Final Report

THE SOUTH DADE WATERSHED PROJECT

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SOUTH DADE WATERSHED PROJECT

A POINT IN TIME

Through our lack of vision, or merely through expediency, we have taken water -- one of the most beautiful and useful resources -- and drained it into a ditch. The time has come for us to put back into play this resource and realize that these ditches must be made into amenities and valued as a means to our future sustainability. The vision is that these canals should be part of a network of water that provides recharge to our regional water system, parks for our local communities, and increased flood protection for our neighborhoods.

Allan Milledge, former Chair South Florida Water Management District

This work must be pushed forward so that the quality of life that our great grandchildren will have will at least equal that of our great grandfathers'. This work will be expensive and like an oak tree, take time, but its value within the next few decades will far exceed its cost. A restored heritage and provisions for a sustainable future will set the long term course for South Dade.

Dennis Olle, Chair, Steering Committee South Dade Watershed Project

ACKNOWLEDGMENTS

As with any project of this scope, it is virtually impossible to credit all those who through their inspiration, forethought, and perspiration assisted in this project. It is, in fact, to all of those individuals who have ever thought about the responsibility we all share for the future that this project owes its timeliness.

Of those we must single out, we thank Allan Milledge for his insight and courage in parenting this project during his tenure as Chair of the South Florida Water Management District; Dennis Olle, Chair of the Steering Committee, for his energy and perspective on the long-term viability of all systems; Sam Poole, Executive Director of the South Florida Water Management District, for his understanding of the connection between land planning and water resource protection; Rick Alleman, Biscayne Bay SWIM Manager, South Florida Water Management District, for his understanding and knowledge of the Biscayne Bay watershed; the Community Advisors, Technical Advisors, and Steering Committee members who have served this project; and Howard Odum, for his searching and stimulating perspective on the systems approach to planning.

We would like to recognize co-researcher Mark T. Brown, for his invaluable assistance in defining the scope of this project. Also, Erick Valle and Chris Jackson for their fine contribution to this report, and Patricia Kahn, Bridgett Singleton, and Joel Hoffman for their helpful editorial comments.

We salute Marjorie Stoneman Douglas for her vision, insight, and perserverance on issues that affect us all. This report is dedicated to the future towns, neighborhoods and children of South Dade.

July 1995.

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PREFACE

Human sustainability is directly connected to the sustainability of nature.

Daniel Williams, **The New South Dade Planning Charrette**, 1992.

This report is a product of the South Dade Watershed Project, commisioned by the South Florida Water Management District in cooperation with the Center for Urban and Community Design to analyze the relationship between land and water in south Dade County.

The destruction wrought by Hurricane Andrew on August 24, 1992 has caused us to question many of our basic assumptions about the future. We have been forced by nature to take a hard look at ourselves and to make choices. In this process, we have gained a greater understanding of our connectedness -- our connectedness with each other, our connectedness with South Florida's environs, the connectedness of all things. Through this experience, we are beginning to realize our responsibility and power as individuals and as a community to create a unique vision for South Dade and to actively define our common future.

South Dade's watershed is increasingly recognized as one of the most critical watersheds in Florida. Located between Everglades National Park and Biscayne National Park, this area is expected to receive a very large percentage of the predicted 700,000 new residents that will come to Dade County by the year 2010. These new residents will consume an additional 125 million gallons of fresh water a day from an already stressed local aquifer; build over the last vestiges of our agricultural heritage; and generate a tremendous amount of stormwater runoff, threatening the already limited flood protection for existing residents and further diminshing the quality of water discharged to Biscayne National Park.

It is the challenge of anticipated water resource demands connected with future growth -- especially, the conflicting demands of too much and too little water -- that the South Dade Watershed Project is seeking to address. These efforts are vital to the long-term preservation and protection of our water resources. They are essential to restoring and protecting the qualitity of life and long-term economic viability of South Dade.

We must create a vision of our community's tommorrow.

We must take the incremental steps to preserve, protect, and define our future.

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INTRODUCTION

At significant milestones in time, we take a look at ourselves, our surroundings, and our relationship to one another; and if everything follows the way it has in the past, we rethink what we do, what we are, and why. It is this process that separates us from the birds and bees, the rocks, the geology, the air, the elements -- we learn!

As the Millenium approaches, there has never been a more desperate time to learn than now. As we look to the future of our children and grandchildren -- those whose lives will be affected by the plans we make or don't make today -- we are reminded of an old "but true" tale: in the Orient a master of pottery made clay and buried it for his great-grandchildren. This simple act assured their future. Without this planning there would be no clay, no livelihood, no future generations. It is perhaps an oversimplification to say, but what isn't planned for the future, our children will not have.

Over the last hundred years there has been a notable lack of vision in planning for our country's future. As a people, we have changed from primarily a rural to an urban society. During this time we have created the worst urban sprawl since the beginning of settlements. The irony is that virtually no one wanted this sprawl, yet the roads we build today promise only to produce more of the same.

Perhaps in a world of unlimited land and unlimited resources we could sustain unlimited sprawl. However, South Florida is clearly limited by both the availability of land and the availability of water. This truth is realized today in times of drought and in times of flooding -- yet more and more people migrate to South Florida everyday.

What then are our plans for tomorrow? How will we resolve this conflict of land, water, and future growth?

THE FIRST LAW OF ECOLOGY IS THAT EVERYTHING IS CONNECTED TO EVERYTHING. BARRY COMMONER

NEW CONSTRUCT

In the past there was a false perception of unlimited natural resources. Their apparent abundance, combined with the seemingly limitless abilities of technology, was seen as sufficient to control the consequences of boundless growth. When an environmental problem arose, a technological solution was sought.

In recent years we have begun to recognize that there are limits to all resources and that technological solutions often cause problems greater than those they were intended to solve.

We have begun to experience the negative effects of our unbridled growth. These effects have been revealed in significant ways: inflation, higher taxes, energy and fuel shortages, and water scarcity. They have been revealed even more significantly in the breakdown of whole biological systems threatening the extinction of species and degradation of the very environment we came to live within. Examples include the dramatic decline in the number of wading birds and the threatened extinction of the Florida Panther in the Everglades; the algae blooms and the "Dead Zones" -- areas virtually devoid of life -- in Florida Bay; and the sick coral reefs of the Florida Keys. These are clear signs that human activities have begun to infringe on the processes of nature; the natural production, cycling, and recycling of materials and energy is being short circuited; more is being taken from the environment than is being returned; "natural capital" is declining.

Today, faced with limited resources, a dwindling tax base, and the increasing costs of government, we can ill afford to apply technology indiscriminately. Instead, we must discover how to do more with less and how to successfully design with nature – to ecologically design our human-made communities to take full advantage of the "free work" of natural systems.

To achieve an interactive network of humanity and nature -- a landscape that has a "place" for both the needs of humans and the functions of nature -- requires that planning and design re-orient themselves from providing "more" to a view that there are limits. It then becomes the responsibility of science, planning, and design to discover these limits and work within them. We must put form to a "common vision" and develop incremental strategies on how to get from "here" to "there."

What then are the critical elements in the South Florida landscape that must be taken into account to avoid calamity? What must be repaired and protected to prevent the continued decline in environmental quality and community quality of life? Once we have culled this information, we can begin to envision how we might incorporate development and environment into one system -- what must be undone, and what must be added. It is the mission of the New Construct to understand the science of the region, and to design within the limits imposed by both the natural environment and economics.

