EVERGLADES Digital Library

Arthur R. Marshall, Jr. Collection

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This collection contains digital reproductions of papers by Arthur Raymond Marshall, Jr., (1919-1985) a south Florida ecologist whose work spanned "every significant environmental struggle in South Florida ... from dredging and filling issues in the 1950's to the repair of the Everglades today" (Al Burt, "The Marshall Plan", "Tropic", *The Miami Herald*, October 21 1984.) He campaigned against building a jetport and a barge canal in the Everglades, and, through his "Marshall Plan", promoted the restoration of the Kissimmee River to its natural state.

Sponsored by the Arthur R. Marshall Foundation & the Florida Environmental Institute, this collection of papers has been furnished to the Everglades Digital Library to provide a total perspective on the career of Arthur R. Marshall. His "total system view", recognizing the scientific basis for treating the Everglades from Lake Kissimmee to the Florida Bay as a single ecosystem, has emerged as the prevailing approach for restoring the south Florida ecosystem today.

If you would like more information on the ARM archives, please refer to the archival register from the Arthur R. Marshall Collection at University of Florida. You may also contact the Art Marshall Foundation for more information.

Arthur R. Marshall Foundation

Arthur R. Marshall, Jr. Collection

Burt, Al ***THE MARSHALL PLAN*** "Al Burt's Florida"

In the same way a farm can have too-much fertilizer on it...a city can have too many people in it.

To reach Fort Marshall, you must leave the asphalt and the concrete and take dirt roads that wind through scrub country. If you can beat the ruts, and can read signs like an Indian, finally you turn into a North central Florida family compound where some real Floridians live, the Marshalls.

Some of their family ancestors have been bumping around Florida since about 1835, a time when the Seminole Indians fought with knives and guns, not bingo cards.

In recent years, the family has tended to gather more often at their woodsy retreat in Putman County where some of them have staked out retirement plans.

Arthur R. Marshall, a publicly fierce sort of a fellow who privately enjoys such benign entertainment as taking wife Kay out to pick blueberries, is the family leader. Not only his two sons but all of the Marshalls, whether sister or brother or niece or nephew, look upon Art with pride.

He is a man who spent a half-century developing a special vision of Florida, with an emphasis on South Florida, and he sees it differently than you and I might. He views it the way a fine doctor examines a beloved, troubled child -- in terms of both disciplined science and attentive love.

Marshall looks at Florida's life-sustaining swamps and rivers and lakes, catching and hooding the water supply, and sees the environment equivalent of a human blood system.

He looks at the people that make the cities hum and flow, and at the wildlife that graces the forests and the delicate scrub country, and he sees the equivalent of a nervous system.

He sees a lot more. His mind constructs intuitions into theories about how and why all works, or does not work. He suggests remedies that are not quite like what anybody else suggests.

In his classic book on the environment, *A Sand County Almanac*, written in 1949, Aldo Leopold offered generalized opinions that described a little bit of what life is like for Art Marshall. "One lives alone in a world of wounds," Leopold wrote. "Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe...or he must be the doctor who sees the marks of death in a community that believes itself well"...

Marshall is a theoretical ecologist, one not only trained in the sciences but also experienced in the field, who uses his intuition to couple the two and to elaborate probable explanations of what had seemed unexplainable.

His dogged pursuit of a trail-blazing role has lighted the path for some scientists, but has infuriated some others, for the proofs and the mathematical formulas for his ideas have not yet been devised.

What scientist Albert Einstein said about theoretical physicist Max Planck, whose Quantum Theory revolutionized physics and won the 1918 Nobel Prize, also applies to Marshall.

Said Einstein: "The state of mind which enables a man to do work of this kind is akin to that of the religious worshipper or the lover; the daily effort comes from no deliberate intention or programme, but straight from the heart."

Marshall, 65 last March, has been involved in virtually every significant environmental struggle in South Florida, where he lived for 49 years. His work has spanned the awakening of environmentalism in Florida -- from dredging and filling issues in the 1950s to the repair of the Everglades today.

Although his theories have been many, probably two have dominated his work -- the principle of moderation in growth, and a consuming dedication to the belief that the healthy flow of water through the Everglades is the key to South Florida's well- being.

"Growth should be stopped rather than managed or controlled", he once said, "In the same way a lake can have too much nutrients in it, like Lake Apopka, and a farm can have too much fertilizer on it, a city can have too many people in it.. Above that point, it's catastrophic in terms of ability of citizens to pay taxes and ability of government to deliver services..."

He prefaces any Everglades discussion with an explanation of what it used to be. "The pristine Everglades was a unique river system," he said. "Its flow of water began in the Chain of Lakes of the upper Kissimmee River Valley....In rainy season those lakes rose...spilling their waters south into Lake Kissimmee and through it onto the floodplain of the lower Kissimmee Valley and then into Lake Okeechobee. When Okeechobee rose...it spilled water south into the great floodplain of the sawgrass Everglades..."

Marshall argued that a naturally meandering Kissimmee River and sheet of shallow flow of water across the Everglades gave South Florida additional reservoirs of water. He said that when the Kissimmee was channelized into a straight ditch, and the sheet flow was interrupted both by that and by levees in the Everglades, those extra reservoirs in effect were lost and there was a chain reaction. Most easily noticeable was that during periodic droughts, Lake Okeechobee no longer was an adequate water reservoir for South Florida.

He, and others, for years have wanted the Everglades restored. They advocated that the way to begin was by de-channelizing the river, reversing the $40 million ditch job done 20 years ago.

When Gov. Bob Graham moved this year to test that de-channelizing theory on a 12- mile strip of the river, Marshall was elated. "No one really knew if Einstein was correct in his theory (of relativity) -- not even he was absolutely certain of its validity -- until that bomb went off at Alamogordo," he wrote me. "My bomb is the Kissimmee ditch restored!"

Not long after that, the doctors told Art Marshall that he was seriously ill. The news came at a time when there seemed to be so much that needed to be done, so many theories to be proven.

But he seemed to take it philosophically, as only men of accomplishments and character can. He felt tired, he said recently, but he made it easy on his friends. He treated it like the weariness of a man who has come home after a satisfying day on the job.

His work is on the table now. It will be in the history books. Nobody seriously interested in the natural health of Florida ever will forget it.

Arthur R. Marshall, Jr. Collection

Guide to the Collection

Prepared by: **John Marshall, Arthur R. Marshall Foundation**

This collection of papers from Arthur R. Marshall starts with Marshall's March, 1972 *Proposal for a Florida Environmental Institute* (FEI) . The questions raised in the proposal are very contemporary, and indicate Art Marshall's appreciation for the system approach, and the system scientist, or "generalist" which he was. The particular copy digitized in this collection was found with papers establishing a Marshall Foundation in 1982, with the assistance of Marjory Stoneman Douglas, and her organization, Friends of the Everglades.

The next few items in the collection represent a series of "Petitions" entitled *For the Future of Florida, REPAIR THE EVERGLADES*, published quarterly from 1981 to 1983, by the Friends of the Everglades. The essense of this four page petition, known as the"Marshall Plan", makes for interesting comparison to The Comprehensive Everglades Restoration Plan (CERP) of the C&SF Project authorized by Congress in 1992, and now under consideration. Art Marshall has penned his approval on the 1982 edition, which appears virtually the same as the 1983 edition.

Art and Marjory took this petition to the South Florida Water Management District (SFWMD) per the June 11, 1981 *Statement to the SFWMD Governing Board*. This was not the first time, nor the last time, the Marshall Plan would go to SFWMD, per the 20 Nov 1980 *Critique of Water Management in South Florida* paper. A current perspective of the "Marshall Plan" and the interaction of Art & Marjory, as well as Johnny Jones, Art's legislative partner, is provided in the Spring 1988 issue of the *Everglades Reporter*.

The Kissimmee Basin - Lake Okeechobee restoration was and remained Art's primary focus. The issues were presented to Governor's conferences in 1972 and 1973, as indicated in the *Energy & Growth*, and the 1971-72 *Water Management Bulletin* autographed by Art Marshall. He had a way of circling things, his sign of unity. His short paper of 26 March, 1982, *Another Prediction for the Everglades System*, indicates his growing concern that his favorite project would not be completed in his lifetime. Art passed away in March, 1985. The fate of Kissimmee Basin restoration is still uncertain.

The Marshall Plan was also presented to the Florida and U.S. Congress per *Statement to the Joint Committee of the Florida Legislature* 17 Jan 72, and *Statement to the Subcommittee on National Parks and Recreation*, 15 Feb 72. An Arthur R. Marshall Foundation founder provides an historical punctuation mark: "We have not acted on it [the Marshall Plan] 26 years later", per the April 6, 1998 Palm Beach Post Article.

The initial collection is rounded out with a few more papers. *South Florida - A Case Study in Carrying Capacity* released 29 Dec 1972, is an overview of growth problems that also reads very contemporary, and answers many of the questions posed in the March 1972 FEI Proposal.

Also included is the document *The Environmental Impact of the Big Cypress Swamp Jetport*, released by the Dept of the Interior, for which Art was a major contributor. The lessons-learned here apply to the current Homestead Airport Controversy as a local issue and how it affects the current plans for Everglades restoration, in general.

Arthur R. Marshall, Jr. Collection

Marshall, Arthur R., *A Proposal To Establish The Florida Environmental Institute* , March 1972, 8 pp.

A PROPOSAL TO ESTABLISH THE FLORIDA ENVIRONMENTAL INSTITUTE

Arthur R. Marshall
March, 1972

The pressures of expanding population and technology on Florida continue to degrade its human and natural resources despite the combined counter-efforts of all existing institutions. Government, more often than not, either fosters or adds to the degradation. Educational institutions seem unable or unwilling to apply their store of knowledge effectively to the problems. Efforts of the business community are often exploitive, non-existent, or are superficial or adds to the degradation palliatives.

It is evident that Florida is on a course which ultimately will insure its joining the parade of states already sunk in environmental quagmires. Some already see Florida as the "New Jersey of the South" where dense population and pollution produce deplorable living conditions. Strenuous efforts of recent years are slowing the progression toward imbalance, but not diverting it. Philosophically we suffer a paradoxical ailment which allows us to look back two hundred historic years in pride, but not five years ahead in preparation or anticipation.

Florida is faced with major social decisions, the outcomes of which will determine the future of its unique environment and the quality of life of its people. Some of those are:

1. Should the growth ethic continue to be the dominant determinant of our personal futures, as well as those of our urban and rural environments?
2. What are the total benefits and costs, economic and environmental, of growth and expanding technology, and to whom?
3. What are the causes of city decay and bankruptcy, of the degradation of lakes, rivers, bays, scenic beauty and wildlife?
4. Are there ways to keep cities economically and environmentally viable?
5. How can we protect the essential values of our fresh and salt waters, soils, wilderness and wildlife?
6. Should we recycle treated sewage effluents? How can it be done?
7. How should we view the doubling of power generation every 7-8 years?
8. If populations must ultimately stabilize at some level, what factors determine this? If they do not stabilize, where are Florida and Floridians headed?
9. Can we de-emphasize the growth ethic and supplant it with other economically viable pursuits which will provide

profits and jobs and prevent environmental degradation?

10. Can we maintain our present life-styles? Should we?

The kinds of decisions we face cannot be made by agencies of government alone, nor by educational institutions alone, nor by the business community alone. They must be made by those who are affected by the results of those decisions - the people of Florida. Though the public decision-making process is imperfect, it is democratic, it solicits participation by those affected by the decisions and it is a means we can and do use to add apples, oranges and grapes and to decide whether the resultant fruit cocktail is palatable.

It is clear that one troublesome tendency which we must overcome is our addiction to specialization. Americans are habitual specialists. Our industries are primarily institutions which specialize in one or a few products, in the exploitation of one or a few resources.

American medicine is practiced through specialties. Its assorted practitioners have come to look at a kidney, a lung; or a genito-urinary tract and only recently are coming again to recognize that these comprise a man or a woman.

Our universities produce many persons specialized to such a high degree that there is no valid reason to expect them as individuals to be responsive to our array of systems problems.

Government is made up of specialists. It was the specialists of government who sought to drain, to farm, to build roads, to divide the Everglades pie into a hundred provincial, geographic, political, and mission-oriented parts which nearly tore it apart.

Cities -- and urban-oriented counties -- are specialists. Their specialty is growth. It is a dedication with much historic momentum and great inertia. The inertia carries us on despite widening bankruptcy. The result can be seen readily in the spreading slum core at the center of the metropolitan area, the general inability of city governments to fund needed utilities and services, and the entrance of large federal funding on the local scene.

In this era of rapid population doubling, burdens on virtually all essential resources have been so intensified that assimilative or carrying capacities are equaled or exceeded, or soon will be. It is no longer possible to regard the endless consumption of space, the discharge of wastes into air and water, the consumption of soils and mineral resources, etc., as matters of little or no moment. They are all prodigal. We must now reckon with the intrinsic functional characteristics and limits of entire life-support systems. We can do this only through combined study and analyses of the problems by interdisciplinary teams of specialists interwoven with the budding group of system generalists which we have.

For these reasons I propose the establishment of the Florida Environmental Institute. The Institute would be a non-profit, tax-exempt independent corporation chartered under the laws of Florida. Its primary purpose would be to analyze environmental problems on an integrated basis and to provide that information to the officials of the State and to the people of Florida. Its second purpose would be to provide selected college students with exposure to the highly complex and integrated nature of our environmental problems. The students would participate fully in the workings of the Institute. Students selected for this educational process would be chosen to insure the representation of many professions and geographical areas of Florida.

While a primary purpose of the Institute would be to serve government, it would be independent of government or any other existing institution. This is not a new concept. In January, 1970, an Environmental Study Group of the National Academy of Sciences stated:

> VI. Decision-making in environmental matters at all levels of government has been hampered by lack of adequate analyses of what is now taking place and alternative options. We *recommend* the establishment of an Institute for Environmental Studies. The Institute would carry out the following functions: 1) Do long-range planning for the enhancement of the environment; 2) provide early warning on potential threats to the environment; 3) conduct rapid analytical studies in response to emergencies; 4) carry out rapid field analysis; and 5) systematically study and analyze the social, political, economic, administrative, legislative, and other factors that influence environmental decisions and the management of the environment. In order to achieve and maintain objectivity arid independence, the Institute should be funded largely by the private sector, though it would, as well, accept grants and contracts from government agencies. The Institute would probably need a staff of approximately 200 professional researchers and analysts, including ecologists, biologists, economists, sociologists, physicians, lawyers, engineers, physicists, chemists, architects, social psychologists, and political scientists, particularly specialists in public administration and international relations, as well as information specialists and others. An institution of this size would require a sizable budget, a substantial portion of which, we believe, should come from the private sector-foundations, industry, and conservation groups-the remainder from contracts with federal,

state, and local governments.

An effective Institute would:

1. Need to be financially independent of any department or agency of government and of industry and special-interest groups
2. Need to build confidence in its integrity among clients and supporters as well as among the public
3. Need a talented and highly professional and dedicated staff, broadly representative of a suitable blend of the various relevant disciplines but well disposed toward interdisciplinary efforts
4. Need experienced and insightful public-policy specialists and, at least on an *ad hoc* basis, participation of administrators and other governmental officials
5. Need sufficient financial resources, with reasonable expectations of continuity of support
6. Need to make widely available to the public all studies and research findings
7. Need a conscious and conscientious recruitment policy aimed at attracting young people and placing them in positions of responsibility and influence

(From: *Institutions for Effective Management of the Environment*, Part I, January, 1970 pp. 8-9. Report of the Environmental Study Group to the Environmental Studies Board of the National Academy of Sciences, National Academy of Engineering.)

More recently, Senator Henry Jackson introduced Senate 1216 to establish on a national basis the earlier recommendation of the National Academy of Sciences Committee. Senator Jackson's bill of March 12, 1971, would "amend the National Environmental Policy Act of 1969 (Public Law 91-190), to fund and establish a nonprofit Environmental Policy Institute, and for other purposes." The bill states in part:

> That as presently constituted local, State, and Federal governments do not have an adequate capacity to integrate and evaluate the growing body of environmental research now underway, nor to develop a systematic and critical manner the alternatives such research presents for the development of new and the restructuring of existing governmental policies and programs; and that there are no existing nongovernmental institutions capable of adequately performing this function in an objective and comprehensive manner and on a full-time basis.

Another section reads:

> (b) The Congress further finds -
>
> > (1) that there is a need for objective, impartial policy analysis to be conducted by an appropriate institute which is independent of government and private enterprise, including a broad program of research, and the identification and development of alternative solutions to existing and emerging environmental problems;
> >
> > (2) that the institute should be a center for systematic environmental problem solving and policy - oriented research conducted on a broad, interdisciplinary basis;
> >
> > (3) that the institute should be available to local, State, and Federal governmental agencies to assist in the assessment, development, and presentation of policy alternatives, but should have the freedom and independence to extend its studies to matters other than those specified by its government sponsors; and
> >
> > (4) that it is a responsibility of the Federal Government, in conjunction with appropriate charitable foundations, to establish, to assist, to encourage, and to fund such an Institute.

Senator Jackson's bill was reported out favorably by the Committee on Interior and Insular Affairs and was passed by the Senate. Although Senator Jackson's bill is aimed at a national institute, the principles are equally applicable to the needs of Florida.

Policy direction would be given to the Florida Environmental Institute by a board of five to seven members who are concerned with environmental problems. The Institute would be lead by a Director, who would be supported by a full-time staff which would include the following professions - each to be selected for his experience in and concern with

environmental problems:

- ecologist
- economist
- biochemist
- biologist
- attorney
- environmental educator
- systems analyst
- public health specialist
- public information specialist

An administrative officer, librarian, computer programmer, and sufficient supporting personnel would also be employed. From time to time, professionals in other disciplines would be employed on a part-time basis. Some of them would be:

- public health officers
- landscape architects
- architects
- hydrologists
- urban planners
- transportation planners
- agriculturists
- pollution technologists
- engineers
- political scientists
- sociologists

The cost of operation of the Institute will run in the order of $80,000 per year for support of each professional staff member. With the Director and nine support members listed on page 5, this would total $800,000. Funds will be sought from private individuals, foundations, possibly from government. Individual contributors might direct their support to a particular staff member. If some business enterprise should seek assistance, such as the power industry, direct funding of costs by them will be required.

In addition to the general problems discussed above, the Institute will seek to:

1. Propose solutions to environmental problems of Florida.
2. To review programs of proposed environmental research for their applicability and timeliness to such problem as they seek to resolve.
3. To inform and assist state government and the public as a first priority.
4. To instruct selected college students in the intricacies and approaches to environmental problems, by bringing them to the Institute for periods of observation and study. Their assignment periods would be established in conformity with the quarters or semester systems of the universities, or as near to that as possible. On this basis, one student would be assigned to each professional staff member for each term of the school year. This would produce thirty to forty "graduates" each year. Some students could be retained for more than one term if they desire and if such extended assignment is in accordance with the goals of the Institute.
5. To establish a computer data-storage and retrieval program for the great masses of environmental and related data which already exist or shall be gathered for Florida.
6. To conduct computer-simulation programs, or advise their conduct, which treat environmental (urban and rural) problems of Florida.
7. To encourage applications of the remote sensing and other capabilities of NASA to the environmental problems of Florida.
8. To operate in conjunction with the two hundred professional volunteers of the Florida Defenders of the Environment.
9. To release all findings, recommendations, reports, etc., to the public on a broad base, including the use of films, slides, and the news media.

The only reason for pursuing such a program as that proposed is that we must. Florida has a host of environmental problems, urban and rural, which disturb its people and the nation. It also has outstanding environmental treasures, yet viable, unique and salvable, unequaled in the nation.

These two disparate circumstances of despair and hope give Florida the opportunity to lead the nation to environmental success or failure - to environmental chaos or maturity - and to protect itself and its people while doing so. It also has many people who care, both experts and laymen.

The approach to Florida's environmental problems envisioned in this plan is basically an enlargement of the present program of the Ford Foundation sponsored Division of Applied Ecology which I direct at the University of Miami. In the first year of this program, we have produced analyses of specific environmental problems. The results have been rewarding and beneficial to both private and public decision making. A 1971 paper entitled "Repairing the Florida Everglades Basin" contributed to Governor Askew's convening of the "Governor's Conference on Water Management in South Florida" in September, 1971. Conference recommendations to the Governor resulted in a Land and Water Use Task Force, of which I was a member. The Task Force prepared significant environmental bills which were presented to the Florida Legislature.

In similar fashion, the Division has published significant studies prepared by our interdisciplinary staff of ecologist, land planner, hydrologist, and biologist:

1. Guidelines to direct development of a large portion of the undeveloped areas of south Dade County. These guidelines focused attention on existing finite resources, particularly water, and proposed development practices and population limits relative to these environmental constraints.

2. The G.A.C. Three-Islands development proposal for Hollywood-Hallandale. At the request of Governor Askew, an environmental impact statement was prepared which defined impacts upon urban resources in terms of noise, traffic, density, open space to name a few.

3. Evaluation of the route of I-75 across the Florida Everglades. Three alternatives and a no-road policy were tested against the ecological constraints of the region and the impact of the road which would encourage development. (in conjunction with others)

4. The proposed Tarpon Spring power plant of the Florida Power corporation (a project accomplished jointly with Conservation 70's and Florida Defenders of the Environment) was studied by a selected group of ecologist, planners, engineers, biologist, to define ecological constraints within the area and make recommendations which FPC could follow before construction was begun.

5. The need to protect the Big Cypress watershed. Through the diligent efforts of conservationist groups and public agencies, the Federal government's attention to the reality of the proposed acquisition was finally achieved.

While no one of these cases is concluded, our work has led to significant shifts in public awareness and actions, and to corresponding shifts in governmental decision making.

In its effort to bring the issues to the people, the Division has sponsored or co-sponsored a number of conferences, its members have made many public appearances and contributions to the press and other news media on environmental issues. A recent conference of agency personnel - state and federal - and interested public, discussed the "Environmental Impact Statement" as a viable tool for inter-agency and interdisciplinary involvement in environmental management. The conference was held in an effort to improve statement preparation and to upgrade its completeness through communication.

The Division employs three graduate students on a part-time basis: a candidate for a degree in law, a graduate engineer, and a meteorologist. This gives the students exposure to environmental issues and greatly broadens their education base. This program further gives the Division contact with at least three respective departments.

We are concerned that our present operations often lack other discipline participation and that we are too few in number to examine more than a fraction of the many opportunities potentially open for study in this time of great concern with the human environment.

Your comments, criticisms, and offers of assistance will be appreciated.

Arthur R. Marshall, Jr. Collection

Marshall, Arthur R., *FOR THE FUTURE OF FLORIDA REPAIR THE EVERGLADES*, 3rd edition, 1982, 4 pp.

PUBLISHED BY THE FRIENDS OF THE EVERGLADES

THE PROBLEM & THE PLAN

The supply of clean, fresh water from the central Kissimmee-Okeechohee-Everglades Basin is no longer adequate to supply all the needs of South Florida. The water itself is threatened by increasing pollution from human, animal, agricultural and toxic wastes. The largest coalition ever formed in the State of Florida proposes the plan found in this brochure as a solution to this serious problem and threat to all life.

In its pristine condition, the Everglades waterway arose in the lakes of the upper Kissimmee basin and flowed south via the meandering lower Kissimmee River to Lake Okeechobee. In wet years, the lake overspilled its southern rim into the Sawgrass Everglades contributing to the shallow surface sheet flow accruing there from direct rainfall. Water slowly flowed southwestward over the Everglades marshes in the form of a very broad river as much as eight feet deep at summer flood, eventually emptying into Florida Bay.

As a result of drainage works, built over the last 90 years, the Everglades today is only one-half its original size and water levels in the remaining Glades have been lowered significantly. In the north, a canal now cuts through the old meanders of the Kissimmee River and sends drainage waters rapidly and erratically to Lake Okeechobee. In the south, freshwater is lost through canals which dump it into the salt tides. In turn, the saltwater invades the drained islands.

The resulting loss of marsh habitat has severely depleted wildlife. Pollution and interruptions of water flow have diminished freshwater and marine fisheries. Instead of the gradual sheet flow upon which estuarine fisheries depend for nourishment and maintenance of vital salinity patterns, canals now deliver destructive sharp pulses of fresh waters increasingly polluted by agricultural and urban runoff. As canals lower the water table, the organic soils dry, oxidize, blow away and burn to bedrock.

The plan for the effective repair of the damaged Everglades system is to restore and purify the sheet flow from the Kissimmee Lakes to Florida Bay. This includes: resolving the pollution problems of Lake Tohopekaliga, Taylor Creek, Nubbin Slough, the Everglades agricultural area, and Lake Okeechobee; refluctuating Lakes Cypress, Hatchineha, and Kissimmee to the greatest possible extent; dechannelizing the lower Kissimmee River and restoring Paradise Run; restoring sheet flow in the Holey Land and Rotenberger Tracts, Conservation Area Three, and Everglades National Park; reestablishing sheet flow connections between Area Three and the Big Cypress Preserve to the west and the Shark River Slough to the south; refilling that portion of Canal 111 which lies under U.S. Highway 1 and the existing portions of Canals 109 and 110; restoring the Turner River in the Big Cypress Fresh Water Preserve; and, plugging the Buttonwood Canal in Everglades National Park as authorized and funded by Congress.

The Florida Legislature has correctly foreseen the need to repair the Everglades system by authorizing the dechannelization of the lower Kissimmee River. By its Act of 1976, the Legislature anticipated that restoration of the lower Kissimmee River would enhance water conservation, ground water supplies, wetland vegetation, energy conservation, conversion of nutrients (nitrogen and phosphorus) to peat and muck, low energy ranching, fresh water fisheries, and wildlife. Restoration of the lower Kissimmee River together with refluctuation of Lakes Hatchineha, Cypress, and Kissimmee would in addition provide the start of a long slow flow of the water in the system - water which could pass through Lake Okeechobee into the Miami Canal and thence as sheet flow into the Holey Land and Rotenberger Tracts.

The opportunity for the State of Florida to dechannelize the lower Kissimmee will not remain long as an option in the repair of the Everglades system. Removal of spoil from the levees adjacent to the existing canal continues, and land in the former flood plain is being sold and developed. Flood plain development would introduce new pollutants into the existing canal for rapid transport into Lake Okeechobee.

Those organizations who support this petition - aware that the option of restoring the lower Kissimmee can be foreclosed - ask the appropriate agencies and officials of Florida to take immediate action to prevent such foreclosure by:

- imposing a moratorium on the further removal of spoil from the area and further developments in the flood plain
- commencing the purchases of all lands in the former flood plain which are not now in State ownership
- petitioning the Congress and President of the United States to direct the dechannelization of the lower Kissimmee by the U.S. Army Corps of Engineers
- directing the relevant agencies of State government to proceed with dechannelization of the lower Kissimmee and refluctuation of Kissimmee Valley lakes.

The purpose of this petition is to achieve environmental benefits accruing from repair of the Everglades system. Water quality in the surface waters of the Everglades system will improve. Restored sheet flow will enable the removal of nutrients from those waters by converting them into the tissues of wetland plants and subsequently storing them in valuable peat and muck soils.

Reducing nutrient enrichment of surface waters is essential to the Everglades system but it is not the only goal to be achieved by repair of the system. Also of paramount importance is the regeneration of peat and muck, of fresh and saltwater fisheries, of wildlife, and of Everglades National Park. Florida's stance on nutrient pollution - as for example in Lake Okeechobee - should not simply center on how much enrichment the Lake can tolerate but rather on means through which we can convert some of those nutrients into vital environmental products. Rather than continuing to risk the accumulation of waste materials in the Lake, we should be moving to derive valuable resources from them.

There will be benefits to fresh and saltwater fisheries, to wildlife, and to water quality. These translate into increased public health and improved recreational experience, protein foods for Floridians and their visitors, and profit for the tourist industry and fisheries, both recreational and commercial. There will also be benefits - little recognized - arising from increase energy efficiency.

Management of water in the Everglades, as established over many decades, has converted it from the solar driven system it was to a highly intensive fossil-fuel system. This exchange drastically displaces the solar-driven processes which produce wetland vegetation, peat and muck, potable water, fish, and wildlife. The prime means through which solar energy activated the system to produce those essential resources was sheet flow - an essential function which has largely been lost. It is only necessary to reestablish sheet flow to regain solar energy products from the Everglades.

The goals of this coalition are entirely in accord with the expanded environmental responsibilities given to all water management districts by the 1972 Water Resources Act and to the South Florida Water Management District by the Kissimmee River Restoration Act of 1976.

THE COALITION

We petition all appropriate officials and agencies of government to begin repair of the Everglades system.

