property limits of the premises occupied or used by the person responsible for the source thereof, so as to interfere with the health, repose or safety of any considerable number of persons or the public ... or causes injury or damage to real property, personal property, human, plant or animal life of any kind,...

"Water pollution" is also defined within Section 24-3 to mean,

> ...the introduction in any surface or underground water, or tidal salt water, of any organic or inorganic matter or deleterious substance in such quantities, proportions or accumulations which are injurious to human, plant, animal, fish and other aquatic life, or property, or which unreasonably interferes with the comfortable enjoyment of life or property, or the conduct of business...

The Director of the Dade County Environmental Resources Management Department is empowered to order the cessation of any activities which have or may threaten to create water pollution or a nuisance as previously defined.

6) Public Works Department. Chapter 9, Article III of the Code of Metropolitan Dade County also provides for the permitting of activities that would obstruct, divert, impound or otherwise interfere, either continuously, seasonally or periodically, with the natural flow of any of the surface waters of Metropolitan Dade County. This section of the Code specifically directs attention to some of the sensitive ecosystems of Dade County within the project study area. Section 9-71 of the Code declares the legislative intent and purpose:

> ...that preservation, to the maximum extent possible, of the natural flow of surface water in Dade County is necessary to protect the environment and the sensitive ecosystems of Dade County as well as those of the Everglades National Park, and to permit proper ground water recharge and to minimize the impact of flooding and to otherwise promote and protect the general health, safety and welfare of the residents of Dade County ....
> (underline added)

The Chapter provides for application for permit to be made to the Public Works Department of Metropolitan Dade County and their subsequent investigation and recommendations regarding the application being presented to the Board of County Commissioners prior to permit issuance.

2.2 PROBLEMS AND CONCERNS

The problems and concerns of the East Everglades Area are those associated with maintaining the environment and the functions it performs within the South Florida ecosystem and within the State and the nation as a showcase of a unique natural area. The impacts of the continuing of urbanization of adjacent metropolitan Miami provides a number of conflicts with the preservation of the East Everglades area. A review of the history of the conflicts between the natural systems and the urban development provide the background for better understanding their current dimension.

2.21 Historical Perspective

The beginning of man's impact on Everglades environment is parallel to the beginning of urbanization in South Florida. The following chronology highlights the beginning and progression of these conflicts. Some of these significant events are given in the following chronology:

1850 Passage of the Swamp Lands Act by Congress led to the transferral of 20 million acres of land to the State for reclamation.

1881 Hamilton Diston contracted by the State of Florida to drain land in the Okeechobee/Kissimmee region.

1907 Everglades Drainage District created by the State Legislature.

1913 Miami Canal from Lake Okeechobee to City of Miami completed.

1916 Royal Palm State Park dedicated by the Florida Federation of Womens Clubs.

1924 Five additional major Everglades Drainage District canals completed.

1926 First bill introduced for the establishment of a tropical national park in south Florida by Senator Trammell.

Muck levee around Lake Okeechobee breached by hurricane tide drowning 250 people.

1928 Muck levee around Lake Okeechobee breached by hurricane tide drowning 2300 people.

Tamiami Trail from Miami to Naples completed.

1929 Congress passes bill directing the Secretary of Interior to investigate the desirability, practicability and cost of establishing the Tropical Everglades National Park.

1934 Act passes Congress providing for establishment of Everglades National Park.

1937 Act establishing Everglades National Park signed by President Roosevelt.

1938 New levee completed along the south shore of Lake Okeechobee.

1947 Secretary of Interior signed order establishing Everglades National Park.

Heavy rains flood urban and agricultural areas of southeast Florida.

Everglades National Park formally dedicated in December.

1948 Corps of Engineers submits to Congress a design for a comprehensive water control plan design for central and southern Florida.

1949 Central and Southern Florida Flood Control District established by the Florida Legislature.

1950 "Rock Farming" came into dominance with the advent of rock plows and crushing machinery.

1953 Levee-30 completed containing summer floodwaters in the Everglades and routing water southward that had previously flowed eastward through the ridge to tide.

1958 PL 85-482 enacted by Congress setting the present boundaries of Everglades National Park.

1960 Hurricane flooding in south Dade County brought about a high priority for improving the drainage system.

1961 An aerospace company entered into contract with State of Florida to lease approximately 25,300 acres of land adjacent to east Park boundary with an option to purchase for $50 per acre.

1962 Levee-29 completed; along Tamiami Trail, controlling water flow from the Everglades to the National Park.

1968 South Dade drainage canals substantially completed.

1970 PL91-282 passed by Congress requiring delivery of water from the water conservation area by the Central and Southern Florida Flood Control District to the northern end of Everglades National Park.

1970 PL 91-428 amended to provide for purchase of the remaining private farmland within Everglades Park and cessation of farming by July 1, 1975.

1971 South Florida experiences severe meteorological and hydrological drought.

1973 Major land owner builds compacted gravel road across Taylor Slough.

1974 County Commission imposes building and zoning moratorium and requests East Everglades Moratorium Area Study of urban encroachment on environment.

County Commission passes resolution accepting the recommendations of the East Everglades Moratorium Study for industrial/commercial down zoning and preparation of development guidelines.

Congress passes PL93-440 authorizing purchase of 570,000 acres of land in Collier County for creation of the Big Cypress National Freshwater Preserve.

1975 Down-zoning of commercial and industrial acres completed by Board of County Commissioners.

County Commission enacts ordinance enabling designation of Areas of Critical Environmental Concern.

1976 Tree removal permit applications to allow farming of 17 sq. miles adjacent to Everglades Park of land not accepted by County due to improper zoning.

Order issued by the Director of the Dade County Dept. of Environmental Resources Management (DERM) to cease and desist all rock plowing or other land alteration in Taylor Slough.

1977 Dade County Environmental Quality Control Board upon appeal of DERM's order, upholds order of the DERM.

2.22 Current Assessment.

The current concerns discussed below represent a consensus of the scientist and resource managers that participated in both the technical subgroups and the general interagency group of the Wetlands Demonstration Project.

2.221 Pollution of Groundwater Supply to Dade County.

Uncontrolled development within the East Everglades area poses a serious threat to the quality of recharge to the Biscayne Aquifer. The placement of septic tanks or sewers in such an area that is covered with water on an annual basis would likely present a severe health hazard to present and future residents of Dade County and consumers of

Dade County produce. Similarly, runoff from urban and suburban environs, including streets, would be a serious threat to the quality of groundwater. Chemicals and products used as pesticides, fungicides, and fertilizers and mulch from agricultural operations in rockland substrate also present potential hazards to the quality of water in the Biscayne Aquifer. Studies, although inconclusive at present, have shown an increase in nitrates, (to levels requiring treatment) in the shallow groundwater as the water moves down gradient under agricultural fields. Dade County does not currently have to treat water supplies to remove nitrates, pesticides, or heavy metals found in agricultural and/or urban runoff. The public cost to do so is very high.

2.222 Pollution of Surface Water to Everglades National Park.

Septic tanks, sewers, urban and suburban runoff and agri-chemical use within the area pose similar hazards to the surface water supply of Everglades National Park. Pollutants picked up by physical filtration and chemical exchange with "soil" materials will concentrate there and later be released in unknown quantities at unpredictable times. Once in the surface water, excess nutrient load, disease pathogens, heavy metals, Polychlorinated Biphenyls, pesticides and other pollutants from uncontrolled urban, suburban, and/or agricultural development act to reduce diversity and productivity, short circuiting the natural cycles of life at the base of the food chain. The potential hazard to the nursery grounds for the Gulf of Mexico and Atlantic fisheries, breeding areas numerous bird species, and the critical areas of other Everglades biota make the dangers of uncontrolled growth in the area of far greater significance than simply providing a large tropical outdoor zoological park for tourists.

2.223 Reduction of Surface Water Flow or Further Deleterious Effect on Periodicity of Flow to Everglades National Park.

Equally critical to the health of the Park is the seasonal fluctuation of water levels. The reduction of ground and surface water levels that accompanies urbanization, suburbanization, and some agricultural uses would result in a stress on the Park's existing life systems and begin a process of alteration of the East Everglades and Park biota, generally towards undesirable exotic species and reduction of marsh areas. In addition, lower water levels will accelerate the oxidation of the organic soils, both by fire and by biochemical processes.

2.224 Reduction of Groundwater Recharge to the Biscayne Aquifer.

The increase in surface water runoff from impervious cover and reduction in surface and ground water levels by positive drainage that has historically accompanied development of wetlands would pose a serious danger to the groundwater recharge of the Biscayne Aquifer if uncontrolled development is allowed to occur in the area. A reduction in high groundwater levels within the area would reduce the water available for drinking and irrigation and would reduce the freshwater head necessary to prevent saltwater encroachment.

2.225 Reduction of Flood Storage Capacity.

The creation of compacted roads, parking lots, roofs, and ancillary impervious and semi-impervious works, along with any attempt to remove ground or surface water would act to impair the historic function of the area as a floodwater retention basin. Furthermore, impairment of surface flow would increase flood stages upstream from the restriction, thereby affecting existing use of upstream lands. In addition, residential and/or agricultural development will without question create a constituency demanding water removal from the area.

2.226 Danger to Future Development from Flooding.

Most of the East Everglades area is under water for extended periods of time seasonally, thereby constituting a danger to human health and safety on a regular basis. The southern part of the area is also subject to coastal flooding during tropical disturbances.

2.227 Irreversible Loss of Vegetation, Pinnacle Rock, and Wildlife.

The Everglades is a complex environment that has evolved over thousands of years to its present condition. The wildlife, vegetation, microbiota, climate, topography, and soils are all interrelated elements of the system. Development by man that alters a part of the system will have unavoidable effects on the other parts. Specifically, the clearing of vegetation, rockplowing, dredging and filling and related activities that generally accompany development will have adverse affects on the organic and marl soils, will decrease the diversity of the landscape that supports resident

and migratory wildlife populations, will alter the historic hydrologic conditions that are the lifeblood of all of the systems, and will facilitate the spread of noxious exotic vegetation species (which will, in turn, cause a decrease in wildlife habitat.)

The effects of uncontrolled development in the East Everglades are especially significant in light of the knowledge that the East Everglades and its downstream estuaries support 1) more than 90% of the American Crocodiles and Cape Sable Sparrows known to survive in the United States, 2) more than 50% of the nesting Reddish Egrets and Roseate Spoonbills in Florida, 3) approximately 50% of the Everglades National Park's nesting Wood Storks, and 4) significant nesting populations of Brown Pelicans, Great White Herons, Bald Eagles and Ospreys, plus substantial numbers of more common water birds.

The critical difference between development in the East Everglades and development on the coastal ridge is the irreversibility of the severe alteration of the environment required to prepare the land for farming or residential use as currently engineered. Once altered, the landscape can never be restored to a natural condition.

2.228 Limited and Uncoordinated Management.

Land use decisions are being made for the East Everglades, both for the present and for the future. Dade County has acted with a strong environmental concern within the last year on permit applications. At the same time, however, only where potential major violations were involved has any level of government with regulatory responsibility attempted to locate and prosecute developers without permits. Non-enforcement of Federal, State, regional and local regulations does in fact constitute a decision. In the case of the East Everglades, land use decisions and non-decisions are usually final, due to the irreversible alteration of the ground surface.

The primary reason for non-enforcement of regulations in the study area is the combination of limited information and inadequate resources resulting from the area being given a low priority status. Management priorities have been low in the East Everglades in the past because there have been few development pressures and, thus, cause for concern about the areas future. As a result there has been little effort made to gain additional information about the environment. Correspondingly, regulation enforcement resources -- staff, vehicles, aerial photography, research equipment -- have been limited. Environmental

data is still absent, and enforcement resources remain limited but development pressures have reached a critical point. The alterations of the East Everglades environment that are prerequisite to agricultural and residential uses are irreversible. As noted previously, the effects of these land alterations are generally undesirable and potentially disastrous for the Everglades Park and the groundwater supply for South Dade County. Viewing the East Everglades situation in light of the consensus of values and concerns expressed by the interagency participants in this project, it is clear that the priorities of the various governmental agencies with East Everglades management authority need to be readjusted.

Beyond, and perhaps even contributing to, the information resource problem is the jurisdictional question: Those agencies with management responsibilities in the East Everglades do not deny their authority, they simply deny that their's is the major interest and/or responsibility in the area.

With regard to the major interest, Dade County administration views the Everglades Park Service as the entity that will accrue the greatest benefits from East Everglades protection. The Park recognizes their own interest, but also notes the ground water benefits essential to South Dade County. The State DER, the SFWMD, and the Corps generally agree that the Park and Dade County are the primary benefactors/losers from management/mismanagement of the area.

Responsibility is the companion issue to the interest question. Dade County, by virtue of downzoning actions, the cease and desist order halting landowner plans for massive rockplowing, and denial of a building permit for a house believes that its management responsibilities are being reasonably addressed, at least when compared to the Park, DER, and SFWMD. The Park is undecided about the wisdom and propriety of committing itself to direct management of resources exterior to Park boundaries. Florida DER states that while they do have authority, there is little regulation enforcement that they can pursue with current funding levels. The SFWMD believes that water use regulations should be adjusted to a Dade County resource management plan for the area. Added to all of these positions is a frequently expressed attitude that the Park either will or should purchase the East Everglades.

The result of this panoply of major interest and responsibilities is a "wait and see" attitude. Resource management has occurred on a crisis basis, with the various levels of government entering into enforcement and/or judicial

actions until sufficient forces had been massed to prevent undesirable resource uses. The rest of the agencies wait in reserve on the sidelines offering advice and encouragement. In each of the major resource management actions to date, Dade County has taken a lead role. With only limited intergovernmental support, Dade County "rolled back" to general use zoning all industrial and business zoning which existed in the East Everglades (1974-75), and issued a cease and desist order that prevented the rockplowing of 8,000 acres of the study area (1976). The County also denied a building permit for a house and extensive ancillary uses on a ten-acre lot in the area, citing the requested amount of alteration as detrimental to the natural and human environment (1976).

The net result of the management by crisis approach has been a prevention of large single actions while the "nickel and dime" activities have generally escaped notice. Most developers in the area either are not required or do not bother to obtain permits. Land uses have gradually moved into the East Everglades to the point that agricultural operations now extend west of Chekika Hammock State Park. In addition, two elevated, non-culverted roads extend two miles west of the State Park, with a spur road extending another half mile west. None of the roads have permits.

At present, the rockplowing case and several other issues either directly or indirectly relating to the East Everglades are in the courts, with Dade County a principal in each. Current events in the study area can be characterized as a quiet crisis; the continued regulated and unregulated conversion of smaller-sized parcels to agricultural and residential uses. Dade County is responding to permit applications, but has taken no action to seek out and prosecute permit violators. The Park, the State DER and the SFWMD are waiting to see what Dade County will do to control these violations and develop a comprehensive resource management program. The Corps of Engineers is developing a dredge and fill permitting program that will be applicable in the study area.

Waiting for management by the County may not satisfy Park desires. In regulating land uses to protect the health, safety and welfare of its residents, Dade County may allow more intensive uses of the East Everglades than would be acceptable for Park management purposes. In that event, the Department of the Interior must be prepared to take additional actions, up to and including purchase in order to protect their interest.

An additional factor operating to deter agency regulation of resource use in the study area is the "taking issue"

(see discussion under 2.321). The absence of site-specific environmental data for the area that could be used as evidence in court has created a reluctance on the part of enforcement agencies to hold developers to the letter, and in some cases the intent, of the law.

The concerns expressed in the preceeding section lead to the conclusion that a comprehensive and intensive resource planning management program for the East Everglades is an immediate necessity. The regulation of activities is essential from the point of view of the existing residents of Dade County, the Everglades National Park, and the consumer protection of future residents of East Everglades lands.

2.3 PLANNING/MANAGEMENT ALTERNATIVES

A long series of public policy decisions have increasingly recognized the important role of the Everglades wetlands in the South Florida natural and urban environments and the nation's need to protect its unique natural areas. Activities ranging from the establishment of the Everglades National Park and the enactment of water quality regulations at the Federal level, through the designation on the State of the Big Cypress Swamp as an Area of Critical State Concern to the designation by Dade County of portions of the area as "environmentally sensitive" in its planning process and the rolling back of zoning from urban uses to rural have all attested to the importance of the Everglades area.

The East Everglades area acts as a valuable buffer between Everglades Park and the expanding agricultural and urban development areas on the east. The numerous planning studies that have sought to provide a proper planning/management framework for the area have each added to the knowledge and understanding of the problems of the area and potential solutions. Also, each has identified the need for additional planning information to better provide for the management of the land/water resources of the area. Against this base of historic and continuing awareness of the importance of this area, the establishment of objectives, approaches and actions for the improved planning/management of the area is largely a manner of refining the information and processes currently applicable to the area. These refinements are described in the following sections.