We find ourselves in the shoes of our forefathers: their job was to unravel the wilderness of nature; ours is to unfold the wilderness of civilization.

The essentials of the old exploration were actualities; the essentials of the new exploration are potentialities. The old exploration described that which is, while the new exploration projects that which can be. The first was based on descriptive science; the second is based on applied science.

We shall explore, first for the ends, and second for the means: we shall seek first our destination and then the way to get there.

Environment is the product of history.

Benton MacKaye, **The New Exploration**, 1928, 1962, 1990

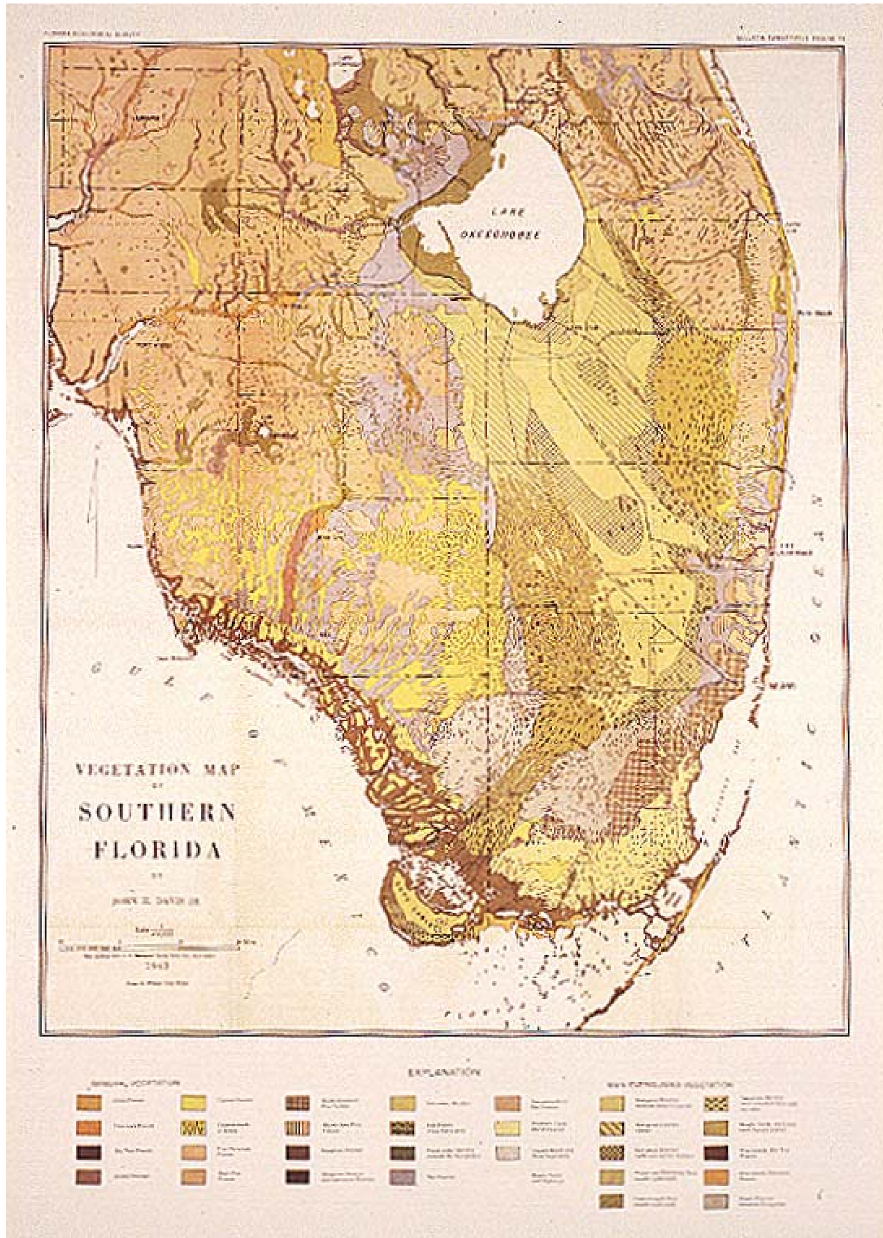
The Davis Map

The 1943 Davis Vegetation Map (p. 15) illustrates the driving forces behind the South Dade Watershed Project. It shows the South Florida system in its natural state, as it existed prior to development. Virtually everything we do is connected, controlled, or reacted to by this environment. This map's inherent value lies in understanding the thousands of years of "research" that brought us the hydrologic and vegetation system we have today.

Since the mid 1800's people have sought to tame this vast interconnected system, with varying degrees of success. However, the existing network of canals -- largely constructed after 1950 -- has allowed development to overtake much of the historic Everglades.

Today, the remnants of the Everglades comprise one of the most complex ecosystems in the world. It drives the life cycle for nature, and the water cycle for the people of South Florida. As water has defined the region, it has also defined the boundaries and the mission of the South Florida Water Management District.

Historically, rainfall from as far north as the Kissimmee chain of lakes traveled via the natural flood plain of the Kissimmee River to Lake Okeechobee -- the second largest freshwater lake in the continental United States. Before the lake was diked to provide flood protection, water would overflow its southern boundary, flowing into the saw grass marshes and tree islands of the Everglades. Some water would filter into the region's vast underground storage reservoir, including the Biscayne Aquifer; some water would be carried east and west to the coastal estuaries of the Gulf of Mexico and the Atlantic Ocean; and in time large quantities of water would slowly travel via the "River of Grass" to the Ten Thousand Islands, Florida Bay, and Biscayne Bay. It is the disruption of this natural flow of water that has led to the decline of Lake Okeechobee, the Everglades and most recently Florida Bay. It is the disruption of this flow that has also seriously impacted the supply of water for all users -- urban, agricultural, and natural.