STATE-WIDE

- Friends of the Everglades
- League of Women Voters of Florida
- Florida Audubon Society
- Florida Chapter, The Sierra Club
- Florida Wildlife Federation
- Florida Division, Izaak Walton League
- Florida League of Anglers
- Everglades Protection Association
- Florida Conservation Foundation
- Environmental Confederation of Southwest Florida
- Florida Federation of Garden Clubs

Organized Fishermen of Florida
- Defenders of the Environment
- South Florida Coalition of Conservation, Civic and Sports Clubs
- Kissimmee River Restoration Coalition

LOCAL

- Tropical Audubon Society
- Audobon Society of the Everglades
- Broward County Audubon Society
- Halifax River Audubon Society
- Royal Palm Audubon Society
- Environmental Coalition of Broward County
- Dade County Federation of Women's Clubs
- Hollywood Branch, American Association of University Women
- Environmental Council of Volusia County
- Miami Business & Professional Women's Club
- Dade County Council of Garden Club Presidents
- Coral Gables Woman's Club
- Rotary Club of Coconut Grove
- Coalition of Issue Caucuses P.A.C.
- Caloosa Bird Club
- Conservation Alliance of St. Lucie County
- West Palm Beach Garden Club
- Allamanda Circle
- Amaryllis Circle
- Azalea Circle
- Oleander Circle
- Poinsettia Circle
- Coconut Grove Garden Club
- Miami Beach Garden Club
- Lemon Bay Garden Club
- Golden Gate Garden Club
- Ken-Pines Garden Club
- Shenandoah Garden Club
- West Miami Garden Club
- Green Thumb Garden Club
- Miami Shores Garden Club
- Periwinkle Garden Club
- St. John Lutheran Church
- Women Sunset Park Garden Club
- Kendall Garden Club
- Landscape Garden Club
- Hammock Garden Club
- Saga Bay Garden Club
- Norwood Garden Club
- Sunset Garden Club
- Concerned Democrats of North Dade County
- Everglades Search & Rescue
- Sierra Club, Calusa Group
- Sierra Club, Miami Group
- Broward County Airboat & Halftrack Conservation Club
- Park Gardens Condominium Association
- Florida Keys Chapter, Izaak Walton League
- Stuart Chapter, Izaak Walton League
- Palm Beach County Archaelogical Society

MUNICIPALITIES

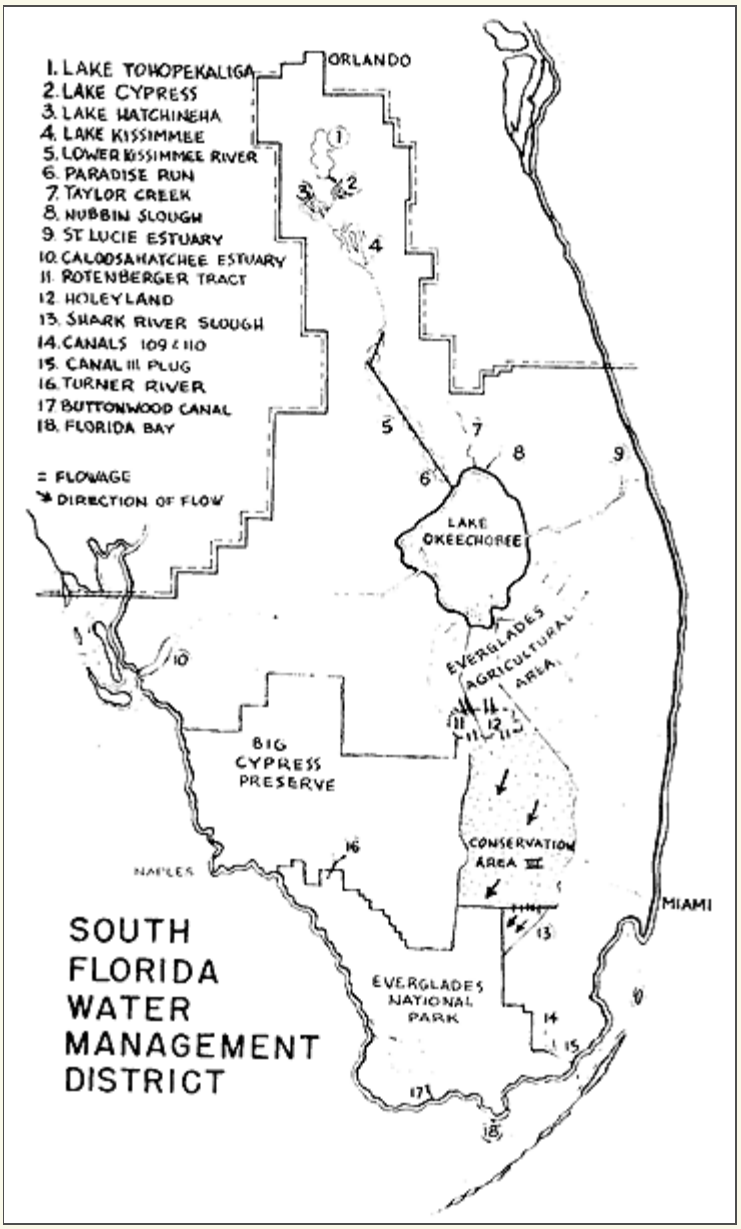
- City of Boca Raton
- City of Boynton Beach

- City of Delray Beach
- City of Miami Beach

COUNTIES

- Monroe County Commission
- Dade County Commission (1976)

COSTS OF DECHANNELIZATION



According to figures obtained from the South Florida Water Management District, as well as private engineering firms, indications are that one-hundred percent spoil removal for complete dechannelization of the lover Kissimmee Rver would cost $16 million.

Much of the spoil has been sold and removed; therefore some portions of the channel would remain as lakes.

According to figures of the SFWMD there are 41,470 acres in the original flood plain. Of this amount 14,060 acres are in public ownership, and 27,410 acres belong to the private sector. Because of periodic inundation of the flood plain, it would be necessary to purchase those lands not in public ownership. Based on an average of $600 per acre, it is estimated that the purchase of the flood plain would amount to $16,446,000.

TOTAL DECHANNELIZATION:

Spoil removal	$16,000,000
Flood plain acquisition	16,446,000
	$32,446,000

"Cost? oh my dear girl, the cost wouldn't be so great as the expense of allowing an increase of pollution in our fresh water. The costs of not doing it are monumental."

- Marjory Stoneman Douglas in an interview by Georgia Tasker, *Miami Herald, March 8, 1981*

It is with a strong sense of urgency that Florida Audubon Society requests all appropriate State and Federal officials and agencies to adopt and implement policies for the repair of the badly damaged Kissimmee/Lake Okeechobee/Everglades system.

At the heart of any such repair (or even lessening of the rate at which the system is degrading) is restoration of the

lower Kissimmee River through dechannelization. It is late in the 11th hour for this restoration measure. Unless the state moves vigorously and promptly, removal of spoil from the levees, land sales, and development in the flood plain will foreclose this vital measure. And, the flood plain development will inject massive new pollution into canal C-38 for rapid transport to the already strained Lake Okeechobee.

By emphasizing the timely urgency of the Kissimmee dechannelization, we do not imply the other measures are less important. An integrated system such as the Kissimmee/Okeechobee/Everglades requires multiple thoughtful, integrated action. It is not possible to "do only one thing" ... and have any hope of restoring a system.

Adopted by the Board of Directors, April 11, 1931

The unique features of Florida Bay offer angling experiences not known to exist anywhere else in the world.

Florida Bay makes up one-fourth of Everglades National Park. And at least two-thirds of this Park is a sea and coastal marine ecosystem influencing marine life throughout Florida's coast.

This marine ecosystem lies at the downstream end of the Everglades watershed and is dependent on the quantity and quality of fresh water supplied by natural events taking place in the northern reaches of the Everglades, Lake Okeechobee and the Kissimmee River Basin.

By reestablishing meandering rivers and surface water sheetflow, nature will again be responsible for the protection and rebuilding of the vast marine resources that made and make Florida Bay unique in all the world.

Everglades Protection Association, Inc.

We support dechannelization of the lower Kissimmee River. Dechannelization is a commitment to water quality and quantity for both the populace and environment of south Florida. Nothing short of dechannelizing C-38 will stem low land development in the lower Kissimmee River Basin. With development, the state's options for restoration of water quality, flood retention capacity and wildlife habitat, diminish rapidly while political pressure for "flood control" and channelization will increase exponentially.

Therefore, we support dechannelization as the most economically reasonable and pragmatic management technique which will assure increased water quality, flood capacity, and wildlife habitat.

Florida Chapter, The Sierra Club and Kissimmee River Restoration Coalition

The channelization of the Kissimmee is an outstanding example of the frontier-hangover belief that natural areas are worthless unless used to produce products directly measurable in dollar values. Although we now know better, we still don't put dollar signs on good health, or clean water, or non-consumable plants and animals that are components of natural systems. It's only after all these good things are lost and we have to pay millions for substitute hardware and medicines that we come to realize that nature's free gifts were priceless, not worthless.

Florida Conservation Foundation (ENFO)

Implementation of this plan will ensure protection of humanity's greatest need for survival - good drinking water.

Florida Division. Isaac Walton League

It's about time we fixed the Everglades to save our water, our wildlife, our energy supplies, and ourselves.

Environmental Confederation of Southwest Florida

We urge total backfilling of the Kissimmee River and restoration of sheet flow through the Everglades - measures vital for the production of seafood and gamefish.

Florida League of Anglers

The Everglades Lake Okeechobee, and Florida Bay are in trouble. We must restore historic water regimes as much as practical. An imperative first step is an immediate moratorium on flood plain development and removal of spoil material.

Florida Defenders of the Environment

We are disturbed with the degradation and loss of natural resources of the Everglades system - water, wildlife, freshwater and marine fisheries, and muck. We strongly support this proposal to repair the Everglades system.

Florida Wildlife Federation

THE GREAT VALLEY

I sat upon my horse and looked from north to south on the west bank of the Kissimmee River, knowing that soon I, more than anyone else, would have the pleasures of knowing the good, the bad, and the beauty of this valley as it existed in those days.

For eight years I had the pleasure of working, gathering, and grazing cattle in this great valley, which was soon to be changed. The areas I knew were "Kisso" to the north, "Micco Bluff" to the south, and Fort Kissimmee in the center.

Once a year we would join our neighbors and gather our stray cattle which had crossed the River to Duck Slough or had stopped mid-way on the Grassy Islands within the river. The cattle would be fat and the calves were always real good. We swam our horses from island to island until all cattle were retrieved and driven back home. We looked forward to this great venture each year.

The river, swollen by summer rains, would flood the original valley and then take the excess waters to Lake Okeechobee for storage and use during the dry months. This skeet flow of water brought new life to the valley by destroying the unwanted vegetation and restoring fresh grasses and new growth for the coming winter. This was nature's way for providing a suitable place for birds, wildlife, and even man, to thrive.

The Kissimmee Valley was fantastic country. It is hard for me to understand how man could have the audacity to think he could improve on the Kissimmee River and Valley by cutting the heart out of the river and replacing it with a canal.

- Bubba Mills, Hendry County rancher

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Arthur R. Marshall, Jr. Collection

Marshall, Arthur R., ***Statement To Governing Board South Florida Water Management District***, June 11, 1981.

STATEMENT TO

Governing Board
South Florida Water Management District

by

Arthur R. Marshall, Spokesman

for

The Coalition to Repair the Everglades System
Marathon, Florida, June 11, 1981

My presence today is in a sense an extension of my remarks to your Shirt-Sleeve Symposium on November 20, last year.

But it is more than that.

I spoke then for myself.

Today I am speaking for the largest coalition of environmental organizations ever formed in Florida. The Coalition also includes organizations which are not primarily environmental and some which are not at all environmental. All of them share a common purpose which is to repair the Everglades System from the Kissimmee Lakes into Florida Bay.

May I first present to you Mrs. Marjory Stoneman Douglas who requested our inclusion on today's agenda. Mrs. Douglas is well known to you and to Florida. Marjory has asked me to present our petition.

Next I wish to present representatives of Friends of the Everglades, Florida Division, Izaak Walton League; Florida Chapter, the Sierra Club; Florida League of Anglers; Florida Wildlife Federation; Florida Audubon Society; Florida Defenders of the Environment; Florida Garden Clubs; Everglades Protection Association of the Florida Keys; Organized Fishermen of Florida; Southeastern Fisheries Association; Environmental Confederation of Southwest Florida; North Florida Environmental Coalition; and the Sport Fishing Guides Association of the Florida Keys. These people represent all of Florida's statewide environmental organizations, several regional organizations and one which is nation-wide. Never before have these people, who often differed strenuously, come together as a group. I would like for them to please rise.

Next I ask those persons to rise who represent local chapters of environmental and other organizations. To save time here, we will furnish later a list of their names and the organizations they represent.

If time allows, our members are available for questions.

We have invited Secretary Tschinkel of the Department of Environmental Regulation; Director Gissendanner of the Department of Natural Resources; and Director Brantly, of the Game and Fresh Water Fish Commission (or their representatives) to join us today. I would like to acknowledge and thank them for coming.

We are here because we know, like so many others know, that south Florida is under a worsening siege in its urban, agricultural and wild regions and that the problems of each are interrelated (sic). We are not here to exclaim, complain, or defame. We are here to begin mustering in Florida the will and the ability to cope with the causes of our common apprehensions. Our ambitions are not to treat the symptoms of the region's ailments, but to get at their causes. Our confidence in the ability of state government to make the great step from symptoms to causes has been severely eroded. Further, if we the public are the cause of the problems as has often been said, then we must also provide the solutions.

This is the first stop in a series of petitions to government we plan to make in South Florida and in Tallahassee.

We have prepared and are distributing widely a brochure entitled "Repair the Everglades" which briefly explains our concerns; lists the membership of our Coalition to Repair the Everglades; gives our thoughts on how that can be done and lists benefits south Florida can derive from repair of the Everglades system. We have provided copies to your Director for each of you.

The South Florida Water Management District has an important role in the matter, but not only one. The District can deal with water management for varied purposes but it cannot deal single-handedly with issues such as: water pollution; highway or airport construction; fresh water or marine fisheries; the Everglades National Park; or with the overriding question of continuing growth and development in South Florida and its multiple and insatiable demands for resources. Yet all of these elements and many more are interrelated as recent events have shown.

The members of our coalition know that every action, every process, in a given life-support system affects every other part of that system. We are convinced that the well-being of city and wilderness in south Florida is unyieldingly inter-connected and inter-dependent. Nowhere in the nation is that inter-connection demonstrated more sharply than in south Florida.

A number of others have seen this.

In 1947, Col. Mason J. Young, Division Chief of the Corps of Engineers in Atlanta, wrote in regard to plans for the Central and South Florida Flood Control Project,: The District Engineer has not sufficiently emphasized the importance of water conservation in the Lake Okeechobee-Everglades and lower east coast areas, nor has he claimed full credits to be derived therefrom."

In 1971, the Director of your Engineering Department, Mr. William V. Storch, in reference to a needed state land use policy said to the Florida Atlantic Builders Association: "With the general objective of maintaining an acceptably healthy environment this policy, as I see it, will have its keystone the control of population through the control of land and related water use."

Then: "Why such a policy? Because it is just possible we may be approaching the point where our demands for water will exceed the supply which can be made available by environmentally, or ecologically, acceptable means.....When we are finally able.... to store water in Lake Okeechobee at higher elevations than it is safe to do now, we will be in a position to relieve some of the strain. But it will not be enough. (Emphasis supplied).

Recent years have confirmed Bill's expectations. Lake Okeechobee - long regarded as south Florida's ultimate water reservoir (sic) - fails now periodically to meet the combined needs of the cities, agriculture, Everglades National Park and the flows needed to keep salt water out of the Biscayne Aquifer of the Gold Coast. This predicament can only worsen as the demands of the cities and of the National Park increase in the future.

Bill said much more including this: "The direction in which Florida is going to move..... will be the result of State-made decisions rather than decisions of the Federal Government."

Bill's foresight is truly remarkable. The shift of responsibility from the federal government to the states is a hallmark of the Reagan administration.

These are the reasons we are here. To ask you, and later the Governor, Cabinet and Legislature, to set a new course for south Florida's future.

Other major institutions have lately aligned themselves with Bill's theses:

On April 28, 1981, the *Miami Herald* labeled 'unlimited water' as a mirage. And further: ".... this environmentally fragile region has a definite "carrying capacity'....."

On May 7, the *Herald* said, "... fresh water is the vital limiter on south Florida's growth."

On May 16, the *Palm Beach Post* added: "There are limits to the number of human beings that can be supported in

Southeast Florida and we may be fairly close to those limits." In November, 1972, Bill Storch tabbed the number for Palm Beach County as 700,000.

We have a lot of coping to do. There is so much to do and it is all so obstreperous - that the only reason for doing it is because we must.

Water is the major concern of our coalition. If Lake Okeechobee fails periodically to be adequate for all needs, what is to be done?

Knowing that rainfall and its retention are the only satisfactory sources of water in the Everglades system, we support the re-establishment of sheet flow in the basin to the greatest possible extent. We cannot ignore the efficiency of the pristine system which often extended the wet period in the Everglades for four months or more beyond the four or five months of the rainy season.

We are guardedly hopeful over possibilities for augmenting water supplies in the basin by reinforcing the rainfall cycle through reestablishment of sheet flow.

Dr. Patrick Gannon, meteorologist, has written of the positive effects of wetlands on rainfall in south Florida. Waters evaporated from the basin return to the basin in a form of natural recycling. In addition to this in-basin recycling, the moist air rising from the basin can trigger additional rain to fall from water laden oceanic air masses as they blow inland over south Florida.

There are observations elsewhere which support these views.

Sheet flow restored to the Kissimmee Basin by dechannelization of Canal 38 coupled with refluctuations of Lakes Cypress, Hatchineha and Kissimmee may be the most direct - of not the only - means of augmenting the effective storage capacity of Lake Okeechobee. The River and its Lakes have the fortunate attribute of lying north of Lake Okeechobee. Their waters can only drain into Lake Okeechobee. Dechannelization of Canal 38 and refluctuation of the three lakes can raise ground and surface water levels which have been lowered in the basin; augment the rain-evaporation-rain cycle there and slow the river flow to Lake Okeechobee. Each of which would benefit the Lake.

Water quality improvement is not the only issue relative to dechannelization of the lower Kissimmee as the Legislature indicated in its Kissimmee River Restoration Act of 1976. We are overdue on assessing the 'seek-tos' of that Act - six of which were for purposes other than water quality. The author of the bill goofed when he separated water quality from the 'seek-tos' for special emphasis. That author was me.

We believe it is time to stop thinking only of the pollutants of the lower Kissimmee - which some regard as unimportant - and to think of the water which it can have - which is important to us all.

Restoration of sheet flow in the Kissimmee is the way to resume the long slow flow into Okeechobee and thence into the sawgrass Everglades. The natural slow flow down the Kissimmee was undoubtedly an integral part of the PROCESS which created the great muck delta now comprising the Everglades farming area. Resumption of that flow as I described in my 'shirt-sleeve' talk also offers us an opportunity to use the nitrogen-phosphorus load in Okeechobee to create muck - an advantageous use of materials which are commonly regarded as wastes in the great Lake.

There is also a social benefit to restoring the lower Kissimmee which I am constrained to mention. Those of us who had the displeasure of helping to pay for a ditch we didn't want would regard as a modest return on our investment the pleasure of helping pay to restore a river which we do want.

Water is the dominant resource issue in the Everglades system. But there are other resource issues. In troubled south Florida resources are the dominant issue. Too few resources demanded by too many people. This is true in the nation and in the world.

Improved water quality; restoration of wetlands; the regeneration of peat and muck; expanded populations of fresh water fishes throughout the system and of marine fishes in the St. Lucie and Caloosahatchee Estuaries and in Florida Bay; the provision of more adequate flows to Everglades National Park - are other resource issues of importance to our Coalition and to south Florida at large. Improvement of these resources will provide food for people and wildlife, expanded bases for recreation; and economic benefits to the tourist industry, the commercial and sport fisheries industry and to south Florida at large.

I don't need to tire you with recitations on these matters. They were all covered in my talk to the 'Shirt-Sleeve Symposium' and are summarized in our Brochure. Beyond that they are easily, almost automatically, accomplishable. All of them will be improved if sheet flow is restored in the Everglades System.

Members of our Coalition have given careful thought to the predicaments of the Everglades and what might be done about them. These are our thoughts:

1) There are both physical and functional limits to the resources of the Everglades and we must live with both. There is only so much land; so much water; so much muck. There is only so much rainfall; so much water to be recycled; so much pollutant assimilative capacity in its waters.

2) Our prime concern with the system has to be centered on PROCESSES -- functional ecologic processes. We have to be much more concerned with them than with the crisis of the moment. We have to care where we are but we must have infinite care about where we are going.

3) Our possible choices of action are:

a. Leave everything the way it is. This is not a viable option. Water quality is worsening; the muck is disappearing; water demands are increasing.

b. Increase demands on the system. This can occur in the East Everglades; the jetport site; wetland developments in Broward and Dade Counties and in the lower Kissimmee basin; and in the Hendry County Canal which is planned. These can only make bad things worse.

c. Take actions to reverse the degrading processes which are operating - or at least to lessen their severity.

I narrow now to our specific petitions to this Board:

1. Maintain the concept of the 'Shirt-Sleeve Symposium' as a continuing means of assessing water management in the Everglades system. We all know that we need lots of heads working together; freely interchanging ideas and learning about each other. The kinds of creative thinking which we all need will result from that effort with the single proviso that there be no boss - only a person to serve as a facilatator (sic) of the symposium's investigations and deliberations.

2. We ask this Board to assess the features of the Marshall Plan. Ideas suggested by members of your staff and of the staffs of the other agencies should certainly be included in that assessment. Those actions which are determined to improve and expand sheet flow over broader areas should be implemented as rapidly as possible.

3. Assist and support Everglades National Park and its efforts to reestablish sheet flow in Shark Slough, block the Buttonwood Canal, and to restore the Turner River - all of which have the potential of reducing rapid loss of fresh water to tide.

4. Continue to work with the National Park in its program of modeling the water needs of the Park.

5. Do not construct the Hendry County Canal as now planned. The project should be re-examined in light of the recent water shortage and in terms of its ultimate effect on sheet flow in the basin of the Everglades.

6. Use your authority to prevent further encroachments on water resources in Broward and Dade Counties and in the Lower Kissimmee Basin.

7. Assess the potential rain-cycle issue for augmenting water supplies.

8. Adopt a position for restoration of the Lower Kissimmee River and refluction of the three lower lakes. We are aware that Florida's agencies have preferred to await the decision of the Corps of Engineers on this matter. As Bill Storch said this should be a decision made by Florida. Just as the decision to channelize was made by Florida - and then submitted to the Corps for action - the decision to restore should be made by Florida - and then submitted to the Corps for action. And there is no reason we must necessarily agree with the Corps on the course to take.

9. Take actions to prevent further encroachments on the lower Kissimmee floodplain which may prevent the accomplishment of whatever plan of restoration is finally adopted. Sand is being hauled away from the levees and house construction has begun in the flood plain. The Board, in conjunction with the State, can declare a moratorium on such activities; begin purchase of the flood plain and announce its intended plans for the future of the basin.

We thank you for listening. We know the burden is not light - just as the burdens on the Everglades and all south Florida are not light. The time has come for Florida to make a choice - whether the Everglades is to survive as a productive and beautiful life system in south Florida.

Some things we have discussed are regarded by many as ordinary, but which are extraordinarily important for all of us.

Please call on us if you wish.

Arthur R. Marshall, Jr. Collection

A Critique of Water Management in South Florida

Arthur R. Marshall, Ecologist

Nov. 20-21, 1980

INTRODUCTION

I consider my time on this platform a moment of grace for me -- however fleeting. I genuinely thank the Board for inviting me. I suspect it was not easy for them to do. I consider their invitation a praiseworthy acknowledgement of the need for full and open communications between all parties in our difficult times - the kinds of communications essential not only to improving water management in south Florida but in respect to all the troubles of the region.

I hope, further, that this seminar is only the first of a series of similar enterprises.

Having just 20 minutes, I shall move rapidly ahead. For those who wish more details than I can give here, I shall supply your moderator with a copy of my recent paper, *Repairing the Florida Everglades Basin.* Please note 'Repairing' - not 'Restoring.' Repairing is possible; restoring is not.

GOALS FOR IMPROVING WATER MANAGEMENT

In any human struggle we should first define its objectives - its goals. Where do we want to go?

There are six major goals which I consider top priorities in improving management of the water in the Everglades system:

1. Regeneration of muck in the Everglades. Muck - however prosaic it may seem - is the star indicator of the health of the system. Fortunately for all of us, it is a diagnostic sign which we can readily observe.
2. Reestablishment of wetland vegetation. Wetland vegetation is of course a necessary precursor to muck regeneration.
3. Enlarged populations of fresh water organisms - fish and shell fish - which are essential foods for people and wildlife.
4. Relief of stress on the endangered species of the Everglades, and on its mammalian species which are periodically decimated by high waters.
5. Enlarged populations of marine fishes and shell fishes in Florida Bay.
6. Enhanced recharge of the Biscayne Aquifer.

These all involve natural resources of increasing importance to South Florida's people and its wildlife. They are all interrelated by ecologic processes to such an extent that accomplishing one of them will cause improvement in all the rest. Conversely, failure to achieve any one of them will lead to failure in all the rest.

Ultimately, many Floridians will evaluate these objectives in terms of their worth to mankind. The values of four of them - muck for food production; marine and fresh water fishes for human food; recharge of the Biscayne Aquifer for water

supply - are evident in our world of increasing needs and diminishing resources.

It is not easy to recognize the value to people of wetland vegetation. Its contribution to the quality of drinking water - as I shall mention later - are also little recognized.

The value of birds and other wildlife? Some of us simply enjoy them. Others recognize that the well being of the Everglades's wildlife is linked in complex ways with the well-being of the people on the Gold and Treasure Coasts. Everglades wildlife thrives on extended hydroperiods; on wetland vegetation; on the generation of muck and on the bountiful production of marine and fresh water organisms - just as people do.

INEVITABLE ECOLOGIC PROCESSES

My second purpose here is to describe a particular set of ecologic functions and processes which cannot be ignored in seeking to achieve the six objectives. In whatever decision result from this conference and others to follow, these processes will be functioning - beneficially or adversely.

The first is "sheet flow." Some refer to it as "extended hydroperiods." I prefer the "River of Grass" because that term implies vital ecologic functions which neither of the two physical terms provide.

In order to generate muck, seven to eight months of surface sheet flow are required. Four or five months of surface flooding will produce wetland vegetation. Another three or four months of flooding, or at least of saturation, are required to convert the annual detritus (leaf fall) of wetland vegetation into muck. If wetland detritus is dried soon after the rainy season, it will pass by means of oxidation into the atmosphere rather than into the muck bed.

If we achieve an extension of hydroperiod sufficient to produce muck, the Everglades system will also produce more forage fishes and shell fishes for wading birds and other wildlife; increases in the larger fresh water fishes and the marine fishes sought by man; increased recharges of shallow aquifers.

There is also the possibility - in accord with concepts developed by Dr. Patrick Gannon - that additional rainfall on south Florida will be induced.

When we have hydroperiod shortfalls, muck is decomposed rather than produced. This not only releases the nutrients stored in the plant tissues - as is well known - but also leads to the transport of finely divided muck particles in flowing canal waters. The blankets of ooze lying on the quiet bottoms of the St. Lucie Estuary have for many years demonstrated the effects of that kind of transport.

It is also possible that decomposition of muck and transport of its fine particles add to the organic load in Miami's drinking water which requires chlorine treatment. This has not to my knowledge been investigated, but it surely should be. If this does happen, then we have a seventh major objective beyond the six I have listed - a reduction in that organic load by replacing muck decomposition with its regeneration through an extension of the hydroperiod.

An extremely important character of sheet flow is that it involves moving - rather than standing - water. Water moving through the Everglades, no matter how slowly, produces muck. Standing water produces ooze as is well-demonstrated in Conservation Area 2A. I do not know why this is so; I can find no one who does. The differences in the products of water moving - even at the slow rate of 20 feet per day - and water standing are marked - muck or ooze. I think it is akin to the dramatic difference between being old and being dead.

The adherence to water regulation schedules in the three Conservation Areas is antithetical to extension of sheet flow in the Everglades. It is not possible to manage water with emphasis being placed on the vertical component and to recreate extended sheet flow on a horizontal plane through the system.

None of these characteristics of sheet flow are difficult to understand. They do require more contemplation than we can enjoy here and I ask that you do that in your leisure.

THE MARSHALL PLAN

There are other issues in the Everglades system but these are enough to indicate my thinking, Time shortens and I now move on to the "Marshall Plan" for improving water management in the system.

I begin with the Kissimmee Lakes. Their existing water quality problem - as exemplified by Lake Tohopekaliga - must be resolved by some means other than discharge of wastes into them. Some years ago, there was widespread acknowledgement that "dilution is no solution to pollution."

I would dechannelize the lower Kissimmee. In addition to the benefits envisioned by the Legislature - benefits expected

largely within the lower valley and Lake Okeechobee - dechannelization has great potential for slowing the inflow of the whole valley into Lake Okeechobee. Not only would that be desirable in periods of water deficiency as Okeechobee is now experiencing, but it could also provide an extension of sheet flow south of the lake to enable muck regeneration now and in the future.