2.31 Objective

The overall planning/management objective of the East Everglades area is to effectively preserve the important natural systems function of the wetlands in terms of its importance to the maintenance of the environment of the Everglades National Park and to the water supply of the adjacent urban areas. The achievement of this objective requires the establishment of proper balance between natural environment, agriculture, and urban activities and the implementation of this balance within the context of public purpose and individual property rights.

2.32 Approaches

By definition, East Everglades planning and management has two components. The planning component seeks to provide the broad long-range oriented direction for the allocation of water and land resources. The management component provides the specific, detailed immediate guidelines for day-to-day decisions regarding these resources. Both aspects are required for effectively attaining the objectives for the study area.

Two approaches to developing the planning/management continuum for the East Everglades area were considered -- a conventional, physical-oriented planning/management approach and a special, economic-oriented approach.

2.321 Physical-oriented Planning Management

The setting of the East Everglades area places it in a key location to the important water regimes of South Florida and thus to the maintenance of the Everglades Park Natural environmental resource. Although resource economists would argue that the decisions about the best use of this land are essentially economic decisions (see discussion below), environmental concerns are generally viewed as physical planning related.

The physical-oriented approach to planning/management of the East Everglades area seeks to achieve the objectives based on understanding of the ecosystem relationships. It is particularly important that planning/management establish the impact capacities of the ecosystem that will permit them to continue to perform their beneficial function. Hydrologic and biologic experts familiar with the Everglades ecosystems have identified that certain land uses, intensities of uses, and appurtenances to these uses sufficiently impact the water regime and jeopardize the objectives of preserving function of these environmental systems. Roadways on solid fill, industrial and commercial activities, and, in some instances, extensive agricultural cultivation have been deemed to pose a threat to the environment.

In recognition of these adverse urban and agricultural impacts, several kinds of planning/management approaches have been developed. In the Comprehensive Development Master Plan the area was identified as "environmentally sensitive" and guidelines were set forth for dealing with these problems in conjunction with development. Urban zoning was "rolled back" to agriculture and general zoning in much of the area. A special ordinance was drafted and implemented to provide for proper surface water flows in conjunction with the construction of roadways in the area. However, both the Comprehensive Development Master Plan and the concurrently adopted East Everglades Area Study recognized the need for additional regulation of the area to remove additional adverse environmental impacts. Two basic means can be used to effect additional protection of East Everglades ecosystem -- through regulation of private land and through public ownership.

1) Private Land Regulation. Management of the water/land use regimes of the East Everglades area through police power function is an approach that has several advantages. The public cost of this means is inexpensive compared to other means (to be discussed in subsequent sections). For the most part, the precedents for regulation for the public good through the police power function is extensive and the administrative mechanisms are in place and operating to apply them. The disadvantage of using police power regulation for achieving of a public purpose is the potential challenge of the excessive dimunition of individual property rights that may lead to requirement for compensation of the owner. The threat of this challenge often times makes local government reluctant to utilize this approach for innovative environmental controls less an adverse court ruling require them to compensate beyond their budgeted fiscal means.

Although administrative and judiciary means exist for enforcement of police power regulations, often the processes are less than satisfactory. At each level of government charged with police power regulation enforcement, adequate administrative resources are seldom proportionate to the amount of regulations to be enforced. Further, to protect the constitutional rights of individual land owners, numerous administrative and judicial procedures are established to provide for appeals to the extent that the process of enforcing the regulations is often lengthy. During the interval required to detect and enforce environmental regulations, irreversible environmental damage may have occurred. In the case of East Everglades area, the remoteness of the location from centers of administrative review at the County, State, and national levels make the area particularly vulnerable to environmentally damaging action that is not permitted by the various regulations.

The needed additional water/land use regulation of private land in the East Everglades area can take two forms -- performance criteria and specification standards.

Performance criteria regulations described the desired state of the several natural environment perameters that are to be preserved; i.e., the levels of water quality to be maintained. They describe the function of key natural processes operated in the environment and the inter-relationships between the environment and its use by man. A broad range of water and land uses will be permitted on land subject to performance criteria regulation as long as the criteria are adhered to; i.e., water quality levels are not altered from the defined state or sufficiently to produce adverse consequences.

The performance criteria approach to regulation is well suited to the East Everglades situation in which detailed scientific knowledge of surface water stage, duration and quality ground water movement and quality; and vegetation and wild life conditions are either unknown or unmapped. In this area there exists an understanding of the processess of the movement of water across and through the surface of the land, the cycling of nutrients through the food web, the movement of wild life in response to habitat and other seasonal variations of the Everglades ecosystems. Although there is an understanding of these processes that is sufficient to delienate the criteria against which water and land and water resource allocation proposals can be evaluated, there is not the sufficiency of information that would permit a precise specification of the kinds of activities that could be accommodated without harm to the systems. For example, performance criteria can describe the Everglades ecosystem processes, their value to man, and the environmental factors necessary for their unimpaired function. In terms of water function, it is known that the entire East Everglades acts as a recharge area for the Biscayne Acquifer -- ground water recharge is the process. The value to man is the provision of water supplies for drinking and irrigation and the prevention of salt water intrusion into fresh water wells. For these ground water recharge processes to remain unimpaired, East Everglades land cannot be excessively drained and ground surface cannot be excessively compacted or rendered impervious.

Another important aspect of the performance criteria is their implied shift of burden of proof to the land owner to demonstrate no adverse effects or results from the proposed water/land uses.

In the preparation of performance criteria in the East Everglades area there is the need to set forth the surface and ground water, wild life, and vegetative functions; the constraints, and the criteria for performance. An administrative process should also be established for bringing the diverse regulatory processes now in effect in the East Everglades area into one central processing point. Since additional information on the East Everglades ecosystems will be required by the developer and the administrative agencies, programs for additional data gathering should be prepared.

A second means of developing additional water/land use regulations in East Everglades area is through the use of specification standards. In this approach the kinds of water/land utilization that can occur without detriment to the ecosystems are specified. Such specifications are usually based on an analysis of some of the same considerations that are a part of the development of performance criteria; the determination of the environmental functions, the processes they serve and the limits of the impacts these functions can sustain. Specification standards go one step further and translate these environmental limits into the type extent, and other limits of uses permitted.

The specifications standard is typical of zoning regulations and most land use development regulations. Their advantage is that they are relatively simple to administer in that they require little additional information beyond what is needed to initially establish the regulations. Also, they give all parties a clear indication of the kinds of water/land usages that will be permitted. Disadvantages include the difficulty of having enough information to properly specify the permitted uses within an area as complex and unique as the East Everglades.

All police regulations -- performance criteria and specification standard -- are required by law to be within the legal limits of the ability to regulate for public purpose without compensation; i.e., to have not improperly taken property rights. Should the required restrictions resulting from performance standards or from specification standards go beyond the legal limit of a proper public purpose or not allow reasonable use of the land by a property owner, then some form of compensation must be provided. The following discussion of acquisition of property rights provide for this eventuality.

2) Property Rights Compensation and Acquisition. If the protection of the environmental ecosystems needed to achieve the planning/management objectives of the East Everglades are deemed to not be a clear public purpose or to be overly restrict private property rights, several alternatives exist for providing for control through partial or complete acquisition of the subject property rights.

If the additional regulations are clearly within the public purpose, though overly restrictive of property rights, several forms of property right acquisition and compensation may be utilized. If the property rights taken are determined to be minimal, then such forms as tax abatement could be a suitable alternative to direct compensation. Where property right takings might be considered more extensive, such approaches as the transfer of development rights are a potential form of compensation that utilizes the private market rather than public funds. Although the transfer of development rights approach has had very limited applications in this country, other than historic building preservation in a few major cities, the approach has been suggested as being applicable to environmental protection situations such as that of the East Everglades. Essentially, owners of property which had been deemed to be rendered beyond a reasonable use would be allowed to transfer their development rights outside of the restricted area to other property within their ownership, or someone elses ownership through sale of the rights. The actual amount of compensation would be largely determined by the market place; no compensation from public funds would be required unless it was necessary to have a public body serve as purchaser-of-last-resort of the development rights to guarantee the efficacy of the system.

For more severe limitations of private property rights full, fee-simple, acquisition may be required. With clear public purpose, public monies could be used to purchase the land utilizing eminant domain procedures. Purchase options could include a variety of alternatives such as acquisition of scenic easements, urban development rights, and water flowage easements.

The principal advantage of purchase of property rights, partial or complete, is the high degree of control provided to the public. The principal disadvantages are the costs of purchase in time and dollars. In an area like the East Everglades it might be difficult to determine a fair market value because of the unique nature of the land. Most of the recent sales reflect the value for speculative purposes rather than for current usage.

Yet another approach to the acquisition of property rights is through the acceptance of them as gifts. This approach provides the same high degree of control of public ownership though with little public cost. Some of the unique characteristics of the East Everglades area make this approach more feasible there than in other locations. It is probable that the speculative value of the land in this area for future anticipated uses exceeds the value for near-term development making a tax write-off a more attractive alternative than current development returns. Unfortunately, in some areas in the East Everglades there are small parcels of land where the owners would be unable to benefit as much from tax write-offs, making the gift alternative less attractive to them. Organizations such as the Nature Conservancy and the Trust for Public Lands frequently act an intermediaries in arranging land gifts to public bodies.

2.322 Economic-oriented Planning Management Approaches.

In addition to the refinement of the basic physical-oriented planning/management approaches for the East Everglades described above, one of the sub-objectives of this study was to develop a special economic-oriented approach to dealing with the resource allocations problems of the area. The approach set forth -- opportunity- cost analysis -- responds to the need for more extensive economic analyses in planning/management decisions involving critical environmental areas and provides an alternative means for dealing with the informational limitations of physically-oriented processes in these areas. The concept and application of opportunity-cost analysis to the East Everglades area is described in the following section.

1) Concept. The standard approach to water/land use decisions in urban settings has major flaws when dealing with areas of unique environmental concern such as is the East Everglades. The normal water/land use decision process are directed to dealing with local input in a more-or-less current context. In a situation involving a resource of regional and nation significance, such as the East Everglades, the means for providing participation by those located in a different place, and in the case of future generations, at a different time are imperfect. Even when water/land use decisions are given economic dimensions, traditional economics does not properly provide value measurements for these aspects of areas of unique environmental concern. Traditional economics is largely limited to dealing with "exchange values" --those values associated with the usefulness of a commodity as reflected in its purchase price. Because a natural environmental amenity is unique and cannot be created, there are two additional values not captured in the market price that

should be considered. The first is the "existence value" of the amenity for local, and non-local, persons who derive some satisfaction, and thus value, from knowing that the amenity exists, whether they can or intend to actually visit it. The second value needing to be considered is the "option value" which the individual assigns to environmental amenity that they actually intend to visit or assume that their children will. These two values exist because of the non-reproducible nature of the natural resource. Conventional economics must be broadened to deal with these aspects of environmental amenities when making land water/land use decisions. There are also the more direct values associated with visitors satisfaction and such things as support of Florida Bay fisheries from which recreational values are obtained.

There are several approaches for incorporating these additional values into a decision process in the East Everglades area. One approach would be an attempt to estimate the dollar value for all the benefits which would arise from the preservation of the natural functions of the area. This would involve attempting to determine all of the above described values. The sum of these preservation values would then need to be weighed against those realized from the development of the area. However, the full realization of this approach encounters such uncertainties as the value future generations will place on the amenity.

The preservation/development analysis will lead to one of two conclusions. The first conclusion would be that the preservation values clearly exceed the development benefits, setting a stage for a preservation decision. However, in the second conclusion, the preservation benefits, because of the uncertainties of the existence and option values, may be adjudged to be less than the development benefits. A difficult choice then must be made of whether to render a development decision or a preservation decision because of the uncertainties of the ability to properly account for these real, but unquantifiable preservation values. Thus, when undertaking a value (benefit-cost) analysis of a preservation/development decision one is confronted with the problem of never being certain that all of the benefits from preservation have been counted. This suggests that preservation should prevail unless the benefits from development are significantly greater than the quantifiable preservation benefits.

Another approach to economic analysis is to adopt a posture of seeking to minimize the maximum possible loss for society in the preservation/development decision. This approach, rather than attempting to measure the

difficult-to-quantify or unquantifiable values of preservation, seeks to compare the more readily determined benefits of development. This basically is the approach of opportunity-cost analysis.

The essence of opportunity-cost analysis resides in the assessment of all possible locations for those activities being advocated such that the benefits to the community are approximately the same but the costs are lower. That is, it involves a search for ways to achieve the benefits -- if possible -- from development without the possible value losses of destroying a unique environmental resource. Often missing from the conventional land use decision process is the attempt to guide development into those areas in which approximately similar outputs from the community-at-large can be achieved with lower costs.

Opportunity-cost analysis is perhaps not as unique and innovative as has been previously stated; it is merely a more explicit application of some general concepts which have guided land use planning in the past. It is entirely compatible with land use planning -- the process that seeks to properly locate various activities so as to achieve optimum benefits.

2) Application. Opportunity-cost analysis can be helpful in the East Everglades area by calling attention to the fact that it may be possible to provide housing development and agricultural production in other locations without posing a serious threat to the ecological integrity of the area. In applying the opportunity-cost analysis to the East Everglades area, two alternative scenarios of land usage need to be analyzed. The first scenario is that of the continuation of the existing pattern of first agriculture, then urban development moving from east to west through the area. The second scenario involves retention of agricultural land in the eastern portion of the area and the exclusion of urban development from the area.

The environmental problems associated with the two scenarios in terms of reduction in quantity and quality of the groundwater supply to the urban area and the surface water supply to the Everglades National Park, the reduction of flood storage capacity and the loss of native vegetation and wildlife habitat need to be reviewed in a general manner in order to assess the environmental values threatened. A more specific evaluation would need to be made of the relative costs and benefits of development in the East Everglades area and in other suitable locations in the County. From this analysis a long range plan could be made for the proper use of the East Everglades area and, where needed, under some of the guidelines described in

the above discussion of physical-oriented planning/management, required compensations to property owners could be implemented.

Opportunity-cost analysis has its most useful application to the preparation of areawide plans for the East Everglades, it would also be useful in conjunction with the preparation of wetlands regulations. When contemplating the adoption of new regulations -- performance criteria or specification standard -- that significantly restrict water/land usage, it is desirable that decision makers have available to them a thorough evaluation of the economic implications of the proposed restrictions. Opportunity-cost analysis would provide information useful in the initial decision and in any follow-up litigation.

2.33 Actions

The proper planning/management for East Everglades requires implementation of a series of specific actions. These are described in the following sections.

2.331 Designate East Everglades As Area of Critical Environmental Concern.

In order to obtain full commitment to the objective of preserving the natural functions of the East Everglades area, it is important that the area be given official designation as an area of environmental concern. The most appropriate means for giving the area local recognition as an area of environmental significance would be through its designation of an area of Critical Environmental Cconcern pursuant to Chapter 33B of the Dade County Code. This designation would then lead to the development of necessary additional water/land use regulations and procedures.

Consideration should also be given to the designation of the East Everglades area as an area of Critical State Concern pursuant to Chapter 380.05 of the Florida Statutes. This designation would be by the State and would require that local development regulation be adopted by the County. The State designation would also provide appeal process to development restrictions that would be adjudicated ultimately by the Cabinet.

2.332 Develop and Adopt Interim Environmental Regulation Performance Standards and Permitting Processes.

Following the designation of the East Everglades as an area of environmental concern, specific local performance standards and permitting processes should be prepared and

adopted. The performance criteria approach prepared as part of this project (see Technical Report), should be refined and adopted to provide a clear indication of the importance of natural functions, development constraints, and performance criteria applicable to each physiographic are of the East Everglades. Within the information available, these adopted regulations should be used by property owners and County administrators to review any development proposals within the East Everglades area.

A companion process needs to be established to properly administer these environmental regulations. This process should add the requirements that a permit be obtained for any land alteration developmental purposes within the area associated with clearing and utilization for agricultural purposes. This permit should be issued by the Executive Committee of the County Development Impact Committee. The regulations should provide that site alteration permits shall be issued only for those activities and/or modifications that are consistent with existing Federal, State, regional, and local development rules and regulations, and that can be demonstrated by the applicant to singularly or collectively cause no adverse effects on those systems and/or values expressed by ordinance as reasons for the critical area designation.

In the reviewing of development proposals within the East Everglades area, the Committee should invite participation from regional, State and Federal agencies with expertise and responsibilities in the East Everglades area. The additional regulations should include the provision that all property deeds in the East Everglades environmental area should carry that designation.

2.333 Develop Cooperative Intergovernmental Enforcement and Monitoring.

A continuing effort should be made to more clearly identify the roles and responsibilities of the County, regional, State and Federal agencies in the East Everglades area. The primary responsibilities for enforcement of water/land use regulations in the area, while resting largely with the County, none-the-less, are shared by other jurisdictional levels. A part of this cooperative effort should be directed to monitoring and enforcement of existing and proposed developmental regulations.