The Davis Map showing the vegetation system prior to development

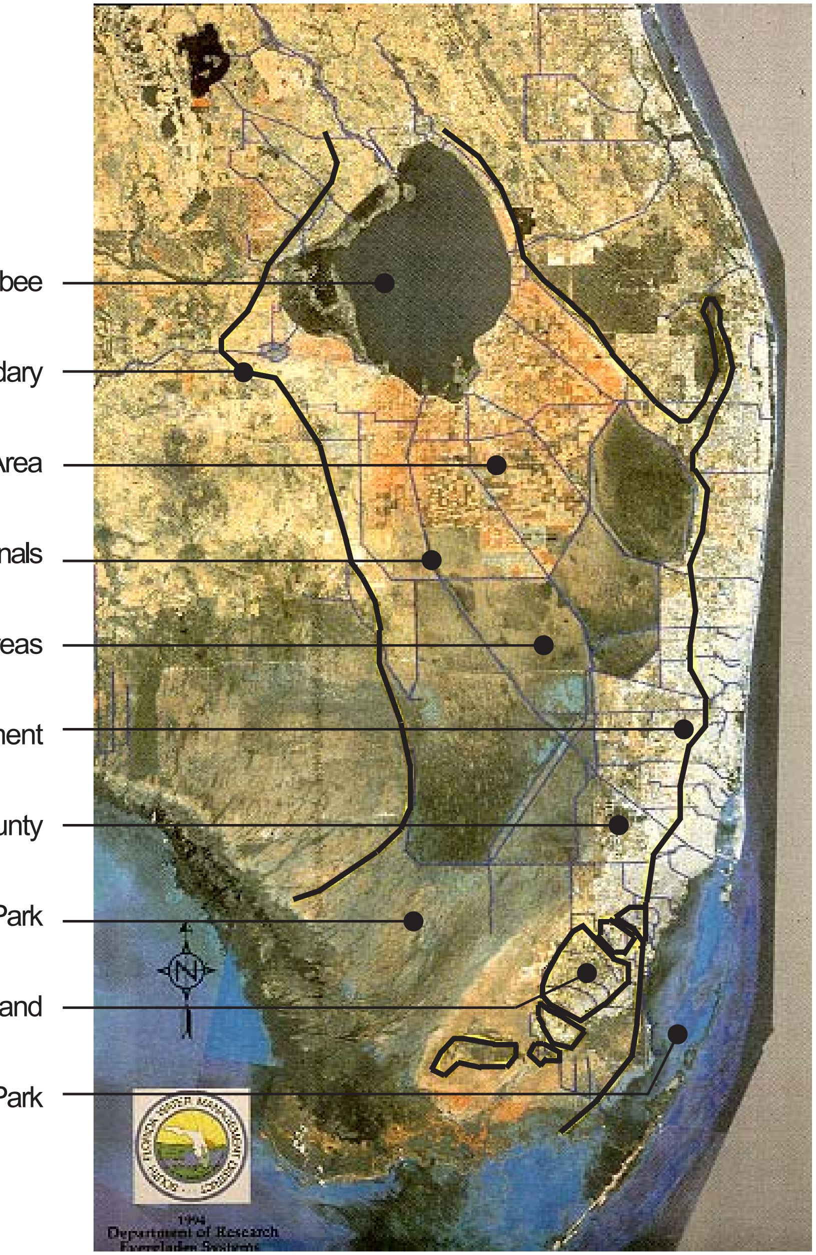
Everything is connected. No qualifications; no exceptions. All deeds have antecedents; all deeds have consequences. Every effect is also a cause, and every cause is also an effect. The actions that we take are like pebbles dropped in a pool: the ripples spread out and away, and no one can know what their effects will be on the far bank.

William Ashworth, **The Economy of Nature**, Boston, New York, 1995.

Satellite Image

A color enhanced satellite image shows the impact development in South Florida on the natural water system (p.17). Overlaid on the image is the generalized historic boundary of the Everglades and the 1500 mile network of canals, which have efficiently drained the area. From this image it can be seen that more than half of the historic Everglades has been lost to urban and agricultural development; and of the remaining 1.9 million acres, a large percentage has been adapted as water conservation areas for water storage and flood protection. The light (orange) area directly south of Lake Okeechobee is the Everglades Agricultural Area (EAA) encompassing approximately 700,000 acres. Agricultural pollution from this area has been a major issue in efforts to restore the Everglades. The lighter (white) areas along the eastern coast indicate the paving over of coastal forms by urban development. The increased stormwater runoff from this development has seriously impacted water quality for all users and resulted in the loss of local recharge of the aquifer -- the underground storage area for our drinking water supply. The draining of this area, though necessary to foster economic growth, will carry a huge cost.

From this image one can also see the unique “bookend” relationship of Everglades National Park and Biscayne National Park to Dade County. The economic benefits reaped from this relationship date to the early settlement of Miami. Unfortunately, we are only just beginning to recognize the true costs and responsibilities that are part of that permanent relationship.



Satellite image showing the impact of development on the natural system

"To grow" means to increase in size by the accretion or assimilation of material. "Growth" therefore means a quantitative increase in the scale of the physical dimensions of the economy. "To develop" means to expand or realize the potentials of; to bring gradually to a fuller, greater or better state. "Development" therefore means the qualitative improvement in the structure, design and composition of the physical stocks of wealth that results from greater knowledge, both of technique and of purpose. A growing economy is getting bigger; a developing economy is getting better. An economy can therefore develop without growing or grow without developing.

"Boundless Bull," Gannett Center Journal, summer 1990, pp. 116-117.

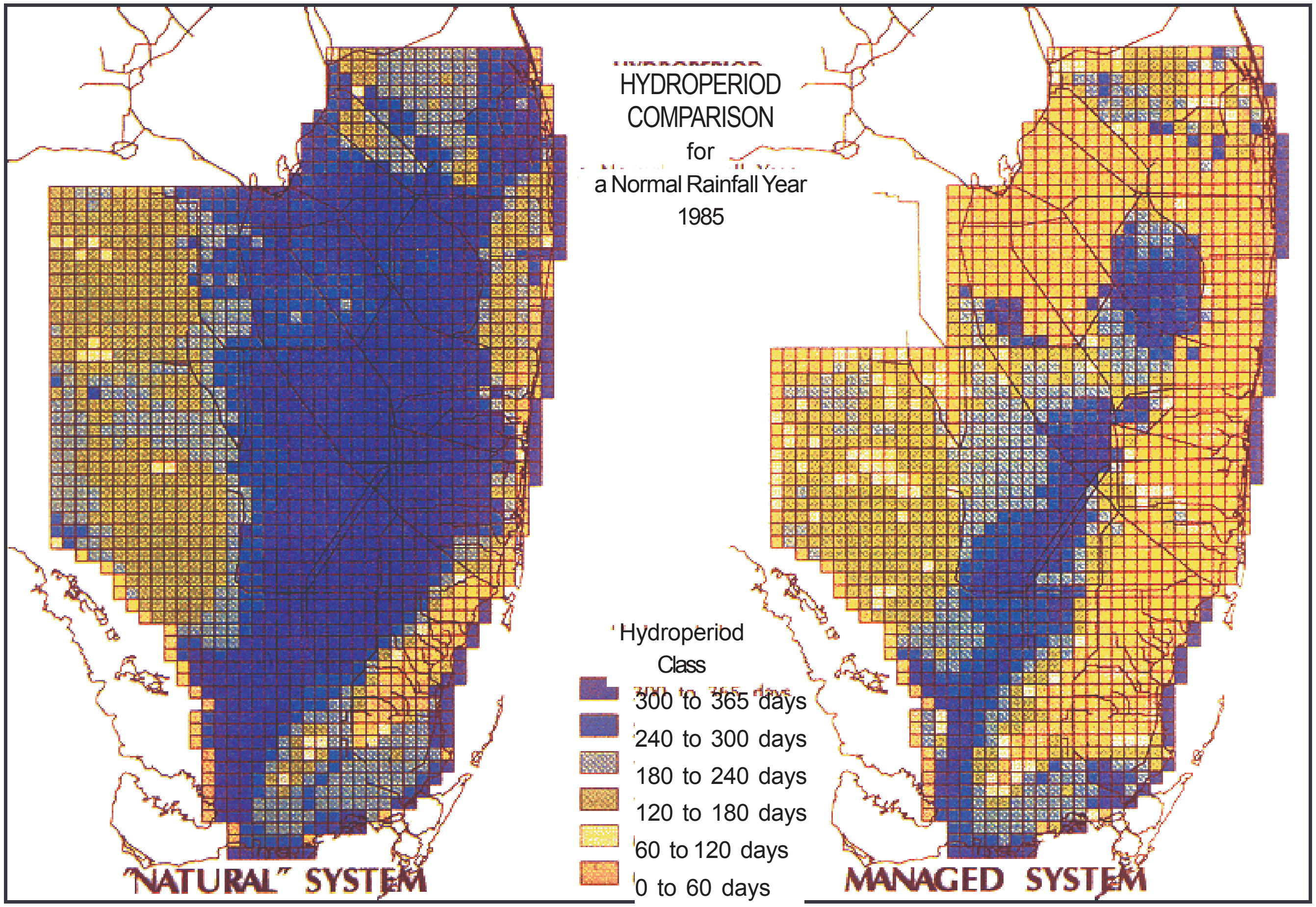
Hydroperiod Map

To illustrate graphically the changes that have occurred in the water regimen of South Florida, two images show the extreme change in hydroperiod, *i.e.*, the surface ponding of water measured in days, in the "natural" system (prior to canals) as compared with the "managed" system (after canals) that we have today (p.19). The darker (blue) zones depict areas that are predominantly flooded, while the lighter (orange) zones depict areas that have little if any flooding.