Following removal of the "hump" in the Miami Canal, I would pass Kissimmee- Okeechobee waters through the present agricultural area via that canal as slowly as possible into the Holey Land and Rotenberger Tracts. Where it is possible, I would also return good quality waters which now go to tide, and which are not necessary to maintenance of marine productivity, to the Holey Land and Rotenberger Tracts or to Conservation Area Three. The purpose of such re-diversions would not be solely to increase the depth of waters in the rainy season, but primarily to extend the period of sheet flow after the end of the rains.

I would sheet the water through Conservation Area Three by: culverting its north levee and Alligator Alley; by blocking the Miami Canal, and the Alley's borrow canal and the Conveyance Canal for L-67-A; and by opening the S-12 structures for flow into Everglades National Park.

I would establish hydrologic connections between Area Three and the Big Cypress Preserve. I would reestablish sheet flow into the North East Shark River Slough. I would refill that portion of Canal 111 which lies under U.S. Highway 1, and all of Canals 109 and 110 now existing.

I would restore the Turner River in the Big Cypress Fresh Water Preserve.

As the agricultural muck diminishes over the years around the Holey Land and Rotenberger Tracts, I would periodically move the line of reflooding northward.

These actions can return sheet flow to hundreds and perhaps a thousand square miles of the Everglades system. They can teach us how to restore muck; the water regimes which are required to do it; and how rapidly we can do it with the nutrient-enriched waters we have available in the system today.

Every objective I presented earlier would be benefited.

SUPER SOLAR BENEFITS

All of the benefits achieved by the plan of repair would derive from solar energy. Which is itself another prime objective of our day.

The great "River of Grass" served as a giant "solar panel" in the pristine Everglades. All of the rich resources of the Everglades were produced by solar energy operating through its surface sheet flow. The sun is still there.

Restoration of sheet flow can utilize enormous amounts of solar energy to produce the valuable benefits I have described. Solar panels on the roofs of the Gold Coast would provide hot water only - no muck; no aquifer recharge; no food for wildlife or people; no improvement in water quality. In further comparison, in terms of total solar energy utilized, a solar panel on every roof of the Gold and Treasure Coasts would fall far short of the amount utilized by a repaired "River of Grass."

OTHER SUBSCRIBERS

There are others beside myself who are moving in these directions, or at least analyzing the possibilities:

The National Park Service, the Fish and Wildlife Service, the Corps of Engineers and the East Everglades Resources Planning Project in their reviews of the North East Shark River Slough.

The Fish and Wildlife Service in its review of water supply augmentation in South Florida.

The Florida Game and Fresh Water Fish Commission in its recent publication on the Fishery Resources of Florida.

Walt Dineen contemplated some major aspects in "Life in the Tenacious Everglades" - 1972, and in "Examination of Water Management Alternatives in Conservation Area 2A", 1974.

Dan Haunert ventured into possibilities for conserving fresh waters for return to the Everglades in his review of the effects of fresh water discharges into the St. Lucie Estuary, 1980.

The Governing Board of the District and the Corps of Engineers have certainly moved on the sheet flow issue by construction of S-339, S-140 and allied structures in Conservation Area 3A. They are also involved in the matter by the

planned three-year drawdown of Conservation Area 2A.

And, of course there are legions of conservationists in and out of Florida who are eager for the repair of the Florida Everglades.

All of which are thoughts related to the well-being of south Floridians and south Florida's wildlife from an ecologic derivation.

GOOD NEWS

In the event efforts are implemented to extend sheet flow in the Everglades, I suggest that these items be monitored.

1. Recharge of the Biscayne Aquifer
2. Increases in muck
3. Extent of reestablishment of sheet flow
4. Extent of reestablishment of wetland vegetation
5. Ooze siltation in the St. Lucie Estuary, Conservation Area 2A and the ponding which occurs just north of the Tamiami Trail in Conservation Area 3A
6. Water quality in respect to organic loading in Miami's well fields
7. Responses of bird life and terrestrial wildlife
8. Responses of fresh water and marine animal populations for both bird forage and human food
9. Effects on rainfall under the concepts of Dr. Gannon
10. Effects on exotic trees - Melaleuca, Brazilian pepper, etc.

In connection with these, I have long thought that researchers who follow the condition of the Everglades would find monitoring its recovery much more enjoyable than monitoring its degradation.

I thank each of you. Have fun in your shirt sleeves as I have had in mine.

Arthur R. Marshall, Jr. Collection

ENERGY AND GROWTH

Arthur R. Marshall
Director, Division of Applied Ecology
University of Miami

Most speakers at this conference are examining the production side of the energy questions; my view is of its use - specifically, its use to generate growth.

Energy in its various forms is, of course, the means man employs to convert solar-fed natural systems into higher-yield managed systems. It is precisely our capabilities to direct energy and its great assortment of products which have enabled us to grow the high-yields of Florida's farms, ranches and forests. It is that same capability which has enabled us to swell our cities to their present impressive sizes.

One concept of the magnitude of our ability to manipulate energy to subsidize growth is rendered by some crude calculations which show that all of primeval North America would be required to sustain the present population of Florida alone.

Obviously one can have many thoughts about our energy-supported population of two hundred million plus persons and all of us do. Some examples: It sure makes money. Watch that crazy driver. Technology will save us. The projected growth is -----. Fishing isn't what it used to be. You can't put a fence at the border. What happens if the juice goes off? Drive safely. Have a good day.

I won't spend any more time on our current mix of paradise and peril; one needs only to visit south Florida's Gold Coast for an adequate exhibition of them. As Governor Askew has said, "We have problems."

For many years I studied the effects of energy-fed growth and its handmaiden technology on the wildlife and wild systems of south Florida. In the last seven or eight years I have examined just as intently its effects on urban systems there. It was a natural transition for me to make for, they both operate under the same principles, ecologic and economic. They are two sides of the same coin. Their unity is exemplified by the statement, "As south Florida's Everglades goes, so goes its Gold Coast," or vice-versa.

I have seen, in my south Florida studies, so many logarithmic, exponential or increasing exponential curves which depict environmental, social and economic conditions - practically all of them deriving from energy and growth - that my day is brightened when I find some phenomenon whose behavior or effect is not exponential. Last week I learned that Florida Power and Light Company's customers paid successively less for electricity each year from 1961 through 1970. I tried not to notice that they paid a little more in 1971.

Our galaxy of exponential functions is cause for concern. I believe they account in good part for our present paralysis of bewilderment. Since virtually every one of them leads to some critical level we are faced with choosing between a set of assorted misfortunes or, more optimistically, responding rationally to a set of inescapable realities. The central one of which is the impossibility of an endless spiral.

It is not easy to understand why we are in trouble - to recognize why it is that actions which led yesterday to successes, lead us today to the precipice. One of the best ways I have found to explain it is a little anecdote about a sinking ship and

a life boat. The life boat quickly retrieves ten persons from the sea which is good; the boat has capacity and supplies for twenty. Everyone is eased, reasonably comfortable and tending to relax. A short time later five more people are retrieved. Now all passengers pull their feet in. Four more are inserted; all sit up straight. A short while later another survivor swims up to the boat. Number twenty.

This is the sort of progression ecologists think of in regard to exponentially rising stresses and critical levels - that we all have to think of now. That last passenger increased the total weight in the lifeboat by less than ten percent, but he did tighten things up.

Ten percent more nutrients in an enriched lake can bring on the algal blooms and the gizzard shad. Ten percent more DDT in an eagle can finish him. Ten percent less water in Everglades National Park can disrupt that biological broth. Ten percent more students in a class, ten percent more cars on an expressway can choke either operation. To most persons, a ten percent gain or loss in salary or profits is likely to be momentous.

Any discussion of "energy and growth" comes ultimately to be a treatment of the assimilative or carrying capacity of life support systems, both urban and wild. With no source of energy other than direct solar radiation, the carrying capacity of natural systems for humans is relatively low. And they do have limits.

But we can and do extend the carrying capacities of natural systems with inputs of energy. The primeval Gold Coast might have sustained 50,000 persons; there are more than two million there now. Energy inputs have elevated its people-carrying capacity to enormous heights. That would seem a desirable accomplishment if one could ignore its galaxy of exponential functions; air pollution; water pollution; diseased fishes; crime; accidents; an aggravated school system; water shortages; jammed beaches, parks and jails. Even its prime supplier of energy, the power industry, struggles painfully from one precipice to another.

Has something gone wrong? Not really. Predictable events have simply been ignored. What we are seeing in south Florida are symptoms of stress or the occurrence of critical thresholds in a highly-energized life-support system whose carrying capacity, however much elevated, is being surpassed.

There is even an orderly progression in these problems - from early symptomatic ones which denote primarily erosion of the quality of human life to more basic effects which are produced by collapse of components of the system.

All life-support systems have limits. Had the primeval Gold Coast become over-populated, it too would have exhibited stress symptoms and critical effects. The array would have differed somewhat from our present assortment, and I am sure its order of complexity would have been lower than ours.

Joseph Wood Krutch underscored a vital part of our current dilemma when he said, "The more completely we bring nature, 'under control,' the more complicated our methods must become, the more disastrous the chain reaction set up by any failure of wisdom, or watchfulness or technique...."

Allied to the intricacy of a high energy-technological society, and the delicacy with which it must be managed is the delicacy of a free society and the intricacy with which it makes decisions. Both procedures become enormously painful under the rigors of an urgent problem.

In order to solve an urban overload problem with technology, i.e., energy, three positive conditions are required. First, the essential technology must exist. Second, there must be a social decision to install it. Third, there must be money to buy it. The absence of any one of these three ingredients is fatal to the effort and leaves us with the problem. We are encountering this threesome in the strident sewage problems of the Gold Coast.

Sewage treatment capability does exist. There is, however, much social indecision about the level of sophistication which is required and certainly about whose neighborhood should harbor its trappings. Finally the panoply of shiny technology widely envisioned not long ago seems to have receded somewhat - concomitant with shrinkages of that third commodity - money.

One of the hangups - i.e., the limitations - of the technological solution is that its cost rises exponentially with the degree of efficiency required. Again referring to sewage treatment technology, the degree of treatment must advance exponentially with the degree to which population overload surpasses the assimilative capacity of a region. Thus, if a receiving water body can assimilate the raw wastes of 10,000 people without harm to its resources, we must advance to primary treatment or 50 percent removal with 20,000 persons, to secondary treatment or 90 percent removal with 100,000 persons, and to advanced treatment or 99 percent removal with 1,000,000 persons - to retain the same beneficial resources in that water body.

EPA Administrator William D. Ruckelshaus has provided another example of this kind. In a speech entitled, "A Prototype of Environmental Civilization," given October 17, 1972, he said:

> But vanishing resources and overpopulation are not the only problems we face. Some are extremely subtle; indeed, geometric processes are even visible in the realm of industrial investment. During this year, investment in industrial facilities is expected to grow by 10.2 percent. At this high rate, capacity would double every seven years. Thus if pollution control technology is 85 percent effective in existing plants it will be just 70 percent as effective in cutting gross pollution tonnages seven years from now when production of everything, including contaminants, has doubled, and only 40 percent as effective seven years thence, when it has doubled again. After three successive seven-year doublings, the actual amount of pollution is 120 percent more than it was 21 years earlier, before abatement began, even assuming pollution control at a remarkable 85 percent effectiveness all along.

In like fashion, mounting pressures on the public facilities and services required in a large and growing city - water supply, sewage treatment, road systems, police, public housing, sanitation, schools, parks, courts, etc., - require that they all be increasingly efficient. While we have not adequately examined these issues in Florida, a number of such studies made around the Nation indicate that there is an optimum size for cities, that surpassing that size introduces diseconomies of scale which lead to insolvency in the city budget (see appended list). The per capita expenses simply exceed the per capita revenues, with the deficit gap continuing to widen with increasing size.

And so the parks, sewage systems, adequate transport, police, etc., simply aren't provided. They cannot be. As wealthy as this Nation is, we cannot afford the high cost of providing each urbanite the highly efficient and costly systems decent life requires. That would be like putting everyone in a Cadillac. As a consequence, one of our major environmental problems, if not the major environmental problem, is the collapse of our cities and the immobilization of their governments. And so we encounter a new limit to urban growth in our high energy society - money. Money which converts to energy. It is likely that this limitation will become more evident in the immediate future as vital federal make-up funds diminish. The problems seem also about to be exacerbated by the increasing costs and decreasing availability of vital energy fuels.

Florida's natural environment is more responsive to overload than those of many northern states. Its water bodies are much shallower, and therefore, more susceptible to all forms of pollution; its lakes and bays being naturally low in fertility are more susceptible to over-enrichment; lowering surface waters six inches in many areas opens thousands of acres to intensive population growth; its subtropical marine life comes within a few degrees of lethal temperature under natural summer conditions. Some expressions of these sensitivities are: the water enrichment problem of Lake Okeechobee, degraded materially by man in only eighty years in contrast to many lakes of the north, which endured several centuries of nutrient loading; the stringent problems of Metropolitan Miami - a youthful city less than eighty years of age; the difficult problem of heated water disposal at Turkey Point.

I suggested earlier that the Everglades and the Gold Coast are integrated parts of a single system - which means that we must consider direct effects, as well as second and third order effects - that changes in either part have on the other. In like fashion, we have to take an integrated view of activities within the city proper; what a new expressway does to growth, to neighborhoods, to air pollution, and to the city budget. If, for example, some unlimited source of water for Dade County were available, we should have to note that there is enough open land there to carry 2.5 to 3 million more people. We should, as a consequence, have to consider what this would do to transport systems, schools, fire protection, power needs, the city budget, and now, of course, to energy supplies essential to all of them. Many specialized missions of the agencies of government, executed successfully in the past to meet "projected growth" needs, become less and less tolerable precisely as pressures of that growth mount on a large urban area. My points are simply these:

- Both nature and man-made systems have limits.
- Both are integrated systems and must be so regarded.
- Both exhibit symptoms of stress as pressures mount, and will ultimately collapse under spiraling growth.
- Nothing in these matters is mysterious.

Out of the concern of Florida and south Floridians with such enlarging crises of energy and growth we must accomplish a vital feat in record time. That feat is to determine the acceptable limits of development within regions of the State - both those limits which are inherent in its natural resources, and those more elevated limits which we are able to attain through inputs of energy and tax dollars. Which resources, we must continually recall, are themselves limited. The survival of Florida's unique natural resources, the conditions of life for its people, the viability of its cities - in terms of their livability, their responsiveness to public needs and their economic solvency - depend on it.

The task is no placid one. Philosophically it involves recognition of the wrenching fact that many of the deep troubles of today result from the successes of yesterday - that the momentum which established a great region can as well destroy it.

If we elect to stay reasonably within the bounds of our life support systems, which must include the support of available energy and dollars, we shall have to discard as a working philosophy our habitual drive to provide endlessly for the needs of "projected growth." The essential question now is whether we shall have the wisdom and courage to do it, or shall simply pass the issue to a subsequent generation.

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GOVERNOR'S CONFERENCE REPORT IN THIS ISSUE

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GOVERNOR'S CONFERENCE REPORT IN THIS ISSUE

Governor Reubin Askew has thanked the more than 150 experts from the fields of science, government, agriculture, and conservation for their contributions to his Governor's Conference on the Everglades held in Miami Beach in September.

The full report, printed as a public service for Water Management Bulletin readers, appears on pages four, five, and six of this issue. It was thought that while most people have read excerpts from the report, many might like to have a copy of the full report for their files.

Governor Askew stated:

> "I want to take this opportunity to thank all the dedicated Floridians who contributed so much to Florida by their attendance at this water conference. mostly at their own time and expense."
>
> "It has been estimated that the State of Florida received more than a million dollars worth of free talent at this conference. I especially want to thank Professor John DeGrove of Florida Atlantic University and Professor Arthur Marshall of the University of Miami, as well as the group chairmen and recorders for their

immense help in making the conference, probably the first of its kind in Florida, such a success."

A listing of persons participating in the conference appears on Page 7 of this issue.

MOBILE LABORATORY - This new mobile lab went into operation this month under the supervision and operation of Jan Browning, environmental engineer; and Ken Foote, engineering aide. Both men work for the Hydrology Section of the FCD Engineering Department. Eventually the section hopes to compile a bank of water quality data on every canal in the District. This lab will have the capability of testing such items as dissolved oxygen levels, temperature, conductivity, chlorides and many other tests. They have a contract with a commercial lab where the water samples can be taken for more extensive tests. When the lab is not actually located at a canal site making direct observations it will be parked in the District's parking lot and used in the same manner as a stationary lab in the building. As the District becomes more and more concerned about water quality, as well as water quantity, this new feature is expended to produce excellent results in their constant fight against pollution.

Dade County Official Endorses FCD Plan

Garrett Sloan, Director of the Department of Water and Sewers for the City of Miami, has endorsed the Central and Southern Florida Flood Control District and Corps of Engineers plan to backpump coastal canals.

Sloan's speech was presented at a technical session held under the auspices of the 22nd annual joint conference of the American Water Works Association and the Water Pollution Control Federation held recently in Miami Beach.

Sloan pointed out that the Flood Control District plan would not only satisfy local water needs but would also supply the Everglades National Park with sufficient water. The plan calls for installing large pumping stations at the eastern edge of the conservation areas. During dry periods these pumping stations would take water from the coastal canals back into the Conservation Areas. Sloan noted that "the great water losses to the sea, now experienced, would greatly be reduced and water of good quality could be retained for storage."

In addition, the plan calls for "raising the levees of dikes around Lake Okeechobee so that an additional four feet of water could be stored with no additional evaporation losses," Sloan said. Sloan also noted that this plan "is the only existing well defined plan for meeting Southeastern Florida' s growing water requirements."

The speaker noted that for the first time in history, the 1970-71 drought forced Miami to draw directly upon Lake Okeechobee for its water. He stated that Miami has traditionally obtained water from wells drilled into the Biscyane Aquifer, a sponge-like limestone formation. It is usually recharged by rainfall, or if rainfall is insufficient, it obtains water by seepage from the FCD's conservation areas or canals.

But during April and May, water table levels in the aquifer had dropped to elevation 1.0 feet, [1 1/2] feet below the required level to salt water out of Miami's well fields. Water was released from Conservation Areas into canals that supply the fields to alleviate the situation.

Sloan noted that "when this resource was exhausted, water was brought in from Lake Okeechobee for over 20 days. If the June rains had not arrived, there was less than two months of supply from Lake Okeechobee storage remaining.

Cities Asked To Pass Model Water Ordinance

A model municipal ordinance restricting use of water by individuals, business and industry, and municipalities during "emergency situations" has been sent to all municipalities in the 18-county Flood Control District.

The ordinance, approved by the FCD Governing Board at a recent meeting, defines "emergency situation" as that which shall be "determined by the FCD due to prolonged drought conditions resulting in the serious shortage of fresh water supply" in any area or city in the District.

Its application would apply to all persons using water both in and outside a city, regardless of whether the water used is by contract with the municipality or taken from the city water supply system.

Restrictions listed under the ordinance include, in part: sprinkling, watering or irrigating lawns, shrubs, gardens or vegetables, washing of automobiles, trucks, campers, boats, railroad cars, or any other type of mobile equipment, except by bona fide business enterprise where vehicle washing is done.

The ordinance also covers exterior surface washing of sidewalks, houses, mobile homes, office buildings; operation of any ornamental fountain or other structure using water without a recirculate [[wading pools not equipped with a recirculating system.]]

It would crack down on wasteage of water because of faulty plumbing which is known to be out of repair.

Penalties imposed for infractions of the ordinance include a fine not to exceed $500, or imprisonment for not more than 60 days. In addition the city commission or director of utilities would be given the power to suspend water service from any property when the provisions of the ordinance have been violated.

Keep YOUR Waterways Clean

Everglades Snapping Back Biologists Survey Shows

Fish populations decimated by record drought conditions in Conservation Area 3 in the Everglades are recovering very slowly, but native vegetation is snapping back satisfactorily, biologists with the Central and Southern Florida Flood Control District (FCD) reported today.

These were the conclusions reached by three FCD specialists in the fields of aquatic and fisheries biology and botany after a three-day biological investigation in Area 3 recently.

It was the second in a series of post-drought studies being conducted in the Flood Control District's Conservation Areas, where water - levels have been rising slowly.

In the initial post-drought investigation in Conservation Area 2 three weeks ago, FCD biologists discovered an "amazing" survival rate for largemouth bass and a variety of other species.

"But it was a different story in the interior of Area 3. We found juvenile shellcracker and warmouth perch, but we didn't turn up any bass," said Walter Dineen, Chief Biologist of the FCD's Environmental Division.

"But the plant communities are responding beautifully," Dineen reported, adding, "We found Area 3 rich and alive. Everything was lush and green." Dineen's two post-drought probes into the Everglades are proving his long-held contention that the ecology of the region is "tough," and not as "delicately balanced" as some ecologists have claimed. Dineen has spent nine years studying the aquatic Everglades community.

Even though the chief biologist often comments on the ruggedness of the Everglades ecology, he admits he was surprised over the survival of fish in Area 2 and was impressed with the speedy comeback of the flora in Area 3.

Dineen indicated he was disappointed over the survival rate of fish in Area 3, but he pointed out there are a great number of big brood female bass that survived in the deep canals in Area 3. These females will replenish the conservation area.

“There will be a tremendous spawn in Area 3 this winter. There will be a high survival rate for the young bass because they will have a rather uncompetitive situation. They'll have 100,000 acres to live and grow in," Dineen said, adding that small forage fish and other food will be plentiful.

The biologist commented that the present poor condition of the fishery in Area 3 was not unexpected because that region of the Everglades was "drier a lot longer" than Conservation Area 2.

Despite the post-drought interruption in the sports fishery, there is one way in which anglers will benefit from the prolonged drawdown, Dineen said.

He explained that underwater vegetation clogging the sloughs frequented by anglers in Area 3 was killed or retarded, creating more open fishing areas for anglers.

"The sloughs will be easier to fish this winter", the biologist predicted.

The investigations being conducted in Areas 2 and 3 are producing the first reported documentary evidence of the effects of the severe and prolonged drought on the flora and fauna of the Everglades. The studies will be continued by the FCD staff of biologists.

Private Hunting Camps To Be Banned In Glades

The Central and Southern Florida Flood Control District (FCD) Governing Board has moved to abolish all illegal private permanent camps on public owned lands in the vast Everglades water conservation areas.

The action came after Don Morgan, Director of the FCD's Department of Planning and Resource Use, told the Board a team of employees sent into Conservation Area 2 on Thursday had discovered one new camp under construction and extensive additions being added to two others.

Although some camps are built on private land, most were built on public lands under permits obtained from the Florida Game and Fresh Water Fish Commission.

FCD Attorney Robert Grafton told the Governing Board that State Attorney General Robert Shevin has "ruled the Game Commission doesn't have the authority to issue permits for camps on state lands."

A five-man team of ecologists has issued a report that such camps in the Everglades are generally harmful to wildlife.

FCD Governing Board Chairman Robert W. Padrick, with full Board support, ordered the staff to immediately ascertain the exact locations of the camps and check with Broward County officials to see whether building and health department permits had been sought.

"We must bring this to the attention of the Attorney General at once," Padrick said. "He has stated publicly that if these camps are on state land, they are trespassers and will be removed."

Padrick said the FCD "has ample basis to proceed in view of the fact that one of the prime recommendations issued at the recent Governor's Conference on Water Resources in South Florida was that all non-public facilities in the Conservation Areas should be removed."

Statement To Governor Reubin O'D. Askew

From The Governor's Conference On Water Management In South Florida

There is a water crisis in South Florida today. This crisis has long-range and short-range aspects. Every major water area in the South Florida basin, Everglades National Park, the conservation areas, Lake Okeechobee and the Kissimmee Valley is steadily deteriorating in quality from a variety of polluting sources that are detailed below. The quantity of water, though potentially adequate for today's demand, cannot now be managed effectively over wet/dry cycles to assure a minimum adequate water supply in extended drought periods.

WATER SUPPLY – QUANTITY

To initiate an action program to solve problems in the area of water quantity, a careful assessment must be made of water demands linked to projected growth. For an adequate long-range water supply, the State must have an enforceable comprehensive land and water use plan. This plan must be developed immediately. It must be designed to limit increases in population and machines, with their attendant demands on the water supply, to a level that will insure a quality environment. Such a management plan would include, as its first objective, a complete inventory and assessment of long-range water resources. The controlling factor in this water resource assessment should be the water supply that can be anticipated in times of shortest supply. A result of this planning effort would be a water budget system based on available resources. This system would serve as a limitation on allowable population increases.

WATER SUPPLY – QUALITY

Water quality is a far graver problem in the long run than is water quantity. The quality of the water in the South Florida water basin is deteriorating. This deterioration stems from the introduction into the basin of pesticides, herbicides, animal and industrial wastes, heavy metals, salt water, sewage and heated waters. Channelization has contributed substantially to the process of deterioration. Water quality in the basin may be restored and maintained by:

1. Zoning or acquiring the flood plains in the basin.

2. Reflooding the Kissimmee marshes.

3. Initiating a comprehensive treatment program to treat pollutants at the source before they enter the water system. (This would necessitate initiation of treatment procedures in agricultural areas and up-grading existing procedures in urban areas.)

4. Phasing out back pumping into Lake Okeechobee or requiring effective treatment at the source before back pumping.

5. Research and funding which should begin immediately to study what to do about recycling water and sewage effluents and solid waste disposal.

LAND RECLAMATION

There should be no further draining of wetlands 1 for any purpose. As an initial step in controlling the drainage of wetlands, it is recommended that Chapter 298 of the Florida Statutes (Soil drainage district law -1913) be repealed. Wetlands are the most biologically productive of all lands. The need to preserve them stems from their value for recreation, water storage, aquatic productivity, nutrient removal and for aquifer recharge. A program should be initiated to reflood the marshes of the Kissimmee Valley. Agricultural lands and marshes not presently in production below Lake Okeechobee should also be reflooded. The initial efforts should be pilot projects that can provide a clearer assessment of the benefits and techniques of reflooding. It is crucial to reverse the process of the steady loss of organic soils.2 Reflooding is the primary method for accomplishing this objective. This program should include the acquisition and consolidation of lands by the State in selected areas north of Conservation Area Three and/or near Conservation Area Two as a major pilot program. Its purpose shall be to determine the effect of controlling water levels, filtering pollutants and recycling wastes to build up organic soils. Muck conservation programs should be coordinated and pursued immediately by the Central and Southern Florida Flood Control District and Trustees of the Internal Improvement Trust Fund. Even if mucklands are not used for agriculture, their preservation and restoration are necessary to maintain the ecological balance of the South Florida basin. Reestablishment of sawgrass may be the best solution to replenishment of the mucklands. However, other approaches should be considered on an experimental basis, including the use of organic material such as sewage sludge.

(A minority position held that limited drainage of wetlands to serve a clear public interest, under strict controls, may be justified.)

1. Wetlands, swamps, marshes, bogs, etc.
2. Organic soils in the South Florida-Everglades area are commonly referred to as muck or muckland.

POPULATION

There is a limit to the number of people which the South Florida basin can support and at the same time maintain a quality environment. The State and appropriate regional agencies must develop a comprehensive land and water use plan with enforcement machinery to limit population. This is especially crucial in the South Florida region. The population level must be one that can be supported by the available natural resources, especially water, in order to sustain a quality environment. A State comprehensive land and water use plan would include an assessment of the quality and quantity of these resources. Moreover, it would set density controls on further development by regions and sub-regions.

GROUND WATER

Localized ground water problems are common in South Florida, but they are especially severe in South Dade County and in portions of Collier and Lee Counties. Ground water contaminations and depletion problems include salt water intrusion, uncontrolled drilling of wells, drainage well pollution, inefficient waste water disposal systems, septic tanks and sanitary land fill. Solutions to ground water problems include:

1. A State Drilling Code requiring licensing of all wells and well drillers.

2. Purchase or zoning of lands to protect recharge areas.

3. Plugging of abandoned artesian wells.

4. Installation of secondary controls in major canals to hold higher heads of water.

5. Construction of additional salt water intrusion control facilities, except on natural rivers, according to a salinity control line established along the entire South Florida coast.

6. Elimination of the disposal of improperly treated waste waters.
7. Consideration of all artificial recharge methods which do not impair the quality of the ground water.
8. Consideration, after study, of filling in certain canals in the South Dade County area to improve ground water quality.
9. Prohibition of deep cuts made into the aquifer at the salt water line which cannot be adequately controlled by salinity barriers to prevent salt water intrusion.

Water quality, quantity and development controls described elsewhere in this report will also improve ground water conditions in the basin.

GEOGRAPHIC CONSIDERATIONS

The South Florida water resources can only be understood by considering the entire area. The area begins with the Kissimmee Valley chain of lakes in the north, extends southward through Lake Okeechobee, the Everglades (including the Big Cypress) and encompasses all coastal and estuarine areas. Any significant change in water quality or quantity in one part of the total area must be considered in light of its effects on the rest of the system.