Dade County should initiate appropriate actions to insure the future fulfillment of the regional, State, and Federal management responsibilities for the East Everglades. Making County permit approvals conditional to SFWMD, State DER,

and Corps of Engineer permit issuance is one technique. Another approach could be through joint permitting. Given the stated desire of SFWMD and DER to cooperate with the current attempts of the County and the Corps to simplify tidal wetland permitting, the East Everglades offers an excellent opportunity for issuance of joint permits from the beginning of enforcement. Upon implementation of the County actions recommended in this report and with the sorting out of the Federal non-tidal wetland responsibility, a joint permit application form should be prepared and a review process agreed upon. Delegation of State authority to the local level, as suggested by DER, should be consumated.

The remoteness and extensiveness of the East Everglades area and the urban orientation of County government leaves little resources available for enforcement in the area. The cooperative sharing of monitoring manpower, aircraft and other surveillance resources located in the area would improve the enforcement of existing regulations. However, it is clear that additional enforcement and monitoring of activities in the area should be provided as part of the adoption of additional regulations. The regional, State, and Federal agencies with regulation responsibilities in the area should all contribute to the provision of adequate monitoring and enforcement.

2.334 Provide for Additional, Environmental Information and Analysis.

The long-term success of proper water/land use planning/management in the East Everglades area is dependent on the provision of additonal information on the environmental aspects of the area. The proper administration of regulations concerned with the individual and accumulative effects of development proposals in the area requires additional insight into the surface and groundwater regimes and wildlife and vegetative habitats of the area and their capacity to assimilate development impacts. Similarly, the economic and legal impact of additional plans and regulations promulgated on the basis of additional environmental information require careful consideration. For example, if the additional studies of environmental impacts reveal that little development can take place without adverse environmental consequences, a determination needs to be made as to whether further regulation promulgated on this basis would represent a taking of part or all of the property rights of private owners. If such is the case, a full range of means of direct and indirect compensation and/or acquisition should be considered.

Water quality concerns are a major linkage between development and the natural environment and thus the logical focal point of additional study efforts. The ongoing EPA Section 208 Wastewater Management Planning Project for preparing a plan of study for obtaining the required additional information and analysis will chart the direction for this work. Followup funding of the proposed study by a Section 208 grant is an important implementation tool and should be given careful consideration by the several governmental jurisdictions with East Everglades roles and responsibilities.

2.335 Reevaluate the Role of Agriculture in Dade County.

Since agricultural activities are the major land use that is in conflict with both environmental and urban development trends in the East Everglades area and is a significant ingredient in maintaining a diversity of economy to Dade County, it is important that careful consideration be given to the future viability of this industry. Careful review should be given to the role of agriculture and adequate safeguards provided for the industry's future either as part of the above plan of study or as a separate activity. Just as the East Everglades area should be designated as an area of environmental concern, proper delineated agriculture land outside of the area should be designated as critical productive areas that deserve preservation for that purpose. A set of incentives and regulations for implementing the designation of these areas should be prepared as part of the study effort.

3. BISCAYNE BAY

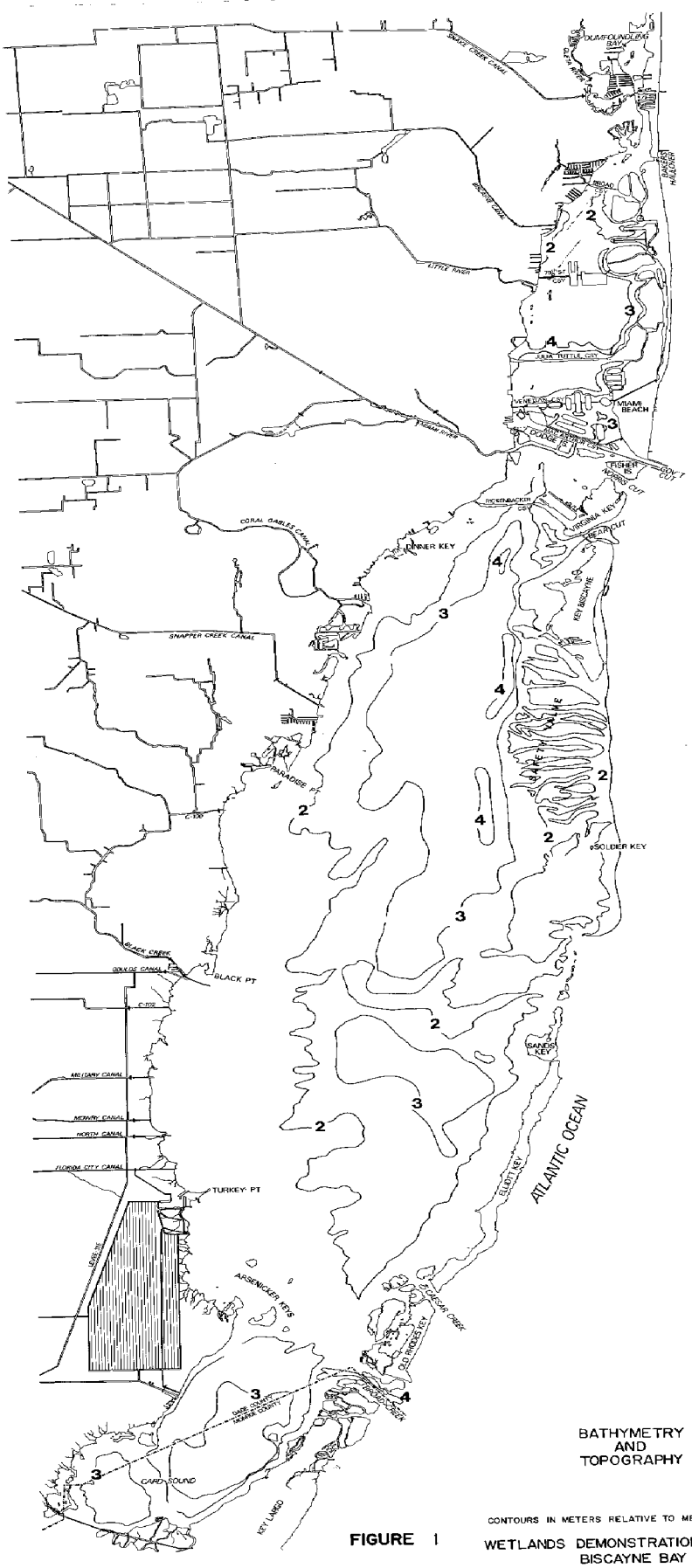
Although there are obvious differences between the East Everglades and the Biscayne Bay Wetlands from a physical standpoint, the resource management problems are strikingly similar. The Bay is a shallow lagoon 45 miles long, from one to ten miles wide and an average of six feet deep. The several hundred miles of shoreline are bordered by intensive urban development in the north and by undisturbed mangrove stands in the south. The attraction the shoreline and waters have for metropolitan area residents and tourists has and will continue to exert tremendous developmental impacts on the Bay. The ability to effectively plan for and manage these impacts is complicated by the numerous governmental jurisdictions with Bay responsibilities. These Bay jurisdictions in addition to those with East Everglades area responsibilities include twelve municipalities and the Coast Guard. As with the Everglades, the Bay shoreline wetlands are a complex and fragile ecosystem which have generated much interest in protection. However, the many layers of authority imposed by federal, state regional and local rules and regulations have generated much friction and an uncertain record for resource protection. Like the Everglades, Bay management itself could be characterized as the ultimate problem that results from many other smaller problems, of which inadequate understanding of the environment and low priority funding are the principal ingredients. The Bay setting, problems, and planning and management solutions are discussed more fully in the following sections.

3.1 SETTING

3.11 The Biophysical Environment

Biscayne Bay is a shallow (average depth 6') sub-tropical lagoon, 45 miles long and varying in width from less than one mile in the north to approximately 10 miles wide in the central location (see Figure 1). To the west the Bay is bordered by the urbanized portions of Coral Gables, Miami, and northern unincorporated Dade County, while to the southwest it is fringed by extensive areas of coastal mangroves. Along the eastern boundary it is partially enclosed by the barrier islands of Miami Beach, Virginia Key, and Key Biscayne; the Safety Valve flats; and the upper Florida Keys. To the south, separated from Biscayne Bay by Cutter Bank, lies the smaller and deeper Card Sound basin. Only the northern third of Card Sound is within Dade County. The following factors play major roles in the Bay's evolution.

1) Geological History. The ridges which enclose Biscayne Bay were formed about 100,000 years ago when the seas were approximately 25 feet higher than at present. On the mainland tiny limestone spheres settled out of the turbulent waters and formed the oolitic limerock of the Atlantic Coastal Ridge. Along the eastern borders sheltered back reefs formed the Keys and the submerged base structure for the barrier islands that would become Miami Beach, Key Biscayne and Virginia Key. During subsequent decades, the ridge and reef structures were alternately exposed and submerged, causing continual geologic sculpting, erosion and hardening.



BATHYMETRY
AND
TOPOGRAPHY

CONTOURS IN METERS RELATIVE TO MEAN LOW WATER

FIGURE 1

WETLANDS DEMONSTRATION PROJECT
BISCAYNE BAY
JUNE 1977

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About 6,000 years ago with the advent of the most recent rise in sea level, the Biscayne basin began to fill with water; first, within the deeper areas near Key Biscayne and later to the south and east. About 4,000 years ago the northern basin was finally enclosed as sand from the mid-Atlantic coast drifted south and accumulated on the ancient submerged reefs. By 2,000 years ago the seas had invaded all of Biscayne Bay except the shallow shelf along the western border.

2) Sedimentary Processes. As the seas rose, five dynamic processes of sedimentation and erosion were continually occurring in Biscayne Bay. In addition to the longshore drift of sands onto the barrier islands, sands of more local and recent origin were deposited throughout the western half of north Bay and along exposed sections of the western bay shoreline as far south as Black Point. Deep tidal bars of calcareous sand and mud were deposited and continually reworked by tidal action to form the Safety Valve and Featherbed Banks. Pockets of mangrove peat and a thick wedge of peaty material were deposited as mangrove forests moved westward across the Bay in response to the rising sea level. A thin veneer of calcareous sand was deposited over the limerock basin throughout the central region of the Bay (see Figure 2).

Unlike other coastal lagoons along the Atlantic or Gulf Coasts, Biscayne Bay is not a drowned river valley with a shifting sand substrate. Rather, these sedimentary processes are controlled by the rigid topography of the basin, the availability of sediment, and wind driven circulation, primarily during periods of winter cold fronts and hurricanes. Here the confined limerock basin not only defines where sedimentation can occur, but also limits the amount of available sedimentary material. Except for the limited drift of sand onto the barrier islands, all of the Bay's sediments are produced by organisms living within the Bay itself.

3) Tidal Circulation. Tidal currents within Biscayne Bay and Card Sound are driven by low energy ocean tides flowing across eight restricted tidal inlets plus the nine mile shoal of the Safety Valve. From north to south the tidal cuts are: Baker's Haulover; Government, Norris, Bear and Sands Cuts; and Caesar's, Broad and Angelfish Creeks. All are natural inlets except for Baker's Haulover and Government Cut. In general, tidal flushing is sluggish throughout most of Biscayne Bay and Card Sound. However, winter storms and hurricanes greatly accelerate water turnover and reduce flushing time from months to days.

4) Hydro-meteorological Factors. There are twelve major waterways which drain into Biscayne Bay: Oleta River; Snake Creek Canal; Biscayne Canal; Little River; Miami River; Coral Gables; Snapper Creek Canal; C-100; Black Creek; and Goulds, Mowry, North and Florida City Canals. The Model Land Canal and Canal C-111 drain into Card Sound. Flow is controlled by the South Florida Water Management District. In general, little or

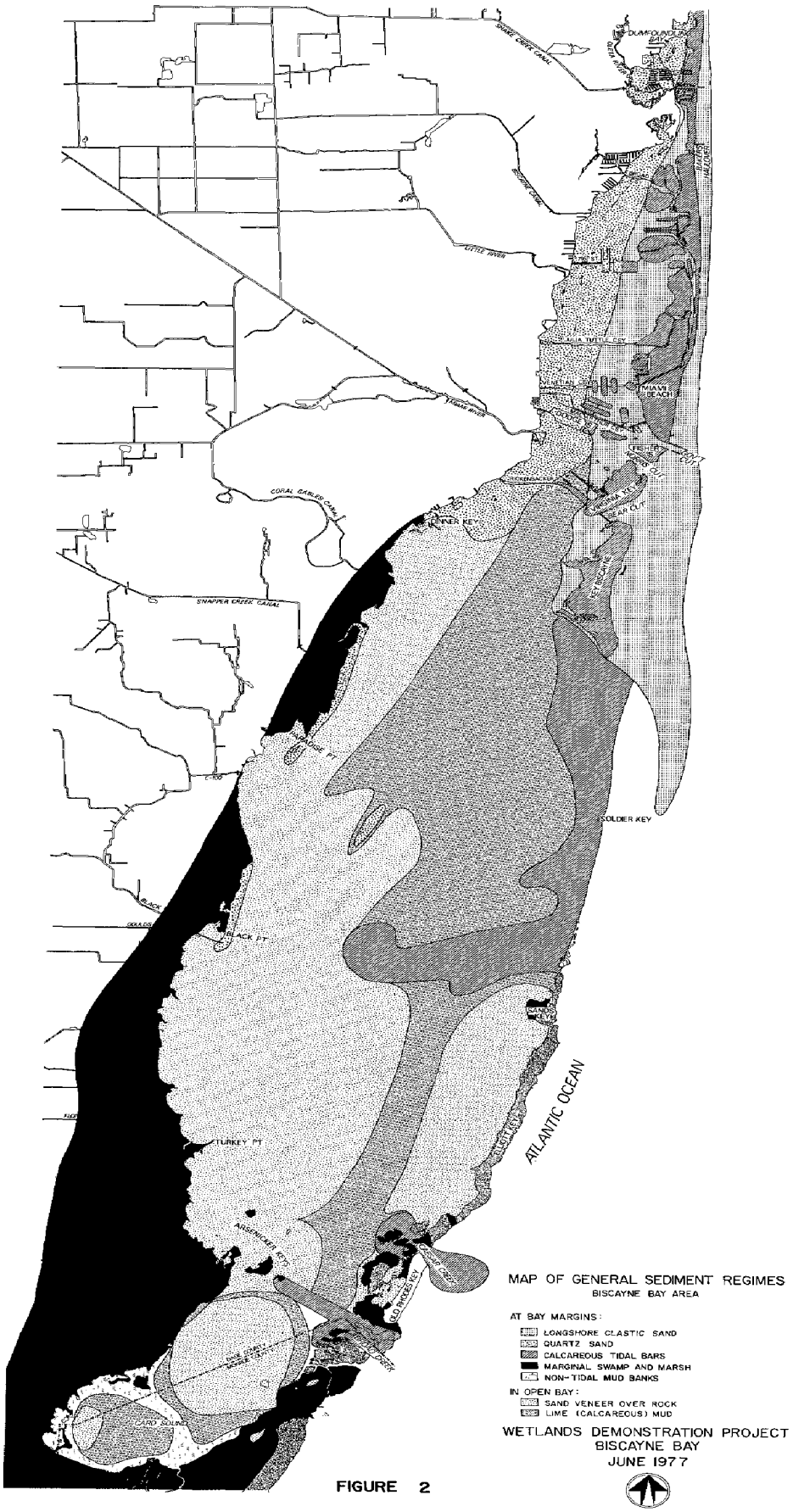
SNAPPER CREEK CANAL
CUTLER RIVER
CORAL GABLES CANAL
SNAPPER CREEK CANAL
BLACK PT
COLDIER KEY
TURKEY PT
ATLANTIC OCEAN
MAP OF GENERAL SEDIMENT REGIMES
BISCAYNE BAY AREA
AT BAY MARGINS:
LONGSHORE CLASTIC SAND
QUARTZ SAND
CALCAREOUS TIDAL BARS
MARGINAL SWAMP AND MARSH
NON-TIDAL MUD BANKS
IN OPEN BAY:
SAND VENEER OVER ROCK
LIME (CALCAREOUS) MUD
WETLANDS DEMONSTRATION PROJECT
BISCAYNE BAY
JUNE 1977
SOURCE: H. WANLESS