These images reflect the fact that a significant amount of fresh water has been drained from the Everglades system and discharged to the ocean to provide flood protection for humans. In so doing, this valuable water has been lost for use by humans and the Everglades alike. The further insult is that the untimely and voluminous discharge of this water resource to our coastal estuaries has severely impacted the health of our coastal estuaries. Supporting the base of the marine "food chain," the estuaries – defined by a subtle mix of salt and fresh water – are the nursery ground for most marine species, including shrimp, lobster, and fish of all types.

Over time, water projects have become increasingly complex, expensive to build, and more damaging to the environment.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

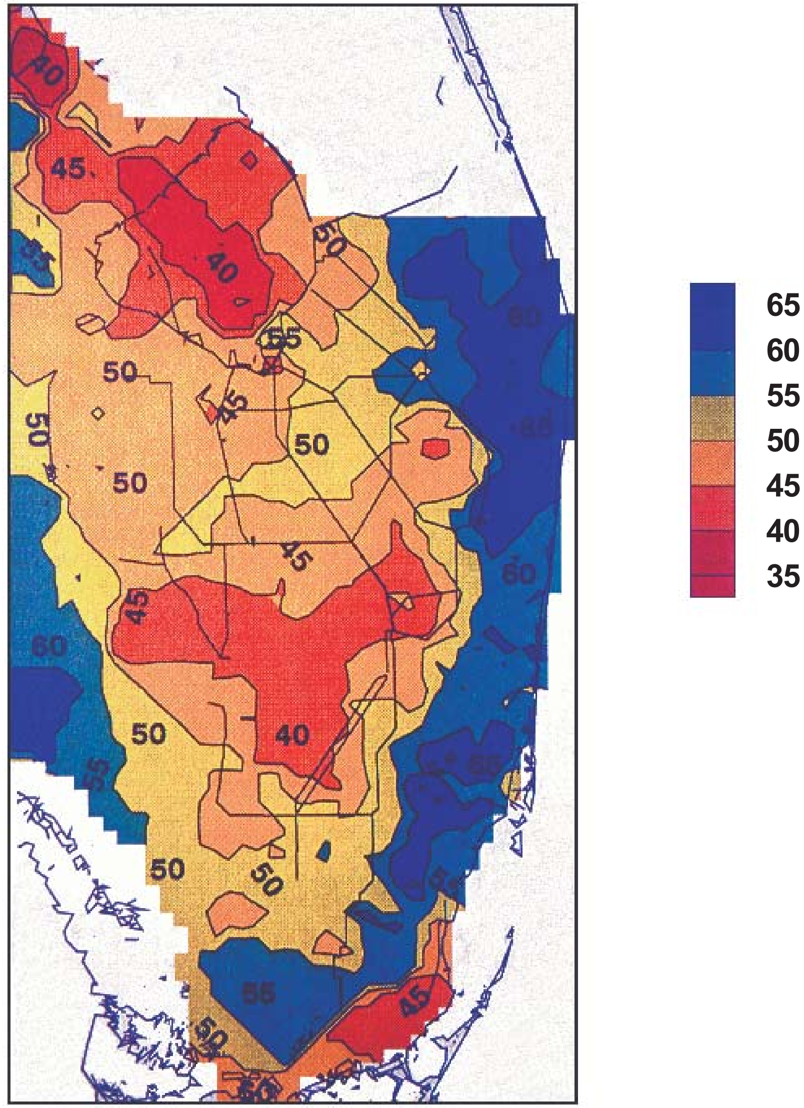


Natural and managed hydroperiod maps showing the changes that have occured in the water regimen of South Florida: SFWMD

Rainfall Map

A map derived from rainfall data over a 29-year period of record (1956-1985) illustrates the spatial distribution of average annual rainfall in South Florida (p. 23). The area of highest average rainfall (55"-65") corresponds to the area of intense development along the east coast; the area of the lowest average rainfall (35"-45") corresponds to the middle of the Everglades. This difference in rainfall pattern is significant in that as the coastal urban form is paved over with buildings and asphalt, less of the rainfall is able to permeate the ground and recharge the aquifer. Instead, the water is collected as highly degraded stormwater runoff and quickly diverted to flood control canals and ultimately the ocean. This loss in local resident recharge of the aquifer, *i.e.*, aquifer recharge at the rainfall location, represents a significant reduction in the total available water supply for all water users: urban, agricultural, and natural. The restoration of local aquifer recharge and water storage in the excessively drained areas of the urban form has been identified by the Army Corps of Engineers as the second largest potential source for storage within South Florida; second only to the maximum potential storage of water within Lake Okeechobee.

AVERAGE ANNUAL RAINFALL



Although water is part of a global system, how it is used and managed locally and regionally is what really counts.

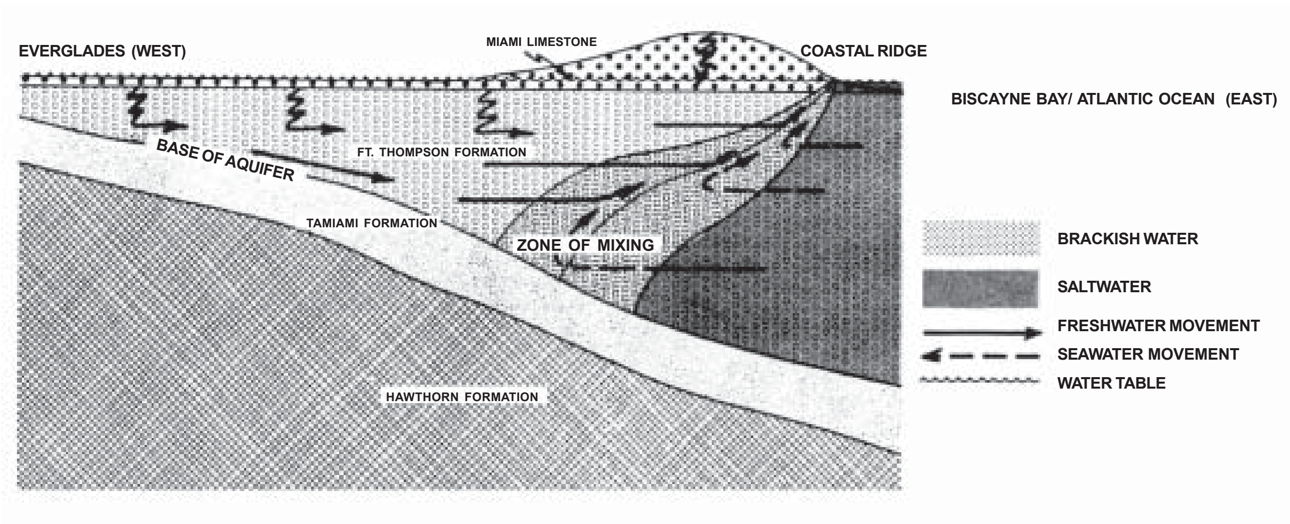
Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