(A) The Kissimmee Valley

Pollutants entering the Kissimmee Valley have cumulative adverse effects on water quality in the Kissimmee chain of lakes water entering Lake Okeechobee. The Kissimmee lakes and marshes should be restored to their historic conditions and levels to the greatest extent possible in order to improve the quality of the water entering Lake Okeechobee. Action should be taken to restore fish resources and wildlife habitats. Contamination by pastured livestock must be reduced. Techniques should be investigated to increase restoration of selective areas to their natural condition by use of advance waste disposal and composting materials.

(B) Lake Okeechobee

Recognizing that Lake Okeechobee is the hub of water quantity and quality in South Florida, the most important and overriding consideration should be not only to maintain the present quality of the lake but also to improve it. Specific consideration should be given to assure that all water inputs into Lake Okeechobee are of high quality. Two primary inputs which could improve the quality of water are (1) reflooding of the Kissimmee Valley flood plain and (2) assuring that only high quality water is back pumped into the lake. We should consider the following ways, in addition, to assure high quality lake water:

1. An appropriate monitoring and enforcement program.
2. Allowing a maximum high water level mark of seventeen and one-half feet. Higher controlled elevations will not be considered unless it can be clearly shown that such elevation would have no adverse effect on the environment of Lake Okeechobee, its water quality or the ecosystem of South Florida.
3. Allowing no cattle or agricultural activities inside the diked area of the lake and immediate cancellation of all agricultural and mineral leases inside the diked area.
4. Ways should be sought to replace chemical control of aquatic weeds with alternate methods which are not harmful to the Lake Okeechobee ecosystem.
5. Nutrient removal by periodic commercial harvesting of the lake's extensive fish population.
6. Nutrient removal by harvesting of aquatic weeds.

(C) Everglades Outside the Park

Everything possible should be done to retain and enhance those areas in their natural condition. There is a need for continuous monitoring and control of these water resources since they provide the supplies to total South Florida area, including urban areas. A specific objective should be to maintain and restore the sawgrass. Present intrusion of non-public interests should be removed from Conservation Areas 1, 2, and 3 and all privately owned lands in said areas be purchased. It is important that the Big Cypress area be purchased to the greatest extent possible and that land use controls be established immediately in the Big Cypress to control development and to preserve this area for the public benefit. Other potentially valuable areas that need protection are the Shark River Slough, its head water areas and the general area near Canal C-111.

(D) Everglades National Park

We should attempt to maintain the water quality and quantity of the Park adequate for the purpose for which the Park was created. Where it is deemed advisable, exotic plants and animals should be controlled in the Park and throughout the Everglades area.

SHORT TERM PROBLEMS

An inter-agency committee should be established immediately to consider short term water management problems. The purpose of this committee shall be to develop an ecologically sound body of guidelines and policy to be followed in the resolution of short term problems of the region. There should be an educational program to alert the public to the possibilities and consequences of water shortage.

(A) Fire Prevention and Control

Through programmed burning maintain an approximation of the original fire regime of the area. There should be controlled burning to protect the natural plant and animal systems and to prevent an undesirable build-up of plant materials. Man should be excluded from critical areas in times of drought. Fire laws should be strictly enforced.

(B) Intrusion of Salt Water

To prevent the intrusion of salt water within the coastal areas, the fresh water head should be maintained as high as feasible. When a water shortage is anticipated, restriction of water use will be necessary in order to maintain this head of fresh water during the drought. Temporary dams should be built on canals, when necessary, with an established emergency system of permitting to allow construction of such dams. During droughts, navigation service should be restricted in order to reduce loss of fresh water. Canals should not be constructed which would allow salt water intrusion inland of the salt water line. Appropriate local laws should be established and enforced.

(C) Establishment of Water Priorities

Since there is competition for water by agriculture, urban areas, conservation areas, estuaries and the Everglades National Park it is recommended that the total water supply be considered a common resource. Survival of the entire South Florida ecosystem, without sacrificing any segment, should be the prime consideration. Maintaining the head of fresh water should be given first priority. The inter-agency committee should propose priorities in its over-all plan.

(D) Regulation of Water Use

A model water use priority ordinance should be developed for use by all affected areas, establishing a series of consumptive controls based on the degree of water shortage.

(E) Desirability of Cloud Seeding

Cloud seeding is not considered a short term solution. There was a division of opinions on the desirability of cloud seeding primarily due to a lack of knowledge, especially as to the possible adverse environmental effects. An opinion is that cloud seeding may be more effective in producing a water supply during the wet season to mitigate low water supplies during the dry season. However, further research is recommended.

(F) Schedules of Water Levels in Lake Okeechobee and the Conservation Areas

The inter-agency committee should develop and maintain close coordination between the U. S. Army Corps of Engineers, the Central and Southern Florida Flood Control District, the Florida Game and Fresh Water Fish Commission, the U. S. Department of the Interior and where appropriate, the Florida Department of Natural Resources. The purpose should be to establish water levels in Lake Okeechobee and the Conservation Areas as well as to establish flexible regulation and delivery schedules for all water needs in South Florida.

MANAGING AGENCY FOR THE SOUTH FLORIDA REGION

Water management should be coordinated at the federal, state and regional levels, with the leadership role clearly being taken by the State of Florida. At the state level there must be an agency or board that has all power necessary to develop and ensure implementation of a comprehensive land and water use plan for the State. The agency or board, whichever it may be, should report to the Governor.

A regional board for South Florida shall be established. The regional board shall be composed of nine (9) members appointed by the Governor. Three year staggered terms shall be used. The board shall represent the diverse interests in the region. It should hold periodic public hearings in its region for the purpose of receiving input from the public. It shall develop and implement a regional comprehensive land and water use plan in accordance with the State plan. The development of this regional plan should commence at once with the proper funding and legislative authority, even in the absence of an adequate statewide plan. In the development of these long range plans, procedures should be adopted which allow and encourage full public participation and input.

The geographical boundary of the South Florida regional land and water management agency shall be the Kissimmee River Basin, the Okeechobee Basin, the Everglades and the Big Cypress Watershed, including all adjacent coastal and extuarine areas. The regional land and water management agency shall be responsible for managing water quality and quantity for the long term benefit of the environment of the region and the State. The agency shall be responsible for establishing policy and guidelines for such activities as drainage, water use, well drilling, land use, estuary protection, watershed management, flood control and soil conservation.

The regional agency shall have all powers necessary to develop and implement the regional land and water use plan including, but not limited to, taxing powers, eminent domain, police powers such as intervention to protect the environment, permits for drainage districts and canals, subpoena and investigative powers and research properly coordinated with other agencies. A law providing for public condemnation of lands for environmental protection is essential to the implementation of the objectives herein presented.

The regional agency shall be required by the State to relate to and coordinate with duly constituted State and regional organizations operating in other functional areas.

Finally, the conference recognizes that present funding for environmental protection must be greatly enlarged to accomplish the common goal of protecting the economic and environmental values of this State.

The citizens who have participated in this Governor's Conference on Water Management in South Florida in plenary session assembled acknowledge and applaud the foresight and courage demonstrated by Governor Reubin O'D. Askew in convening this meeting and offer their continuing support in accomplishing the objectives set forth in this statement.

Approved in Plenary Session September 24, 1971

Panel Members Listed

Some 150 experts from the fields of science, government, agriculture, and conservation participated in the Governor's Conference on Water Management in South Florida. The panels were headed up by Professor John DeGrove of Florida Atlantic University and Professor Arthur Marshall of the University of Miami. Names of members on the panel follow:

Group 1 - Hal Scott, Audubon Society, Chairman, and Donald 0. Morgan, FCD, Recorder. Panelists included: Dr. Harry A. Allison, University of Florida; B. 0. Beck, Osceola County Commission; Mrs. J. W. Bernhard, Tequesta; Richard Bogosian, Indian River County Commission; Richard Brusulas, Miami; T. J. Buchanan, U.S.G.S; Thomas E. Furman, University of Florida; Joel Gustafson, State Representative, 87th District; Fred W. John, Belle Glade Chamber of Commerce; Thamas A. Kimball, President National Wildlife Federation; Henry Kittleson, Lakeland; Richard Klukas, Everglades National Park; Harry H. Kuck, Jr., South Everglades Planning Council; Ross McCluney, University of Miami; John McCue, Dade County Public Works; Dr. Howard Odum, University of Florida; William Robertson, Everglades National Park; Dick Robinson, Bureau of Sport Fisheries and Wildlife; Dr. Robert Simpson, N.O.A.A.; Angelo Tabita, Corps of Engineers; Dr. Kenneth Tefertiller, University of Florida; John W. Wakefield, U. S. Department of Health, Education and Welfare; George V. Warren; Palm Beach County Commission; and William Zinkil, Sr., State Representative 85th District.

Group 2 - Dr. Robert Homas, Florida Atlantic University, Chairman and Dr. Manley Boss, Florida Atlantic University, Recorder. Panelists included: Durward Boggess, U.S.G.S.; Joe Brown, Everglades National Park; Dr. George Cornwell, University of Florida; Gratton W. George, Hendry County Commission; Dr. John Gerber, University of Florida; Robert Gibbs, South Florida Environmental Project; Robert Grafton, FCD; E. E. Green, St. Lucie County Commission; Theodore Haeussner, Corps of Engineers; C. Knecht, U. S. Sugar Corporation; Philip Lewis, State Senator, 33rd District; Bill Lund, Jupiter; Frank Nix, Everglades National Park; Gerald Parker, South West Florida Water Management District; Ted Randall, State Representative, 112th District; J. W. Stevens, Broward County Commission; Dr.Kerry Steward, U.S.D.A.; Robert B. Steylter, Dade County Water Sewer Authority; Mrs. Joyce Tarnow, Coral Gables; and Dr. William Woodley, W.O.A.A.

Group 3 - Dr. Carl McKenry, University of Florida, Chairman; and Colonel J. W. Sollohub, State Department of Natural Resources, Recorder. Panelists included: Lothian Ager, Game and Fresh Water Fish Commission; Dr. Taylor Alexander,

University of Florida; John Bethea, Director Division of Forestry; Mrs. Jean Booker, Fort Lauderdale; Stephen P. Clark, Mayor Dade County; George Cooper, Princeton; Mrs. Marjorie Stoneman Douglas, Miami; Dr. Charles Eno, University of Florida; W. E. "Bill" Fulford, State Representative, 40th District; George Gardner, U. S. Department of the Interior; James H. Hartwell, University of Miami; K. K. Huffstultler, E.P.A.; Ray Knopke, State Senator, 23rd District; Dr. Charles M. Loveless, Denver Wildlife Research Center; Art Marshall, University of Miami; William G. Meyers, Martin County Commission; Martin Northrup, Florida Audubon Society; Dennis O' Connor, University of Miami; Vincent Patton, Air and Water Pollution Control Board; John Pennekamp, Miami.Herald; Ralph Poe, Orange County Commission; A. W. Sarrinen, consulting engineer; William Schneider, U.S.G.S.; Bruce Scott, Lee County Commission; Garrett Sloan, Dade County Water-Sewer Authority; and William V. Starch, FCD.

Group 4 -Dr. Lloyd B. Stover, Florida International University, Chairman; and Bill Partington, Environmental Information Center, Recorder. Panelists included: Mrs. Jean Bellamy, Miami Chamber of Commerce; Dr. J. I. Garcia Bengochea, consulting engineer; Joe Carrol, Bureau of Sport Fisheries and Wildlife; Dr. Frank C. Craighead, South Florida Environmental Project; Don Crane, State Representative, 52nd District; J. Walter Dineen, FCD; Robert Graham, State Senator, 48th District; Aaron Higer, U.S.G.S.; Mrs. Virginia Hine, Miami; Dr. Wayne C. Huber, University of Florida; M. J. Kolpinski, U.S.G.S.; Stanley D. Leach, U.S.G.S.; Larry Lukin, Palm Beach County Environmental Director; Riley S. Miles, Water Users Association; Dr. William Morgan, University of Florida; Dr. Oscar T. Owre, Audubon Society; Richard Pettigrew, Speaker of the House of Representatives; H. H. Raulerson, Okeechobee County Commission; James F. Redford, Miami; Larry Shanks, U. S. Department of the Interior; Cecil P. Skipper, Highlands County Commission; Dr. Sam Snedecor, University of Florida; William R. Vines, Naples; Lorenzo Walker, State Representative, 113th District; James 0. Woodward, Glades County Commission.

Group 5 - Jack Shreve, State Representative, 75th District, Chairman; and Joel Kupperberg, Trustees of the Internal Improvement Fund, Recorder. Panelists included: Peter Baljet, Dade County Health Department; William Bevis, Commissioner Florida Public Service Commission; David Blumbert, Miami Chamber of Commerce; Joe Burgess, House of Representatives Committee on Natural Resources; Aldine Combee, Polk County Commission; Clyde Conover, U.S.G.S.; Hugh M. Evans, Brevard County Commission; Harry Harris, Monroe County Commission; Dr. Robert C. Harris, Florida State University; E. T. Heinen, Environmental Protective Agency; John C. Jones, Florida Wildlife Federation; Walter Kautz, Florida Farm Bureau; Dr. Ariel Lugo, University of Florida; John R. Maloy, FCD; John Opel, Palm Beach Post-Times; George Patten, Legislative Aide to U. S. Senator Lawton Chiles; Earl Rich, Highland County Commission; Lyman Rogers, Conservation 7O's; Dr. Ernest T. Smerdon, University of Floirda; Guy Spicola, State Representative, 75th District; Dr. Durbin C. Tabb, University of Miami; Richard Tillis, Department of Education, Tallahassee; Reggie Walters, Director of Planning for Dade County; Lester Whitaker, Sr., Collier County Commission.

Water Levels Low For This Time Of Year

The FCD Governing Board received at its November meeting, two comprehensive reports on water conditions in central and south Florida, both of which indicated that water storage levels are far below desired schedules.

A report by Zeb Grant, FCD Director of Field Services, painted a dismal picture for central Florida.

"We are going into this dry season in worse condition than we were at this time last year when we faced a drought of major proportions," Grant said.

"All gages in the Upper Kissimmee Basin are just at or below the levels recorded at this time last year - most of them are very deficient; and the lakes in the Kissimmee Basin are, on the average, more than two feet below schedule and the ground water tables are exceedingly low," he revealed.

In a report on water conditions from Lake Okeechobee south, FCD Chief Engineer, W. V. Storch said that although water stored in Lake Okeechobee and the three Everglades water conservation areas is slightly above levels at this time last year, they are far deficient of optimum levels for this time of year.

His report reveals that rainfall in the Lake Okeechobee area is deficient 49.7 percent compared to the long-term average, the north Everglades off 42 percent; central Everglades down nearly 55 percent and the southern Everglades nearly 69 percent.

"Ground water levels are very close to or below last year," he stated.

He informed the Governing Board that, as it had requested, a meeting has been arranged with Dade, Broward and south Palm Beach County officials to discuss possible trouble spots in the event of deficient winter and spring rainfall.

MERRY CHRISTMAS

From the FCD Governing Board and Staff

Okee-Tantie Reopened

OKEE-TANTIE REOPENED - A greatly enlarged and improved Okee-Tantie Recreation Area has been opened by the Recreation Section of the Flood Control District. Roads and 75 parking spurs have been paved, ample parking has been provided for the boat ramps, 100 cabbage palms along with Acacia, Eucalyptus, Mimosa, Red Maple, Sycamore, grapefruit and camphor trees have been planted. The area has been graded and grass planted. The comissary is ready to provide food, beverages, fuel, etc.

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Arthur R. Marshall, Jr. Collection

Another prediction for the Florida Everglades System

by Arthur R. Marshall

26 March 1983

General Perspective:

I don't see any more hope for the world in the continuous expansion of nuclear weaponry; or hope for our people in the continuous pursuit of growth in America's cities than I have seen in the continuing technological invasions of Florida's Everglades - which can now be described as violently raped.

They are all part of the same destructive philosophies which are tearing the earth and its people apart.

The choice of leaving the lower Kissimmee River as a ditch is an option open to the state's political leaders only if they wish to risk their political careers on assuring:

1. Repeated periods of critical water shortages for all water users in south Florida - its agriculturalists; the people of its cities; its fish and wildlife resources; the Everglades National Park.
2. Repeated massive shocks to the estuaries of the Caloosahatchee and St. Lucie Rivers.
3. Abandonment of the one substantial step politicians alone can take to lessen the sever (sic) water quality plight of Lake Okeechobee.
4. Removal of all opportunity to effectively increase the storage capacity of Lake Okeechobee in the only place where it can be done - the Kissimmee River Basin.
5. Total elimination of the peat soils of the Everglades agricultural area; of the Conservation Areas and of Everglades National Park.
6. Abandonment of any hope for restoring the Everglades hydrological system which produced the peat soils of the Everglades in its agricultural and wilderness areas in the first place.
7. Giving up all hope for reducing the invasion of salt water into the Biscayne Aquifer which supplies millions of south Floridians their only naturally available potable fresh water.
8. Insuring the continuous degradation of the entire Everglades system and all of its natural resources - esthetic and economic.
9. Running the continuous risk of converting south Florida into a desert through further disruption of its hydrologic cycle - now referred popularly as the 'rain machine.'

   Even politicians are smart enough to risk running this gamut of choices.

   I hope.
10. Assuring repeated massive mortalities of the Everglades deer which have occurred 10 times in the last 35 years.

Arthur R. Marshall, Jr. Collection

Marshall, Arthur R.,
Statement To Joint Committee Of The Florida Legislature On South Florida Area Regional Organization,
January 17 1972, 4 pp.

From discussions I have had with others in regard to the assignment to your Committee, from testimony others have given to you and from press articles I have read, I conclude that we are evolving to some yet undetermined new mode for managing the environment of the south Florida region.

Evolve we must, for time is running out. Some evidences of this are likely to be recognized primarily by the natural scientists and the wilderness environmentalists -- the old-time conservationists. I would include in this category the many evidences of stress in the Florida Everglades -- the greatly reduced populations of 15 or 16 wild species, the bloom and bust cycle of the Everglades deer herd, losses of wetland vegetation, extensive wild fires, rapid consumption of the agricultural muck soils south of Lake Okeechobee, and deterioration of water quality in Okeechobee itself. Related to these are the degraded conditions of some east coast estuaries -- notably the St. Lucie at Stuart and south Lake Worth in Palm Beach County, both of which have been badly damaged by Okeechobee-Everglades drainage into them.

Another class of environmental stress is evident in the urban areas, especially those of the Gold Coast. The people here know it. Some examples of its components are growing air pollution, visible water pollution, a twice-a- day traffic abomination, crime, an enervated school system, police forces which confront crime or traffic but not both, enormous ghetto areas which are expanding at an enormous rate, fear, debilitated units of government which are increasingly unable to provide the services they were created to provide, rampant visual ugliness and, last spring, a touch of water shortages, with a sprinkle of salt.

These are the kinds of problems our evolving regional managers, however established, must confront. The pressures on the resources and most of the people of south Florida are so intense and precipitous that the decade of the 70's is truly the decade of our environment, not by anyone's choice. There are two allied goals our environmental managers must pursue. One is to protect and restore the resources of the region so as to insure the health, safety and decent conditions of life for all its inhabitants, now and in the future. The other is to prevent the buildup of such enormous pressures and demands on local units of government that they lack the ability or the funds to act.

It is fair to say, and disquieting, that whatever managers and managerial systems we choose now shall set the quality of life, the viability of south Florida -- whether good or bad -- into the far distant future. This places a burden on yourselves, on the legislature, on the Governor, and on anyone who pursues a particular means for responding to the problems to either do the job which is required or to become, by omission, a contributor to the racing degradation of south Florida.

My profession is ecology -- human ecology. It is a complex profession which lacks, as I well know, the ultimate sophistications which our pressured times require. Despite those shortcomings, there are now available to us well-substantiated ecologic principles that we must apply or fail in attempts to manage our environment.

One of these is the concept of living systems. We have ignored their reality at present great cost to ourselves. One cannot build a road across the Everglades, an expressway through the city, erect highrises or attract ten thousand additional residents in a vacuum. The effects of these reverberate throughout the system -- they have done so in south Florida and we still have difficulty believing it.

Americans are habitual specialists. Our industries are primarily institutions which specialize in one or a few products, in the exploitation of one or a few resources.

American medicine is practiced through specialities. Its assorted practitioners have come to look at a kidney, a lung, or a genito-urinary tract and only recently are coming again to recognize that these comprise a man or a woman.

Our universities produce many persons specialized to such a high degree that there is no valid reason to expect them as individuals to be responsive to our array of systems problems.

Government is made up of specialists. It was the specialists of government who sought to drain, to farm, to build roads, to divide the Everglades pie into a hundred provincial, geographic, political, and mission-oriented parts which nearly tore it apart.

Cities -- and urban-oriented counties -- are specialists. Their specialty is growth. It is a dedication with much historic momentum and great inertia. The inertia carries us on despite their widening bankruptcy in ability to fund or even to decide critical public issues. The result can be seen readily in the spreading slum core at the center of the metropolitan area.

In south Florida we are suddenly confronted with the impinging and over- lapping results of our pursuits of multiple special goals. All east coast communities, and Fort Myers on the west coast now compete for water. There is nit enough Everglades for the potential swamp buggy and airboat populations of the region. Garbage and sewage and air pollutants and traffic are inter- community properties to be shared in some yet undetermined way by all the cities of the Gold Coast.

The job of putting it all together is the special mission of your Committee, or of any other organization which exercises that opportunity. It is not an easy assignment. Bold souls and bold actions are essential.

We must construct a mechanism of system generalists which can assemble the products of the multiple specialists, and from those reconstitute the human ecosystem of the south Florida region.

The establishment of the South Florida Regional Planning Council was a recognition of the need for putting it together. They, however, or anyone else have much more to do than planning, and little time to do it in. They or anyone else shall have to usurp some of the present authorities of the cities. They or anyone else must soon have the authority to implement or be a participant to continuing erosion of living conditions in south Florida.

Senator Graham's bill enacted would move us ahead in these issues. I would hope that it can be further fortified by other actions of the legislature, actions which would put the State of Florida fully into comprehensive and functional land and water use planning on a scale which our great growth requires.

I am attaching a copy of an incisive column written by Mr. Nixon Smiley published in yesterday's *Miami Herald* which describes our condition forcefully -- the way it is. I commend it to you for your reading.

Arthur R. Marshall, Jr. Collection

Statement to the Subcommittee On National Parks And Recreation of the Committee on Interior and Insular Affairs, United States House of Representatives, at a Public Hearing held in Fort Myers on February 15, 1972, to consider means of protecting the Big Cypress watershed, Florida.

STATEMENT TO THE SUBCOMMITTEE ON NATIONAL PARKS AND RECREATION OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS, UNITED STATES HOUSE OF REPRESENTATIVES

Prepared by:

Arthur R. Marshall	Ecologist
Frank C. Craighead, Sr.	Ecologist
William B. Robertson, Jr.	Animal Ecologist
James H. Hartwell	Hydrologist
Bernard J. Yokel	Estuarine Ecologist

Congressman Aspinall, Congressman Taylor, and other members of the House of Representative's Subcommittee on National Parks and Recreation:

I am James H. Hartwell, a hydrologist with the Division of Applied Ecology, Center for Urban Studies, University of Miami, Florida. The following statement contains recent contributions from Arthur R. Marshall, ecologist, and Director of the Division of Applied Ecology; Dr. Frank C. Craighead, Sr., ecologist; Dr. William B. Robertson, Jr., animal ecologist; and Mr. Bernard J. Yokel, estuarine ecologist. This group has produced books, articles, and scientific publications on the Everglades region , its geology and water resources, its vegetation, soils and wildlife, that number more than a hundred. Jointly, these scientists have spent a total of 84 years studying the many and varied aspects of the Everglades ecosystem.

As concerned natural(sic) scientists, we wish to thank this subcommittee for convening this hearing in Fort Myers in an effort to become apprised of the necessity to protect the Big Cypress watershed. Not only south Floridians, but all of the people of the United States will benefit from the protection of this unique area, for its maintenance is essential to the well being of Everglades National Park and west Florida.

The principal concern is fresh water -- water for the Park, for plant life, wildlife, marine resources, recreation, and for people.

On south Florida's lower east coast, the water resources have been much abused, in both quantity and quality. As a result, this region is facing a water crisis. Last spring the long debated water management problems were accentuated by a severe drought. Restrictions on water use were imposed and many private and public water supplies became too salty for human consumption. The lowering of water levels below the ground throughout the Everglades rendered the area tinder dry and the peat soils and vegetation burned for several weeks filling many cities with noxious smoke. The eastern cities depend upon the Everglades water to recharge its well fields.

The Big Cypress watershed also serves as a recharge area for water supplies. As the urban areas of the lower west

coast expand, those municipalities will have to utilize waters farther to the east to meet their water demands; a reversed, mirror-image, if you will, of the water demand versus supply situation of the east coast cities, who must reach continually further to the west and north for potable supplies.

No one can say with certainty when the growing demand will encounter the limits of supply for the west coast cities, for no such analyses have been made farther into the future than twenty years. We can say with considerable certainty, however, that the progression of events will mirror-image those of the populous east coast, in that salt intrusions along the coastline will become increasingly severe, that intermittent water-rationing will become necessary, that recycling of sewage wastes for re-use will become as necessary on the west coast as it is now urgent on the east. Development of the Big Cypress watershed, will decrease the water supply and increasing demand will markedly accelerate the day of water crisis. The Big Cypress is the only major water source outside of Everglades National Park which has not been massively altered.

For all the years cited, the members of this panel have observed and documented the stresses generated by mistreatment of the water resources in the interior portions of the Everglades basin. As life-long students of the interdependencies in nature and of the ultimate dependence of all life on natural systems, we are not surprised that the stresses have moved to town. Unless rainfall exceeds the norm during the next few months, we have ample reason to anticipate that these problems will recur in the coming spring.

The operating agencies of the federal government did not have, prior to passage of the National Environmental Policy Act of 1969 a legislative mandate to give substantive attention to environmental values, and agencies have frequently pursued conflicting goals. State governments often have been ambivalent. Land-use management decisions which involve regional, statewide or national values are matters of broad public concern and in the past they have been given only cursory treatment. A national and state land use policy is an imperative.

Hydrology:

The watershed of the Big Cypress is a broad, nearly flat area interspersed with pinelands, grass prairies and shallow cypress ponds and sloughs. With the land sloping gently south and southwest, water accumulated from the summer rains flows overland about seventy per cent of the year to and through the western panhandle of Everglades National Park into the Gulf of Mexico.

About 55% of the average annual overland flow into Everglades National Park since 1940 has been from the Big Cypress watershed. Flow in the watershed, quite unlike a normal main-stem river, is in the form of a broad shallow sheet which covers much of the area in the summer and fall high water period. When the rains abate, beginning in November, water levels in the Big Cypress recede slowly from heights a foot or two above ground to perhaps three feet below ground in the dry months of the year.

The flora and fauna of the watershed, including that of its downstream estuaries, are attuned in their reproductive and breeding cycles to this cycle of summer flooding followed by recession. In the warm waters of the summer, many rather ignoble aquatic species such as freshwater shrimp, crayfish, mosquito fish, and killifishes reproduce themselves in great numbers, foraging over the flooded lands. As the winter recession occurs, these organisms are sufficiently concentrated to supply tremendous quantities of protein food to active bird rookeries and to some species of marine fishes which invade the brackish areas and lower marshes. Thus continued production of many animal species depends on the cycle of summer flood and subsequent recession. When wetlands are drained for development, both the flooding and the recession are so drastically altered that reproductive failures commonly occur -- which is a major reason that seventeen Everglades species are now considered rare and endangered.

Vegetation:

The Big Cypress comprises the western portion of the great wetlands of Florida south of Lake Okeechobee. It is a woody swamp dominated by trees, whereas the eastern portion of the Everglades is characterized by a marsh of herbaceous plants, sedges, sawgrass and assorted grasses. A low divide separates these two portions. These wetlands catch and hold the rainfall on the area which is vital not only to the wetland resources but also for the well-being of coastal towns.

Together with the flatness of the Big Cypress, its vegetation retards the flow of surface water and permits part of it to sink into the underlying soils and bedrock aquifers. The vegetation is also responsible for the formation of the extensive peat beds of the area.

As a brief description of the vegetation of the Big Cypress, one must first think of it as a forested area spotted with many grassy prairies and rocky outcrops which stand above the general water surface for several months of the year. Under all of this lies a rather permeable limestone transversed by numerous sloughs and marked by isolated solution holes. Much

of this bedrock is now covered by sandy deposits left by former seas, or by marl or peats each bearing a distinctive type of vegetation.

The rocky outcrops are covered with thin soil and pine forests which cannot stand continuous flooding.

The prairies are dominated by a mixture of grasses, sedges and a few shrub species. All can tolerate a long period of flooding during the rainy season and light fires in the winter.

The deeper sloughs -- 4 to 6 feet deep -- support stands of cypress on their thick peaty soils. The isolated potholes also support cypress in characteristic domes called cypress heads. In either situation, the deeper the peaty soil the taller the trees. Many native epiphytes -- orchids and bromeliads -- are abundant in the Big Cypress. The orchid flora is one of the richest known anywhere outside of the tropics.