FIGURE 2

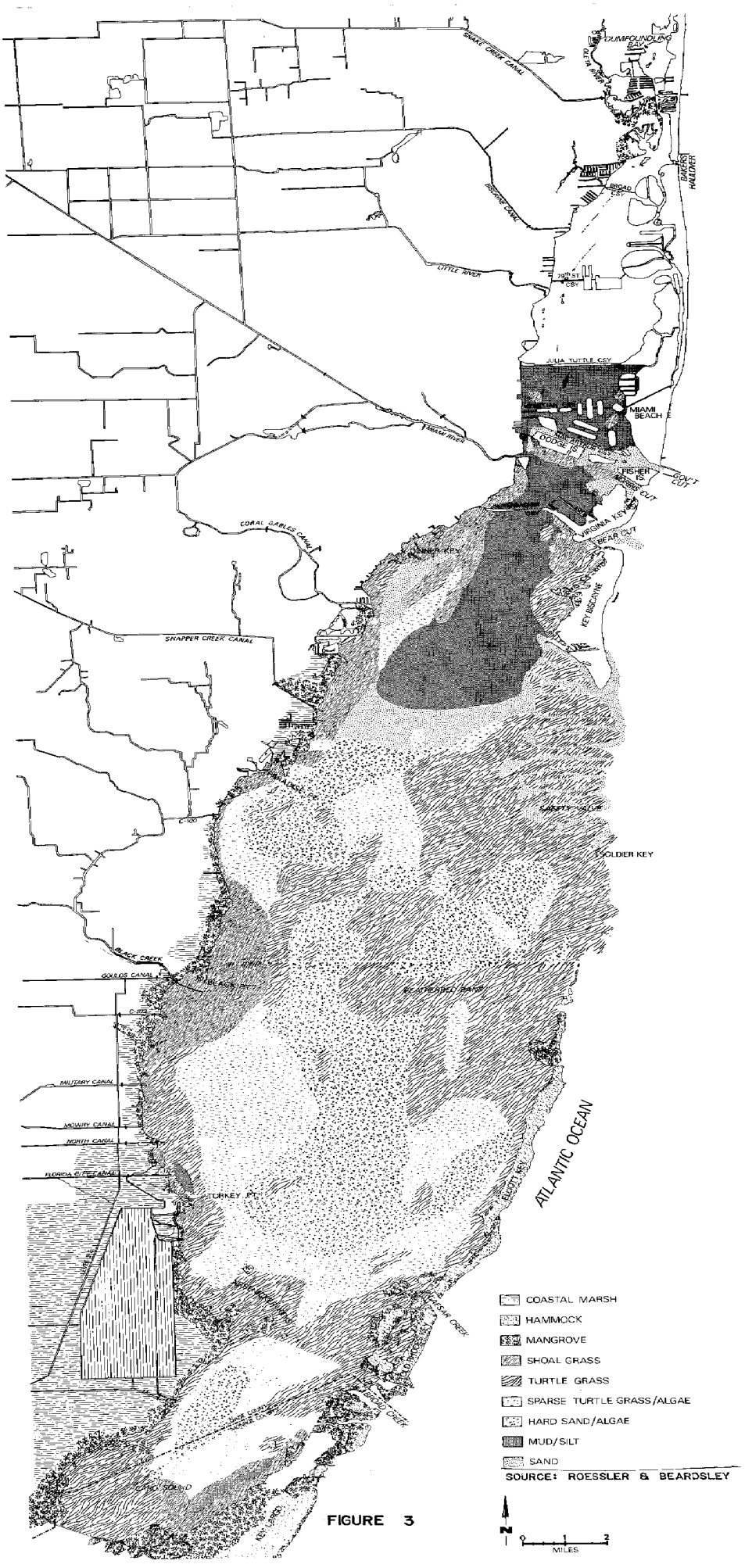
SNAKE CREEK CANAL
OUMPOUNDLING BANK
BISCAYNE BAY
BAKERS HAULOVER
BISCAYNE CANAL
LITTLE RIVER
79TH ST CSY
JULIA TUTTLE CSY
MIAMI BEACH
GOLDEN BEACH
NORTH BAY
FISHER IS
GOVT CUT
MIAMI RIVER
CORAL GABLES CANAL
VIRGINIA KEY
BEAR CUT
DINNER KEY
KEY BISCAYNE
SNAPPER CREEK CANAL
C-100
SOLDIER KEY
BLACK CREEK
GOULDS CANAL
C-102
BISCAYNE BAY
MILITARY CANAL
MOWRY CANAL
NORTH CANAL
FLORIDA CITY CANAL
TURKEY PT
ATLANTIC OCEAN
ELLIOTT KEY
BOCA CHITA KEY
BISCAYNE CREEK
BLACK CREEK
COASTAL MARSH
HAMMOCK
MANGROVE
SHOAL GRASS
TURTLE GRASS
SPARSE TURTLE GRASS/ALGAE
HARD SAND/ALGAE
MUD/SILT
SAND
SOURCE: ROESSLER & BEARDSLEY
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FIGURE 3

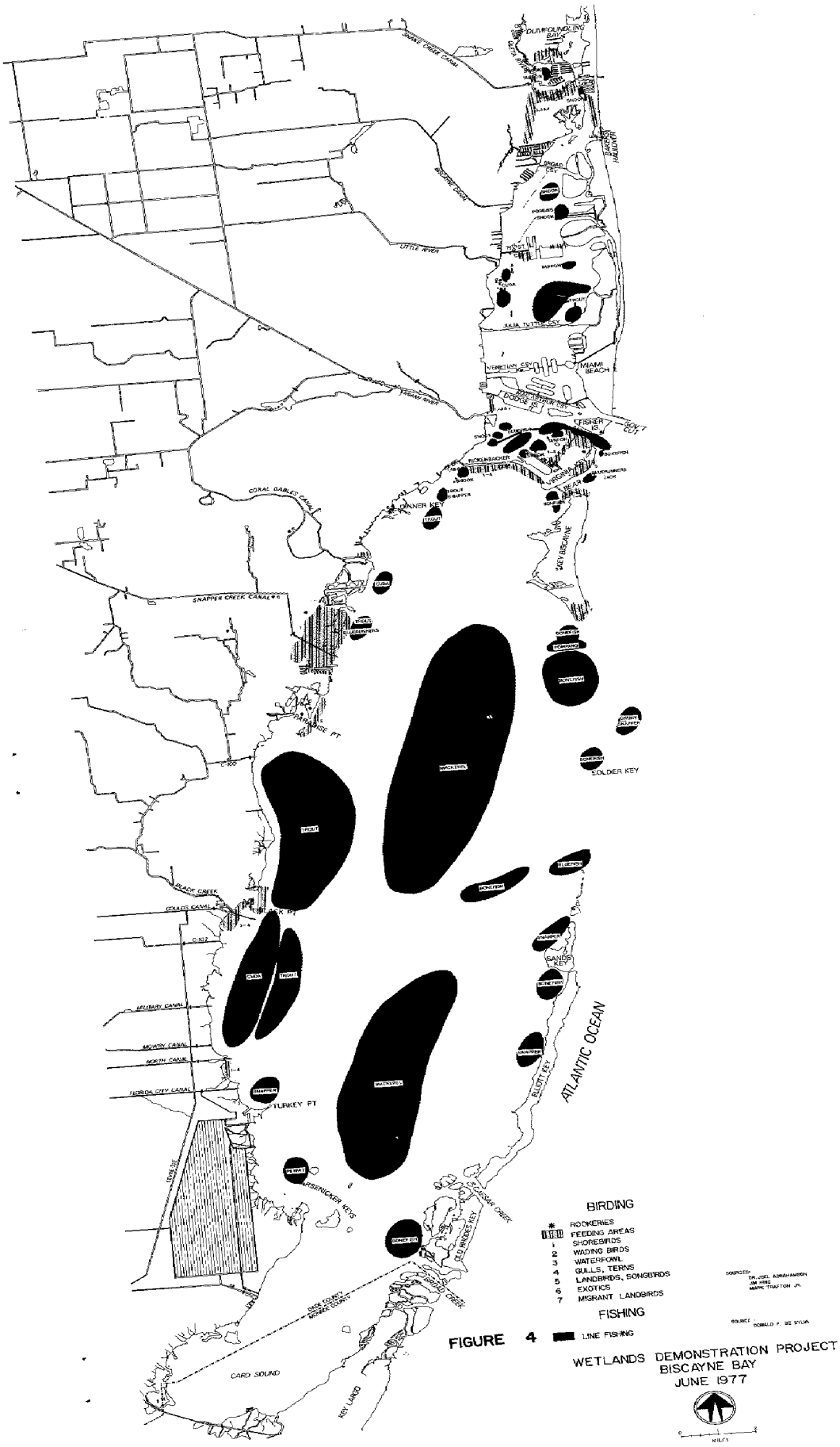
DUMFOUNDLING BAY
SNAKE CREEK CANAL
BISCAYNE CANAL
LITTLE RIVER
JULIA TUTTLE CSY
VENETIAN CSY
MIAMI BEACH
MACARTHUR CSY
DODGE IS
FISHER IS
GOV'T CUT
ROSENBACKER
VIRGINIA
BEAR
CORAL GABLES CANAL
DINNER KEY
KEY BISCAYNE
SNAPPER CREEK CANAL
PARADISE PT
SOLDIER KEY
BLACK CREEK
COULDS CANAL
SANDS KEY
ATLANTIC OCEAN
ELLIOTT KEY
MILITARY CANAL
MOWRY CANAL
NORTH CANAL
FLORIDA CITY CANAL
TURKEY PT
ROSENCKER KEYS
OLD RHODES KEY
BROAD CREEK
CARD SOUND
KEY LARGO
BIRDING
ROOKERIES
FEEDING AREAS
1 SHOREBIRDS
2 WADING BIRDS
3 WATERFOWL
4 GULLS, TERNS
5 LANDBIRDS, SONGBIRDS
6 EXOTICS
7 MIGRANT LANDBIRDS
FISHING
LINE FISHING
SOURCES:
DR. JOEL ABRAHAMSON
JIM KING
MARK TRAFTON JR.
SOURCE:
DONALD P. DE SYLVA
WETLANDS DEMONSTRATION PROJECT
BISCAYNE BAY
JUNE 1977
MILES

FIGURE 4

no fresh water flows into the Bay from the canals from January through May. During the rainy season the outflow carries loads of urban and agricultural pollutants into the waters of Biscayne Bay and Card Sound.

Salinity, which is directly related to canal outflows, varies from season to season. During the rainy periods salinities as low as 5 parts per thousand (as compared to 35 ppt normal sea water) have been measured along the western shoreline of Biscayne Bay. When canal flow is restricted during the winter months, the Bay may become hypersaline. There is normally an east-west salinity gradient across the Bay, except during periods of winter storm fronts. However, in the shallow Bay waters vertical gradients are rare.

Bay water temperatures also vary depending on the season. They average 17°C in winter and 31°C in summer. Two to three degree centigrade day-night fluctuations are common. Winter cold fronts may reduce Bay temperatures by 10°C within a twenty-four hour period.

5) Benthic Communities. There are seven generalized communities within Biscayne Bay: turtle grass flats, shoalgrass flats, sparse turtle grass and algae, sponge-alcyonarian, open sand, rocks and pilings, and sandy mud (see Figure 3). Turtle grass flats, which are considered to be the most valuable, cover about 30% of the Bay bottom from Rickenbacker Causeway south. There are over 250 species of fish and 200 species of macro-invertebrates, which use the grass flats during some part of their life cycle. Since turtle grass blades grow, excise and decay within a ten week period, the grass beds contribute an enormous amount of detrital plant material to the bay system.

In south Bay and Card Sound, turtle grass is frequently associated with Cuban shoalweed and manatee grass. Along the peat wedge on the western shore of Biscayne Bay thick beds of almost pure Thalassia are fairly abundant. As one proceeds bayward into the tide, manatee grass may become increasingly more abundant, and frequently replaces turtle grass at lower depths. In regions of the Bay where sediments are less than 10cm. in depth, sponges, alcyonarians (sea whips, sea fans and sea feathers) and algae form the dominating communities. Because of the diversity of environmental conditions within Biscayne Bay there are often complex interrelationships between different communities, and community boundaries frequently grade into one another making clear delineation of boundaries almost impossible.

There are approximately 1200 animal species (macro-invertebrates and fishes) and two marine mammals (the bottlenose dolphin and the manatee) which are found in Biscayne Bay. Included are many species of fish which have economic value plus sponges, shrimp, lobsters, and crabs which are fished commercially. In

addition, there are about 25 groups of birds which forage for food in the Bay waters, including cormorants, ducks, pelicans, ospreys, terns, kingfishers, gulls, herons, ibises, oystercatchers, and spoonbills. Many other birds forage within the mangrove forests, and the top carnivores, the falcons, hawks and owls prey upon other animals throughout the Bay system. Figure 4 indicates where many of the birds and fish may be found.

3.1 Socio-Economic Environment

While a discussion of the natural system of Biscayne Bay begins to answer the question: "What is Biscayne Bay?; a consideration of the uses and users of the Bay is necessary to make the answer more complete. The following is a cursory synopsis of who uses the Bay and what it means to them.

WHAT BISCAYNE BAY IS
to the following users/interests ....

boaters	• A place for a day or weekend cruise with a chance to fish, swim, snorkle, water ski, or relax. • A transit corridor to the reef and Gulf Stream. • The location of speed boat and sailing regattas. • A long wait for ramp space or dockage.
commercial bait fishermen, spongers, crabbers, and lobster fishermen	• A source of income. • A valuable nursery ground.
tropical fish collectors	• A source of sea horses, small angelfish and other tropical fish.
stationary shore fishermen	• A place to catch mackerel, pompano, sea trout, blue fish, lady fish, jack, blue runners, snapper. • A place to net shrimp.
the sports fishermen	• A point of departure for the reefs or Gulfstream. • A source of bait fish. • A place for exciting bonefishing and many other kinds of linefishing.

tourists	• A view from a causeway or hotel. • A tour along millionaires' row or to the Seaquarium. • A chance to participate in a multitude of recreational activities.
bayshore residents	• A view. • A point of access for boating, fishing, swimming, etc.
swimmers	• A shoreline with limited access and crowded conditions. • A place of infinite possibilities, if one has a boat.
skin divers	• A point of access to the reefs • A place with localized (mostly within Biscayne National Monument) opportunity for snorkeling, scuba diving and underwater photography.
marine industries (ship and boat builders, fish stores)	• A transit corridor. • A source of income.
commercial shipping interests.....	• A safe harbor and access to the ocean.
Florida Power and Light	• A remote location. • Formerly a source of cooling water. • A transit corridor for oil barges.
marine scientists	• A back-yard laboratory. • A source of income.
developers	• A choice location with many legal and environmental constraints.
the birdwatcher, beachcomber, shell collector, etc.	• A place for quiet observation or photography. • A site for intensive collecting with glimpses of the rare and unusual.
municipal and county governments	• A unique natural asset, formerly viewed primarily as valuable real estate and land fill. • A receptacle for urban and agricultural wastes. • A tourist and resident attraction. • A Dade County Aquatic Park.

the Water Management District	• A receiver of flood waters.
the State of Florida	• Sovereign submerged lands. • An Aquatic Preserve. • A natural resource to be managed.
the Federal Government	• Navigable waters of the United States. • A National Monument.

3.13 Existing Management and Legal Structures

From a management standpoint, Biscayne Bay may be best described as navigable waters of the United States overlaying sovereign lands of the State of Florida and bordered by twelve municipalities and Dade County.

As even a brief glance at the matrices (Tables 1-4) on agency responsibility reveals authority to regulate any function within the Bay system is split among and within the various levels of government. At the Federal level major jurisdictional responsibility is vested in the Corps of Engineers (Department of Defense), the Coast Guard (Department of Transportation), and Biscayne National Monument (Department of the Interior).

At the State level, the Department of Natural Resources has the responsibility to manage bottom lands and the living resources within the Bay's waters, and to promulgate rules for the Biscayne Bay Aquatic Preserve. The Department of Environmental Resources (DER) has the duty and power to control and prohibit pollution; to approve and promulgate long-range plans controlling air and water pollution; to administer and enforce laws, rules and regulations pertaining to air and water pollution; to establish air and water quality standards; to conduct field studies for air and water quality determination; to identify sources of pollution and to establish a system for permitting any operation or construction.

While there is no direct regional control over the Bay, the activities of the South Florida Water Management District directly affect the Bay, since the District controls freshwater discharge from all canal outlets. While canal outflows control the rate at which pollutants reach the bays waters, the rate and amount of pollutants flowing into canal waters is determined by the (1) planning activities of Dade County and the individual municipalities, (2) zoning, (3) building, and (4) pollution regulation. Local governments also control access to the bay and make the final decisions about all dredge and fill activities within their respective boundaries.

TABLE 1

AGENCY RESPONSIBILITY MATRIX-NATURAL RESOURCE PROTECTION & UTILIZATION

	FEDERAL:						STATE:		COUNTY:					CITIES:		
	Biscayne National Monument	Coast Guard	Corps of Engr.	Environmental Protection Agency	Fish & Wildlife	Dept. of Natural Resources	Dept. of Environmental Regulation	County Manager	Dept. of Env. Resources Mgmt.	Park and Recreation Dept.	Planning	Public Works Dept.	Coral Gables	Miami	Miami Beach
Fishing	R[1]			T/A	R[4]	R/P[5]									
Game & Wildlife Mgt.	R[2]			T/A	R					R[10]	T/A			R	
Submerged Land Ownership	R[2]					R/P[6]								R	R
Aquatic Preserves & Parks	R[2]						R[8]	T/A[9]							
Navigational Activities	R[2]	R[3]	R			R[7]							R		

All regulations which pertain to maintenance of water quality, most especially the regulations governing dredge and fill and surface water drainage, also directly affect maintenance of the living resources within the bay.