Rainfall map showing spatial distribution of rainfall over a 29-year period: SFWMD

Aquifer Maps

Two maps detail the spatial location of the Biscayne Aquifer (pp. 24-25). This aquifer -- one of the most prolific in the world -- is the only storage of fresh water for public water supply and irrigation for Monroe, Dade, and Broward counties, and much of Palm Beach County. It is designated a "sole source aquifer" by the U.S. Environmental Protection Agency (EPA) under the provisions of the Safe Drinking Water Act – designating the highest protections afforded by federal law. As can be seen in the cross-sectional graphic below, the Biscayne Aquifer is located just under the land surface. Viewed as a wedge, the thickness of the aquifer varies from some 10 feet in the middle of the Everglades -- the most western part of Dade County -- to as much as 200 feet along the coast and the shore of Biscayne Bay.

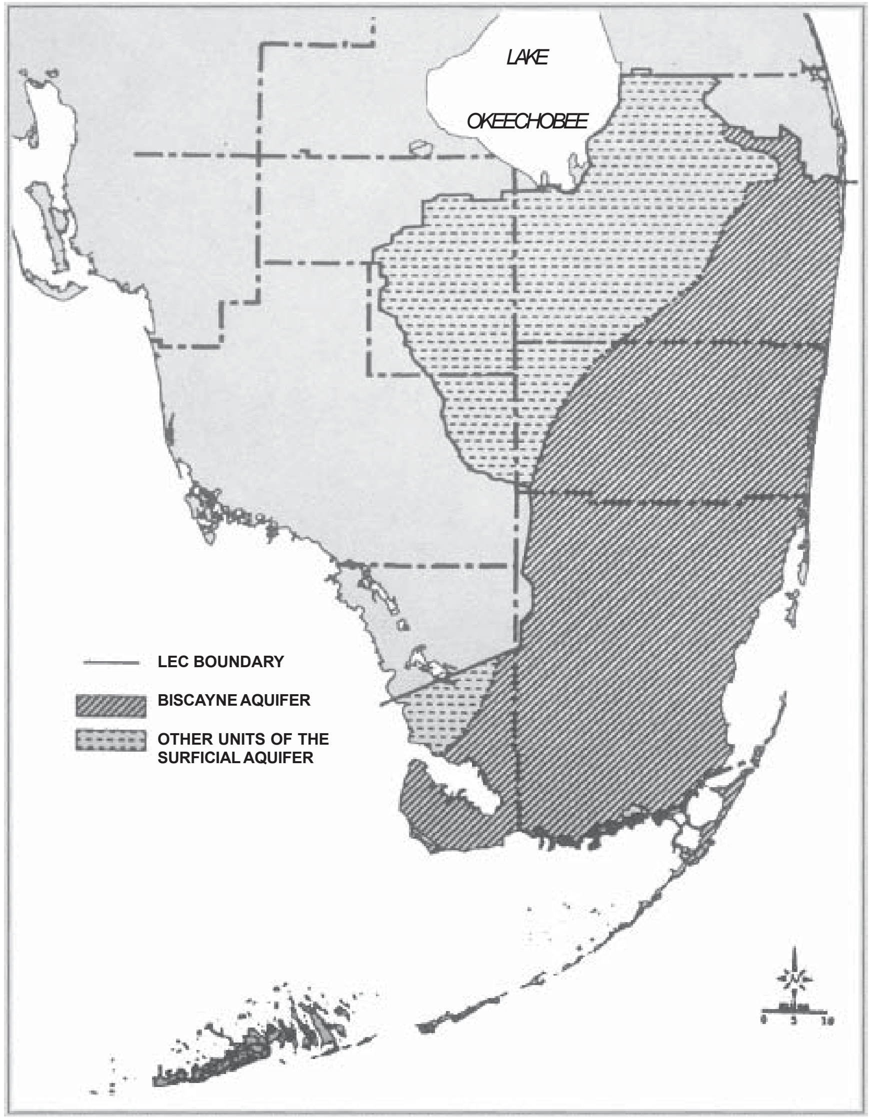
The arrows in the cross-sectional graphic illustrate the recharge of the aquifer from local resident rainfall and surface water from canals, lakes, rivers, and streams – including the “River of Grass.” The arrows also show the movement of water, much like an underground river, through the aquifer. As can be seen, water collected by the aquifer out in the middle of the Everglades moves under the coastal ridge and our coastal communities and eventually flows to Biscayne Bay and the Atlantic Ocean. This underground movement of water is critical to holding back the movement -- in the opposite direction -- of saltwater from the Bay and Ocean to protect our public water supply well fields. It is this continuous flow that helps to maintain a steady supply of the water that is withdrawn daily for our urban and agricultural uses.



Cross Section of the Biscayne Aquifer: SFWMD

However, as our communities continue to grow -- in population and area -- and as we continue to indiscriminately pave over land surfaces, the recharge of the aquifer, locally, will be lost. The impact of this is that we will become ever more dependent for our water supply, on water that is captured and stored in the Everglades. It is this competition for Everglades water -- for flood protection and water supply – that threatens the health of the Everglades and Florida Bay today; it is the increasing competition for Everglades water that will eventually define the limits of the growth of all systems in South Florida. There is only so much and it is not being stored for future users.

A most important point emerges when the two aquifer maps are overlaid upon the preceding rainfall map: we are paving over the recharge area with the greatest amount of rainfall – the coastal urban area - and we are increasing our dependence on water that is recharged in the area of the least amount of rainfall -- the Everglades. Figuratively, we are building on top of our own "water supply hose".



Map of the Biscayne Aquifer: SFWMD

By re-establishing water storage within the land form we effectively create a new supply of water.

South Dade Watershed Project, Workshop, July 1994.

Throughout history, the water cycle has served humans as a model of the natural world. Early civilizations saw in it a figure of the basic pattern of life, the cycle of birth, death, and return to the source of being. More recently, science has added to that ancient religious metaphor a new perception: the movement of water in an unending, undiminished loop can stand as a model for understanding the entire economy of nature.

Donald Worster, **The Wealth of Nature**, Environmental History and The Ecological Imagination, 1993.