Wildlife:

For most of the conservationists and scientists, the wildlife of south Florida and the Big Cypress is an essential unit of the regional ecosystem. Seventeen species that are officially listed as rare and endangered -- 4 mammals, 12 birds, and the alligator -- inhabit the Big Cypress and its downstream estuaries during at least part of the annual cycle. These include some of the most characteristic wildlife of south Florida, such as the roseate spoonbill, and species such as the brown pelican and bald eagle which have been extirpated from much of their former range in the United States. A number of these, including the Florida panther and wood ibis, are virtually certain to disappear from Florida if the Big Cypress habitat is diminished and destroyed by drainage and development.

Besides these species in the rare and endangered category, the Big Cypress supports the full spectrum of the resident and native wildlife. Of particular importance is the seasonal and alternative feeding habitat that the Big Cypress provides to wading bird populations which breed in Everglades National Park.

Without access to the resources of the Big Cypress, a long term of decline of populations of large water birds of the Park is predictable. The preservation of the Big Cypress offers the only long range hope of maintaining huntable populations of larger game animals such as white-tailed deer and wild turkeys in southern Florida.

The Coastal Zone:

As water moves from the upland marshes, it finally enters the coastal zone. At the inner edge of the coastal zone fresh water marshland gives way to a broad mangrove-dominated estuarine zone. The area is characterized by mangrove-fringed creeks, ponds, and bays which receive water from both the upland marshes and the sea. The tidal mixing which occurs in these bays and estuaries produces brackish conditions favorable to the growth of estuarine-dependent animals such as shrimp, blue crabs, mullet, oysters and many gamefish.

Utilizing special processes involving tidal mixing and physico-chemical phenomena, the brackish estuaries tend to conserve the nutrients which, under natural conditions, are contributed by the upland fresh water and the open ocean. These nutrients tend to be retained in the estuary and cycled continuously in the food chain. The bays and estuaries are many fold more productive than the marshes above or the sea beyond.

The very high natural productivity found in the estuaries, which supports important National fishery resources, derives many benefits from the upland marshes. The extensive marsh system serves as a reservoir and control system which absorbs the heavy summer rains and slowly releases this water into the estuaries. This mechanism serves two important purposes. The marsh filters the water in transit, removing sediments and utilizing some of the nutrients and releases the fresh water into the estuary at a reasonably uniform rate across a broad front. Hence, the water coming from the marshes is normally clean and arrives in quantities which usually permit optimal salinity ranges in the estuaries. Under natural drainage conditions heavy rainfall in the interior may require 10 to 90 days, dependent on distance, to appear in the estuaries because of the low gradient of the of the region and frictional effects imposed by marsh vegetation.

Man-made drainage systems, on the other hand, are designed to accelerate the run-off of fresh water through canals. During periods of heavy rainfall, canalized run-off from the uplands moves quickly in large volume into the receiving estuaries bearing massive deposits of organics, silt, and sand. Freshets of this type cause abrupt salinity changes which frequently kill plants and animals, especially attached forms such as oysters. Oxygen demand caused by abnormal quantities of organic material further stress the large bay areas, already laboring under the burden of abrupt salinity changes.

The high productivity of our coastal systems is intimately linked to upland marshes and especially to the brackish areas. To safeguard this unique unit, the entire marsh sheet flow system must be protected to insure that the coastal zone receives high quality water in sufficient quantity and in the right seasons.

Conclusion:

We urgently suggest that any bill you may consider or propose state that the primary purpose of the legislation is to protect the watershed as to quantity, seasonality and quality of its waters, and that only such other uses be allowed which are consonant with that primary purpose.

There are infinite more details to the Big Cypress story, so impossible to present here that we have chosen to present a composite view of the resources and their values and problems as we see them. We have appended a list of the most significant publications which provide such details.

Further, actions taken by the people and the state of Florida this year have begun a procession to alleviate many of the problems. The ambivalence of the State is cracking.

The Speaker of the Florida House selected a special task force which has made recommendations to the presently convened legislature for protecting the water resources of Florida. Governor Askew has expressed his support of these proposals.

The Florida Cabinet is negotiating to acquire the central portion of Fakahatchee Strand -- about 25,000 acres -- and about 9,500 acres of mangrovelands in the Ten Thousand Islands area.

Last summer the Florida Cabinet stopped the construction of three new drainage canals of the Central and Southern Florida Project (C-108,109 and 110) two of which had already been commenced.

The Attorney General of Florida instituted legal proceedings to stop the construction of canals in the Big Cypress watershed south of Tamiami Trail.

Last September, Governor Askew convened more than a hundred persons to advise him on means to protect south Florida's water resources and all the values that entails. The recommendations of the conference run the gamut from renunciation of further drainage of wetlands, restoration of water quality, development of land and water use plans to protect vital resources and to limit populations, protection of the Big Cypress and re-organization of state government to provide a water management agency for the entire south Florida ecosystem.

I am optimistic enough to say that Florida is developing a new environmental ethic which is pertinent over all the land. Any decision in behalf of the Big Cypress will be a tremendous spur to us to develop that ethic; at the same time you will protect the many resources of the watershed, the western extension of Everglades National Park and the water supply for the people of southwest Florida.

We commend you for your consideration and thank you.

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South Florida - A Case Study in Carrying Capacity

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 1972 ANNUAL MEETING IN WASHINGTON

Subject	South Florida - A Case Study in Carrying Capacity
Author	Arthur R. Marshall, B.S.; M.S. Director, Division of Applied Ecology Center for Urban Studies
Address	University of Miami, P. 0. Box 8002, Coral Gables, Florida 33124
Time	9:00 a.m., December 29, 1972
Place	Sheraton Park Hotel, Dover Room
Program	AAAS Section on Geology and Geography, Human Impact on the Atlantic Coastal Zone
Convention Address	Sheraton Hotel

RELEASE TIME
9:00 a.m., December 29

This paper explains in ecologic-economic terms some major reasons south Florida's Everglades and Gold Coast are degraded - and degrading. It discusses the stresses and overloads which have been placed on the air, water, space, and budgetary resources of these two integrated components of the south Florida ecosystem.

South Florida is a classic demonstration of the facts that growth and development cannot proceed endlessly without intolerable social costs; that the constraints of ecosystems ultimately clash with the economics of city budgets; that a holistic interdisciplinary approach to environmental problems is essential; and that the impoverishment of our large urban areas may be the yet unrecognized environmental catastrophe many have been awaiting to trigger the nation into action.

South Florida - A Case Study in Carrying Capacity

As a natural scientist who is disturbed by our disposition to arrogant and short-sighted treatment of the environment which supports us, I long have thought we would profit more by centering our attention on the obvious faults of our behavior in lieu of our fixation with the obscure. Further, that while not abandoning our legitimate concerns with global or cosmic problems, we are more likely to begin to solve environmental problems by focusing on limited geographic areas.

The popularity and the problems of coastal south Florida present just such opportunities.

In recent years, south Florida has attained a new eminence. In tandem with and dimming its popularity, it has achieved great notoriety in the national media because of its environmental problems. I assure you that eminence is valid.

What Are These Issues?

The issues can be simply stated. Drainage of fresh waters to tide has reduced the carrying capacity of the Florida Everglades for its formerly abundant resources of water, wildlife, and muck. More recently the glades has acquired the disturbing specter of pollution.

Contrarily, the carrying or assimilative capacity of basic natural resources of the urban Gold Coast - air, water, and space - has been exceeded by an overload of people, their associated technological demands, and their wastes. As a direct result, municipal budgets are overloaded and unable to provide the facilities needed to compensate for the excessive population.

Though I have stated these tied irrevocably in one coastal as two separate conditions, both elements are life-support system (Figure 1)

Everglades Waterway

My accounting of the classic uncontrolled experiment in south Florida, which I offer in the belief that there is much instruction in the case, begins with the Everglades.

All life except that of the sea in the south Florida ecosystem depends upon a direct fresh water supply - water which in this case is derived directly from rainfall and is thereafter momentarily retained in what I prefer to call the "Everglades Waterway" - the area of the Kissimmee-Okeechobee-Everglades basin.

FIGURE 2: HISTORIC WETLANDS

In its pristine condition, this strange waterway arose in the lakes of the upper Kissimmee River and flowed south via the meandering lower Kissimmee River to Lake Okeechobee. In some very wet years, the Lake overspilled its southern rim into the sawgrass Everglades, adding that flow to the shallow surface sheetflow produced in the glades by direct rainfall. The greater part of the glades water was and is lost through seepage and primarily through evapotranspiration; the only significant surface flow to tide water historically was at the tip of the peninsula into Florida Bay. This shore of Florida Bay is now contained in Everglades National Park.

The eastern boundary of the waterway was the 10 to 15 foot high Atlantic Coastal Ridge; the western boundary in the glades portion was the 10 to 30 foot high sand plateau lands of the southwest coast.

It is difficult for one who has not seen the Everglades to imagine its flatness. Slope within the basin from Okeechobee to Florida Bay - a distance of more than 100 miles - averages about two inches per mile. This flatness, together with the friction of the dense marsh vegetation produces a southerly flow rate of less than one-half mile per day.

In its lower reaches, water flow curves to the southwest; its direction is emphasized by the axial alignment of thousands of elongate "tree islands" which stand two to five feet above the general marsh floor.

Heavy tropical rains come to south Florida in the summer and fall (Figure 3). Throughout the Everglades waterway the water rises out of its shallow scattered depressions - lakes, rivers, ponds, and sloughs. It sheets over the southern Everglades marshes in the form of a very broad river which historically was seven or eight feet deep at summer flood.

FIGURE 3: AVERAGE MONTHLY RAINFALL IN THE EVERGLADES OF FLORIDA

Regenerative processes bloom with the rising spread of the water under the warm summer sun. Plant germination and growth flourish. Many aquatic organisms - insects, crayfishes, killifishes, reptiles - engage in an orgy of reproduction and in a few weeks their progeny can be seen in all reaches of the summer river.

After the rains let up, the sheet water recedes into the deeper ponds and sloughs and concentrates the summer's production of small organisms, making them available in essential densities to the waiting large predators. This phenomenon of flood-bloom-recession-concentration is a marvel of synchronization - for the summer's organic products are thus served up to the flocks of colonial birds who are then fledging their young and to the young and adults of many marine fishes which invade the brackish and fresh waters of the lower Everglades to forage there.

"Flood Control" Projects

Over an 80-year period, many canals have been dug in the basin for the primary purpose of leading fresh water more quickly to tide - a euphemism for drainage.

We now have an enormous $300 million public works project - an elaborate plumbing system with some 1500 miles of canals plus levees, pump stations, and assorted control structures draped liberally over the Everglades to control floods and to purportedly conserve its water (Figure 4). It is instructive to note that drainage and conservation of water are opposite goals. Despite the intricacies of this system, its essential nature can readily be determined by noting that its major canals serve to speed the flow of fresh water to tide. These are the Kissimmee, Caloosahatchee, St. Lucie, Palm Beach, Hillsboro, North New River, and Miami Canals.

FIGURE 4: CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL PROJECT

An inventory of the environmental effects of all this alteration must include:

1. A gradual lowering of summer high water levels over an 80-year period by about six feet in the sawgrass Everglades.
2. Reduction of the area of the Kissimmee marshlands by 65% and of the wetland Everglades by about 50%.
3. A drastic shortening of the surface flood period in Everglades National Park from 6 to 8 months down to 3 or 4. By recent Congressional action, the project now must deliver some water via canals each month into the northern rim of the Park.
4. Massive declines of the colonial wading birds - from about 1.5 million birds in 1935 to 150,000 in 1970. The wood stork alone has declined from about 100,000 to about 3,000 birds in the same time period.
5. Massive declines - in the order of 80% - of the alligator populations.
6. The classification of 20 animals in the Department of Interior's Rare and Endangered Species list.
7. Induced expansions of the Everglades deer herd in the lengthened dry periods, followed inevitably by cyclic highwater stress which decimates them.
8. Rapid loss of the organic muck soils in the agricultural area just south of Lake Okeechobee through atmospheric oxidation. The remaining life of this great peat and muck bed, a deltaic fan formed over a 5,000 year span of decomposing marsh vegetation in the overspill from Lake Okeechobee, is now estimated to be less than 25 years.
9. Extended fires throughout the Everglades, most often of accumulated plant debris, but intermittently of the muck itself.
10. The induction of salt water intrusion along the Gold Coast, brought about by lowering the head of fresh water in coastal aquifers.

Although it is not prescribed in law, he who controls water in south Florida effectively zones the use of much of its land, for removal of water from wetlands opens it to urban and agricultural use (Figure 5). Thus the water manager not only effectively commandeers the role of the zoner, he further augments demands for water and collaterally regulates its use through his storage and distribution system.

FIGURE 5: MUNICIPAL BUDGET DEFICITS IN RELATION TO CITY SIZE

In the spring of 1971, south Florida experienced critical water shortages - and now expects to experience even more critical shortages in early 1973. These are shortages generated by the short-run canal discharges to tide coupled with the increased demands so greatly generated by drainage - the simple expectable crossing of two lines on a graph.

Increases in water users have also raised the specter of pollution from sewage, industrial, and agricultural wastes. Lake Tohopakeliga of the upper Kissimmee River has already become eutrophic. Others, including Lake Okeechobee, are in an early eutrophic (over-enriched) state and are exhibiting the customary symptoms of blue-green algal blooms, intermittent fish kills, bacterial death of fishes, birds and alligators, and rapid accumulation of organic ooze on their bottoms.

One of the three water conservation areas of the sawgrass Everglades - Conservation Area Number 2 - now has organic oozes 8 to 12 inches deep covering about two thirds of the bottom of this 10 year old pool. This is significant, for the pool is usually only 3 or 4 feet deep and it is the only one of the three conservation pools which is more a reservoir than an evaporating pan. Fertilizer- laden waters pumped into this pool from adjacent agricultural lands energizes the bloom of algal masses along with that of other plants, the decomposition remnants of which form the watery ooze.

That is a summary story of the Everglades and its tribulations.

The Gold Coast

For the past dozen years, a handful of natural scientists, and many more citizen-conservationists, have noted, quantified, and publicized the growing plight of the Everglades. For much of that time, many of them voiced their intuitions that the "Everglades is the miner's canary of the Gold Coast" or "that as the Everglades goes, so goes the Gold Coast." We know it now, in true ecosystem fashion. Their importunings had little effect, however, for they were considered to be "for birds and not people" and were labeled "anti-progress."

Their motives, which stemmed from concerns for wildlife, were good; their strategies were wrong. They also should have been noting, quantifying, and publicizing the "wood storks" of the Gold Coast. Some of them are:

- water shortages
- water pollution
- air pollution
- traffic and transport problems
- overloaded schools, parks, beaches, courts, and jails
- crime
- shortages of power and problems of power generation
- spread of depressed areas
- overloaded municipal budgets

Had these stresses not developed in the Gold Coast, the future of the Everglades would be brighter - in true ecosystem fashion - and certainly the emigration from the Gold Coast cities of those who can afford to emigrate would not now be causing rumblings of concern in Martin and Marion Counties to the north. Further, we may have avoided such degradations as that of the coastal estuaries by shore-line filling and pollution, the near-shore continental shelf by pollution, and coral reefs by pollution and siltation. The moon over Miami is substantially dimmed by the gloom over Miami.

It is often said that we must take a holistic view of our environmental problems. That has not been easy to do for the Everglades, for no one finds it easy or objective to add or even to compare aborted water, declining wood storks, muck, and alligators. At best, we must subjectively adjudge this array. Actually the Nation has done that for the Everglades. It has made a subjective choice for its preservation which forestalled the construction of a giant jetport there; has induced the Congress to legislate a water supply for Everglades National Park; now impedes the construction of an interstate highway across the heart of the sawgrass Everglades; and has encouraged Florida's Cabinet, Senators Chiles, Jackson, and Gurney, and Congressmen Haley, Saylor, Fascell, Rogers, and Burke, and the National Administration to seek enactment of a bill to protect through purchase more than half a million acres of the Big Cypress portion of the wetlands remaining in the Everglades basin.

The City Budget as Indicator

Despite those gains and hopes, the task can be more holistic and objective in the city. The medium is the city budget.

When so many people occupy an area that they exceed the assimilative or carrying capacity of its air for their wastes; its water for their supply or assimilation of their wastes; its space for driving, recreating, educating, garbage disposal, etc.; we can select one of two courses of action. We can let the overloads remain burdensome - our normal course - in which case the quality of life drops. Alternatively we can purchase something, either land or technology, to try to accommodate the burden of the overload to the resources of the region. At that point the municipal budget enters, and the picture becomes holistic - our much sought goal. Since it involves dollars rather than wood storks, it also becomes more socially acceptable.

One of the earliest overload problems we encounter in urban areas is pollution of water bodies by the wastes of human bodies. If we do anything about it, we buy sewage treatment technology. From disposal of raw sewage into water bodies, we advance to primary treatment, then to secondary and, fashionably of late, to advanced treatment systems. This is simply necessary escalation in treatment efficiency. For, if a receiving water body can assimilate the raw wastes of 10,000 people without harm to its resources, we must advance to primary treatment or 50% removal with 20,000 persons, to secondary treatment or 90% removal with 100,000 persons, and to advanced treatment or 99% removal with 1,000,000 persons, to retain the same beneficial values in that water body.

As every engineer knows, exponential increases in efficiency in technology routinely carry with them exponential increases in cost. The cost progression in the several levels of sewage treatment for a 10 million gallon per day plant

(100,000 persons) - both for construction and for operation and maintenance - is in the approximate ratio of 1-2-4.

In the Gold Coast, the rising rate of sewage treatment cost will exceed the average, for we are ensnared in a debate regarding the disposal of effluents eastward via ocean outfalls (into areas where coral reefs are dying and diseased fishes abound); westward into the already troubled Everglades (from which we drink); injecting it downward into deep aquifers (of which we know little or nothing); pumping it northward 100 miles to rural counties (which are not likely to be overjoyed with the gift); or just blowing it upward in technicolor.

Unfortunately, we aren't persistent in acquiring such costly technological solutions. As a consequence, the quality of life declines with increasing pollution in water bodies. That is the case in south Florida.

In like fashion, the per capita cost of supplying water has also increased with population even though the municipal budget doesn't show it. Early Miamians supplied their own water from private wells near the mouth of the Miami River. City well fields established in subsequent years have steadily retreated farther upstream to evade the encroaching sea. A major well field which pumped up salt water in the drought of 1971 is eight miles up river. Though it doesn't show in the urban water user's monthly bill, some complex prorata portion of the $300 million canal system supplied him water in the drought of 1971 - from Lake Okeechobee some 100 miles distant - and it will be called upon to do the same or better in 1973.

Another way in which municipal per capita costs rise exponentially with population growth is in the acquisition of land for all public purposes. Park lands can be purchased in rural areas of Florida for $300-500 per acre. In Dade County a new State Park cost nearly $10,000 per acre and two small areas now being considered for urban parks are priced at $35,000 and $100,000 per acre. Similar cost increases are experienced in buying lands for roads, schools, and other public buildings.

These are a very few examples of accumulative effects on municipal budgets of increasing population overloads. The evidence is that just as in increasingly efficient mechanical systems, cost rises exponentially in essential urban systems. We have barely scratched the surface in making analyses of this kind. However, there is an appreciable amount of partial studies, some broad and some very specific, which support the concept of an exponential rise in city costs accompanying continued increases in population. A few of the more extensive studies show that the rapid rise in costs outdistances the rise in revenues, and that the gap continues to broaden at successively greater population levels. One such analysis, made by Boulder (Colorado) Zero Population Growth, indicates that per capita costs exceed revenues in relation to city size generally in accord with the following graph:

FIGURE 6: MUNICIPAL BUDGET DEFICITS IN RELATION TO CITY SIZE

In simplest terms, it appears that once a city is insolvent, it becomes more insolvent by getting bigger.

For those who wish to pursue this subject, I suggest some additional publications:

1. Barada, W. R., "People Pollution," *ENFO Newsletter*, Environmental Information Center of the Florida Conservation Foundation, Winter Park, Florida, October, 1972.

2. Hammer, L. I., *The Best Buy is Open Space*, Preservation Society of the EAST END, INC., East Hampton, New York, 1970.

3. Institute of Environmental Sciences, Rollins College and Winter Park Chamber of Commerce Symposium, "Toward a Quality Environment for Central Florida," Winter Park, Florida, April 15, 1972.

4. Little, Malcom G., "Report of a Study of Housing Developments and their Effects on County Fiscal Capacity," Georgia Institute of Technology, 1970.

5. "Regional Planning and Urban Prospect," Part V of *Basic Issues in Environment*, Ira J. Winn [ed.], Charles E. Merrill Company, Columbus, Ohio, 1972.

6. Veri, Albert., *An Analysis of Density as it Relates to Future Environ- mental Quality of Naples and Coastal Collier County, Florida*, A. R. Veri Associates, Coconut Grove, Florida, November 1, 1972.

Economists join the engineers in recognizing that costs rise exponentially with increasing efficiency above some optimum. In their analyses of the micro-economics of particular operations, they find diseconomies of scale in association with small size and again with large size, with optimal economies of scale in between (Figure 7).

FIGURE 7: ECONOMIES OF SCALE IN RELATION TO SIZE OF COMMERCIAL OPERATIONS

Most mayors of large cities agonize over these very issues. Yet because of the historic addiction to the growth ethic, many of them have remained convinced that a large population would improve their situations. There is a time in the history of each municipality when this is, or was, true. Apparently, the fault in their reasoning is that they think in terms of straight lines rather than in terms of the curves of the micro-economic theorists.

In my search for studies of the economic aspects of urban communities, I concentrated for many years on those problems in large cities. I was pleased recently to find in the *Yearbook of Agriculture for 1971* development of the concept that rural communities must grow to achieve economies of scale and quality of life. Eldridge, on page 246, presents a graph which indicates that rural communities will benefit through growth (Figure 8).

FIGURE 8

Note: The horizontal axis indicates size or volume of firm or institution. The vertical axis indicates the cost of producing each unit of product or service.

From USCA "A Good Life for More People:' 1971 *Yearbook of Agriculture*

DISTRIBUTE GROWTH

Perhaps in the face of our growing national population, that concept offers some hope for our large cities and therefore for the coastal zone of south Florida. Certainly the particular growth problem of south Florida - immigration - is one which neither ZPG nor even zero birth rate could readily solve. Some 3000 non-contraceptible, non-foetuses are moving into south Florida each month and the rate is increasing.

The growing cities of the Gold Coast and the Everglades are tied ecologically and culturally in myriad ways. Some of them are:

1. The agriculture industry - in which there are exchanges of machinery, chemicals, fertilizers, food, and dollars.
2. The wildlife of the region. Some move back and forth. All depend on habitats of some minimum size, with certain kinds of vegetation and standards of quality of water. The quality of water factor relates directly to the well-being of hundreds of marine species.
3. The plant and animal habitats of the Everglades also serve as park and recreational areas for people.
4. Water. Intermittently both city and wildlands have suffered from shortages. If the cities continue to grow into drained wetlands, the intermittent overbalances will become more frequent and severe in each part of that water-based ecosystem.

The views which I have presented are ecologic, centering on the limitations of life-support systems, including man's cultural and financial life-support. They are holistic, interdisciplinary. I have done no more than present a fragile framework by which we may measure our environmental conduct and health both in and around urban areas. There are many places in that framework which must be fleshed out by persons of many professions. Obviously the matter requires the continuing input of the sciences, for knowledge of how life-support systems work or fail is fundamental. Natural science alone, however, cannot do the whole job. Economists are required, as are planners, political scientists, communicators, and a host of others. Additionally, resolution of the problems require new cultural ethics and a vast amount of social decision.

It appears that the south Florida ecosystem has approached severe degradation much more quickly than many degraded areas in other states. Miami, for example, is less than 80 years old. While enormous population growth partly explains the rapid degradation of south Florida, natural factors also play a significant part. As practically all lakes, streams, and enclosed bays are no deeper than 16 feet, they are very vulnerable to pollution. Florida's soils and fresh waters are generally quite infertile; cultural addition of small amounts of nutrients rapidly alters their biota. Many marine organisms are naturally very close to their upper temperature limit in the summertime; a rise of only 2 or 3 degrees from heated waters can be lethal. South Florida is so nearly flat that change of water levels of 3 or 4 inches can dewater or flood thousands of acres. For these and other reasons, I believe we must accept that south Florida's ecosystem - both urban and wild - is relatively more sensitive, more responsive, to alterations than many of those of the north.

I see our alternatives as these:

1. Continue as we have been doing, which surely in south Florida will lead to further degradation of our cities, their budgets, and impoverishment of the area's natural resources.

2. Slow our growth rate, stop it in some areas, and re-distribute it to others where natural and budgetary resources are not overloaded. Do not allow such areas to become overloaded.

3. Reduce the intolerable demands of our life style - in resource consumption, treatment of land and water, generation of wastes. In my opinion, the benefits which have accrued to us, material and cultural, from two hundred years of American history dictate a responsibility to its future.

4. Learn the truths of life-support systems and respect them.

5. Acknowledge that despite our great wealth, we cannot afford to "carry" 80% of our people in the cadillac-style which the exponential costs of large cities require.

6. Re-order our priorities.

We have already taken large whacks out of the quality of human life and of the natural resources of Florida's subtropical coastal zone. It seems to me the expected environmental catastrophe which would trigger us to action is already with us.

The lives of the people in our cities are degraded. Our basic unit of American government - the city - is impoverished. As Oliver Wendell Holmes once said, "We need education in the obvious more than investigation of the obscure."

I have to believe, as all scientists should, that the more exactly we define realities, the closer society will adhere to them. If this is not true, then many of our careers are personal opiates rather than contributions to hope in the world.

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Statement to Governing Board, South Florida Water Management District, (June 11, 1981){PDF, HTML}

Water problems of South Florida, (January 26, 1971)

The Marshall Plan (Al Burt's Florida)

Another prediction for the Florida Everglades System, (March 26, 1983)

A critique of water management in south Florida, (Nov. 20-21, 1980)

Energy and growth, (March 13-14, 1973)

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Statement to Joint Committee of the Florida Legislature on South Florida Area Regional Organization, (January 17, 1972)

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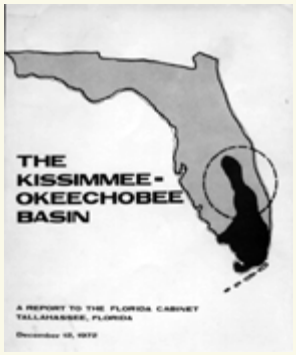
The Kissimmee-Okeechobee Basin

December 12, 1972

Arthur R. Marshall



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THE KISSIMMEE-OKEECHOBEE BASIN

A Report to the Cabinet of Florida

Reubin O'D. Askew	Governor
Richard Stone	Secretary of State
Robert L. Shevin	Attorney General
Floyd T. Christian	Commissioner of Education
Doyle Conner	Commissioner of Agriculture
Fred O. Dickinson, Jr.	Comptroller
Thomas D. O'Malley	Treasurer

December 12, 1972

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Second Edition

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I have just returned from south central Florida and the death-bed of an old friend. Although it has been definitely established that the death will be a boon to something called "progress", the sight was a most depressing one.

The about-to-be-deceased is a river, the Kissimmee River that wound for nearly 100 miles down to Lake Okeechobee. It twisted from a couple of lakes near Kissimmee, across great marshbanks, past cypress heads and live oak and cabbage palm hammocks.

Now under the assault of great, floating suction dredges and draglines -- seemingly enough of them to build another Panama Canal -- a straight-gut canal is being chopped through it, cutting its length in little more than half.

It is the more depressing to those who love their rivers au natural because this sort of thing has become a rapidly increasing pattern in a state where wooded streams once were a major natural asset.

Steven Trumbull in *THE MIAMI HERALD*, October 3, 1965

> ……conservatively we can expect another million people in this belt of urbanization in the central part of the State [Daytona south to Lake Okeechobee]. It is probably going to go higher, and the doubling of the population of this State, which is predicted by Jerry Picard, the noted population expert in the ST. PETERSBURG TIMES this morning is that growth, a substantial portion of it, will be an expansion in the Orlando central area and which now will be connected with both coastal flanks of the State. This will be a continuous urbanization from the coast at St. Petersburg, east through Orlando and northeast to Daytona, impinging on the Green Swamp, impinging on the headwaters of the Reedy and the Kissimmee Rivers. . . .
>
> So we have here an area which is the heartland of the State within which gigantic development is taking place and which is of direct concern to the future water supply of the peninsula from the Oklawaha south.

Carl Feiss in *Florida: The Seeds of Crisis*
Red Flag Charette, Findings and Recommendations
March, 1972

INTRODUCTION

ARTHUR R. MARSHALL:

Despite the stringent nature of our statements, my colleagues and I are on a conservative mission -- to try to restore some of the lost values of the Kissimmee basin and, in association with that, to try to prevent an Apopka-like collapse of Lake Okeechobee. Since the basin has been gutted and the Lake is already highly enriched, that is not going to be an easy task.