1 includes enforcement of traditional rules under F.S. 371.
2 in Monument waters
3 control over all registered moving vessels
4 over all endangered species
5 under Chapters 370, 372, and 258 of the F.S.
6 for leases under Chapters 20 and 253, F.S.
7 under Chapters 258, 370, 371 and 861 of the F.S.
8 under F.S. 358.165
9 required to promulgate plans and rules for the bay.
10 in park property

KEY:
R = regulatory enforcement authority
F = finance
P = permitting responsibility
T/A = technical advisory

TABLE 2

AGENCY RESPONSIBILITY MATRIX-SHORELINE PROTECTION

	FEDERAL:						STATE:			REG	COUNTY:							CITIES:		
	Biscayne National Monument	Corps of Engr.	Environmental Protection Agency	Fish & Wildlife	Housing and Urban Development	National Oceanic and Atmospheric Administration	Dept. of Environmental Regulation	Game & Fish	Dept. of Natural Resources	South Florida Water Mgmt. District	Building and Zoning Dept.	Dept. of Env. Resources Mgmt.	Development Impact Committee	Parks and Rec.	Planning	Public Works	Tree Preservation	Coral Gables	Miami	Miami Beach
Construction Bulkhd./Dredge Fill above Mean High Water	R[1]	R/P[2]		T/A[3]	R-F[5]	T/A					R/P		T/A[8]	R[9]	T/A	R/P		R/P	R/P	R/P
Drainage		T/A	T/A							R/P[6]		R[7]			T/A	R/P				
Conservation & Preservation	R		T/A	T/A[4]				R-T/A						R[9]	T/A		R/P	R[10]	R[11]	

1 within the Monument
2 under section 404 of PL-92-500
3 for endangered species
4 designation of habitats for endangered species
5 in flood hazard zones
6 manages water and controls canal outflow
7 canal water quality
8 addresses the County Commission on developments of County impact
9 in park property
10 trees
11 wildlife and trees

KEY:
R = regulatory enforcement authority
F = finance
P = permitting responsibility
T/A = technical advisory

TABLE 3

AGENCY RESPONSIBILITY MATRIX - PUBLIC ACCESS/MARINE FACILITIES

Marine Facilities (1)	FEDERAL:						STATE:			REG	COUNTY:										
	Biscayne National Monument	Coast Guard	Environmental Protection Agency	Fish & Wildlife	Housing and Urban Development		Dept. of Environmental Regulation	Dept. of Natural Resources	South Florida Water Mgmt. District	Building and Zoning dept.	Commission	Dept. of Env. Resources Mgmt.	Development Impact Committee	Park and Recreation dept.	Planning	Public Works Dept.	Seaport Director	Coral Gables	Miami	Miami Beach
Ports		R[1]								R/P	R			R	T/A		R		R	R
Marinas	R	R[1]								R/P	R		T/A	R	T/A			R	R	R
Docks & Moorings	R	R[2]						R[3]			R									
Shoreline/Visual Access	R								R[4]	R/P[5]	R		T/A	R	T/A			R	R	R
Beach Access	R													R	T/A			R	R	R

(1) This list does not include permits for construction which are considered under dredge & fill.

1 for access to
2 if a navigational hazard
3 through the leasing of sovereign submerged lands
4 canal ROW easements
5 through zoning decisions

KEY:
R = regulatory enforcement authority
F = finance
P = permitting responsibility
T/A = technical advisory

TABLE 4

AGENCY RESPONSIBILITY MATRIX- MAINTENANCE OF WATER QUALITY IN BISCAYNE BAY

	FEDERAL:							STATE:			REG	COUNTY:					CITIES:		
	Biscayne National Monument	Coast Guard	Corps. of Engineers	Environmental Protection Agency	Fish & Wildlife	National Oceanic and Atmospheric Administration	Housing and Urban Development	Dept. of Environmental Regulation	Dept. of Natural Resources	South Florida Water Mgmt. District	Building and Zoning Dept.	Dept. of Env. Resources Mgmt.	Park and Recreation Dept.	Planning	Public Works	Coral Gables	Miami	Miami Beach
Land Based Pollution	R[1] T/A[2]	R[3]	R/P[6]	R[9]	T/A			R[12]	T/A[13]			R/P[16] T/A[17]	R[19]	T/A	R/P[20] R[21]	R[23]		
Vessel Source Pollution	R[1]	R[4]	R[7]												nuisance			
Construction/ Dredge & Fill Below Mean High Water	R[1]	R/P[5]	R/P	R[10]	T/A	T/A		R/P	T/A[14]			R/P	R[19]	T/A		R/P[24]	R/P	R/P
Construction Above Mean High Water	R[1]		R/P[8]			T/A	R[11]				R/P			T/A	R/P	R/P	R/P	R/P
Surface Water runoff Canal Discharges			T/A							R/P[15]		R[18] T/A-208			R/P[22]	R/P[22]		

1 within monument
2 monument water quality
3 oil spills from on-shore sites
4 oil spills/sewage discharges from vessels/turbidity violations
5 bridges/structures on navigable waterways
6 discharge of dredge or fill material
7 removal of derelict vessels
8 under Section 404 of Pl 92-500
9 National Pollution Discharge Elimination System
10 water quality certification in navigable waters
11 in flood hazard zones
12 water pollution under Chapters 403 & 258, FS
13 promulgation of Rules for Biscayne Aquatic Preserve 258 & 165 FS
14 rulemaking under 258 & 165 FS
15 control canal discharge
16 under Chapter 24 of the Dade County Code
17 monitor water quality
18 canal water quality
19 within county parks
20 solid wastes
21 environmental
22 drainage
23 discharges into waters
24 under 256 & 129 FS

KEY:
R = regulatory enforcement authority
F = finance
P = permitting responsibility
T/A = technical advisory

3.131 Federal Legislation which Controls the Bay

Federal laws which regulate bay activities under the River and Harbor Acts of 1899 and 1902 and the Water Pollution Control Act of 1972 (PL-92-500) have given the Corps of Engineers broad powers to regulate and plan activities such as dredging and construction of seawalls, piers, water control structures, etc. in navigable waters of the United States. The Corps also regulates filling in navigable water, including headwaters of all tributaries and associated wetlands. The Corps authority also includes removal of wrecks and other obstructions in navigable waters.

In order to preserve and protect a rare combination of terrestrial, marine and amphibious life, the Federal government established the Biscayne National Monument (PL-90-606) in 1963. With very few exceptions, the National Park Service has total authority over navigation, construction, water quality, wildlife, and public access within the Monument. There are only three restrictions upon the actions of the Park Service.

First, since commercial and sport fishing were established as traditional uses of the Monument's water resources, the authorizing act stated that the fishing in monument waters should continue in conformity with Florida State laws. However, the Secretary of the Interior may prohibit, limit, or otherwise regulate species that may be caught, methods that may be used, and areas and times within which fishing is permitted in the interest of sound conservation. Commercial fishing will not be expanded beyond the level at the time of the Monument's authorization,

Second, the State of Florida reserved to itself or to Dade County six 150 foot wide navigation channels in Biscayne Bay's submerged lands. Of these six channels, the Turkey Point Barge Channel is the only one currently in operation.

The final restriction limits revision of the Monument's boundaries and states that "no boundary shall be revised outward or in such a manner as to obstruct any seaport channel which may be hereafter constructed outside the boundaries."

While not involved with direct regulatory enforcement or property management within the Bay, the Coastal Zone Management Act of 1972 (PL-92-583) will be a major element in all future bay planning and management. The Act contains many direct and indirect objectives, including the need to understand the short and long term consequences of impacts on the coastal zone, to minimize adverse impacts, and to broaden the decision-making process to include all those affected by management decisions. These objectives are clearly

applicable to Biscayne Bay. Furthermore, the Act is important since it sets guidelines for coastal zone planning, defines the relationship between Federal, State and local levels of government for coastal zone planning, and provides a major source of funding for coastal zone planning and management.

The Act requires that boundaries, permissible uses, areas of particular concern, and priority uses be determined. The rules adopted pursuant to the Act provide guidelines for each of these determinations. Finally, the Act requires that a description of the proposed implementation structure, including jurisdictional responsibilities and interrelationships of local, areawide, State, regional, and interstate agencies be specified in the coastal zone plan.

One of the major tenets of the Act is Federal supremacy in matters concerning the coastal zone. If a state wants to receive Federal monies for its Coastal Zone Management Program (CZMP) then it has to follow the Federal guidelines. It is only by developing an approved Coastal Zone Management Program that the states will be able to have any control over Federal agencies. In Section 307 (d) of the Act there is found the "consistency clause" which states that:

> Federal agencies shall not approve proposed projects that are inconsistent with a coastal state's management program, except upon a finding by the Secretary that such project is consistent with the purposes of this title or necessary in the interest of national security.

As can be seen, only if the Secretary of Commerce approves a state's plan will Federal agencies be bound by the consistency clause. Another portion of the clause, which will be discussed later, shows that the consistency clause does not hold in all situations.

Under the CZMA it is the State to whom the Federal government delegates some of its authority. The Act, however, requires the State to work with the local governments and gives it the power to delegate authority to the local level. This division of authority is extremely important in bay management reorganization plans. If the County is interested in receiving any Section 305 (planning) or 306 (implementation) monies, it has to work through the State. Under Section 305 (g) the State can allocate its planning grant to a local government and under Section 306 (f) it can allocate a portion of its management grant to the same group. Only with State cooperation is it possible for the local governments to get these Federal monies and if the State does not qualify for Federal money, then the County would not be able to receive any under these sections.

However, under the 1976 amendments to the Act, Section 310(2), Federally funded research grants are available for the development and implementation of management programs. The County could be eligible to receive these monies to support the development of a new Bay Management Plan.

In Florida, the Regional Planning Councils have been the recipient of the largest local share of State CZM monies and have in most cases prepared regional elements for inclusion in the State CZM plan. The South Florida Regional Planning Council has prepared a 9 volume draft of background information for the draft State Coastal Zone Management Plan.

3.132 State Laws Which Control Bay Activities

Two State acts, The Biscayne Bay Aquatic Preserve Act (258.165F.S.) and the Local Government Comprehensive Planning Act (163.3161F.S.) have the power to significantly control what can and will occur within and around the Bay.

It is the intent of the Biscayne Bay Aquatic Preserve Act "that Biscayne Bay be preserved in an essentially natural condition so that its biological and aesthetic values may endure for the enjoyment of future generations." In order to carry out this mandate the Act requires that there be no further sale or lease of sovereign lands unless the applicant can show extreme hardship and that the sale is in the public interest. The Act further declares that there will be no dredging and filling except under certain specified conditions; that there will be no drilling or excavation, and that no wastes shall be discharged into the preserve in a manner that will subvert the intent of the Act. However, the Act also states that regulation of human activity within the preserve should not interfere with "lawful and traditional uses" of the preserve, nor infringe upon the rights of riparian owners. The Department of Natural Resources (DNR) is charged with the responsibility of promulgating rules to accomplish the stated objectives of the Act, and the Department of Environmental Resources (DER) is charged with enforcing the provisions of the Act and overseeing the dredge and fill permitting process.

In Part 1 of Chapter 403.F.S., the Legislature declares that the pollution of the air and waters of the State constitute a menace to public health and welfare, and is harmful to fish and other aquatic life, for domestic agricultural, industrial, recreational and other beneficial uses of air and water. The public policy of the state is to conserve the air and water of the state.

Under Chapters 253, 258 and 403, Florida Statutes, and under the National Pollution Discharge Elimination System in the Federal Water Control Act of 1972 (PL-92-300,) DER is given control over dredge and fill activities and over the establishment and maintenance of water quality standards for the waters of the Bay and its tributaries.

The Local Government Comprehensive Planning Act of 1972 was passed to "utilize and strengthen the existing role, process and powers of local governments in Florida in the establishment and implementation of comprehensive planning programs to guide and control future development." The Act requires that cities and counties prepare and adopt comprehensive plans with certain specified elements prepared on or before July 1, 1979. To accomplish this, the State gave the local governments more power and responsibility to encourage the rational development of land, and the protection of natural resources.

Included in the required planning elements of the plan are (1) element for "conservation, development, utilization, and protection of natural resources in the area including .. beaches, shores, flood plains, .. harbors, forests, fisheries and wildlife, and other natural and environmental resources"; (2) a recreation and open space element, including, but not limited to: "natural reservation, parks and playgrounds, ... beaches and public access to beaches, open spaces, and other recreational facilities"; and (3) where appropriate, a coastal zone protection element, related to the conservation and open space elements and including "surveys of existing vegetation", surveys of traditional patterns of public access and use of beach resources, and setting out the policies for:

1. Maintenance, restoration, and enhancement of the overall quality of the coastal zone environment, including but not limited to, its amenities and aesthetic values.

2. Continued existence of optimum populations of all species of wildlife.

3. The orderly and balanced utilization and preservation consistent with sound conservation principles, of all living and non-living coastal zone resources.

4. Avoidance of irreversible and irretrievable commitments of coastal resources.

5. Ecological planning principles and assumptions to be used in the determination of suitability and extent of development; and

6. Proposed management and regulatory techniques.

The Act gives the coastal zone element a special place in the adoption and state review of the plan by requiring local governments to submit the coastal zone element for State review at least 60 days before its local adoption and there is a specific requirement for a coastal zone element of the comprehensive plan for any local government lying in part or in whole in the coastal zone.

3.2 PROBLEMS AND CONCERNS

The problems and concerns of Biscayne Bay are from the conflicts between man and the environment. A review of the history of the conflicts provides a background for better understanding of their current dimensions.

3.21 Historical Perspective.

The problems of Bay degradation are of recent origin. With the expansion of Flagler's Railroad to Miami in 1895, the stage was set for a period of urban development and extensive alteration of the northern Biscayne Bay basin. Since 1890 over 20% of the natural water area of north Bay has been filled to create almost 30 islands and six causeways, and another 20% has been dredged into waterways, borrow pits and channels. Some of the most significant events in the recent history of Biscayne Bay are given in the following chronology:

1821 1855 Riparian Acts allowed owners of adjacent uplands to fill tidelands and place structures upon the filled lands.

1902 Government Cut authorized in 1902, completed in 1905, dredged to 18', redredged 1925, '35, '75.

1903 Miami Canal from Lake Okeechobee to Biscayne Bay completed in 1913.

1926 McArthur and Venetian Causeways to Miami Beach filled and constructed.

1928 Major canals completed from Snapper Creek on the north to Snake Creek on the south. Artificial islands in north Biscayne Bay dredged.

1919-1928 Intracoastal Waterway dredged and a borrow channel along the entire eastern edge of north Bay completed.

1943-1945 Drought led to construction of salinity control structures on canals into Bay.

1942 Rickenbacker Causeway completed to Key Biscayne.

1951 Broad Causeway to Miami Beach completed in north Bay.

1955 Virginia Key Sewage Treatment Plant completed eliminating most of the direct sewage disposal into north Biscayne Bay.

1960 Construction begun on new Port of Miami.

1967 Randall Act passed by Florida Legislature, required biological survey as a prerequisite to any state or local decisions allowing alteration of tidelands.

1968 Passage of PL-90-606 establishing Biscayne National Monument preserving 4,000 acres of uplands and 92,000 acres of submerged lands in south Bay and the Atlantic Ocean.

1970 South Bay Area Study providing plan for 14 square mile area along the Bay, reviewed by County Commission. Maximum population ceiling of 150,000 set by County Commission and the Commission approved "in principal" the concept of a scenic drive with no development on Bay side except public recreation and private marinas.

Three Federal/State Conferences on the pollution of the navigable waters of Dade County were held at the request of the Governor. Recommendations included requirement that there be a cessation of direct sewage waste discharge into inland canals by 1974 and a prohibition of any further discharges into the waters of south Bay.

Saga Bay development plan, conforming with South Bay Area Study, was approved by Dade County Commission allowing total population of about 40,000 persons.

1971 Circuit Court issued an order that required the County to set the Bulkhead Line at Mean High Water or show scientific justification for another alignment.

Federal and State agencies and Florida Power and Light agreed to a closed-cycle cooling canal system for Turkey Point generating facility.

1974 Biscayne Bay Aquatic Preserve Act signed into law by Governor Askew prohibited dredge and fill below Mean High Water except in public interest. Department of Natural Resources charged with duty of promulgation of rules.

Dade County Commission passed resolution (R-1179-74) establishing the Bulkhead Line at Mean High Water along the western shoreline of Biscayne Bay from Coral Gables to the Monroe County Line.

1975 Rules on Coastal Boundary Surveying passed by Governor and Cabinet allowing Mean High Water Line to be set at mangrove edge.

1975 On November 13 & 20, a task force of County officials heard testimony regarding the status and problems of Biscayne Bay, and proposals for future management options.

1976 In April, University of Miami Sea Grant conducted two Bay symposia. During the first meeting scientific testimony on the oceanography, biology and impacts on Biscayne Bay was presented. At the second meeting, government, business and civic leaders discussed questions regarding Bay problems

1976 July, Wetlands Demonstration Project begun by the Dade County Planning Department to determine feasible decision making techniques and to formulate a planning process for Biscayne Bay.