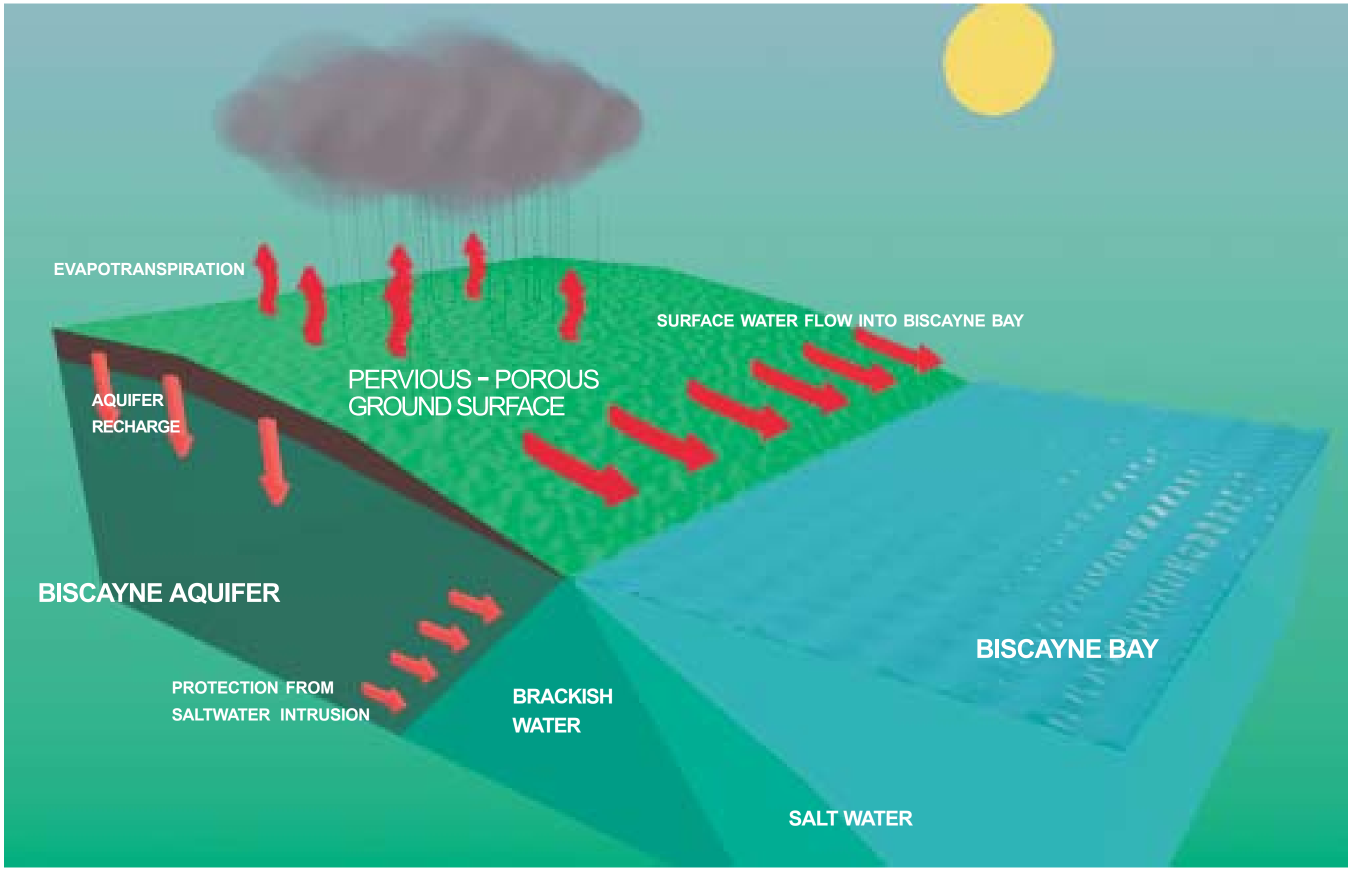


Diagram of the hydrologic cycle prior to development: UM, CUCD

The Natural System vs The Managed System

The hydrologic cycle is the natural cycling of water, where rainfall eventually recycles via evaporation and plant transpiration (evapotranspiration) to create more rainfall. Two conceptual graphics compare the "natural" system prior to development, and the "managed" system after development (pp 24-25). The principal changes to the land form in the managed system are the flood control/stormwater drainage canals, and the paving over of pervious (porous) undeveloped land surfaces with impervious (non-porous) developed surfaces (buildings, parking lots, roads). The combined impact of these two changes are: i) the overdraining of surface and ground water resources re-

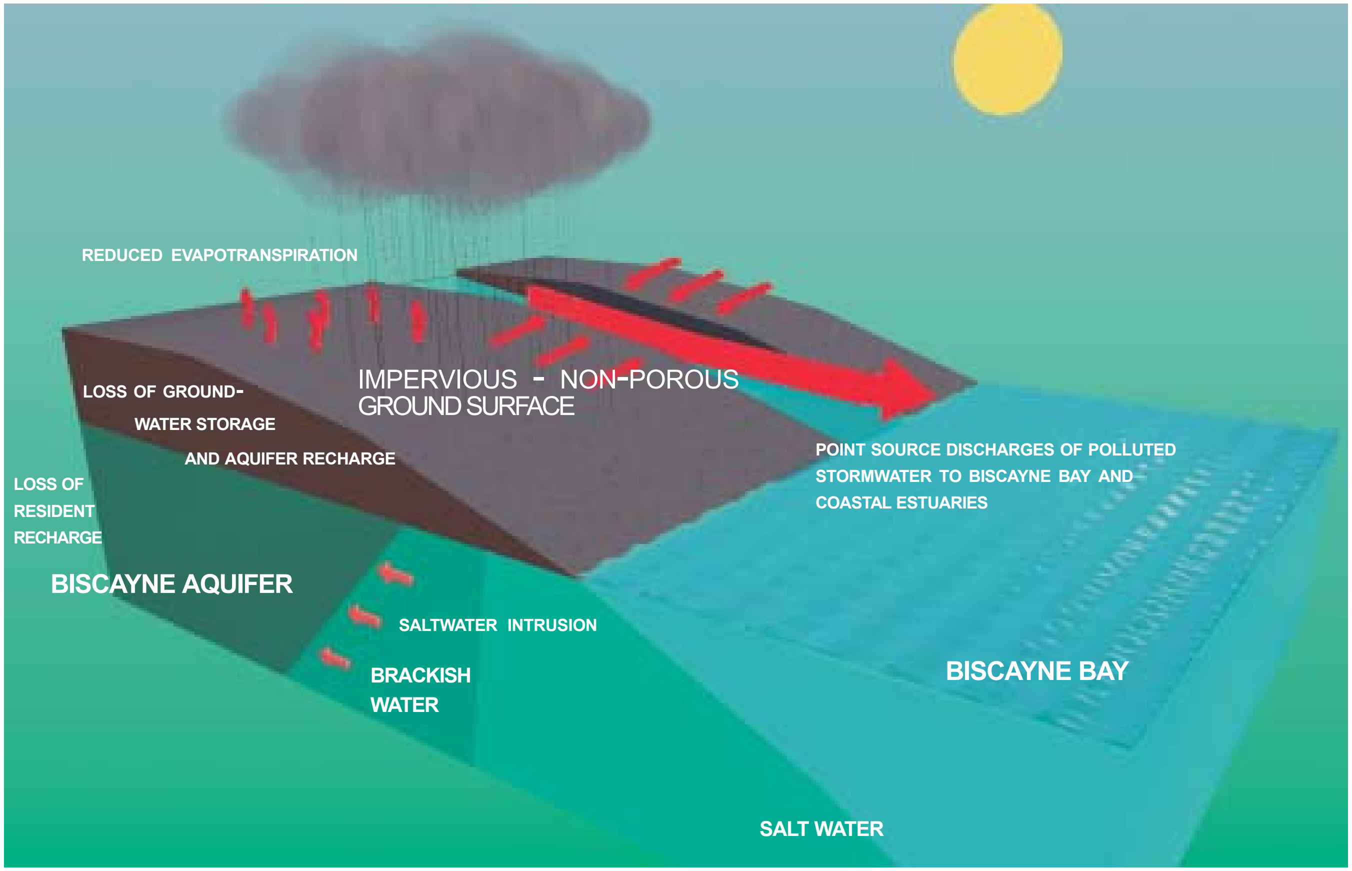


Diagram of the hydrologic cycle after development: UM, CUCD

Protecting water systems depends on regulating the use of those critical areas of land that help moderate water's cycling through the environment. Degradation of the watershed -- the sloping land that collects, directs, and controls the flow of rainwater in a river basin -- is a pervasive problem in rich and poor countries alike.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