Arguments over the canalization of the Kissimmee River began while the work was being planned in the late 1950's and the turmoil really never stopped. Widespread complaints against these works were based on the destruction of the aesthetics of a natural meandering river and its rich marshes (a complaint heightened by the fact that natural rivers in south Florida are rare indeed), on the near decimation of popular fish resources, and on the vast reductions of wintering water fowl in the valley.

That such concerns did not originate entirely from sources beyond the design engineers is evidenced from an almost clairvoyant memorandum (Appendix #l) of October 4, 1957 to the Executive Director of the Flood Control District which stated:

> The Kissimmee marsh has an ever increasing aesthetic value which is not provided sufficient protection under the present plan. Rapidly expanding population and land development in Florida, plus a dependence on the tourist trade, makes it especially necessary for this state to protect certain wild areas for the future. Improper development could destroy much of the value of this natural resource forever, and such destruction could conceivably spell the political doom of the Flood Control District.

That memorandum originated from Mr. Thomas Cunningham, at that time Director of the District's Division of Planning and Resources.

Since 1957, Florida has had a liberal education in the over-enrichment of fresh waters, now proven to be a

matter of concern for Okeechobee. This is of top importance to all Floridians, but especially to those of south Florida who now depend on it for their drinking water. It is also the prime dependable storage facility for south Florida, as in intermittent dry seasons, Okeechobee's waters are diverted via canals to ebbing coastal aquifers to combat salt intrusion, and to provide a ground water supply for direct pumpage into municipal water systems. These factors -- of deteriorating lake water quality and increasing dependency on the lake supply -- emphasize the gravity of our subject. Clearly, it is conservative to protect our waters, the most vital of all natural resources; it would be radical to do otherwise.

We were compelled to seek this Cabinet hearing because we are convinced that the water quality situation in Lake Okeechobee is tending rapidly toward irrevocable misfortune and because we recognize that no arm of state government other than the Cabinet has the sweep of authorities necessary to remedy the matter. Further, years of attempting to persuade other arms of government to alternate courses of action have not avoided the calamity facing south Florida now. It is now evident that the inaction of those years has brought us to a precipitous position in regard to Lake Okeechobee.

The Kissimmee-Okeechobee problem is regional in scope. At a minimum, its solution involves the Florida Cabinet; the Florida Legislature; the Department of Pollution Control; the Department of Administration, Division of Planning and Bureau of the Budget; the Department of Agriculture; the Florida Game and Fresh Water Fish Commission; the Trustees of the Internal Improvement Trust Fund; the Department of Natural Resources; and the Central and Southern Florida Flood Control District. Federally, the U. S. Army Corps of Engineers; the Environmental Protection Agency; the Department of Interior; the Department of Agriculture and its Soil Conservation Service; the Congress and the Administration also are involved.

A few special words about the Flood Control District. It obviously has had and still has a vital role in the issue. We recognize the necessity for its participation; but we recognize as well the inadequacies of its authorizations as weighed against the scope of the problem and the speed of action which is required. In news releases pertaining to the restoration work proposed for the public works project in the lower Kissimmee Valley, the District has emphasized that two additional feet of water placed seasonally in four or five subimpoundments will increase the aquatic life and bird life there. It will -- and all of us admire that. But it will do little to resolve the threats to the water quality of Lake Okeechobee, a truth which the District publicly admits (Appendix, #2).

The region of concern is the Kissimmee-Okeechobee drainage basin. It includes the chain of lakes in the upper valley, all situated in proximity to Orlando and the impact zone of Disney World; the now canalized lower Kissimmee; and other tributary areas surrounding Lake Okeechobee.

The lower Kissimmee River, which was canalized in the mid-60's as a part of the Central and Southern Florida Flood Control Project, plays a prominent role in the Kissimmee-Okeechobee problem -- prominent because many resented and still resent the destruction of a beautiful and productive river, because the Canal drained 65% or more of the valley's marshes, greatly reducing their fish and wildlife populations and nearly obliterating their ability to reduce the passage of nutrients to Lake Okeechobee, and because the Canal serves as a pipe in speeding the flow of wastes accumulated in the upper lakes to Okeechobee.

That Canal, like all drainage canals in south Florida, struck another hard blow. It opened up former marshlands for extensive real estate development, generating wastes where we can least tolerate them and elevating land prices so markedly that the public can consider land purchases only because failure to do so will jeopardize prime water supplies. This element is clarion-clear in the case of the Kissimmee Canal. The FCD estimates that it can purchase the lands to be re-flooded in four of their proposed subimpoundments along the Kissimmee Canal for about $4 million -- about $400 per acre. To buy the fifth impoundment -- in

the vicinity of River Ranch Acres development -- will cost about $18 million or about $4000 per acre.

This is a particularly important issue in the future of the lower Kissimmee Valley, for whatever reflooding we accomplish now will likely fix the limits of marshland development, whether or not we find later we need more marsh. By that time all adjacent lands will have been opened up to $4000 per acre development -- all the way down the valley -- forever.

Prior to canalization, the lower Kissimmee River meandered down several braided channels or in high water flowed sluggishly southward over a flood plain up to three miles wide (Figure 1). It is now thoroughly regimented in its flow ((Figure 2) if not so efficiently suited for producing fish and wildlife or in helping to maintain water of potable quality in Class 1 Lake Okeechobee.

UNREPRODUCIBLE

FIGURE 1: THE KISSIMMEE RIVER AND MARSHES PRIOR TO CANALIZATION

UNREPRODUCIBLE

FIGURE 2: THE KISSIMMEE RIVER AFTER THE INCURSION OF CANAL 38 LOOKING NORTH EAST S-65A.

Note oil banks and remnant of the river at mid-left.

At the John F. Kennedy Space Center, the National Aeronautics and Space Administration graciously assisted us in this presentation with several recent photo-prints of the Kissimmee area. A photo made from a Gemini satellite in November of 1966 ((Figure 3) shows the succession of straight cuts which shortened the distance water must travel from 100 to about 50 miles in the reach between Lake Kissimmee and Lake Okeechobee. A more recent printout from imagery in the infrared spectrum made from an Earth Resources Technology Satellite in September, 1972 displays the stark scar made by the Canal (Figure 4). It is interesting to note that no other human artifact is readily discernible in this print -- neither farm nor city. Perhaps that offers us an alien scale of our doings.

UNREPRODUCIBLE

FIGURE 3: PHOTOGRAPH MADE FROM A GEMINI 12 SATELLITE;

note spoil banks of Canal 38 mid-right. (NASA photograph)

FIGURE 4: MOSAIC OF INFRA-RED IMAGERY SHOWING LAKE OKEECHOBEE AND MAJOR CANALS:

Caloosahatchee (C-43) at 7 o'clock; Kissimmee (C-38) at 11 o'clock; and the St. Lucie at 2 o'clock (ERTS-1 photograph)

HYDROLOGY

JAMES H. HARTWELL:

I would like to describe to you the streamflow characteristics of a natural stream and those of a stream that has been canalized. In particular, I would like to acquaint you with the flow changes that have resulted from the incursion of Canal 38, of the Central and Southern Florida Flood Control Project into the watercourse of the Kissimmee River between Lake Kissimmee and Lake Okeechobee.

The sinuous shape of the natural Kissimmee River was formed by variations in water flow caused by rainfall and topography. The flows set in motion erosion and deposition processes which continued unabated for eons. A broad, flat floodplain evolved which was interspersed with lakes and ponds -- the remnants of former watercourses left by the river's meanderings. This floodplain, subjected to inundation from river overflow, fashioned a wetland area up to 3 miles in width. Between Lake Kissimmee and Lake Okeechobee these intermittent wetlands comprised some 45,000 acres.

The completion of Canal 38, with its appurtenant water control structures (S-65, 65A, 65B, 65C, 65D, and 65E) has drastically altered the wetlands. Personnel of the Flood Control District have estimated that under present operating procedures only 8,000 acres of wetlands remain in a wet condition. Recently, the Central and Southern Florida Flood Control District (FCD) proposed that the operational water levels be raised at certain times during the year. By their estimate, this new water regulation change would inundate an additional 9,000 acres of former wetlands. Even if this change were instituted and it provided 17,000 acres of wetlands, this is a far cry from the original wetland acreage.

Beyond change of acreage, the construction of Canal 38 has made a drastic change in the regimen of water flow. Historically, after a rainfall, the flow would increase gradually and then recede slowly. The time to reach a peak flow would be several days after the cessation of rainfall. Today, the peak flow is usually reached on the day when the heavy rain falls, and, with the closing of the water control gates, the flow rapidly declines. These remarks describe simply the hydrology of canalization.

An example of the changes in flow into Lake Okeechobee that have resulted from the construction of Canal 38 are illustrated in figure 5. The dotted trace shows the daily flow into Lake Okeechobee which occurred in October, 1953 -- prior to the canal construction. The peak flow of 17,600 cubic feet per second (cfs) on October 13th was the highest occurring during the entire period of measured natural flow - October, 1928 to September, 1962. For comparison, the solid trace

FIGURE 5: KISSIMMEE RIVER AT STRUCTURE 65E

Source: Records of U. S. Geological Survey and U. S. Weather Bureau.

is the daily flow in October, 1969 -- the highest flows that have occurred since the completion of Canal 38. It also should be noted that the peak flow of October 3, 1969 (23,500 cfs) occurred on the day of maximum rainfall, whereas, the peak on October 13, 1953, occurred 3 days after the cessation of rainfall. Also, note the rapid decline in flow after the peak in 1969, and the slower recession in 1953. Despite the changes in daily flow patterns, the total monthly inflows to Lake Okeechobee for the two years were somewhat the same. In 1953 about inches of rain produced an inflow of 724,000 acre-feet, and in 1969, 9 inches of rain produced 615,000 acre-feet.

A further comparison of flows can be made using information prepared by the Corps of Engineers in their *General Design Memorandum, Kissimmee River Basin, 1956*, the engineering design document for Canal 38.

This report describes the August, 1928 storm as "one of the most severe of known record." It further States (sic):

> Torrential rains accompanying two tropical storms occurred throughout Central Florida during the period August 7-14 [1928]. In that period a total of 16.21 inches of rainfall was observed at St. Cloud, in upper basin. No streamflow or stage data are available to indicate the extent and severity of flooding in the Kissimmee Basin. However, it is estimated that a peak flow of about 20,000 cubic feet a second was discharged from Kissimmee River to Lake Okeechobee, exceeding any discharge since that time...

Both the 1953 and 1969 peaks were generated from about **4 inches** of rainfall with peak flows of 17,600 cfs and 23,500 cfs, respectively. The August 1928 storm with a reported **16** inches of rain produced only a peak flow of 20,000 cfs. These comparisons show the dampening effect of runoff afforded by a natural stream system.

One might ask: What is wrong with providing works that move water much more rapidly into Lake Okeechobee? First, the wetlands do not remain inundated, and thus cannot perform their nutrient uptake function. This will be elaborated by others. Second, the speeded water flow, which acts as a transporting agent, rapidly discharges concentrated contaminants into the Lake, thus hastening the degradation of the Lake's waters. And, third, the large surges of flow cannot be readily discharged from the Lake, owing to insufficient conveyance capacity. Maintaining safe water levels in Lake Okeechobee has become uncontrollable at certain times of high water with the present canal system.

The proposal to raise the operational levels at structures 65 (A through E) needs elaboration. Presently, the water impounded above the various structures forms a reservoir with a nearly flat water surface. The gates are manipulated to maintain an "optimum" water level. When this level is maintained, only a small portion of the original wetlands, in short reaches just above the control gates, is inundated --- 8,000 acres by FCD estimate. The raising of the operation schedule two feet would add another 9,000 acres of under-water area. The new total of watered area would be 17,000 acres which compares with the original 39,000 acres of wetlands between S-65 and S-65E.

Neither the present operation of the S-65 gates nor the proposed operational change will reconstitute the original wetlands. Historically, these lands were subjected to periodic inundation, in season, with a flow through of water. Presently, the maintenance of nearly the same water level year round creates a pond whose ecosystem functions differently from that of natural wetlands. If the water level is raised two feet, or oven eight feet, the result will be to merely increase the size of the ponds -- not to restore the viability of the wetlands.

To further illustrate this point, I refer you to figure 6. At the top is a profile of the original river bank with the optimum and proposed schedule of water levels. The general downstream slope averages about one-half foot per mile. The upstream extent of the present, optimum water level at each gate is shown in the lower, shaded area. It extends only a short distance, in the canal, above each control structure. When the level is above the river bank, water spreads laterally onto the wetlands. By raising the regulation schedule 2 feet to the proposed, maximum level, the ponds would be extended further upstream, and area of floodplain inundation would be enlarged. Even with this change, more than one-half of the wetlands would still remain dry under the new regulation schedule, except for rainfall on the area.

A typical section across the Kissimmee Valley would show that the floodplain is very flat. This flatness is of importance, for when the water level in the canal exceeds the river bank height, the water readily spreads

over the former wetlands.

FIGURE 6: GENERALIZED PROFILE AND PLAN OF THE KISSIMMEE RIVER BETWEEN 3 S-65A and S-65E

Source: FCD data

The lower graph shows schematically the general area of inundation in plan view. Note again the large uninundated area.

Under the present regulation schedule, water levels are held within a few tenths of a foot of the optimum level nearly all of the time. The seasonal variation of high and low water levels in the wetlands is no longer present. This fluctuation, as well as a wet condition, is vital to the well-being of the wetlands. Neither the present nor proposed FCD operation of the S-65 structures will reconstitute the Kissimmee River wetlands.

EUTROPHICATION: PROCESS

DAVID S. ANTHONY:

LAKE OKFECHOBEE - POLISHING POND FOR EAST CENTRAL FLORIDA?

Often, a biologist or medical researcher studying the effects of a chemical or drug on living things finds that a little is essential, a bit larger amount may or may not be beneficial, but a real overdose has disastrous results. I believe you in political life have observed a similar set of phenomena applicable to taxes, laws, and regulations. Thus any presumed breach between our professions may be more imagined than real.

The waters of the Kissimmee-Okeechobee system are receiving an overdose of nutrients (such as the familiar fertilizer ingredients nitrogen (N) and phosphorus (P). The warning signs of impending disaster are visible. If we continue overdosing the Kissimmee-Okeechobee system as we are now, the collapse of Lake Okeechobee is certain. Only the timing is uncertain.

A full treatment of this subject requires consideration of several questions, namely:

1. What disaster are we talking about?
2. What is causing it?
3. (Hopefully) what can we do about it?

THE DISASTER

(The technical term is eutrophication.)

Stated simply, the waters of the Kissimmee-Okeechobee system, due to man's activities are receiving an overload of nutrients, and Lake Okeechobee, acting quite normally as a nutrient trap, is storing much of what it receives. This is establishing the conditions for an explosive growth of plants in the lake -- algae, hyacinths, hydrilla - which will be followed by changes from sports fish to rough fish (such as gizzard shad), algal "blooms", bad odors; fish and animal kills have already occurred. All of these conditions and the attendant economic losses have been seen in nearby Lake Apopka.

When one considers the factors which tend to maximize plant growth in lakes, it is no wonder that Florida's lakes are especially vulnerable to the effects of added nutrients. The dominant factors maximizing aquatic plant growth are:

1. High levels of nutrients (such as N and P)
2. High light intensity
3. Warm temperatures
4. Time (long growing season)

As you can see, the last three of these factors are basically natural phenomena , not readily affected by man. Even a nutrient input into lakes is a natural phenomenon. That is, lakes naturally accumulate their nutrient supply and, over the span of thousands of years, may develop some of the symptoms described previously. That is, they may slowly become eutrophic through natural processes.

Man's activities, however, greatly increase nutrient inputs into waters. Other conditions here in Florida -- the warm, shallow lakes and the presence of exotic plants such as hydrilla insure that **man's activities maximally damage Florida's lakes**. Eutrophication occurs in decades instead of millenia (sic) and the waters of the Kissimmee-Okeechobee system are well on their way to such collapse.

THE CAUSE

As we have already indicated, the major source of trouble in Florida's lakes is a build-up of nutrients, which causes greatly excessive plant growth, that in turn leads to fish kills, algal "blooms", accumulations of organic ooze, etc.

The question is: Where are the nutrients coming from? This question may be answered eigher (sic) geographically, or on the basis of the activities ultimately producing the nutrients.

Geographic sources of nutrients: As indicated in figure 7, the major input of nutrients to Lake Okeechobee in 1969-70 was via the Kissimmee River, with substantial input from rainfall, and from other tributaries.

FIGURE 7: NITROGEN INPUT INTO LAKE OKEECHOBEE

Source: U.S.G.S. "Appraisal of Chemical and Biological Conditions of of Lake Okeechobee, (sic) 1969-1970.

While these inputs have been enough to cause serious water quality problems already , the future is far more frightening. Although there were enough people contributing their nitrogen input to the Kissimmee drainage in 1970 to make it far and away the major source contributing to the eutrophication of Lake Okeechobee, by 1990 the population of this region is expected to be three times the 1970 population. Lake Okeechobee simply cannot stand three times the nitrogen input!

Activities of man producing nutrients: The usual sources of man- added nutrient input into the waters of a mixed urban-agricultural land use area (not necessarily in order of importance) are:

1. Sewage effluent
2. Agricultural runoff
    a. from fertilizers

2. animal wastes
3. from food processing

3. Urban runoff

The relative importance of these sources depends on the urban/rural ratio, on the efficiency of sewage treatment, and on agricultural practices the area . In an area experiencing an explosion in human population such as this region, we would expect sewage effluent to be quantitatively the most important source of man-added nutrients, with urban runoff not far behind. Further, the canalized Kissimmee River will squirt this load directly into Lake Okeechobee. Tragically, the spoil banks of the Kissimmee canalization project effectively prevent using the nutrient removal capabilities of the river marsh which lies only scant yards away, but walled off by the banks. Even worse, these same spoil banks have actually buried and destroyed substantial acreage of this valuable marsh. Dr. Lugo will discuss in greater detail the nutrient removal by marshes.

SEWAGE POLISHING POND ANALOGY

Downstream from some sewage treatment plants and directly connected to the Plant by a pipe is a pond. This body of water, in the jargon of the trade called a polishing pond, is normally a hideous green soup because it is filled with a rampant growth of algae. The bottom accumulates a fine, watery organic mud as the partially decomposed husks of dead algae settle out. The builders of the sewage plant put the polishing pond there precisely because the algae do grow, die and settle out, carrying with their bodies some of the excessive amount of nutrients in the sewage effluent. These unpleasant bodies of water are designed to function as a partial nutrient trap, but no one swims or fishes in them. In fact, they usually are fenced off behind high wire fences so no venturesome children or animals can even accidentally get to them.

On a very large scale, the Kissimmee-Okeechobee system is already beginning to serve as the polishing pond for east central Florida (all or parts of Orange, Osceola, Polk, Highlands, Okeechobee, Glades, and Palm Beach Counties). The excess nutrients from the people already there are causing excessive algal and other plant growth, the bottoms of lakes in the system are building up organic muds (ooze). Fish kills are becoming more frequent and the lakes are becoming more and more turbid.

Since the population of this region, centering on Disney World as it does, is expected to increase enormously in the next 20 years, the nutrient load on the Kissimmee-Okeechobee system can be expected to increase accordingly. All of the biological signs now present say that if we allow this to happen, **Lake Okeechobee will become the polishing pond for east central Florida**.

WHAT CAN WE DO?

We are between a rock and a hard place.

If we do nothing, fouling of Lake Okeechobee is certain, only the timing is in any real doubt. If we take half-measures to correct the situation, the costs will be very substantial, but the gains uncertain and temporary. If we take all of the measures necessary to have the greatest probability of success over a long time, the costs will be very great indeed, but the costs of not preventing the collapse of the Kissimmee-Okeechobee system will be far greater than even this. Mr. Marshall will explain and evaluate the options in greater detail, and will suggest some immediate actions to get on with the task.

How did we get into this bind?

Quite simply by not even coming close to paying the costs of growth over the years. Now, Mother Nature is demanding payment of past dues and payment on time or in advance for any future growth.

As a minimum, we will have to do all of the following if Lake Okeechobee is to continue as it must, to serve south Florida as its source of portable water, and if it is to continue as a great recreational resource.

1. **We must reduce nutrient input into tributaries and into Lake Okeechobee**.

   This means advanced waste treatment for the whole present population of the Kissimmee- Okeechobee basin. Most especially, it means such treatment installed in advance and paid for in full by any future developments in the region. It also will require modification of agricultural practices to reduce agricultural runoff. Back-pumping of nutrient-rich agricultural runoff must cease.

2. **We must remove nutrients from tributaries**.

   Since a serious nutrient input will come from urban runoff even if we have advanced treatment of all sewage, we must remove as much of the nutrients as possible before they enter the Lake. This can be done most efficiently by allowing the tributary waters to flow through extensive marshes in the area before they enter Lake Okeechobee. Dr. Lugo discusses this point in detail. This will involve purchase of control of the marshes and will require virtual elimination of the canalization of the Kissimmee River (now more properly called Canal 38).

   The FCD proposal for a series of small, shallow subimpoundments will not deny the problems of Okeechobee -- as the District states. Taken by itself, even with present nutrient loads, this course of action will be at best a temporary expedient. Such small bodies of water would be rather quickly overwhelmed (eutrophied) by the nutrients, spilling the excess into Okeechobee. Further, such ponds, with their control structures, would present a great temptation to simply open the gates in periods of high water -- injecting a great slug of untreated nutrient-rich water directly into Lake Okeechobee.

3. **We must remove nutrients from Lake Okeechobee**.

   Systematic harvesting of fish (consistent with its carrying capacity) from the Lake would remove significant quantities of nutrients. The Lake is currently greatly under-fished. Mechanical removal of noxious plants would also aid in nutrient removal.

SUMMATION

No one can say with certainty how much time these actions will buy for Lake Okeechobee as a valuable resource. We probably can buy a very great deal of time. What can be said with absolute certainty is that such actions will buy very much more time than is now remaining if nothing is done.

Because Okeechobee is already in early eutrophy, we are apprehensive about another significant parallel between it and Lake Apopka. In the latter case, a supercharge of nutrients was suddenly released from piles of rotting vegetation along the shore, plants which had been windrowed (sic) there by the 1947 hurricane which passed over that Lake. The high nutrient load already in Apopka before the hurricane made it a prime candidate for full-scale eutrophy. Nutrients leaching from the rotting plants triggered its collapse.

A similar situation also could occur in Okeechobee, though, perhaps from a different mechanism. Throughout the dry months of the year, wastes of all sorts accumulate through great areas of the basin. At some point of

time a sudden wash of these to Okeechobee with the onset of rains can suddenly trigger Okeechobee to severe eutrophication.

We know the situation is precipitous, that only prompt actions will suffice, and that time is short...and counting,

EUTROPHICATION: HAZARD

JOHN V. BETZ:

HAZARDS AND COSTS OF ALTERATIONS

I believe that all my colleagues would agree that the success or failure of our presentation hinges on our making to you a central point of paramount importance: that is, that the public works project which transformed the Kissimmee River in Canal C-38 will do great harm to many of the people it was intended to help.

We are not here solely to bother the ultimate executive authority of the State of Florida about a scientific abstraction called the "ecology of the Kissimmee-Okeechobee system," although this is important to us. Rather, because the natural ecology of the entire Kissimmee River simply is no more, the quality, the usability of the ultimate water supply of south Florida is now deteriorating rapidly. And in south Florida, the water supply is the key not only to the ability to make progress and profits, but also to sustain life.

The public-works projects linking the lakes, streams, and swamps of the Kissimmee basin to one another, and Canal-38 dug to link these with Lake Okeechobee, were intended to provide flood protection for urban and agricultural lands. They have accomplished that purpose. Bt (sic) speeding the runoff to Okeechobee they also have caused its water to become so contaminated, so impure, that it will be much less usable than it is even now, and usable only at far greater expense. Those who will suffer from the deprivation of usable water are not only the animals which formerly utilized the Kissimmee- Okeechobee ecosystem, it is also the 3 million plus human beings who will try to live a decent life in south Florida in the 1980's.

Put very simply, but I believe, realistically, the present and proposed canals on the upper Kissimmee basin lakes and streams serve as a funnel to collect the domestic sewage, the urban runoff, the agricultural wastes and the industrial effluents from booming central Florida into a single collection vessel, Lake Kissimmee. Thereafter, Canal-38 acts as a conduit which transports this waste rapidly, efficiently, and without purification directly into Lake Okeechobee, the perrenial (sic) water supply for south Florida.

What was intended to help answer the coming water needs in south Florida has instead brought them to a crisis by forging a short circuit from the bathrooms and streets of central Florida to the major drinking-water reservoir of south Florida.

At the top of this funnel, in Orange and Osceola Counties alone, there are 53 sewage treatment plants which discharge their effluents into the Kissimmee drainage system. Of these 53 plants, less than half (only about 25 of them) clearly meet the minimal state requirements existing now. These 53 plants currently discharge over 27 million gallons a day of sewage which has had varying degrees of biochemical oxygen demand (BOD) and solids removal. In none of these plants, however, is nitrogen or phosphorus removal practiced. So from the two counties alone, all of the nitrogen and phosphorus of 27 million gallons of sewage enter the system

now. The permanent population of Osceola, Okeechobee, and Highlands Counties, and that portion of south Orange County drained by the Kissimmee can be expected to increase to almost 400,000 by 1980. If the 30,000 motel rooms and campsites in the Orlando area are full most nights, a total of 500,000 people will be then discharging at least 50 million gallons per day of sewage effluent toward Lake Okeechobee.

But sewage is the brightest part of the problem. We are coming, slowly, to realize that our standards for sewage treatment are inadequate, and it can be argued that eventually, maybe in 10 to 20 years, the sewage of most of the population of this area will be treated adequately and its nutrients largely stopped from entering the drainage into south Florida.

But again, sewage is only part of the problem. There is also the newly recognized specter called urban runoff, and it is precisely this water, unlike sewage, that the flood control canals were **designed** to catch and to transport. Contained in urban runoff are varying amounts of: trash, garbage, animal droppings, dead animals, insecticides, herbicides, fertilizers, dead vegetation, soaps and detergents, gasoline, oil, grease, brake fluid, transmission fluid, other lubricants, lead, mercury, cadmium, zinc, cyanide, arsenic, coliform bacteria, the bacilli of tetanus, gangrene, botulism, other common soil organisms, various viruses, and last but not least, just plain old dirt, whatever that may be.

In other words, urban runoff contains most of the things that sewage contains, plus a few sewage may not, in concentrations roughly equal to those in sewage. It is the best guesstimate of water quality experts that urban runoff increases the contaminant load from a developed area by about half again as much as the sewage from the same area.

The most pronounced difference between sewage and urban runoff, however, is its timing -- when it enters the system. Sewage is the conventional wastewater of the community, and to the degree that we are creatures of habit, the rate of flow, the types and concentrations of contaminants are, more or less, constant and predictable each day.

But urban runoff drains an urban area after rainfalls. It is exactly that water that drainage projects are **designed** to collect as rapidly as possible before it inundates built-up areas where it can no longer simply seep into the gound (sic). It is exactly this water that the actual or planned channels of Reedy Creek, Shingle Creek, Boggy Creek, and the Kissimmee Canal are **designed** to collect and to speed from central Florida into Lake Okeechobee.

Sewage usually flows into the system at a measured, constant rate at all times. But, under the present system, urban runoff will only contaminate the water supply of south Florida at certain sporadic, relatively unpredictable times: it will only hurt when it rains!

When C-38 was dug, thousands of acres of land were dramatically claimed for human benefit from the marshy valley. Thousands of cattle now roam this land. They browse year-round now on huge areas which would have been closed to them during the rainy season prior to the coming of the flood control projects which efficiently carry off any excess water shortly after the rain stops. Cows, like all other herbivores, consume prodigious amounts of food constantly. They spend a higher percentage of their time eating than we do sleeping. Inevitably, what goes in must come out, and milk and beef are not the only things which Florida cows produce in prodigious quantities. A large percentage of this material is efficiently washed off the land into C-38 and rapidly transported to Lake Okeechobee for polishing. Agricultural runoff, like urban runoff, is not a problem all the time. During dry times it accumulates almost harmlessly on the ground. Again, it only hurts when it rains.

From these considerations, it may appear that I am suggesting that the best thing that could happen to save the water quality in Lake Okeechobee under existing circumstances is an almost complete cessation of rain in the Kissimmee basin.

If we assume things remain as they are at present, and the trends of eutrophication described by Dr. Anthony continue, how may Okeechobee differ in not so many years from what it is now, or was a few years ago?

A natural, healthy lake has the following beneficial uses. They are:

1. A drinking water supply to those communities adjacent to it.
2. An emergency water supply reservoir for distant communities.
3. A recreation site for swimming, bathing, water-skiing, etc.
4. A habitat for the nesting and feeding of water birds.
5. A potentially valuable commercial and sports fishery.
6. A reliable water source for agriculture and industry.
7. A thing of beauty -- an opportunity for aesthetic re-creation which increases in importance to our urban masses even as it decreases in availability to them.