3.22 Current Assessment

The Bay has been the focal point of numerous heated controversies. With the advent of scientific documentation on the value of the coastal zone as highly productive nursery grounds for offshore ocean areas, there has been increasing awareness of the Bay as a valuable natural system. With scientific literature in hand, environmentalists have helped stop an oil refinery, create a national monument, stop further causeway construction, eliminate thermal effluents from the Bay, and legislate an aquatic preserve. Today, however, the Bay rests in a state of uneasy peace. Major environmental battles are past, but there is general perception among those who know and care, that the Bay's problems are far from over.

Perhaps the most comprehensive statement of Bay problems and concerns were the product of two recent symposia. The first, sponsored by the Dade County Administration invited knowledgeable persons to address the County Biscayne Bay Task Force on problems of water quality, resource protection, shoreline management. A second symposium was sponsored by the University of Miami Sea Grant Program.

At the first meeting, scientists were invited to present updated information on the oceanography, and biology of the Bay system, plus Man's interactions with and impacts on the Bay. At a second meeting over 100 representatives from government, public and private interests addressed questions on resource management and protection, shore-line protection, and overall Bay management. A consensus paper detailed the group response to the questions presented.

The problems identified can be grouped in a few manageable categories: environmental (e.g. decline in water quality and habitat); socio-economic, (e.g. inadequate access, conflicts, overuse) and management (lack of single clear authority, overlapping jurisdictions, inadequate enforcement, inadequate data base).

As part of this project, a survey was conducted to determine the community perceived priorities for these problems. A questionnaire was sent to approximately 250 persons who had attended various Bay symposia, plus members of the Marine Council, power squadrons, yacht clubs, fishing clubs, environmental organizations, homeowner groups, major developers along the Bay, Chambers of Commerce and any other interested parties that were identified. The response indicated a substantial interest in Bay problems, as about fifty percent of the questionnaires were returned.

The tabulated results showed that there was a major concern for the Bay's natural resource values. Fifty-one percent of the respondees rated environmental problems (decline in water quality, destruction of mangrove and grass flats, and habitat destruction) as the most important Bay problem when valued on a scale of 1 through 12. Of these categories, decline in water quality was considered to be the most significant problem by 27% of the respondees. Twenty-five percent of the respondees rated inadequate Bay management as the most significant overall problem. Six percent rated either overcrowding or inadequate public access as the major concern and 11 percent inadequate marine facilities.

These figures are more pronounced when one considers only those questionnaires which replied with absolute ratings (i.e. where only one problem was rated as number one), as opposed to the tabulation above where the percentages of all number one ratings were included. Of the 83 questionnaires which responded with absolute rating, 60% considered environmental problems to be most significant, and 30% responded that inadequate bay management was most significant. Six percent rated inadequate marine facilities, and 2% rated inadequate access, while only 1% rated overcrowding as the single most significant problem in Biscayne Bay.

Following are descriptions of the six major areas of Bay concern.

3.221 Decline in Natural Resources Habitat.

Many Bay uses, if inadequately managed, can contribute to the decline in its natural resources. Habitats may be disturbed or ultimately destroyed. Flora and fauna may be overcollected and eventually eliminated from the Bay.

Dredge and fill, barge and boat scour, thermal effluent, pulses of fresh water discharge, net fishing and other fishing and collecting practices all have the potential to destroy major plant communities and Bay habitats.

The functions of the various plant communities within the Bay are relatively poorly understood. The single exception is the Thalassia, or turtle grass community which is known to perform many functions that are necessary to the maintenance and continued viability of the Bay system.

Turtle grass communities produce large quantities of plant materials which are continuously released into the Bay system as the grass blades grow, excise, and decay. In addition to providing an important food source of the Bay system, the turtle grass flats are recognized as valuable nursery areas for numerous species of fishes and invertebrates. While few animals, except sea urchins, turtles, and some fishes graze upon the grass blades directly, many animals eat the tiny epiphytic plants which grow upon the turtle grass blades. Finally, seagrass leaves produce a baffle effect which causes suspended sedimentary material to settle out of the water column. To insure the continued productivity of the grass flats, the sediment producing areas must be protected and the sediment trapping ability of the grasses must not be exceeded through over siltation.

In general, the abiotic factors which control plant community distributions and viability are fairly well known. Hydrologic flows, tidal and wind driven currents continually bring new sources of nutrients into and through the system and remove waste products. Temperature and salinity regimes not only control the distribution of organisms, but also affect the rates of chemical reactions among the biota, water column, and sediments. The amount of light available to plants which controls growth and productivity is limited by the clarity and depth of the water column.

Sediment depth is also extremely important in determining the distribution of Bay communities. In general, areas with more than 15 cm. of sediment are vegetated by seagrasses, and regions with less than 10 cm. of sediment are dominated by sponges and alcyonareons and certain algal species.

Much of our misunderstanding of benthic animal communities in the Bay is based upon knowledge of the individual animals which live in the Bay for all or part of their life cycles. Although there have been over a dozen ecological studies done in Biscayne Bay during the past 25 years, most of the work to date has been descriptive and has dealt primarily with development, feeding behavior, and distribution.

Few quantitative studies have attempted to relate the abundance of primary consumers to the higher trophic level analysis done in Biscayne Bay which could be considered comparable to the work of Odum and Heald in the North River Estuary of Everglades National Park. As a result, the dynamics of the Bay's food webs remain largely unknown.

Dredge and fill has removed or altered almost half of the bottom vegetation of north Bay, (Chardon 1976). In 1956 McNulty found some small patches of Thalassia in north Bay; however, by 1961 no Thalassia was found. McNulty (1971) attributed this decline to the dredge and fill activities at Dodge Island and Government Cut during the intervening years. In south and central Bay and Card Sound patches of grass flat vegetation have been removed directly or indirectly (due to siltation) by dredge and fill.

Boat and barge traffic causes the grasses to be directly torn up or indirectly disturbed due to continuous siltation. Wanless (personal communication) has documented the destruction of grass flats in the vicinity of the Intracoastal Waterway. He attributes the damage to large boat traffic which continuously stirs up the bottom sediments. Additionally, small boats are notoriously negligent about remaining within marked channels, and numerous cuts and plugs can be seen in the grass beds through south Bay. These exposed cuts leave the grass flats more susceptible to damage from storm tides and hurricanes.

Small increases in water temperature (as little as 3°C) can drastically alter the Bay's ecosystem. Thermal effluent severely altered benthic communities in south Bay. Temperatures of 31.6°C at Turkey Point removed 75% of the animals and most of the macroalgae.

Fresh water discharge has been observed to alter biological zonation and to favor the less diverse and probably less productive Cuban shoalweed community over turtle grass. While relatively few animals can tolerate the extremely brackish conditions which may exist at canal outfalls during the rainy season, certain animals such as the commercial pink shrimp, require different salinity ranges at various stages of their life cycles. The maintenance of salinities at less than oceanic concentrations for most of the grass is important to the maintenance of the Bay as it currently functions.

Overcollection is another problem. Already the majority of lobstering and crabbing is done outside of the Bay because the quantities of legal sized specimens have declined in the Bay. In spite of laws prohibiting it, coral is being collected both inside and out of the Bay.

There is a concern that much of the bait fishing in the Bay is done by unregistered "sport" fishermen, -- people who occasionally go out bait fishing and who bring in commercial size loads. The problem is that the law does not adequately define commercial fishing. There is no limit on the amount of shrimp which may be brought in nor are there any equipment requirements. The true commercial fisherman -- the person who fishes for his livelihood -- is very concerned with the maintenance of the species as his income is dependent on this. As an example, recently the commercial shrimp fishermen in Biscayne Bay voluntarily imposed a two week moratorium on shrimping because of the low catch rates and fear of depleting the juvenile shrimp population. Abusive collection techniques can likewise adversely affect the Bay habitats. Indiscriminate bottom trawling can wipe out many species of animal life from an area in addition to tearing apart the seagrass flats. Frequently, in order to comply with the law, the shrimpers have to toss back undersized shrimp which have been caught because the mesh size of the nets is too small. These shrimp rarely survive this treatment.

There is some controversy over the procedure used for stone crabbing. Some fishermen believe that removal of both of the crab's claws is tantamount to leaving the animals to die, and they argue that the whole animal might just as well be taken if this procedure is to be followed. Others believe that restricting the fishermen to one claw per crab is an unnecessary regulation.

3.222 Overcrowding and Overuse

Overcrowding of the Bay occurs when any particular use exceeds a certain density threshold or when two uses are not compatible (cannot occur at the same time and place) such as water skiing and swimming. Overcrowding is dependent on time and location. If uses don't occur in the same place (e.g. on the Bay vs. shoreline) or if they don't occur at the same time, there is no potential for overcrowding.

Conflicts between uses are evident when accidents or mishaps start occurring. A density threshold is exceeded when there are just too many activities happening within a given area. As a result, either the activity cannot be performed or it is no longer enjoyable to perform. Table 5 indicates where a potential for overcrowding exists for uses on the Bay and specifies the type of overcrowding (maximum density threshold vs. mutually exclusive). Although all uses have the potential for reaching some maximum density threshold, not all of them preclude the occurrence of other activities. For example, swimming and sport lobstering can

Table 5

POTENTIAL FOR OVERCROWDING

BAY USES

	line fishing	diving	bait fishing	water skiing	swimming	cruising	sponging	sport crabbing*	sport lobstering*
Line fishing	O	X	X	X	X	X	X	O	X
diving	X	O	X	X	X	X	X	O	O
bait fishing	X	X	O	X	X	X	X	X	X
water skiing	X	X	X	O	X	X	X	X	X
swimming	X	X	X	X	O	X	X	X	O
cruising	X	X	X	X	X	O	X	X	X
sponging	X	X	X	X	X	X	O	X	X
sport crabbing*	O	O	X	X	X	X	X	O	O
sport lobstering*	X	O	X	X	O	X	X	O	O

SHORELINE USES

	beach uses	birding	commercial shipping	municipal services	marinas	residential land uses	commercial land uses	preservation	recreational land uses
beach uses	O	O	X	X	X	X	X	X	O
birding	O	O	X	X	X	X	X	O	X
commercial shipping	X	X	O	O	O	X	O	X	X
municipal services	X	X	O	O	X	X	X	X	X
marinas	X	X	O	X	O	X	O	X	O
residential land uses	X	X	X	X	X	O	X	X	X
commercial land uses	X	X	O	X	O	X	O	X	X
preservation	X	O	X	X	X	X	X	O	X
recreational land uses	O	X	X	X	O	X	X	X	O

*this specifies sport crabbing and lobstering as there really is no commercial activity going on in the bay.

X potentially mutually exclusive

O maximum density threshold

occur concurrently although each of them, if done in excess, can be overcrowded.

Overcrowding can contribute to other Bay problems too, such as the lack of public access, the destruction of the shoreline, the decline in biological resources and the decline in water quality.

3.223 Shoreline Destruction

The shoreline functions as a transition zone between the Bay and the inlands. As such it has many varied biological functions. It works as a two-way system, simultaneously buffering the interior lands from the Bay and visaversa. The natural mangrove vegetation stabilizes the shoreline, filters particles such as salt and pollutants from the air and the ground and surface water systems, and it provides shelter to the inlands from hurricane surges. The mangrove swamps are fertile fish and shellfish nurseries. Litter produced by leaves, twigs, wood and fruit from the 19,456 acres of mangroves adjacent to south Bay amounts to over 37,000 tons/year (see Table 6). The highest rates of litter production occur along the coastline where figures of almost four tons/acre/year have been recorded (Teas, 1974.) This compares very favorably to other recorded values for non-fertilized land plants and seagrasses which range from two to over ten tons/acre/year. The distribution of litter production for the various communities of mangroves along Biscayne Bay is given in the following table:

TABLE 6

SUMMARY OF LITTER PRODUCTION BY MANGROVES ALONG BISCAYNE BAY

	Community					
	Coastal Band	Dense Scrub	Sparse Scrub	White Mixed	Black Marsh	Total
Area (acres)	5,415(28%)	4,022(21%)	8,586(44%)	401(7%)	32	19,456
Litter Production tons/year	21,173	8,044	5,473	2,620	40	37,350
% Distribution Total litter production	56.7	21.5	14.7	7.0	0.1	100.0

Source: Teas, 1974

Litter production is intimately related to the overall metabolic processes within the mangrove forest. Mangrove productivity and respiration are, in turn, directly related to tidal inundation and upland surface water runoff. Not all of the nutrient export from the mangroves to the Bay is in the form of detrital particles. Dissolved substances are also highly important to the life and well being of the Bay. Although the link between mangroves and coastal waters have been recognized for the past few years, the other essential link between upland terrestrial systems and mangroves is less appreciated. While mangroves thrive in areas that receive nutrient rich surface water runoff, much of the construction activity in Dade County has served to sever these forests from their upland sources.

Unfortunately, as development has occurred, the mangrove and their functions have been destroyed in increasing amounts. Because the mangrove forests restricted access to the Bay and were generally viewed as a nuisance, they have been targets for wholesale dredge and fill actions during the past seventy years. In 1972, the County Parks and Recreation Department estimated that there were approximately 46,000 acres of mangroves in Dade County prior to development, and that over 37,000 acres occurred from Coral Gables north. By 1972, it was estimated that the total number had been reduced to just over 10,500 acres with about 1,800 acres remaining north of Coral Gables. It should be noted that the Park's figures did not include the vast area south of Turkey Point. In 1974, a study on mangroves of Biscayne Bay (Teas) estimated that there were 19,456 acres of mangroves from Coral Gables south to the Monroe County line.

With the recent public awareness of the mangroves' functions in the coastal system, the pendulum of public opinion has swung widely, toward an almost total preservation ethic. However, no final public decision has been made on how much preservation is necessary, and at what total cost. Today, however, there are several choices: (1) to destroy the mangroves and seriously degrade the Bay, (2) to totally preserve the remaining natural shoreline (effectively saying "no development"); or (3) to allow some regulated development while assuring the maintenance of shoreline forest functions.

Channelization, drainage, levee and road construction have severely altered overland flow into and through the mangrove forests along south Bay. Channelization and drainage effectively "short-circuit" the overland flow, circumventing the natural filtering systems of the mangrove forests and inland marshes and rushing nutrient (and pollutant) rich waters off the land and into the

Bay. In this manner, the mangroves are deprived of valuable nutrient sources, and the Bay becomes a potential dumping ground. Additionally, the period of freshwater run-off has been substantially shortened. During the rainy months freshwater pours into the Bay, but in the drier months almost no freshwater is allowed to flow. Thus, substantial fluctuations in salinity are observed in the mangrove forests and Bay waters along the western shoreline of the Bay.

Levee and road construction have severely limited terrestrial runoff into the mangroves of the extreme southern portion of the Bay and Card Sound causing a situation of reduced growth (such as that observed in the scrub forests south of Turkey Point). However, it has been observed that even under conditions of adequate nutrient influx, tidal action is also necessary to provide maximum exchange of materials between the tidal water and the mangrove forest substrate.

Acute siltation from dredge and fill operations can destroy mangrove trees. Mangroves which have survived the devastating effects of hurricane winds have been reported to have succumbed afterward to the direct and indirect effects of siltation (Savage, 1972).

3.224 Inadequate Public Access

Traditionally, shorefront lands have been considered available for the public's use as access points to the Bay. It is only in recent times (with the expansion of private residences and commercial developments) that shorelands have often become closed to all but private use. Only a modest amount of the shoreline property has been developed for the public, with access to the Bay provided at 54 public land areas (including ten public marinas), 56 private docks, marinas and boat ramps, as well as at private lands which have traditionally been used as public access points (see Figure 5). Additionally, the bridges which crisscross the Bay provide visual access.

In spite of these access points, there is an ever increasing demand for more public access. The Marine Council has estimated that there is a demand for at least 2,500 boat slips today, and that by the year 1985, an additional 6,500 slips will be required. Dade County's Parks and Recreation Department is looking into the feasibility of providing three new marina expansions (at Chapman field, Black Point, and Homestead Bayfront Park).