sulting in the significant loss of freshwater supplies for all uses; ii) the loss of local aquifer recharge, *i.e.,* the resupply of water used by all users; iii) saltwater intrusion which threatens to pollute our public supply of water; iv) the transformation of clean rain water to highly polluted stormwater which in turn pollutes our aquifer, lakes, canals, and bays; v) large and untimely discharges of stormwater which threaten the health of our fragile coastal estuaries, and; vi) the reduction of local evapotranspiration, the effect of which is unknown. Each of these impacts - arising from the "use of land" - represents a negligent use of water that must be addressed in future planning.

Effects of Urbanization

Stormwater Quantity

As an area urbanizes, streets, sidewalks, parking lots and buildings cover the ground surface. In addition, the process removes natural vegetation and compacts the soil. The land's surface becomes impervious. Rainfall no longer soaks into the ground as readily as before. This causes an increase in runoff and accelerates the speed at which runoff flows (the peak discharge rate).

Historically, the primary concern about stormwater was to remove it from a developed area as quickly as possible after a storm for flood protection. This led to drainage systems that maximize local conveyance and flood protection, without considering other important factors such as off-site damage from accelerated flow, water pollution, or even the loss of a water resource. Other problems include increased channel erosion and flooding, deposition of sediment, flood plain and channel erosion with a resulting loss of property, wildlife habitat, natural vegetation, and total storage capabilities.

In an undeveloped area, a natural stream normally adjusts so that its cross section and slope are in approximate equilibrium. Increased volumes and peak discharge rates of stormwater produce drastic changes in the natural stream channel. Eroded banks and frequent flooding are not only unsightly but cause damage to adjacent property and homes. Structures are undermined, homes are damaged, recreational areas are threatened and aesthetic values are destroyed.

Accelerated channel erosion also creates downstream damages by the deposition of eroded sediment. Lakes and reservoirs fill, storm sewers and culverts become clogged causing flooding; and, areas adjacent to streams and lakes may become covered with mud and debris left after the flood.

Increased stream volumes and velocities, associated with the stormwater from urbanized areas, produce more frequent floods. Areas that previously flooded only once every five years may flood every year, or several times each year. Flood plain erosion and damage to structure and vegetation also increase.

Stormwater Quality

Land use directly affects water quality. In an undeveloped area, natural physical, chemical, and biological processes interact to recycle most of the materials found in stormwater. As human land use intensifies, these processes are disrupted and everyday activities add materials to the land surface. Leaves, litter, animal wastes, oil, greases, heavy metals, fertilizers, and pesticides *are washed off by rainfall and are carried by stormwater to our lakes, rivers and bays. These materials can create high pollutant loadings of:*

Sediment *which clogs waterways, smothers bottom living aquatic organisms and increases turbidity.*

Oxygen demanding substrates *which consume the oxygen in water, sometimes creating an oxygen deficit that leads to fish kills.*

Nutrients *(nitrogen, phosphorus) which cause unwanted and uncontrolled growth of algae and aquatic weeds like hydrilla or hyacinths.*

Heavy metals *(lead, cadmium, chromium, copper, zinc) which can disrupt the reproduction of fish and shellfish and accumulate in fish tissues.*

Petroleum hydrocarbons *(oils, greases) which are toxic to many aquatic organisms.*

Coliform bacteria and viruses *which contaminate lakes and shellfish waters and prevent swimming and harvesting.*

Excessive fresh water *which changes the salinity of estuaries, alters the types of organisms which live in estuaries, and disrupts this important nursery area.*

Stormwater is the major source of pollutants to Florida's lakes, estuaries and streams. Improved stormwater management will reduce pollution loads from new developments and from old stormwater systems that were built primarily for drainage.

Excerpt from ***Stormwater Management: A Guide for Floridians****, DEP.*

Average Rainfall Graph

A graph derived from data over a 74-year period of record from 1915 to 1989 shows the variability in average annual rainfall for all areas within the 16 county area of the South Florida Water Management District (p. 31). The line running horizontally across the graph represents the 52" average annual rainfall for the region; the vertical bars reflect the measured annual rainfall for each individual year. As can be seen from the graph there is tremendous variability in the measured rainfall from year to year, from a low of 35" in 1962 to over 70" in 1970. In fact, dry years have occurred as frequently as wet years, and there are relatively few years of so called “average” rainfall. This extreme variability, raises serious questions as to the set of conditions upon which a management program should be based: flooding, droughts or somewhere in between. Also, it is this variability that, from time to time, reveals the engineering “real world” design limitations of our managed canal system. Witness: Tropical Storm Dennis in 1981 and the 26" of rain that fell on Dade County in just 7 days; the drought of 1989-1991; and just last year, 1994, Tropical Storm Gordon and the more than 80" of rain that fell in some parts of South Florida.

This engineering frenzy has embodied the [false] hope that, by controlling an ever greater portion of nature's water cycle, humanity could be freed from the constraints posed by rainfall's unequal distribution in place and time.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