Let us examine some effects of extreme cultural eutrophication on these benefical (sic) uses.

When a lake becomes grossly polluted through the process known as cultural eutrophication, its waters become unfit for human consumption unless unusually expensive and extensive purification procedures are employed.

It becomes enriched in disease-producing bacteria and viruses which must be killed or removed before the water is safe to drink. These include the bacteria of typhoid, dysentery, food poisoning, and many others. There may be viruses which cause aseptic meningitis, rashes, myocarditis, diarrhea, paralytic polio, respiratory infections, hepatitis, and several other exotic diseases.

Concentrations of nitrate and nitrite may at times be so excessive that ingestion of the water produces a blood disease called methemoglobinemia which can be fatal, especially to small children.

On occasion, pesticides, herbicides, heavy metals like mercury, lead, cadmium, and arsenic may accumulate in concentrations toxic to man and may pass through normal water treatment processes unless great care is taken.

Bacteria of the gangrene and botulism groups, which thrive in putrefying anaerobic mucks, and certain types of blue-green algae which are symptomatic of eutrophic lakes, may release soluble toxins not eliminated by treatment processes which screen out the causative organisms.

The water has color, odor, turbidity or, cloudiness which make it objectionable to drink. These can be removed through treatment, for a price which rises directly with the quantity of the color, odor, or turbidity.

There are certain combinations of pollutants which make water more difficult and expensive to treat than the sum of the pollutants occurring singly. Viruses, by themselves, can be removed reliably by careful chlorination. But when a water containing viruses also contains significant turbidity and/or ammonia, which are characteristic of polluted lakes, the viruses are protected from the disinfecting action of the chlorine. In such cases, far larger doses of chlorine must be applied for longer times to achieve the same probability of virus removal. The disinfection is thus less reliable and more expensive.

For these same reasons, the waters of the lake become much less useful as an emergency water supply. In times of drought in south Florida, the waters of Okeechobee are released via canals to flow to distant communities. Before being used, they may be diluted by other waters and may filter through the ground into the aquifers. In times past, both of these factors served to increase water quality before use. However, water in many of the canals of south Florida is now more polluted than that of Okeechobee and cannot serve to purify it by dilution. Further, many of the dangerous pollutants accumulating in Okeechobee now are either in true solution like the nitrates, pesticides, and heavy metals or of extremely small size such as the bacterial toxins and viruses. Once these reach certain critical levels, they will be found to persist through the crude filtration they receive on entering an aquifer, and become a component of the water pumped out of wellfields into municipal supplies.

All of the same problems which make a eutrophic lake undesirable as a source of drinking water also make it unsafe for human contact recreation such as swimming and skiing. In addition, no one enjoys wading through muck. Besides the painful but seldom serious "swimmer's ear" fungus common to many Florida waters, there is the much less understood, less common, amebic meningoencephalitis. The first American cases of this newly recognized disease entity were reported from Orlando. The hysteria caused by sporadic reports of the killer ameba is not justified, but in the words of Franklin A. Neva, M.D., writing in the *New England Journal of Medicine*:

> The striking association of the great majority of cases of Amebic Meningoencephalitis with a recent history of swimming or diving in warm water of a high organic content is a matter for sober reflection. Study of environmental factors that influence the biology of amebas, such as encystment of **N. gruberi** by increased environmental carbon dioxide, may provide clues to the pathogenesis of human disease caused by free-living amebas. Is this another example of a new disease pattern that man creates by fouling his environment?
>
> (*New England Journal of Medicine*, ***282****:450- 452. Feb. 19, 1970.)*

Knowledge of the process of eutrophication only now is becoming widespread. For somewhat similar reasons, our knowledge of the hazards of the array of organisms, toxins, and chemicals I have described is with some notable exceptions, even more tardy, less sophisticated. We expose ourselves to them in a wide aura of ignorance. None the less, when their large numbers and their individual potentialities for harm are coupled with the fact of their increasing concentrations in polluted waters, the probabilities are sobering.

The Kissimmee valley and Lake Okeechobee in its coming condition can no longer support the abundant water fowl of previous years as shown in this table prepared from information supplied by the Florida Game and Fresh Water Fish Commission:

MONTHLY CENSUS FLIGHTS
(Kissimmee River Valley between S.R. 60 and Lake Okeechobee)

Before Canalization	Water Fowl Days*
1954-1955	164,362
1956-1957	115,472
After Canalization	
1970-1971	51,300

*Average number of waterfowl utilizing the River during the winter census period (November 1 - February 15).

Lake Okeechobee itself has been the scene in recent years of increasingly frequent bird kills. These are most often caused by the same organisms which can cause gangrene and botulism in human beings. These organisms thrive in the anaerobic bottom sediments and produce highly lethal toxins. Birds which filter these sediments for food or otherwise ingest them while capturing small animals, become paralyzed and die.

Pesticides, especially DDT and other chlorinated hydrocarbons, are now accumulating in the tissues of certain fish eating birds to the point of interfering with their reproductive processes. The slow extinction now closing about the bald eagle and the brown pelican threatens many other species as well.

Officers of the Florida Game and Fresh Water Fish Commission estimate the average annual value of the commercial fishery in Lake Okeechobee at a minimum of $500,000. Perhaps more importantly, they estimate over 140,000 as the number of sport fisherman trips onto the lake in 1969. Increasing eutrophication will decimate these fisheries. Fish kills are becoming more frequent and larger as the condition of the Lake worsens. Spawning sites are being eliminated by accumulating muck and silt.

It is not at all likely that all fish life in Okeechobee will die off. What will happen though, has been seen so often before as to enable a foregone conclusion -- the disappearance of desirable fishes and their replacement by other fishes adapted to survive under eutrophic conditions -- large numbers of gar and gizzard shad.

We may also anticipate effects on other cold blooded animals. During the crisis in Lake Apopka a couple years ago, people asked: "But what could kill an alligator?" Now we know. And the same **Aeromonas** bacteria is present in Okeechobee and all other dirty waters. Only the conditions need be right, for the path Okeechobee has followed so far has paralleled Apopka in detail.

After all this, there will come the noxious aquatic weeds -- hydrilla, hyacinth, elodea, naiad, watermilfoil and all the others. These are the hallmark of the over-enriched lake in Florida. They will infest and spread and clog -- and, curiously enough, they will purify. They will compete for the nutrients which otherwise stimulate pea-soup blooms of algae. The water in the infestations of elodea and hydrilla will be the clearest in the lake. But they will clog passages and foul propellers, and will invite action by those who prefer to treat symptoms rather than diseases. For noxious aquatic weeds are so often a symptom in Florida.

Last to be considered are the aesthetic values. The lake I have been describing will be an unlovely thing. It will be offensive to all the senses: sight, touch, smell, taste, even hearing -- there will be few birds and many mosquitoes.

All of this has started to happen and it will continue moving inexorably to the conclusions we have outlined unless you gentlemen have the wisdom and the courage to break cleanly with past practices and take the steps to set it right.

Please let me leave you with the thought with which I began.

It is not alone the ecology of the Kissimmee-Okeechobee system which concerns us. Ecologies don't get thirsty. But the people of south Florida do. Two and a half million of them, and climbing every day.

MARSH ECOLOGY

ARIEL LUGO:

OPTIMIZING THE MANAGEMENT OF THE KISSIMMEE RIVER BASIN MARSHES FOR MAXIMUM VALUE TO MAN

The Kissimmee River basin is a large regional ecosystem capable of sustaining a high diversity of plants, animals, and habitats. Prior to canalization, this potential was evident in its five major plant communities, its extensive fisheries, and the thousands of migrating waterfowl that formerly visited the region annually. At that time, the annual flooding of wetlands was responsible for the maintenance of the productivity of the region, the linkage between plant and animal communities, the maintenance of high water quality, the storage of excess waters and nutrients, and the overall moderating effect on seasonal climate of the area.

It is demonstrated in this paper that with the construction of Canal-38 many of the above trends were reversed, causing losses in wildlife and fisheries. Water quality deteriorated, and the dampening effects of the flood plain on water flows were eliminated. Today water quality deteriorates as one moves downstream, casuing (sic) alterations to the ecology of Lake Okeechobee, and water discharges now show sharp peaks during the rainy period followed by very low discharges during the dry period. Utilizing some values from the scientific literature, it is demonstrated that marshes are capable of enhancing water quality by removing nutrients and heavy metals through the process of photosynthesis and by accelerating the sedimentation of suspended materials in the flood waters. By photosynthesis alone, about 1,500 acres of marshland are capable of storing all the nitrogen and about 25% of the phosphorus from the sewage of a population of 62,000 people. The process of sedimentation, which also occurs in marshes, will further increase the efficiency of nutrient and heavy metal removal. Since the Kissimmee River basin contains, or can be made to again contain, many thousands of acres populated by marshes, their value to society is very obvious.

Other roles of marshes which are discussed this paper: 1) Their high productive capacity, which places them among the most productive ecosystems in the world. This has value to man in the form of recreation, and environmental quality control. 2) Their water storage capacity during flood periods. 3) Their buffering service to an increasing urban population. 4) The role in lowering governmental costs when the area is protected from further development. 5) Their value in the future, when our knowledge of management and manipulation of nature becomes more sophisticated.

Finally, this paper explores some ideas about the philosophy of ecosystem management. Regional management, with mechanisms to avoid conflicting uses and over- exploitation of the region is advocated. When a region is put to work to its maximum biological potential, that region will maintain itself with little help from man. At this point, the region is said to have its maximum value to man and soicety (sic) in general.

THE BASIN

The Kissimmee River basin is a large area (3,000 square miles) with a high diversity of plants, animals, and habitats. Like any other basin, the Kissimmee River basin is linked to surrounding ecosystems by the inward and outward flows of water, chemical substances, and organisms. Figure 8 is a schematic representation of the basin with its original meandering river, showing the major movements of water, chemicals, and organisms. These inputs and outputs, as they are called, are listed in table 1.

FIGURE 8: KISSIMMEE WATERSHED SCHEMATIC

TABLE 1

Substance	Form of Input	Form of Output
Water	Rain, Runoff, and ground water	Runoff, ground water and evaporation
Plant nutrients	Agricultural fertilizers, sewage, animal waste, and with water inputs	Harvest of animals and plants, with water outputs, and volatilization of certain compounds.
Heavy metals	Agricultural activities, urban runoff, and with water inputs.	With water outputs, and with suspended organic matter in water.
Organic matter	Wildlife migrations, with water inputs, urban and animal waste, and plant photosynthesis.	Wildlife migrations, with water outputs, oxidation, and fires.
Organisms	Migrations (air and water)	Migrations (air and water)

Without intrusion of man, these substances and organisms entered the region, remained trapped (Table 2) within the basin for a certain period of time, and then left the region, each with a characteristic intensity and periodicity.

TABLE 2

Substance	Location where it is trapped
Water	in lakes, canals, the marsh, vegetation, and peat.
Nutrients	in sediments, peat, vegetation, water and wildlife.
Heavy metals	in organic sediments, peat, and vegetation.
Organisms	in their various habitats.

The net result of all this dynamic activity is the process of life itself which in the Kissimmee River basin was expressed before canalization in the five major communities depicted in Figure 9. Each of these communities (mixed marsh, mixed swamp, wet and dry prairie, pine flatwoods, and upland

FIGURE 9: VEGETATION MAP OF KISSIMMEE BASIN

Source: U.S. Fish and Wildlife Service

forests) is adapted to a particular set of enviornmental (sic) factors dictated by the periodicity of climate in the basin and by its interaction with the topography of the land. Since the climate is seasonal, and the periodic flooding of the river altered the topography of the land, the communities of the basin were linked to each other, and adapted to the oscillations of their natural environments. In wet periods the marshes would expand at the expense of the drier sites while during dry periods, drier communities expanded their territories at the expense of the wet marshes.

Large flocks of migrating waterfowl would visit those communities with the highest food production and thus their feeding areas would change as the local conditions changed. The result of these oscillations in the community structure and function is a region which has room for high diversity of species of organisms each adapted to a particular set of environmental circumstances. When the conditions that favor "species X" are

present, that species will become abundant and when the conditions change, another species flourishes while "species X" become less abundant. Only nature is capable of tuning such a complex machinery so that all species are allowed to survive through periods of stress and to flourish when the conditions for growth are favorable.

THE MANAGEMENT

When managing such an intricate ecological system it is imperative to remember that all communities, and all the components of the system are somehow interrelated by the dynamic flow of water, chemical substances and organisms. Actions on one part of the region will have repercussions on another part which one had no intention of altering. Since each species and community of plant and animals is by definition different from each other and adapted to do a unique job in the regional system, it follows that the proper management of a large and diverse system such as the Kissimmee River basin would involve maximizing the natural capabilities of the biological and physical system. By this I mean that a manager maximizes those properties of the system which the system does best, and avoids asking the system to do something it is not adapted to do, or worst yet, utilizes the system for objectives which degrade the intrinsic assets of the system.

Natural ecological systems are centers of biological activity whose main product is the support of life on earth. As a result of this activity, all living creatures, including man, benefit. To maximize this life-support role is to maximize the value of the system to society. But care should be taken to avoid two common pitfalls of bad ecosystem management: 1. Use of an area for conflicting uses. An example of this is an attempt to manage the same waterway for rapid water discharge and for fishing. These are conflicting uses, incompatible with each other.. 2. Over management of a system requiring a system to do more than it is adapted to do. This can take the form of overhunting, overfishing, overgrazing, etc.

Proper management involves (1) A regional approach to include all the interacting communities; (2) The utilization of the system’s natural adaptations to the local conditions so that its value may be maximized at minimal cost; (3) The planning of compatible uses to avoid conflict of objectives; (4) The control of the intensity of use to avoid exploitation and deterioration of the resource. When these are followed, the region is put to work to its maximal potential and it is said to have its maximum value to man. Table 3 contains some uses which can be properly planned for maximizing the value of the restored Kissimmee River basin.

TABLE 3

MANAGEMENT ALTERNATIVES FOR THE KISSIMMEE RIVER BASIN ECOSYSTEM
1. High water quality for human consumption. 2. Water for recreatonal (sic) use. 3. A limited transportation waterway. 4. A meandering river wildlife refuge. 5. An area for personal agriculture and ranching use. 6. A place to build limited human dwellings. 7. A waste processing area. 8. A basin for atmospheric cleaning and oxygen regeneration. 9. An area to preserve live genetic material for future use 10. and experimentation. 11. An historical site for the enjoyment of future generations. 12. A living laboratory for the study of the ecological laws of nature.

13. A buffering and relaxation area to surrounding high density human populations.

CANAL – 38

The construction of a deep canal through the heart of the Kissimmee River basin is contrary to the expressed philosophy of ecological management because such a structure disrupts many of the natural mechanism that link the plant communities of the region; it converts the area into a series of independent communities which now must readapt to new regimes and in the process lose much of their value to man. The deep canal not only disengages the communities of the region but it also adds an element of shock to the region in the form of sharp peaks of water discharge which did not exist before and to which the region is not adapted. Compare water flows at high water in the canal versus the natural river in Figure 5. Figures 5 and 10 show how the region is flushed of many of its chemicals, water , and organisms as the result of these sharp surges in discharge caused by Canal -38. The magnitude of the Canal's effect on the system may be explained by discussing the role of marshes in the regional ecosystem.

FIGURE 10: MAN IN THE KISSIMMEE WATERSHED

THE MARSH

For our purposes, we may define a marsh as a community of grassy vegetation adapted to frequent flooding. The seasonal flooding of the marsh brings with it sediments rich in plant nutrients which are deposited in the marsh as the plants offer resistance to water flow and force flood waters to lose velocity. In Florida, where the growing season is long, and the temperatures of the air favorable, marshes are very productive because they couple the Florida climatic conditions with the abundant water and nutrient supplies from the river. In fact, marshes and swamps are among the most productive systems of the world.

As a result of their adaptions (sic) to seasonal flooding and high productivity, marshes become areas of ideal habitat for wildlife and a great number of plant species. This results in high biological diversity and activity. The movement of water and animals links both flanks of the marsh to the river and to the prairies and drier sites. The question of interest is their role in controlling environmental quality, and their service and value to man.

DIRECT ROLE OF MARSHES ON MAXIMIZING REGIONAL VALUE TO MAN

One of the most controversial issues is the role of marshes in the removal of nutrients from water, i.e., their control of water quality. One reason for the controversy is the inadequacy of past and current research. However, one might search the literature and with some calculations, assumptions, and presentations of the data, obtain enough evidence on their role in water quality control to demonstrate their value to man.

Figure 11 (next page) shows the deterioration of water quality as one moves south from Lake Tohopekaliga through the Kissimmee-Okeechobee basin. The rapid flow of water laden with nutrients into Lake Okeechobee is one of the main factors which accounts for the deterioration of these waters. Once nutrients enter a lake, its physical and biological configurations will tend to retain them in the basin. Table 4 compares water quality in

FIGURE 11 : MEDIAN WATER QUALITY VALUES

Source: U.S. Department of Interior, "Appraisal of Water Quality Needs and Criteria for Everglades National Park", 1971.

TABLE 4

COMPARISON OF WATER QUALITY IN MARSH AND CANAL WATERS WITH THOSE U.S. WATERS WITH THE HIGHEST REPORTED QUALITY.

Chemical substance	5% of U. S. waters have their value or less (mg/1)	Canals mean values (mg/1)	Marsh lands mean values (mg/1)
Nitrate	0.2	0.4	0.3
Sulfate	11.0	40.0	1.0
Calcium	15.0	60.0	7.8
Dissolved Solids	72.0	393.0	54.0
Iron	0.0	0.05	0.03

Data on canals and marshlands from Loxahatchee National Wildlife Refuge Area from Appraisal of water quality needs and criteria for Everglades National Park, USDI NPS. May, 1971.

canals, marshes, and those United States waters reported to have the highest quality (top 5%). Notice that the water quality in marshes is above the quality of the best waters in the United States. Canals, which are either devoid of vegetation or have large volumes of runoff water flowing through them, are reknowned (sic) for their poor water quality. Many times, toxic heavy metals are found in these waters, particularly near agricultural and urban areas, and these chemicals further deteriorate water quality.

Table 5 shows the concentration of these metals in canal and marsh waters in undeveloped areas. Notice that land development is accompanied by rapid deterioration of water quality. Marshes aid in water quality by actively taking up nutrients and heavy metals from the water and by reducing water flow and thus inducing sedimentation of suspended matter. Data on rates of sedimentation were not available. However, Table 6 contains data on the differential storage of heavy metals by plant parts as compared to the amounts in the suspended matter fraction of the water.

TABLE 5

Dissolved-metal content in canal waters of developed and undeveloped areas in south Florida. (Data from R. C. Harriss, 1971).

Metal	Undeveloped Area*	Developed Area*	Developed Undeveloped
Manganese	4.2	29.0	6.9

Cobalt	0.8	34.0	42.5
Cooper	1.4	4.7	3.4
Zinc	1.7	14.6	8.6
Cadmium	0.4	2.8	7.0
Lead	0.7	12.0	17.1

*All values in ug/l

TABLE 6

CONCENTRATION OF ELEMENTS FOUND IN SUSPENSION AND IN PLANT PARTS
* parts per trillion ** parts per million
Data from Harriss, Mattraw, Horvath, and Andren, 1971

Element	Suspended Matter	Plant (shoot leaves)	Roots
Iron	5.5 ppt*	0.89 ppt*	4.89 ppt*
Manganese	60.1 ppm**	163.4 ppm*	259.4 ppm*
Cooper	37.0 “	5.0 “	8.2 “
Nickel	15.0 “	7.0 “	5.4 “
Cobalt	10.4 “	6.3 “	9.7 “
Lead	12.7 “	13.3 “	16.8 “
Cadmium	6.8 “	0.84 “	1.05 “
Zinc	74.1 “	63.4 “	49.2 “

It is important to note the following points: 1. When the marsh induces sedimentation, a large fraction of those heavy metals in suspension and often a substantial fraction of the phosphate will be retained in the organic sediments of the marsh. Once there, these metals will remain in such storage for a long time period. 2. The magnitude of heavy metal absorption is, different for different plant parts and for different metals. For this reason plant diversity is important. Each plant species will absorb a different metal type at a different rate. When one eliminates a species, one destroys its particular buffering capability.

The mechanism by which plants absorb nutrients and heavy metals is the process of photosynthesis which is also responsible for the organic productivity of the marsh. In Table 7 I have included estimates of the rate of organic production in a marsh, as well as the marsh's nutrient storing capacity and capacity to remove nutrients during the growing season. These date have been extrapolated to the Kissimmee River basin.

TABLE 7

The storage and uptake of nutrients in marsh species and peat, and the inputs of man into the Kissimmee River Basin.

Ecosystem Component		AQUATIC PLANTS	SAWGRASS	PEAT
Weight-tons/acre		10	4.8	200
Standinq crop of nutrients tons/acre	N	0.155	0.035	6.36
	P	0.020	0.001	1.0
	K	0.248	-	.016
Productivity of organic matter-tons/acre/year		28	13	0.04
Uptake of nutrients tons/acre/year	N	0.43	0.095	0.0016
	P	0.07	0.004	0.0002
	K	0.90	-	0.00004
Additions by Man*: tons/acre/year				
N	P			
0.103	0.192			

*Based on five sewage plants (see Table 8)

Table 7 also gives rates of sewage input to the basin so that we may determine the role of the marshes with respect to nutrient removal. For purposes of calculation, we assumed 1500 acres of marsh as the unit receiving all the sewage effluent. Obviously, much more acreage could be so employed. This comparison demonstrates that through plant production alone, 1500 acres of marsh can utilize nearly all the nitrogen and 25% of the phosphorous from the total nutrient input of effluents from sewage plants serving 62,000 people. The addition of the sedimentation value during floods will greatly increase this figure. These figures are only rough estimates; the assumptions and data sources are included in Table 8.

TABLE 8

Data and assumptions utilized in calculating the nutrient uptake and storage in marshes.

1. The weight of aquatic plants was obtained from Boyd, 1970-a; for sawgrass from K. Stewart, unpublished; for peat from Bayley and Odum, 1971.
2. The standing crop of nutrients was obtained by multiplying the weight of the plants or peat by the % nutrient composition. The % nutrient composition was obtained from Boyd (1970-a,b,c,d,e) for aquatic plants, from K. Stewart (unpublished) for sawgrass, and from Davis (1946) for peat.
3. The estimates of productivity were obtained from Boyd, 1971, for aquatic plants, and from Bayley and Odum, 1971, for sawgrass and peat.
4. The uptake of nutrients was calculated by multiplying the productivity figure by the % nutrient

composition. It was assumed that the growing season was 250 days.

5. The addition of nitrogen and phosphorus by man was calculated from the annual data given by Wegener and Holcomb, 1972 for five sewage plants near Lake Tohopekaliga and assuming that there are 1,000 acres of wetlands in the Kissimmee River Basin.

6. Some of the original data before conversion to short tons:

   For aquatic Plants: P is 0.20% of dry weight; N is 1.55% of dry weight; K is 2.48% of dry weight

   For peat: P is 0.5% of dry weight, N is 3.18% of dry weight; K is 0.08% of dry weight

   A mean input of sewage to the Lake Tohopekaliga area is: for N 310,551 lbs/year; for P 579,530 lbs/year

   The sewage plants were: Orlando #2, S.W. Orange County, Kissimmee, Kissimmee Highlands, and St. Cloud

While I think that the role of the marsh has been underestimated, we need research in both areas to verify these figures. Other direct values of marches which are discussed by others in this volume are:

1. **Water storage during periods of flood stage**. This serves to excess water during flood conditions, to remove sediments from the water, and to reduce sharp peaks of water discharge through the main canal . Lengthened stay of water in the marsh yields more benefits per volume of water in contrast to present conditions when the water rushes to Lake Okeechobee. Some of these benefits of stored water are higher plant productivity, milder temperatures, and more time for water purification.

2. **Wildlife maintenance**. Because of its plant diversity and high productivity, a natural marsh sustains a higher diversity of wildlife than a man-managed system. Man may maximize the number of individuals of a given species as is now advertised for the Kissimmee basin but these are surges similar to the increases in the fisheries of new impoundments. On a long term basis, the natural marsh supports more species on a sustained basis. Figures 12 and 13 show populations of fisheries before and channelization.

FIGURE 12: GAME FISH RECOVERY SUBSEQUENT TO STREAM ALTERATION

Source: Bayless and Smith, "Effects of channelization upon fish populations of lotic waters in eastern North Carolina,".l965.

FIGURE 13: FISH CAPTURED IN WIRE TRAPS

Source: Florida Game and Fresh Water Fish Commission, Recommended Program for Kissimmee River Basin, 1957.

INDIRECT BENEFITS FROM PROPER MANAGEMENT OF MARSHES

By properly managing the region and the marsh, man will derive larger benefits which are indirect

consequences of the natural function of the area. Four of these are:

1. **Buffering of Lake Okeechobee and surrounding urban areas**: The marshes of the Kissimmee River basin will buffer Lake Okeechobee from high inputs of nutrients, heavy metals, and sediments, and from the shocking high water discharges characteristic of the current Canal-38 situation. When one looks to the present and potential developments in these regions of Florida, the potential role of the marshes as buffers of man's activities becomes very significant. Failure to protect these buffer zones will result in increasing deterioration of water quality, higher costs of water treatment, and more uncertainty in the minds of the people and governments of south Florida about the health of their water supply.

2. **Recreation**: These are side effects of any natural facility but particularly of the Kissimmee River basin due to its size and diversity. needs to look at the documented populations of wildlife and fisheries prior to the construction of Canal-38 to appreciate the potential of the region. Given enough time, ecological succession will restore the productivity of the land to its original high values. With proper management and vision the area will be of value to the increasing number of naturalists and sportsmen in our State.

3. **Lowering of population demands in the area**: As areas are developed, not only does the surrounding water quality deteriorate, but the area’s capacity to support and absorb further growth also deteriorates as the natural systems are destroyed, As this occurs, man must protect the environment at a high cost in the form of dollars, effort, time, and a lower life quality. If the Kissimmee marshes are restored to protect local environmental quality and to buffer Lake Okeechobee and surrounding urban zones, fewer areas will be developed. As a result, costs of government will be reduced, and life quality enhanced. This is a significant ancillary benefit.

4. **Options for the future are left open**: Restoration of the Kissimmee River basin marshes will return the area to its original function and production. This will reopen our options for future management and land use. As time goes on, our knowledge of ecosystem management will increase and we will become more sophisticated in techniques maximizing the value to Floridians of this region of our state. With the great and growing pressures of population, that sophistication will become increasingly vital.

SUMMATION

It is clear that the Kissimmee River basin under its present land use policy is not supplying the maximum benefits it can provide to the people of Florida. Its communities have been decoupled, its capacity to support life decreased, its water quality deteriorated, and the number of different uses diminished. To restore its potential high value to man , communities must be reintegrated into the original unified system of the basin; periodic water fluctuations must be reinstated, and marshes restored. As nature takes its course this region will restore itself to high production, higher water quality, more wildlife, greater diversity and value to man.

Conclusions and recommendations.

The facts that canalization of the lower Kissimmee River essentially destroyed its aesthetic values and eliminated most of its fish and wildlife resources are readily understood because those consequences were visible and abrupt.

The fact that canalization of the lower river and other major developments in the Kissimmee-Okeechobee

basin have materially worsened the water quality problem in Lake Okeechobee is not so readily comprehended because the issue involves complex processes.

To understand Okeechobee's difficulties, one must examine at least three interrelated phenomena.

The first is the Lake's nutrient budget. It is like all budgets, so much in, so much out, and so much remaining.

A related phenomenon is that of nutrient accumulation. This refers to the fact that surface-fed lakes such as Okeechobee tend to trap, physically and biologically, the nutrients which they receive. This phenomenon is analogous to the way in which persistent pesticides are accumulated or magnified -- the jargon is biomagnified -- up the successive levels of food chains.

The process of biomagnification is no great mystery -- it is in fact commonplace. All living organisms -- plant and animal and you and I -- are biomagnifiers of the many chemical constituents which yield life. We are very late in comprehending the analogous fact that ecosystems such as lakes are also magnifiers. This has been a failing of obviously great moment as we consider the losses and costs associated with accumulations of wastes in Boca Ciega Bay, Lake Apopka, Lake Tohopekaliga, and now Lake Okeechobee.

Conceptually, these processes advance in many fresh water surface- fed lakes in Florida as shown in Figure 14.

FIGURE 14: LAKE EUTROPHICATION PROCESS

For a period of decades we can add wastes to a lake and detect no visible difficulties, no particular evidences of stress. Sometimes the slight enrichment of this period invigorates a lake, e.g., fishing may be improved. Even the most extensive chemical data collected in this period are likely to elude any far-seeing interpretations. Lake Apopka, so long studied, was a classic example of this fact. This predicament is quite comparable to our inability to predict the onset of concern occasioned by long-term smoking. The best we can do in the early decades in either case is to respect the probabilities of the **process**.