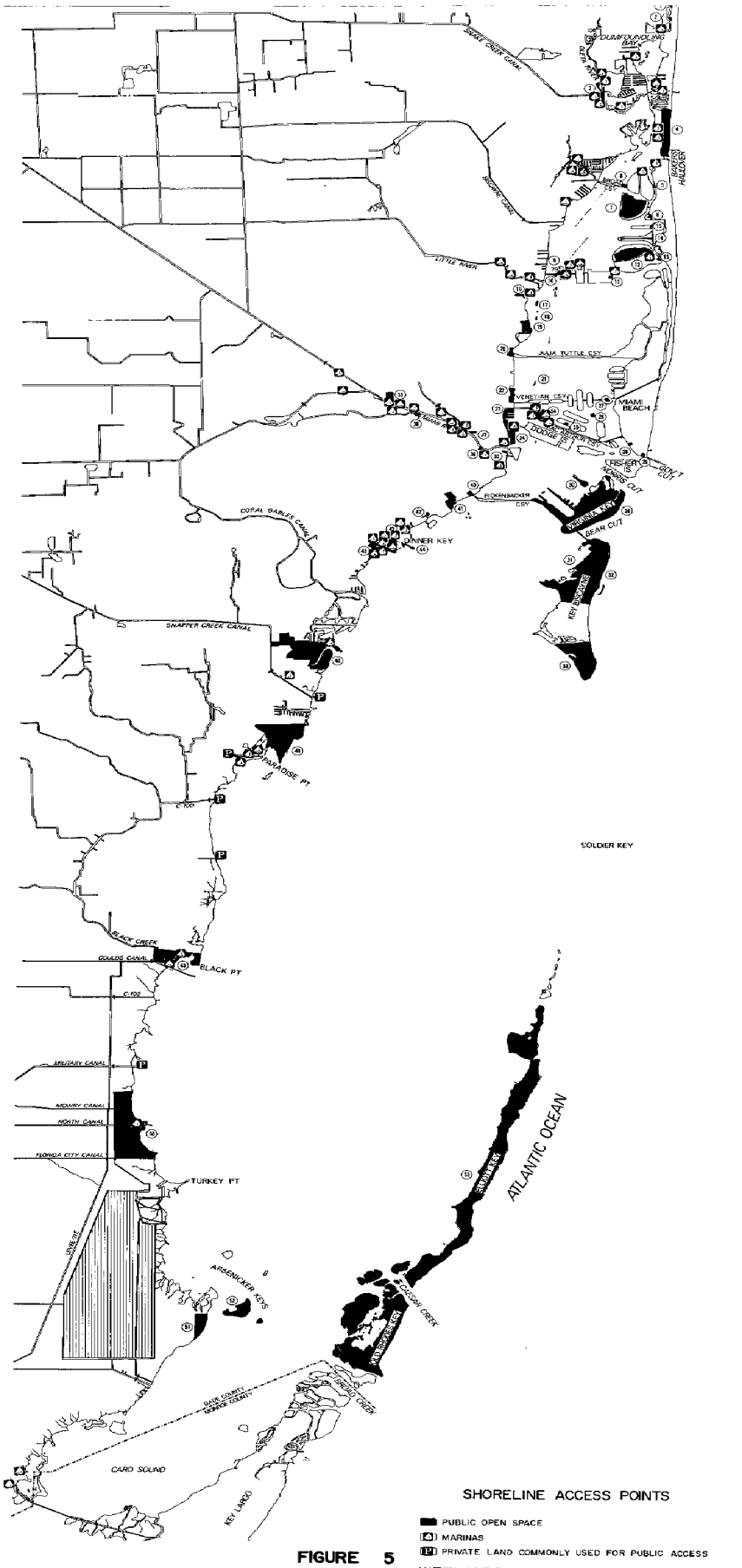

FIGURE 5

WETLANDS DEMONSTRATION PROJECT
BISCAYNE BAY
JUNE 1977

Unfortunately, the major concern has been almost exclusively for providing marinas or preservation (no development) areas. Several other uses -- such as shoreline fishing, viewing and swimming -- have inadequate Bay access and have been almost totally overlooked. There is a definite demand for swimming areas. The atoll at Matheson Hammock and the swimming area at Homestead Bayfront Park are always crowded in good weather and frequently (even though it is not a designated area), there are people swimming and snorkeling on the Bay side of the Matheson dike. More thought must be given to these other forms of public access, including shoreline viewing, nature trails, bike trails, and the like.

3.225 Decline in Water Quality

The boom years took their toll on the Bay, as canals and channels were dredged, and the Bay bottom lands were filled to create valuable real estate and causeways. As the population grew, sanitary and storm sewer lines were built with outfalls directly into the Bay or the Miami River. By 1922 citizens were sufficiently vocal about the odors and nuisance that the City of Miami started to create a sewage treatment plan. However, the hurricanes of 1926 and 1928, the depression, and World War II stopped all planning, and it was not until the post war years that the matter was seriously considered again. By that time the Miami River was considered to be little more than an open sewer, and septic conditions existed from the Miami River to the 79th Street Causeway and out beyond the Intercoastal Waterway.

Water pollution in north Bay was studied by McNulty before and after the installation of the Virginia Key Sewage Treatment Plant in 1956. In 1960 he concluded that north Bay was no longer grossly polluted but that significant water quality problems still existed. He found that grass flats which had existed in 1956 had disappeared by 1960, and he speculated that the loss might be attributed to the siltation caused by construction of the Port of Miami.

In 1970, Governor Kirk called a conference on pollution in the navigable waters of Dade County at the request of concerned local citizens. A report published by the Federal Water Quality Administration concluded that: (1) the inland (canal) waters of northern Dade County were grossly polluted, (2) the inland waters of southern Dade County showed evidence of severe water pollution as indicated by fish kills in the area, and (3) the major cause of poor water quality in Dade County was inadequately treated municipal sewage effluent.

The most obvious effects of poor water quality in Biscayne Bay are observed in north Bay. The synergistic effects of past sewage outflows and dredge and fill activities have altered over 40% of the original Bay bottom, leaving a permanent sediment of soft mud, silt and sludge, and severly restricted water circulation. As a result of these past actions, the Bay north of Rickenbacker is probably incapable of "recovering" on its own.

Human viruses have been found in the Bay and in marine fishes. The whirling fish disease, bacterial fin rot, scale disorientation and fish with tumors have become constant reminders that there are significant water quality problems in Biscayne Bay. Although a Fish Pathology Study was sponsored by the University of Miami Sea Grant Program, the causes of fish diseases have eluded scientific definition to date.

Causes of Bay water pollution can logically be divided into two categories: (1) those activities which occurred in the past and have continuing impact, but are unlikely to be repeated in the future; and (2) those activities which currently (or potentially) threaten the Bay's waters. In the former category are: (1) drainage of the Everglades and canal construction which increased the rate of surface water runoff, lowered the ground water table six feet in fifty years, and circumvented the natural filtering processes of the coastal marshes; (2) levee and road construction which further restricted overland water flow and cut off the southwestern coastal marsh from freshwater runoff; (3) construction of salinity structures which stemmed the salt water intrusion brought on by canal construction and excessive drainage, but also effectively stopped freshwater flow into the Bay for four to six months out of the year. As a result "pulses" of freshwater, carrying loads of nutrients and toxic substances are dumped into the Bay at the start of every rainy season.

In addition to activities on land which have severely impacted the Bay, there have been construction activities within the Bay itself; numerous dredge and fill activities associated with causeway and artificial island construction, which destroyed valuable bottom environments and impacted large segments of the bay through siltation and smothering of turbidity inhibitors. Additionally, dredge and fill activities created two artificial environments which continue to perturb siltation and turbidity problems: (1) shallow spoil banks and unbulkheaded spoil islands which release fine muds into the Bay waters as waves and winds erode the exposed banks; and (2) fine muds which settle out from construction areas and are continuously re-introduced into the water column during succeeding years.

Dumping of untreated or poorly treated sewage into the Bay, and runoff from septic tanks, storm sewers, and discharges from live-aboard boats have also seriously degraded Bay water quality. The addition of heated effluents at the Cutler Ridge and Turkey Point Power Plants had localized demonstrable negative impacts on water quality and the biota in those areas.

In the latter category, it appears that canal outfalls contribute the majority of the pollutant loadings into Biscayne Bay. Thus, to adequately evaluate current (or potential) water quality problems in the Bay, sources of nutrients and toxic substances in canal waters must first be identified. It is generally believed that canal pollutants are primarily derived from fertilizers and pesticides used on agricultural lands and urban lawns, from auto exhausts, from sewage and from industrial wastes, septic tanks, leachates, and rain.

While direct discharge of sewage wastes into the Bay is no longer permitted, 32 sewage and industrial plants dump wastes into canal waters and thus, indirectly into the Bay. Each day over 25 million gallons of sewage effluent is discharged into canal waters. Throughout Dade County all roads and subdivisions within 300 feet of any canal until very recently have been required to dump their surface water runoff directly into the canals. In this manner, oils and grease and other highway pollutants such as lead enter the Bay.

Undetermined amounts of nutrients and toxic substances enter the Bay directly via storm sewers, surface and ground water discharges, rain and ocean tidal inflows. It has been shown that over 70 percent of the sewage effluent from the Virginia Key outfall enters the Bay on the following flood tide via Bear and Norris Cuts. Recent work done on chlorinated hydrocarbons in the water off Virginia Key revealed that the chlorine which is added to sterilize the sewage effluent is replaced by bromine, a natural component of sea waters. The reaction, which takes place in less than a minute, creates brominated hydrocarbons, which may be even more toxic than their chlorinated equivalents.

As development occurs both inland and on the shorelands, the potential for decline in the Bay's water quality increases. Land development which significantly increases the amount of impervious ground surface area, also accelerates the rate of surface water runoff and enhances the potential for higher concentrations of pollutants in the runoff water. Studies done within the Coral Gables Canal system by Waite and Greenfield (1975)

provided evidence that runoff from paved areas, parking lots and streets, contained significantly higher concentrations of pollutants than runoff from non-impervious areas.

In 1971 the USGS calculated that a highly urbanized canal basin transmits 16 percent of the rainfall which falls within the basin into the Bay, via direct canal runoff, while 1 percent flows overland and 3 percent enters the Bay from ground water. From studies done in the Snake Creek basin, the Geological Survey suggested that urbanization could potentially increase the rate of surface water runoff by 42 percent over the rate obtained in an undeveloped area.

In addition to the impacts of upland sources on Bay water quality, uses within the Bay also have the potential to cause a decline in water quality, especially as the uses become more intensified.

Periodically, the large oceangoing cargo ships which enter the Bay through Government Cut come in with empty holds. These ships have been carrying bilge water as ballast on their trip to the port. This water is usually flushed out just prior to entering the port. In the process of flushing, tar and oils are exuded along with the water. Although this is to be done at sea, these materials still manage to migrate to shore. Most of the tar collects on the ocean side of the Bay islands, however, tar is occasionally found on the beach at Matheson Hammock or Chapman Field. Another source of oil, grease, and toxic chemical pollution comes from the numerous abandoned boats which are found in the Bay.

Boat traffic contributes to the turbidity of the water. Because of the Bay's shallowness, the water streams created by boat propellers and turbojets tear up the sea grasses and stir up the bottom sediments when boats stray from the channels. The boats also deposit gas and oil materials which contribute to the pollution of the water. Unless marine industries come up with technology for a cleaner engine system, this pollution will continue. Houseboats and live-aboard boats also are sources of human wastes. The majority of these boats currently flush these wastes directly into the Bay or into the ocean.

There is also a potential for a major oil spill in the Bay from the barge which daily supplies Turkey Point power plant with fuel oil. This is a particular concern during the hurricane season. Such an oil spill would prove disastrous not only to the water quality but to the entire Bay system. In addition, the barge's six foot

diameter propeller stirs up the Bay bottom and creates a turbidity plume which also contributes to a decline in water quality.

3.226 Inadequate Bay Management

Post-war rapid growth, due largely to a boom economy, has created many environmental and socio-economic problems within Biscayne Bay and its environs. These problems range from health concerns to overuses. Unless an effort is made to balance the development and conservation activities, these problems will continue to increase, thereby jeopardizing the maintenance of a viable Bay environment for future generations.

Many factors contribute to the ineffectiveness of the current management situation. Of the fifty percent of the respondents to a questionnaire on Bay problems (Planning, 1977) who felt that inadequate Bay management was a major problem (ranking it one, two or three), fifty-three percent indicated that overlapping and conflicting authority was of major significance to the management problem. One look at the matrix of agencies involved in regulating the Bay (see Tables 1-4) is enough to point out this problem.

Currently no single agency is responsible for the management of the Bay. Likewise, no single agency is responsible for coordinating the interests of the twelve municipalities, one County, two regional and several State and Federal agencies which are involved in governing various aspects of the Bay. To date, each municipality controls access and zoning and has the final word on all dredge and fill projects within its respective boundary. Lack of a Bay management master plan implies that the solutions to developing problems fail to meet a uniform approach and further that there is no established format for the coordination of activities for the Bay as a whole. Various interests are regulated or represented by various agencies at several levels of government.

The permitting process is an example of the confusion over management responsibility. Although several efforts have been made to expedite it, the process can be a long, difficult and expensive task. Figure 6 shows basic steps in the permitting process. Problem areas include inordinate opportunity for permit delay and/or denial and for overlapping jurisdiction. For example, in order to get a marina installation permit, permission has to be received at the local, State and Federal level.

Some may take the view that the existing system adequately manages the Bay, and that a complicated permitting procedure justifiably stops or slows down excessive waterfront development. This is inefficient, however, and in the long run may create a backlash resulting in the repeal of environmental legislation, or may prevent development which is in the public interest.

Failure to provide laws which control abusive uses of the Bay contributes to bad management. In some instances, the presence of laws would help to alleviate the problem altogether. In terms of water quality, for instance, if new developments were required to provide berms and swales for on site retention/detention of runoff, fewer pollutants would reach the Bay.

Another major contributor to poor management is the lack of enforcement of existing laws. In a survey of persons who are concerned with Biscayne Bay (Dade County Planning Department, 1977) it was found that 45% of the respondents who ranked "lack of Bay management" as an important problem felt that the lack of enforcement is a major contributing factor.

Improper interpretation of existing laws is one enforcement problem. Write-in comments on the above mentioned questionnaire criticized the permitting of dredge and fill at Cocoplum and the Interama (Munisport) sites. Among many considerations, it's argued that this fill should not have been permitted under the Aquatic Preserve Act, (F.S. 258.165.) Conflicting laws may also be a problem on occasion.

Another example of inadequate or substandard enforcement involves unrealistic rules such as the turbidity standards for the Bay. Presently, a maximum of 50 JTU's above background is permissible. This standard is unrealistically high for the Bay since the average Bay background is only 3 to 5 JTU's.

Many rules are not enforced due simply to a lack of enforcement personnel. Illegal net fishing for mackerel and pompano is done at night over the tidal channels in the Safety Value, spearfishing occurs on several bridges over the Bay. Illegal and unsafe boating occurs throughout the Bay as boaters abuse the speed limit and go into unsafe areas.

Whether the lack of enforcement is due to interpretive problems, conflicting regulations, unrealistic or nonexistent rules, or to a deficiency in enforcement personnel, the end result is the same, inadequate management.

3.3 PLANNING/MANAGEMENT ALTERNATIVES

In view of the multiple governmental and agency responsibilities for Biscayne Bay management and the lack of significant planning for the conservation of Bay resources, priority should be given to the establishment of a comprehensive plan and a coordinated management process for its conservation. The objectives, approaches, and actions associated with establishing such a planning/management structure and process are described in the following sections.

3.31 Objectives

While many agencies have significant amounts of authority over certain Bay-related functions; i.e., dredge and fill permitting; or certain portions of the Bay; i.e., Biscayne National Monument; each agency operates within the intent of its enabling legislation and frequently in its own best interest. The picture that emerges is of many agencies desiring to adequately manage and protect the Bay's resources, but no clear picture of exactly what should be done.

The lack of comprehensive goals for the Bay is a major problem for the individual agencies and governments involved since in the absence of such goals each decision must be made on "ad-hoc" and often crisis basis. Without overall goals and objectives to guide future Bay usage, any small decision can set a precedent for many additional small actions which can have a devastating cumulative effect.

The most basic objective of proper Bay planning and management can be found within the stated purposes of some of the specific legislation related to the Bay. For example, the State Aquatic Preserve Act, while authorizing the State to preserve the Bay in "essentially natural condition", provided for the following overall goal:

> To preserve and protect Biscayne Bay and all natural waterways tidally connected with the Bay by reasonable regulation of all human activity which might have a deleterious effect on the Preserve and through the development and implementation of a comprehensive management program.

More specific objectives may be developed from the problem statements set forth in the Bay symposia and the prioritizing of the concerns reported in the recent survey of Bay interests.

In response to the identified Bay problems and concerns, objectives should be developed for positive approaches to dealing with these issues. Specifically, objectives should be directed to improving the natural resources habitat, providing appropriate Bay-use levels, avoiding shoreline destruction, improving public access and enhancing water quality.

3.32 Approaches

There are two basic approaches to Bay planning and management. One seeks to improve the day-to-day management (regulation and permitting process) to achieve better overall results toward meeting Bay objectives and the other seeks to provide a comprehensive long-range plan as a frame work for day-to-day decisions. The first approach tends to be reactive and the other, initiative.

3.321 Basic Planning Management

The plan approach has several advantages over the permit response process. A plan provides for a comprehensive view of all potential Bay uses and establishes optimal use zones based on economic, environmental, and social information. Permit applications respond to a proposal for a specific use at a specific location often without full consideration of the other uses that might occur there. Also the preparation of a plan can consume less staff effort than required to review on an individual basic each and every permit application. Time spent in preparing a plan is often time saved at the permitting stage.

An important aspect of selecting a planning/management approach to Biscayne Bay is identifying the proper planning entity. While there are a number of options for a planning/management, the choice of a suitable entity for conducting these functions is relatively limited. Although the highest level of authority for many Bay concerns resides with the Federal government and the Bay is a resource of national concern, the difficulty of initiating a planning process under the leadership of a Federal agency with major responsibilities, such as the Department of the Interior, does not make such an approach an attractive option. Furthermore, the final product of such a planning process, while potentially binding upon the State and local agencies, would not necessarily be binding upon the actions of other Federal agencies such as the Corps of Engineers of Coast Guard, except through voluntary interagency agreements.

Looking to the next level of government, the State has significant control over the sovereign bottom lands and the living resources of the Bay. In addition, the enabling legislation which declared Biscayne Bay a State Aquatic Preserve authorize the State to preserve the Bay in "an essentially natural condition." The rules proposed by the Florida Department of Natural Resources to administer and manage the State Preserve recognized the need for "the development and implementation of a comprehensive management program."

The major shortcoming in having the State spearhead a planning effort for the Bay stems from the fact that its authority over the Bay extends only to the Mean High Water Line. It would probably be possible to amend the Biscayne Bay Aquatic Preserve Act (CH. 258,165, F.S.) and the Local Government Comprehensive Planning Act (163. 3161 - 3211 F.S.) to form an independent Aquatic Preserve Planning and Management District to broaden the Bay planning/management preview of the State. Such a special district could possibly be structured similarly to the regional water management districts.

The time factor is a major drawback in the establishment of such a special district. It is estimated that a minimum of three years would be required to pass a general bill of this nature through the State Legislature. However, the time could probably be significantly shortened if an emergency special purpose bill were sought.

An alternative to the special Bay planning/management district approach requiring State legislation would be to administratively establish a planning group with the maximum amount of "clout" to prepare a plan. Such a group including elected officials, top echelon people from all involved agencies and influential and involved local citizens, could define goals and objectives and propose specific policies to achieve the selected goals, to designate the future management structure, and most importantly, to sign off on the plan once it is finalized. Within the authority of Ch. 258.165, Ch 163, and Ch 23 of The Florida Statutes, a Bay Planning Council could be established. The most effective and expedient means of creating such a council, would be a resolution by the Governor and Cabinet and the Dade Board of County Commissioners designating representatives from State, regional, County and local agencies, and citizenry, plus invited Federal representatives.

3.322 Specialized Opportunity Cost Analysis

In addition to the basic approaches to Bay planning/management described above and the more or less accepted procedures for accomplishing them, it was a sub-objective of this study to provide additional insight into an approach applicable to both planning and management (permitting) -- the use of opportunity cost analysis.

Whether preparing plans or responding to permits, there is clearly the need to have increased ability to dimension the economics of environmental preservation. In development/environment conflicts throughout the Nation, State

and locality, there has been clearly identified the need to have better dimensioning of environmental economics -- establishing the environmental values of natural amenities in addition to the more traditional economics of development decisions.

1) Concept. The full set of concepts involved were set forth in some detail of the East Everglades portion of this report and in full detail in the supplementary opportunity cost analysis report of this project. However, the concept can be briefly summarized as a shift from the current approach of seeking to demonstrate the cost of environmental loss involved in environment/development decisions to the approach of demonstrating the foregone development costs. There are clearly many unknowns involved in evaluating the impact of development on the environment and many difficulties in attempting to establish the cost of lost environmental amenities. In addition, there are the problems of trying to determine the loss to whom -- the question of evaluating the losses to persons living in other places and at other times in the process. Many of our environmental amenities belong to the Nation and to future generations.

   The opportunity/cost analysis approach seeks to refine the more traditional benefit/cost analysis of the preservation/development decision. In the latter analysis it is difficult to determine when all the benefits have been counted. The approach to opportunity/cost analysis seeks to minimize the maximum possible losses to society of environment amenities. The essence of the process involves the assessment of all possible locations for development proposals such that the benefits to the community are the same but the costs are less. The development benefits are achieved and environmental costs minimized. This approach is primarily a more explicit economic application of the same general concepts which have guided land use planning in the past and present. This is essentially the selection of the best location for various activities, and in the case of the environmental preservation, non-activities.

2) Application. To demonstrate the concepts of opportunity-cost analysis as it relates to Biscayne Bay concerns, a case study was prepared of the need for additional marinas. Assuming that demand for

an additional 2000 wet berths analysis was made of the options available for meeting the supplies in terms of the size and location of facilities. The first option evaluated the construction of a single new marina in the southernmost part of the Bay; the second, two new facilities in the mid-Bay area and the third, additions to existing facilities in the northern part of the Bay (with the least environmental impact). Existing and projected usage assumptions were made for each of the three options.

The impact of the three options in terms of land requirements, public service needs, and traffic facilities, and environmental degradation were next determined. In the latter case, mangrove fringe disturbance and Bay bottom disturbance were prime considerations. Other factors evaluated were the potential of the options for conflicts among Bay users, for changes in neighboring land values, for induced economic activity and for effects on various income groups. All of these various effects were given relative values.

The case study demonstrated a technique for evaluating the positive and negative implications of the sites and providing a basis for better making decisions effecting environmental resources.

3.33 Actions

Several specific actions are recommended to provide for a proper planning/management program for dealing with Biscayne Bay concerns. Their recommendations are related to planning/management organization, program and funding.

3.331 Establish Planning/Management Organization

The basic organization for the preparation of a Biscayne Bay plan should include an advisory committee -- a Bay Planning Council -- and a staff. In furtherance of the recommended approach of administratively establishing a Bay Planning council within the context of the existing State legislation, the first step necessary would be for the Board of County Commissioners and/or the Dade County State Legislative Delegation to petition the Governor to establish a Biscayne Bay Planning Council. Such a request should include the request that participation in the Council should include representatives from State, regional, County and local agencies and ex-officio representatives from appropriate Federal agencies. In addition, interested parties from marine related clubs and councils, environ-

mental groups, builder/developer organizations, homeowner and civic groups, marine industry and Chambers of Commerce, committees, the media, should be invited to become ex-officio members of the Planning Council.

To act as liaison between this large Planning Council and the project planning staff (described below), a smaller Policy Committee should be designated and composed of the following members:

- Two members of the Dade State Delegation (one from the House, one from the Senate)
- Two members from the Dade Board of County Commissioners
- A member from each city commission of the following major municipalities with major Bay responsibilities:

  Coral Gables
  Miami
  Miami Beach
  North Miami

- The District Engineer of the Corps of Engineers or his representative
- The Superintendent of Biscayne National Monument
- The District Commander of the Coast Guard
- The Secretary of the State Department of Environmental Regulation
- The Secretary of the State Department of Natural Resources
- The Chairman of the Dade County Bay Task Force

In addition to acting as liaison, the Committee should advise the planning staff on policies regarding the form and content of the planning management activities of the Council. In addition, the Policy Committee should have the responsibility for delivering the final plan to the County Commission and the Governor and Cabinet for their approval.

The Bay planning program staff should be an adjunct to the staff of an appropriate governmental jurisdiction and agency. Two major considerations for the selection of the

organizational location of such a staff -- jurisdiction compatability and resource availability.

Although State and regional planning/management agencies have jurisdictions encompassing the Bay boundaries and a variety of Bay planning/management responsibilities, Dade County is the jurisdiction most closely encompassing of the Bay's geography and concerns. The several municipalities, although having strong responsibilities and interests in portions of the Bay are without complete jurisdiction. The County has, in addition to the geographic coverage of virtually all of the Bay, major upland planning/management responsibilities and the basic staffing structure and resources to properly provide for a Bay planning program staff. Within the County agencies -- the Planning Department, Department of Environmental Resources Management, Public Works Department and Parks and Recreation Department -- staffs of considerable breadth and depth of experience that could readily augment and work in close coordination with a basic, core Bay planning staff. Because of its broad planning experience, it is recommended that the Dade County Planning Department be designated as the lead staff agency to receive grants, enter into contracts as necessary with consultants, and/or agreements with other agencies to keep the public informed about the progress of the planning process, and to prepare the detailed procedure and background reports for the planning process.

It is estimated that this process would require the services of five full time staff members (1 Principal Planner; 2 Senior Planners; and 2 Planning Technicians), plus secretarial, research and graphic support staff. One of the staff members should be designated as responsible specifically for public information activities.

3.332 Structure Planning/Management Program

The planning/management program designed and prepared by the Bay Planning Council and staff should address the problems and concerns previously stated. Further, the focus should also go beyond minimizing the identified problems to maximizing the opportunities the Bay affords.

In terms of dealing with the problems of decline of natural resources habitat, planning/management should be directed to determining areas of the Bay that are important to habitat maintenance and to designating high resource value areas, and to monitoring populations.

Provisions should be established for implementing catch limitations as necessary to sustain populations and for limiting access and dredge and fill activities.

Planning/management considerations for correcting problems of Bay overcrowding and overuse should include designating "use" zones. Such management techniques as restricting and licensing use of these zones need to be developed.

Shoreline protection considerations should seek to preserve proper overland water flows and nutrient loadings to maintain optional mangrove productivity in designated areas. Particular attention should be directed at providing site planning and subdivision design standards for making development compatible with mangrove preservation.

Considerations for improving Bay access should examine both physical and visual access considerations. An analysis of these two forms of Bay access should be made to determine the most advantageous locations. Where these locations are on public property, means for their enhancement should be developed; where on private land techniques for preserving or acquiring should be determined.

In areas of access potential, guidelines should be promulgated for increasing public access is development and redevelopment occurs. Access forms given particular attention should include marinas, walkways, scenic roadways and parks. Special consideration should be given to the access potential of canal rights-of-way in the vicinity of the Bay for bikeways, fishing spots and passive recreation areas.

Planning/management considerations for Bay water quality problems should relate to Federal and State standards.

Current EPA regulations of water quality have decreed that there will be no degradation of existing water quality in waters of national significance. Since the waters of Biscayne National Monument clearly fall within this category, the minimum level of future water quality that needs to be planned for in the extreme southern portion of the Bay has been determined.

Furthermore, proposed water quality rules for the State of Florida (Ch 17-3) declare that there will be no degradation of water quality in any State Aquatic Preserve.

Although the waters of north Bay were specifically excluded from the non-degradation provision in the draft 17-3 regulations, the region where water quality must be maintained includes the entire region of central and south Bay. It is proposed that water quality in north Bay must meet the Class III Recreational Waters Standard. The significant consideration for planning/management is how this can be accomplished in an expanding community which is continuously making greater demands on the Bay's waters.

There are some potential solutions for the problems of pollutants flowing into the Bay. The planning process needs to review the findings of the ongoing urban Section 208 waste water management program investigation of potential sources of pollution in canals and detailing the relative severity of the various sources. The 208 study will evaluate the degree and kinds of pollution from each different land use and the distribution of pollutants once they enter the canal waters. Finally, possible methods of eliminating or minimizing the effects of pollution sources on canal waters will be proposed. Many techniques which currently exist can be utilized to decrease or prevent the detrimental effects of pollution. Proper planning of development both inland and along the canal and Bay shorelines should include consideration of the use of berms, swales, reverse drainage, shoreline planting and catchment basins. Both the Bay and canals would certainly benefit from the removal of toxic chemicals, such as heavy metals, and certain hydrocarbons.

Restoration of the degraded waters of north Bay should be approached in a logical and coordinated manner in the planning process. As a possible first step, the Corps of Engineers should develop a plan to enhance water circulation in north Bay. Included in this effort should be a consideration of the continuing problem of turbidity and siltation from unconsolidated bottom sediments and the unbulkheaded shorelines and spoil islands.

In addition, a plan for the abatement of toxic inputs should be prepared by Dade DERM as part of the overall effort. Once developed, these elements of a water quality plan should be used to formulate specific policies and performance standards for all future public and private activities in north Bay. For example, as vertical bulkheads must be replaced or as new development occurs, policies detailing the requirements for shoreline treatment, including revegetation should be specified.

If it is determined that natural revegetative processes, plus any required (or voluntary) incremental re-planting cannot sufficiently revegetate the north Bay area, then a planned revegetation program should be undertaken wherever appropriate. Also, the advisability of creating artificial reefs or other habitats should be investigated.

Problems which stem from overuse or misuse of the Bay itself will require additional corrective strategies. An adequately funded program under the auspices of the Corps of Engineers, the Florida Marine Patrol, and Dade Public Works Department could rid the Bay of unsightly and unsafe derelict vessels. The current Federal regulations regarding holding tanks should be enforced and requirements for pump out facilities should be included in the rules for the Biscayne Aquatic Preserve. There are hundreds of live-aboard vessels moored in Biscayne Bay. Means of providing stricter regulation of these vessels is badly needed, including enforcement of the holding tank requirements. Turbidity problems caused by boat scour should be addressed with attention to better channel marking and enforced penalties for boats caught moving across grass beds. Alternative solutions to be examined include limiting the density of boating in given areas or limiting the type of boating which may be done in certain areas.

There is a definite need for a base line water quality monitoring program for Biscayne Bay. Without such a program future impacts can never be adequately assessed. At the beginning of the Bay planning process a determination should be made of the water quality parameters that will yield the maximum amount of usable information about the Bay, and whether any cooperative arrangements for a monitoring program can be worked out. For example, Dade County has adequate laboratory capability, but no boats to use for routine Bay sampling, while Biscayne National Monument has boats, but less laboratory space. This would suggest that a cooperative agreement might be mutually beneficial to both agencies.

The planning/management process should follow a logical progression in addressing the Bay problems and opportunities.

At the outset of the planning process the administrative interpretations of the Coastal Zone Planning Act of 1972, the Florida Local Comprehensive Government Planning Act, and other significant laws and guidelines should be carefully checked for specific requirements applicable to Biscayne Bay. Within the first month of the planning

period a legal advisory committee, made up of legal staff from the Corps of Engineers, Florida Department of Environmental Regulation, Florida Department of Natural Resources, Dade County, Miami, Miami Beach, and Coral Gables should meet with the planning staff. Their first task should be to define the boundaries encompassed by the Bay plan. Secondly, they should begin determining which forms of interagency agreements (memoranda of agreement, delegation of authority, or consistency under the Coastal Zone Planning Act, etc., could best be used to involve and bind various agencies to the final Bay plan.

The initial meeting of the Policy committee should also be held during the first month of the planning period. The Committee should determine the format of the planning process, specifically the number and schedule of planning Council meetings, the designation of chairpersons, and the selection of the scientific-technical sub-committees for each of the four major planning tasks discussed below. It is proposed that separate scientific-technical committees be appointed for each task, as agency involvement and responsibility varies for each of the task problem areas.

There are many options for Bay Planning Council meetings, including monthly night meetings, or less frequent week-end meetings. Since many people would be traveling from out of town, and since many others would be serving unpaid, on their own time, it is recommended that the meetings be held in seven Friday-Saturday symposia, spaced over the two-year planning period as follows:

First Year

Task 1
a) To receive information on natural resource preservation and uses and to formulate goals and objectives.

b) To finalize policies to further the proposed natural resources goals and objectives.

Task 2
a) To receive information on shoreline protection and utilization and to formulate goals and objectives.

b) To finalize policies and guidelines for shoreline protection and utilization.

Second Year

Task 3 a) To receive information on water quality and to formulate goals and objectives.

b) To finalize policies for water quality maintenance and restoration and to resolve conflicts between earlier policies on shoreline utilization and natural resource uses and preservation.

Task 4 a) To vote on final Bay plan to recommend management plan, with description of who should manage and how Bay-related decisions should be made.

At the first, third and fifth meetings the first day of the symposium should be devoted to descriptions of the problems under consideration; i.e., how it affects particular agencies or groups and proposed recommendations for planning and management solutions. On the subject of water quality abatement, the Dade County Department of Environmental Resources Management, Florida Department of Environmental Regulation and Biscayne National Monument should be invited to give presentations on current water quality assessment in the Bay, what parameters could best be used to continually assess baseline water quality, and what resources each agency could commit to any overall Bay management effort.

Prior to the first Planning Council meeting on each task, a background paper prepared by staff should be circulated to the scientific-technical committees and Policy Committee for recommendations and refinement. A summary of the revised background paper should be sent to all members of the Planning Council.

After the Planning Council has approved goals and objectives for each task and suggested policies to implement the selected goals and objectives, the legal and scientific-technical committees should review the goals and objectives for possible negative impacts and conflicts. They should make recommendations regarding possible solutions to minimize or eliminate the identified impacts and conflicts.

At a second meeting on the first three tasks, the Planning Council should resolve all conflicts in their previously proposed goals and objectives, and should make final recommendations on policies to implement the specified goals.

In all instances, the final recommendations of the Planning Council should represent a consensus which is voted upon by the members.

3.333 Secure Planning Funding

The two year effort to develop a management plan for Biscayne Bay would cost an estimated $250,000. Funding for such a plan would most likely come from the Federal Coastal Zone Management program, with matching funds from State, County, and municipal contributions. Most other funding approaches require local or State government to provide the bulk of the support.

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