As the nutrient budget grows in a lake, stress begins ultimately to accelerate. Early expressions of this are increasing turbidity of the water and localized blooms of floating algae. If the nutrient loading continues, a period of exponentially increasing stress sets in -- at which time greater blooms of algae occur, tending to displace the normal emergent and submergent vegetation of the shallows.

Following the bloom of the algae, their dead and dying husks cascade to the bottom, further clouding the water and blanketing the bottom rapidly with organic ooze. Because the masses of dying algae consume much of the dissolved oxygen in the water, intermittent fish kills result. Some algal masses float, especially in the quieter backwaters, with an odor characteristic of sewage.

Ultimately gross shifts in species occur in the lake -- from its normal aquatic vegetation to massive blooms of green algae and later to blooms of blue-green algal species. Spreads of the exotics hyacinth and hydrilla which, unlike native plants, can compete with algae are common at this time. Figure 15, an infrared NASA color photograph of Eagle Bay on the north shore of Okeechobee, is an example of the success of such competition by hydrilla.

UNREPRODUCIBLE

FIGURE 15: INFRA RED COLOR PHOTOGRAPH OF EAGLE BAY, LAKE OKEECHOBEE,

SEPTEMBER, 1972, DEPICTING HYDRILLA INFESTATION

Photograph by NASA Kennedy Space Center)

Algal blooms and mud bottoms favor the expansion of the rough fish, gizzard shad. This species becomes very dominant in an enriched lake, displacing the more desirable sunfishes -- blue gill and black bass.

Enriched lake waters serve as rich culture mediums for the bloom of‘ a host of undesirable bacteria and viruses, as Dr. Betz has explained.

It is a strange but quite common circumstance that gross alterations of many natural habitats incidentally disfavor species and conditions which we value, and favor many which we do not. Thus, marsh-bordered blue gill-black bass lakes are converted by discarded wastes to algae-dominated gizzard shad-garfish lakes; clear lakes become murky, sand bottoms become mud-covered.

It is especially important to note the relatively short term of the period in which nutrient stress rises exponentially. We can ignore inputs of wastes by man for 60 or 70 years or more -- while having endless debates on their meaning -- to find ourselves suddenly confronted with the rash of symptoms characteristic of a nutrient-stressed lake. Though no one can say how quickly that condition will reach the ultimate critical zone, we can be sure it will happen in a relatively short period, perhaps 10 or 15 years. The addition of a given quantity of nutrients in the period of rapidly rising stress produces a much greater effect than the same quantity would product in the long benign period; ecologic (sic) magnification feeds on itself. This is the precipitous condition of Lake Okeechobee. This situation can be compared to a five-foot rise of water on a six-foot man; he can enjoy that five feet, but he will suffer with the sixth.

It is not trivial to mention that once a lake has become critically eutrophic, correction may be either impossible or arduous and costly, as evidenced by Lake Apopka.

The flood Control District Board has stated today its conviction that Okeechobee is now in an early eutrophic state. This represents progress for a lengthy debate has finally expired.

Where do we go from here?

If we do nothing significantly different from what we have, Lake Okeechobee will soon join ranks with Lake Apopka with all that entails. Further, since Okeechobee waters are at times passed via canals to Conservation Area 2 -- the most efficient storage pool in the Everglades -- a serious water quality problem already existing there may be worsened. Conservation Area 2 now has 8 to 10 inches of organic ooze blanketing about two thirds of its bottom.

We can choose new courses which must be innovative and prompt if they are to succeed. To accept the challenge is advisable only in terms of the consequences of failing to accept it. Those consequences involve the health, safety, and welfare of more than two million south Floridians. Against a background of traffic jams, droughts, dirty air, polluted bays and canals, broken neighborhoods, crime, exponentially rising costs, and deteriorating services, they need no more stress.

We must put a buffer system, whatever that entails, between the wastes of central Florida and Lake Okeechobee.

Our convictions on these matters compel us to recommend that:

1. Governor Askew immediately appoint a Water Quality Master for the Kissimmee-Okeechobee basin. The person appointed must already understand ecosystems and eutrophication processes and must be vigorous in prosecution of his duties . He must be responsible to the Governor as Florida's Chief Planning Officer and be supported by the authority of that office.

2. Key state employees be assigned on an as-needed basis to assist the Water Quality Master for the duration of his assignment. When serving in such capacity, these people must be relieved of their normal duties and obligations to the specific purposes of their agencies.

3. As representative of the Governor, the Water Quality Master be given license to obtain assistance from all agencies of government which have knowledge, responsibility or capability to assist in resolving the water quality problems of the Kissimmee-Okeechobee basin and must be empowered to utlize (sic) the services of others in the private sector.

4. The Water Quality Master be provided funds sufficient to accomplish the responsibilities assigned to him.

5. The Cabinet include costs of renovation works needed in the Kissimmee-Okeechobee basin in its public works budget submission. Individual Cabinet members as appropriate should seek other needed technical and financial federal aid in areas other than public works.

6. The Legislature prescribe state policy in regard to restoration of the lower Kissimmee River.

7. The Cabinet instruct all agencies and interests that protection of water quality in the basin will be a major consideration in their deliberations and that in accord with this no further canalization of streams or destruction of marshes and swamps will be approved in the basin.

8. The Cabinet instruct the design engineers to develop plans for reflooding the historic marshes of the lower Kissimmee Valley, to include restoration of its fluctuations and its flow-gradient in lieu of subimpoundments and that specific attention be given to removing or reshaping the massive spoil areas which occupy over two thousand acres of former marshlands. Such plans shall consider the need for flood prevention in the upper valley.

9. The Governor reconsider the order of priorities in regard to the Water Basin Management Plans (EPA and Florida) so as to elevate the problems of the Kissimmee-Okeechobee basin.

10. The entire program be regarded as a means of reversing the process which has reduced the quality of water in Lake Okeechobee to its present condition, and that the program center on actions rather than studies and monitoring.

We further recommend that the Water Quality Master:

1. Proceed to locate and map within three months all sources and amounts of nutrients and other pollutant inputs -- urban, industrial, and agricultural -- to the Kissimmee Lakes, the Kissimmee canal and Lake Okeechobee.

2. Develop means to halt, divert, or treat to the greatest extent possible, all wastes entering the basin, using the best knowledge and technological and legal means available to do so.

3. Develop a plan to fluctuate the lakes of the upper Kissimmee basin on a regular basis consistent with

other reasonable uses in order to remove a significant portion of accumulated organic oozes through atmospheric oxidation, using the lessons of Lake Tohopekaliga.

4. Develop plans to harvest fishes, both sport and commercial, in accordance with the dictates of sustained yield concepts, as a nutrient- removal device,

5. Develop plans for control of noxious vegetation, determining when such control shall be regarded as essential and prescribing methods to he employed. Because of the need to remove nutrients and of the hazards of applications of chemicals to aquatic life and to drinking water supplies, physical removal of unwanted vegetation should be emphasized.

6. Report all appropriate findings and recommendations to this Cabinet for their action.

I especially wish to acknowledge here the kind assistance which NASA and the Interior Department have given to us in this matter and further to say that while their contribution to this problem was short-term and therefore necessarily limited, my colleagues and I believe that the contributions they can make in solving future environmental problems, as they develop techniques and applications, promise to be very great.

Finally, time allows us only to base our actions on the obvious; we can no longer afford to be entangled in the obscure -- if south Florida is to avoid an irredeemable loss.

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APPENDIX #1

MEMORANDUM
October 4, 1957

TO: Executive Director
FROM: Division of Planning and Research
SUBJECT: Lower Kissimmee Valley Water Control Project (C-38)

I. Introduction

It recently became evident that in order for this District to intelligently evaluate the recommendations by the Corps of Engineers, U. S. Fish and Wildlife Service, and the Florida Game and Fresh Water Fish Commission concerning the improvement of the Lower Kissimmee Valley, it would be necessary to have additional information on the area. Accordingly, this report concerning the land capability of the present flood plain and the effects of the proposed project on land use and land owners in the valley was undertaken.

This Memorandum is concerned only with that portion of the Kissimmee River flowing between Lake Kissimmee and Lake Okeechobee, its flood plain which averages **approximately 1.2 miles in width and 60 miles in length**, and any of the adjoining lands which would be affected in either a beneficial or detrimental manner by the project. It contains certain statements which while not relating to land use per se, are significant in providing insight into the general problem under consideration.

Information in this report was obtained by interviews with landowners, fish camp operators, real estate agents, Country agricultural Agents, Soil Conservation fieldmen, and material on the project published by the Corps of Engineers, U. S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission.

After a rather intensive study of the subject, the following conclusions were reached:

1. The majority of the landowners are relatively uninformed about the project and although there is general agreement on the desirability of some sort of improvement, most are worried about its effect on their interests.

2. The present utilization of the Kissimmee marsh is mainly as unimproved pasture and in its present state is estimated to **be approximately twice as valuable for amount of unimproved upland**. The recreational usage (mainly for duck hunting and bass fishing) is of less importance economically at the present time.

3. Although the engineering on the proposed project may be excellent, its application does not appear to be geared to the needs and desires of the people in the area. A basic conflict is evident between wildlife and agricultural interests and in order to be acceptable **in fact**, to either group, a number of adjustments will be required in the present plan.

2. Uninformerd Public

A decided lack of and desire for information about the project was evidenced by a large proportion of the people contacted. This is not surprising considering that at this time no definite plan has been decided upon; however, even the most general purposes and expected results of the project are not understood by the majority of the public.

The most widespread fears and misconceptions discovered were as follows:

1. All factions appear to fear that the project has been turned into a “political football” and their interests are to be sacrificed for the benefit of the cattlemen, wildlife interests, Everglades Agricultural Area, or the Upper Kissimmee Valley.

2. Smaller landowners feel that they will not be consulted and their interests will not be considered.

3. Sportsmen are concerned with possible destruction of the wildlife and esthetic beauty of the valley.

4. A few feel that the canal will dry up the valley, and most do not understand that the proposed improvement will eliminate the majority of the fluctuation and control the river at a desirable level.

In spite of the above, not one person was found who was dead set against all types of improvement. Most favored the project, but mentioned certain reservations and qualifications.

3. Land Capability of the Flood Plain

Under present conditions, the flood plain is of limited usefulness for the purposes of both recreation and native range. Water level fluctuation is continuous with a difference of maximum and minimum levels averaging about 12 feet over the course of the river. In general, high water favors use of the river for recreation, while low stages improve both the amount; and quality of forage available on the flood plain.

The Florida cattleman has two basic and very real problems, a shortage of winter grazing due to frosts and lack of winter rainfall, and the extremely low average soil fertility. For years cattlemen along the river have relied upon the Kissimmee marsh to furnish a large portion of the required forage during the winter months. Also, the majority of the flood plain has a **peat or peaty muck soil** with the inherent fertility lacking in the upland prairie or flatwoods soils and as a result, furnishes at **least as much forage per acre annually as upland native range** in spite of the fact that it is under water the majority of the time.

Because of these two advantages, there have been a number of attempts to control the water and introduce improved grasses on the flood plain. Of the approximately 4,350 acres of lowland on which development has been attempted, only 600 acres appear even partially successful in controlling high water, and agricultural technicians in the area doubt that even these have been economical. This rather large scale attempted development under adverse conditions serves to point up the value which the cattlemen place upon the flood plain and its potential usefulness when the river is brought under control.

Recreational development along the river consists of 10 or 11 fish camps and a limited number of private camps and homesites on the higher banks overlooking the main stream. The areas now utilized

for recreation are generally the least desirable from the cattleman's point of view since woodland, high bluffs, river channel, and cut off meanders produce little of value for cattle feed. Under natural conditions, recreational and residential use could be expected to greatly increase in the future due to the population pressure on available water front property and the increased amount of leisure time and money available to the general public for recreational purposes.

Although some inflation is apparent in land values along the river, it appears that the long term recreational possibilities are being ignored by the average cattleman and should the river be improved with no provision for recreation it would undoubtedly be a long range economic loss to these large landowners whether they realize it or not. Present inflationary tendencies in land values are caused by the following factors:

1. The widespread speculation along both coasts of Florida has spread inland with a wave like action to the point that most range land has a price tag considerably higher than warranted by its beef producing ability.

2. Dairy farms, which have been driven out of the Lower East Coast of Florida by high land values, are settling in the Lower Kissimmee Valley and can afford to pay high prices for their land.

3. There are very few small ownerships along the river, and since the demand for such plots is greater than the supply, high land directly on the channel with good access to highways is bringing in excess of $1,000 per acre.

Future value of the land for recreational and residential purposes, which in many cases will be its highest and beat use, will be determined by the following factors:

1. Maintenance of a desirable water level for fish and waterfowl.

2. Preservation of esthetics while improving channel.

3. Location in relation to highways and access roads.

4. Elevation of the land and existence of desirable vegetation.

Since it is obvious that under project improvement very little of the flood plain can serve both ranching and recreational interests, some arbitrary decisions will have to be made concerning:

1. Water levels

2. Amount of land to be preserved for recreation

3. Location of these recreational areas

It goes without saying that long range economic land use and political aspects, as well as the engineering viewpoint, must be given serious consideration.

4. Weaknesses of Present Proposals

From a land use aspect, the project as presently proposed certainly leaves much to be desired. A large portion of the land, which it is proposed to inundate, is valuable to its present owners as winter pasture,

while a number of the existing fish camps and private residences will find themselves left relatively high and dry. Naturally, in any project with the scope of this one, a few people can be expected to be hurt for the benefit of the majority, but is (sic) is felt that in this case some adjustments should be made to soften the detrimental effects.

The water level to be maintained at the structures and its resultant water table in the surrounding land is the key to the land use problem in the flood plain. High water levels somewhere between normal or median river stages and flood peak stages benefit recreational interests, while a water table of between 14 and 30 inches below the surface of the flood plain is optimum for agriculture. Present proposals permit **overdraining the flood plain** just below each of the five structures **to levels approaching the worst droughts on record** while providing a disappointingly shallow depth in the proposed “lakes”. Also, the acreage of these inundation areas is estimated by this to be closer to 7,000 than 10,000 acres, and final results are expected to be extremely disappointing to the Florida Game and Fresh Water Fish Commission, although they have expressed their general satisfaction with the present plan.

The Kissimmee marsh has an ever increasing esthetic value which is not provided sufficient protection under the present plan. Rapidly expanding population and land development in Florida, plus a dependence on the tourist trade, makes it especially necessary for this state to protect: certain wild areas for the future. **Improper development could destroy much of the value of this natural resource forever, and such destruction could conceivably spell the political doom of the Flood Control District.** Therefore, it is imperative that considerable thought be given to canal location, spoil placement, and maintenance of the bypassed river channels , especially in the inundation areas. **It would be more desirable to err by setting water level too high than too low as pool elevations can be adjusted downward, whereas it is practically impossible to raise them**.

V. A New Proposal

After considerable study, this division is convinced that adjustments in the project are desirable from the standpoint of land use. Although this plan may not be feasible in its entirety from an engineering point of view, its effects on land use certainly warrant its receiving serious consideration.

It is believed that four structures located as indicated on the attached map will maintain sufficient water control while providing the following advantages :

1. Elimination of one structure would dispense with the nuisance and cost of additional lockage and save the cost of the structure itself, or approximately $800,000.

2. Location of structures at narrower points on the flood plain would decrease the length of tieback levees by about 20%.

3. Location of two structures at highway crossings might result in additional savings by dual usage of highway embankments and particularly at State Road #70 where a new bridge will be necessary in the near future.

4. Location at highway crossing, where possible, should decrease costs of construction while maintaining or improving the recreational and residential utilization already concentrated at these points of access.

5. Increased maximum pool depths will improve recreational and residential attractiveness and

enlarge the inundation areas while eliminating approximately one fifth of the marginal wet land at the upper ends of the lakes which is practically useless for agriculture or recreation.

6. No inundation of diked and developed land is necessary which should enable land to be purchased more cheaply.

7. Location of two of the structures at major highways, and one on land owned by the U. S. Government, should receive the backing of most of the wildlife interests along the river and at the same time generally mollify the damage to the cattle interests.

The disadvantage to our proposal would be:

1. A slighthly (sic) degree of water control which is not as detrimental as it would first appear. Much of the flood plain lands, which will benefit by drainage, are peat and muck soils and some of what seems to be overdrainage will be necessary in order to have an optimum water table after an initial subsidence of about 6 inches upon development and 1 foot every 10 years thereafter.

Additional details of this proposal are available in the office of the Planning and Research Division.

VI. Recommendations

1. Since many of the landowners now view the project with doubt and suspicion, it is recommended that an educational program be set up to include additional personal contacts, public meetings and news releases. Also, it is considered important to include landowners in meetings in the planning stages of the project rather than just gathering them together solely to inform them of what the District intends to do.

2. Since the Kissimmee marsh is, even in its present condition, important to the rancher as a source of winter and drouth (sic) pasture, and therefore extremely valuable as a balance for his upland acreage, it is recommended that the District make every effort to correct the false assumption on the part of other agencies that the land is useless.

3. Since the projects previously proposed do not appear to be geared to the needs of the people in the adjoining areas, it is recommended that additional study be given to the problem in order to fit the engineering to the highest and best use for the land, while at the same lime protecting a portion of this great natural resource for the public interest.

ASC/et
Attachment

MAP OF KISSIMMEE RIVER AND ADJACENT AREA

APPENDIX #2

FINDINGS AND RECOMMENDATIONS
OF THE

GOVERNING BOARD
CENTRAL AND SOUTHERN FLORIDA FLOOD CONTROL DISTRICT
AS THE RESULT OF
PUBLIC HEARING CONCERNING ALLEGED ENVIRONMENTAL DAMAGE
RESULTING FROM CHANNELIZATION OF THE KISSIMMEE RIVER
November 15, 1972

Findings

1. It is abundantly clear from the testimony that the problems associated with the Kissimmee Basin and Lake Okeechobee (the Lake already being in a state of early eutrophication) go far beyond the existing responsibility and authority of any single agency of government.

2. The chief concern of those testifying relates to the degradation of water quality. This is a serious and perplexing problem.

3. Land use must be regulated in the Basin; and the products of rapid urbanization and improved agricultural lands, which contribute to degradation of water quality, must be controlled.

4. Total restoration of the Kissimmee River marshes, primarily as the tool for water quality management and enhancement, may or may not be an effective solution by itself in view of other possible grave consequences, especially flood control. In any event, pollution inputs at the source must be controlled through a fully implemented land and water management plan. The estimated cost to acquire all of the lands in the flood plain of the Kissimmee River, and to eliminate the present conveyance channel and negate the function of the control structures and locks, is estimated to be $88,000,000. The benefit-cost factors involved in major restoration will have to be carefully weighed.

5. The staff of our District is to be complimented for its efforts during the past two-and-one-half years resulting in the plan described by Mr. Morgan to improve, within the limits of the works of the Project, the environmental quality of the Kissimmee River.

Recommendations

1. A program should be immediately initiated to correct existing pollution sources in the Kissimmee Basin. Adequate restrictions should be placed on any new facilities which will discharge into the waters of the basin.

2. A program should be initiated to plan and control all land and water use activities in the basin. Particular emphasis should be given to treatment of agricultural and urban runoff, sewage effluent, and industrial discharges. Acceleration of land and water use planning and control within the State plan is mandatory.

3. It is essential to implement the first two (2) recommendations above, before or concurrent with, further restoration of the Kissimmee marshes, beyond that recommended by the Flood Control District staff. A study should be initiated to determine if additional restoration will be needed and to what extent. In this conjunction, it is recommended that an interdisciplinary team be established to assist in making such determinations. In conjunction with the study, and as a part of it, there should be an extensive

monitoring program of water quality in the Kissimmee Basin and Lake Okeechobee to determine the effectiveness of pollution control at the source and land and water use regulations.

4. Because of the presently divided responsibility for water quantity and and land use planning, among several agencies and subdivisions of government, it is recommended that authority in the Kissimmee basin for these necessary elements of land and water management be given administratively, if possible, and legislatively, if necessary, to the Flood Control District. This is the best means of accomplishing the overall task of land and water planning and management in the Kissimmee basin.

5. If the task of land and water management in the basin is to be accomplished properly, it will be necessary to confer upon the District the power of eminent domain with sufficient latitude to fulfill the objectives of the program. Furthermore, it appears that Chapter 72-317, Laws of Florida (The Environmental Land and Water Management Act of 1972), will have to be strengthened to confer the power of eminent domain where it may be necessary to acquire lands in areas of critical State concern.

PREPARED BY: Messrs. Clark, Padrick, DeGrove, and Marshall

Arthur R. Marshall, Jr. Collection

Marshall, Arthur R., ***Water Problems of South Florida***, Water Resources Conference, Tallahassee - January 26, 1971.

Water Problems of South Florida

Governor Askew - Gentlemen of the Cabinet:

My sole purpose for being here is to help solve some of the environmental problems of Florida. Environment - or human ecology - is complex for it involves not only the intricacies and injunctions of nature but also the culture and the needs of man. As a humanistic ecologist with 20 years professional involvement in Florida, I am satisfied that most of the problems you must solve in this conference and in your other responsibilities have both their roots and their solutions in ecologic phenomena. To ecology as a major parameter in this problem I would add one other - ethics - as expressed in love of the land and of each other.

My special topic is the water resources of southern Florida - the essential on which all life depends. In that area some water quantity problems are:

The canalization of the lower Kissimmee River is as clear an abuse of the public's water supply and wildlife resources as we have in Florida. That canal now transports water to Lake Okeechobee so rapidly that much must be wasted to tidewater for the lake can't hold it and it can't overspill the southern rim into the Everglades. Most of the marshes of the river basin have been destroyed, the coastal estuaries suffer from mudladen fresh water surcharges, and the lake cannot be managed even in accord with its established schedules. I am sure that we shall, in this decade, have to spend millions to restore some of the Kissimmee's lost values - values which originally came gratis.

Another large area in multiple stress is the water basin of the Everglades. Here despite expenditures of several hundred millions, we have witnessed a switch from flood to drought in 9 months. This discourages confidence in this system on which south Florida man and wildlife depend.

In the interest of expanded land use - for farm and city - we have balkanized the Florida Everglades to a degree which threatens its own existence, a national park, and the water supply of south Floridians. We are told by the project designers that south Florida may experience critical water shortages by 1976. In light of the present drought it would be nice if we could depend on that optimistic prediction.

The Everglades is too much shrunken. A remnant half of the original glades must now provide flood protection and water to users in the drained half as well as those on the natural uplands. Because we have a boy doing a man's job we saw the yo-yo principle invoked from March to December of 1970. Man has too much occupied the flood plain - an act which often produces short-term gain and long-term loss. It is an extension of our good fortune that no city of a million people exists in the Everglades National Park.

We have further plans to stress the system. Because we have markedly lowered ground water levels in south Dade and in the Taylor Slough Drainage of the Park, we must now tap Conservation Area 3 to re-supply these non-riparian areas. And we plan yet more canals in south Dade (C-109 and C-110). We also have congressional authorization to drain the very large wetland known as Southwest Dade - a further invitation to trouble.

A plan in the wings for Martin County would pump excess water from a large non-riparian area to Lake Okeechobee

when the lake doesn't need it and take water from the lake when riparian users are sitting on dry.

The water supply situation alone is enough cause for objection to drainage of the Fahkahatchee Strand by developers and of the eastern Big Cypress by works associated with a major airport.

We must not only halt all further drainages from the Everglades - we must hold what we have and expand its wetlands wherever (sic) possible. Preservation of the Big Cypress is an outstanding need in this. Canals such as 302 planned for Conservation Area 2A should not be built. Conservation Area 3 is already struggling along with overdrainage from its interior canals. We shall have to reflood drained areas.

Robert Ruark once wrote that we ain't paying no more money to no more admirals to run no more battleships onto no more sandbanks. We should as lucidly inform canal builders that we intend hereafter to spend our public monies on useful purposes such as retaining our water resources.

As an aside we have generated a formidable heritage for subsequent generations by consumption of the everglades muck. Soil authorities give it a life of 30 years. We have concurrently destroyed the mechanism which produced that much over thousands of years.

Much of the Everglades is besieged by imported trees - Brazilian pepper, Australian pine and Melaleuca. Unless their spread is stopped the next generation of glades watchers will see a vastly different world. Certainly no agency of government should encourage the planting of these or other imported trouble-makers; the practice should be forbidden by law.

A problem allied to water quantity is water quality. In the Kissimmee- Glades basin Apopka-ese conditions are advancing like a wave. With stabilization of the Kissimmee Lakes, increasing nutrient input into the valley, destruction of the Kissimmee marshes and the rapid transport of upper Valley nutrients to Lake Okeechobee we can expect nothing else.

Lake Tohopekaliga's decrepit condition is being quadruplicated in Lakes Cypress, Hatchineha, Kissimmee and Istokpoga, and Lake Okeechobee may not be far behind. This situation demands an approach paralleling your own recent action for the Miami River - in which you were so effectively and hopefully represented by Secretary of State Stone and Attorney General Shevin in Miami on January 21st. Many await your attendance, Governor, together with Secretary Stone, in subsequent meetings on that issue.

Along the Gold Coast from West Palm Beach to Homestead a phalanx of polluted canals awaits the command to advance on the Everglades. If authorized plans are instituted to backpump from about one thousand square miles of the coast, Lake Okeechobee and the Everglades shall receive the errant excrement - treated or otherwise - of a million or more people. It cannot survive such an onslaught. We are thus caught between the need to conserve water and the need to have it in a useful condition.

There is a bright spot in this. As we shift our national priorities, we can with versatility direct a lot of individual and organization talents and resources to these problems - thus responding to the economic needs for paychecks and profits while pursuing essential environmental goals.

We have not progressed so far in the St. Johns Valley. Private projects have drained virtually all the headwaters south of Highway 60 and we have built one major diversion canal to Sebastian and Indian Rivers. Private projects continue to encroach into the flood plain in the form of levee and pump systems. Approximately 260 million gallons per day of variously treated sewage is discharged into the River between Vero Beach and Jacksonville. Symptoms of over-enrichment are occurring in parts of the River. A small boat channel is planned for the upper River which will produce some 15 million cubic yards of spoil to be placed somewhere - possibly on the vital marshes. Construction of the federal flood control project will divide the upper River into a series of reservoirs and accelerate its flood run-off with channels.

A careful re-examination of this River, its present problems and plans for its future could prevent its further degradation and hold and restore some of its great values for Florida. Such a study should aim to:

1. Retain the vital river marshes through purchase.
2. Locate all waste inputs - capture, treat and recycle them.
3. Reassess all planned construction in light of the current condition of the River, public needs and new environmental laws.

Here again we can generate jobs and profits in the pursuit of publicly beneficial purposes.

I would like to sum what I and others have said by referring to a common ecologic phenomenon - the curve of stress.

Enrichment of lakes in Florida is an example. As nutrients are too abundantly added to a lake, its curve of stress ascends gradually until a critical level is reached. A catastrophic decline in the lake's resources then ensues - which we call over-enrichment. Algae and rough fish flourish, odors emanate from the lake and the bottom is rapidly blanketed with organic ooze

Some characteristics of the stress phenomenon are: the critical level comes abruptly, it is often beyond the range of human experience and can rarely be foreseen; there are great differences in the functioning of the system before and after the critical level; curative measures - if at all possible - must be drastic.

This phenomenon occurs not only in lake eutrophication, but also in the matter of DDT's effects on bird eggs, extirpation of a species, demands on a water resource and a host of others.

I have in recent years been impressed with frequent examples of the 'curve of stress' operating in society in association with increasing population density. Some examples in south Florida are the increasing crime rate, slowed traffic flow on the freeways, costs of the public educational system, inability of the county government to resolve pressing problems, backlogs in the court dockets and the tax burden.

I am convinced that the numerous stresses in the Everglades are related to the numerous stresses on the people living on the Gold Coast; that the decreasing quality of human life is signaled to us by the sinking viability of the Everglades; that in neither case are the old aims of promotion growth and development compatible with these systems under duress; that there is a possibility of social and environmental forces moving beyond our control.

In this light, I view environment - human ecology - as the number one problem of Florida - in the cities and out - to be dealt with by you who govern our destiny.

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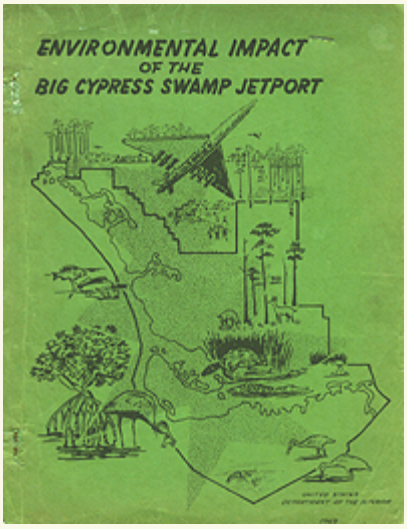
Environmental Impact of the Big Cypress Swamp Jetport

Arthur R. Marshall, 1969

Arthur R. Marshall



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