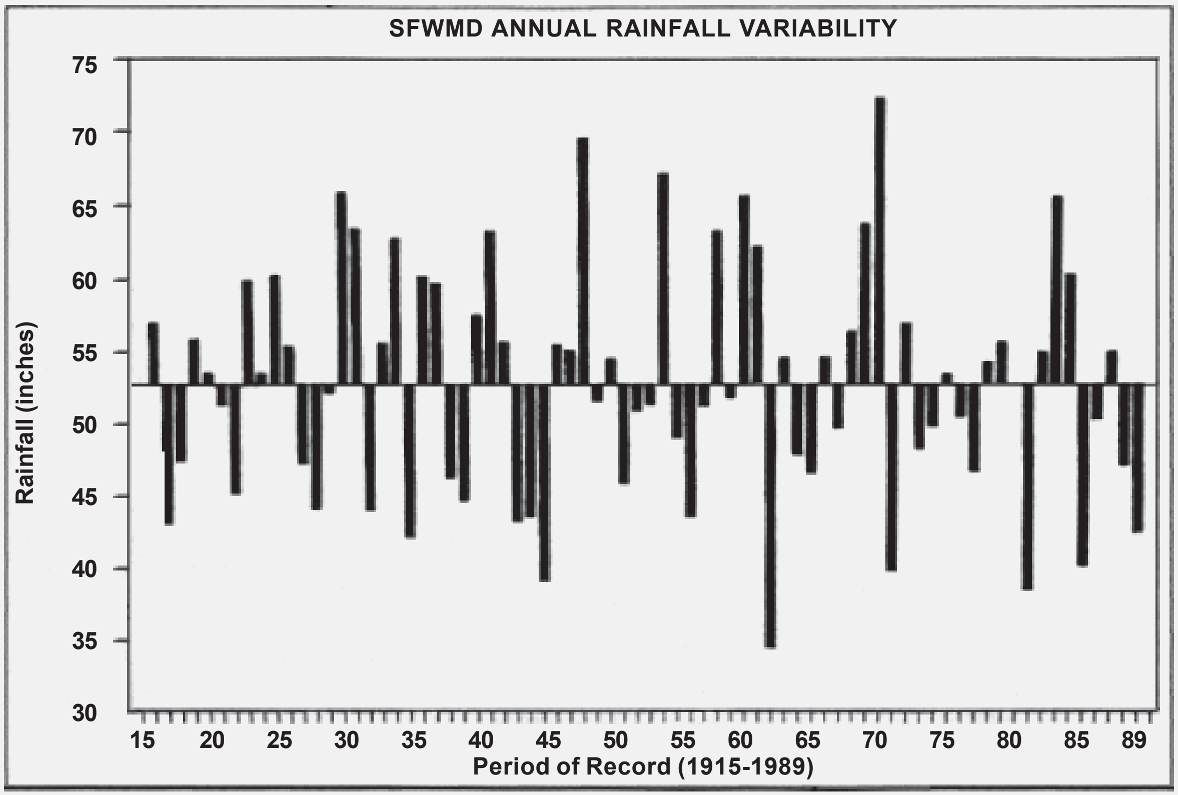


Figure I-6. Variation from Annual Average Rainfall within the South Florida Water Management District. (Source: SFWMD, 1991)

Graph comparing average rainfall to yearly totals

Seasonal Rainfall

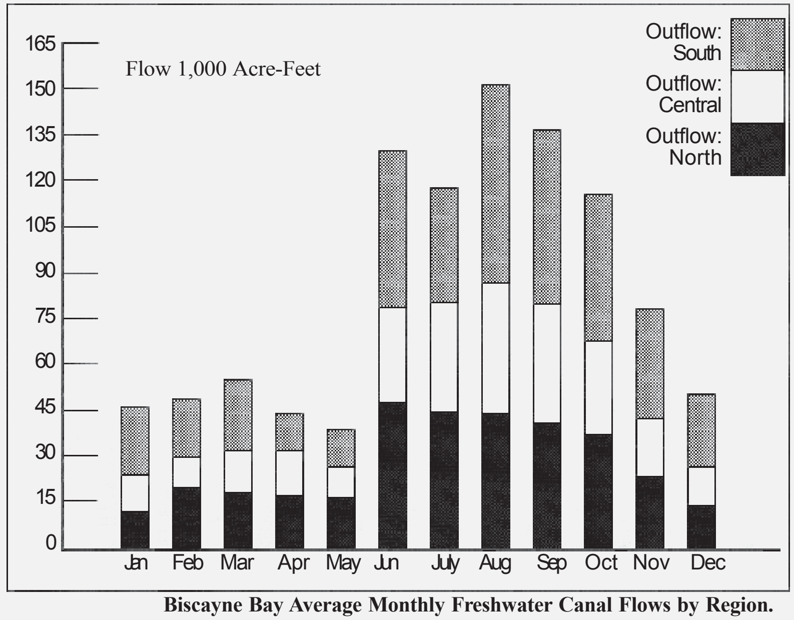
Two graphs speak to the seasonality of rainfall in South Florida: a wet season that runs typically from May through October, when we receive two-thirds of our rainfall, and a dry season that runs typically from November through April. These graphs also reveal the dilemma we face in satisfying our conflicting need for flood protection and water supply -- the need to get rid of too much water and the need to save water.

The top graph represents canal discharges into Biscayne Bay. Predictably the largest outflows occur during the rainy season. What is perhaps less obvious is the fact that the canals continuously discharge water year round. This occurs, in part, because water flows down hill, *i.e.*, the canals were designed with a slope to get rid of water. The other reason has to do with the water level in the canals, the soils, the hydrology and the continuous movement of water through the aquifer.

The bottom graph is a generalized plotting of supply and demand for water. It compares the annual supply of water coming from rainfall (the solid line) with the annual evapotranspiration and water supply demands (the dashed line). Not surprisingly, the shape of the rainfall curve mirrors the wet and dry seasons curve shown in the canal discharge graph just discussed. The demand curve, although similar in shape, is out of phase with the rainfall curve. What these two curves show is that the demand for water exceeds the supply of water during the dry winter months, and that the supply of water exceeds the demand for water during the wet summer months. In other words, we have a tendency to deplete our water supply during the winter, and to recharge our water supply during the summer.

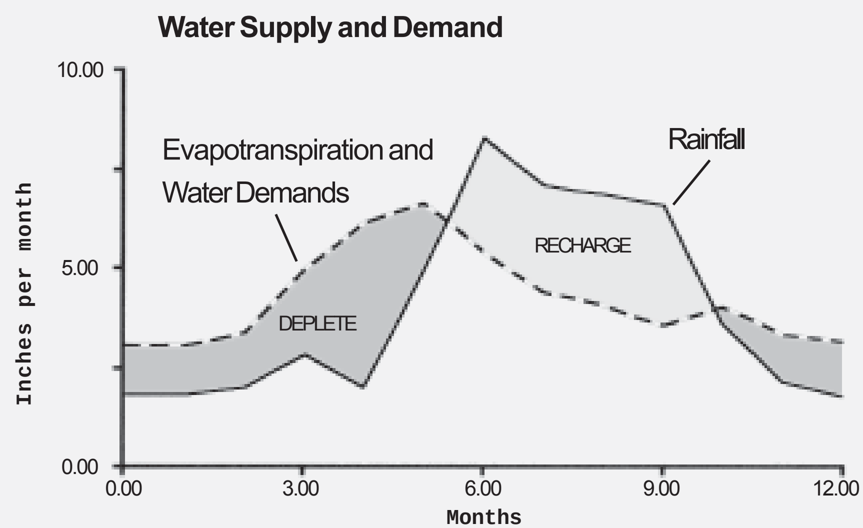
Also, it is interesting to note that the amount of depletion is almost equal to the amount of recharge. Unfortunately, this fact does not hold true in the real world. The reason is that, as we have previously discussed, we have lost much of our ability to recharge the aquifer with local resident rain (remember, we're building on our "water supply hose"), and as we have just learned from the canal outflow graph, the excess water is readily discharged to the Bay.

The critical agenda is thus to increase our storage of water during the wet months and decrease our loss of water during the dry months. By reclaiming the storage of water under the coastal ridge we can buffer the effects of seasonal rainfall and the extremes of nature. In addition, we must recognize that the rainfall and storage within the region is that region's budget *i.e.,* supplies from outside the region are "borrowed" and cannot be counted on during times of drought.



Biscayne Bay Average Monthly Freshwater Canal Flows by Region.

Graph illustrating the flow of water through the canals: SFWMD



Conceptual graph comparing supply of rainfall to the demand for water: SFWMD

The flood control canals which have permitted the intense development of South Florida have effectively drained 30% of the region's water supply to the ocean.

Allan Milledge, SFWMD Governing Board, **South Dade Watershed Project Workshop**, July 1994.

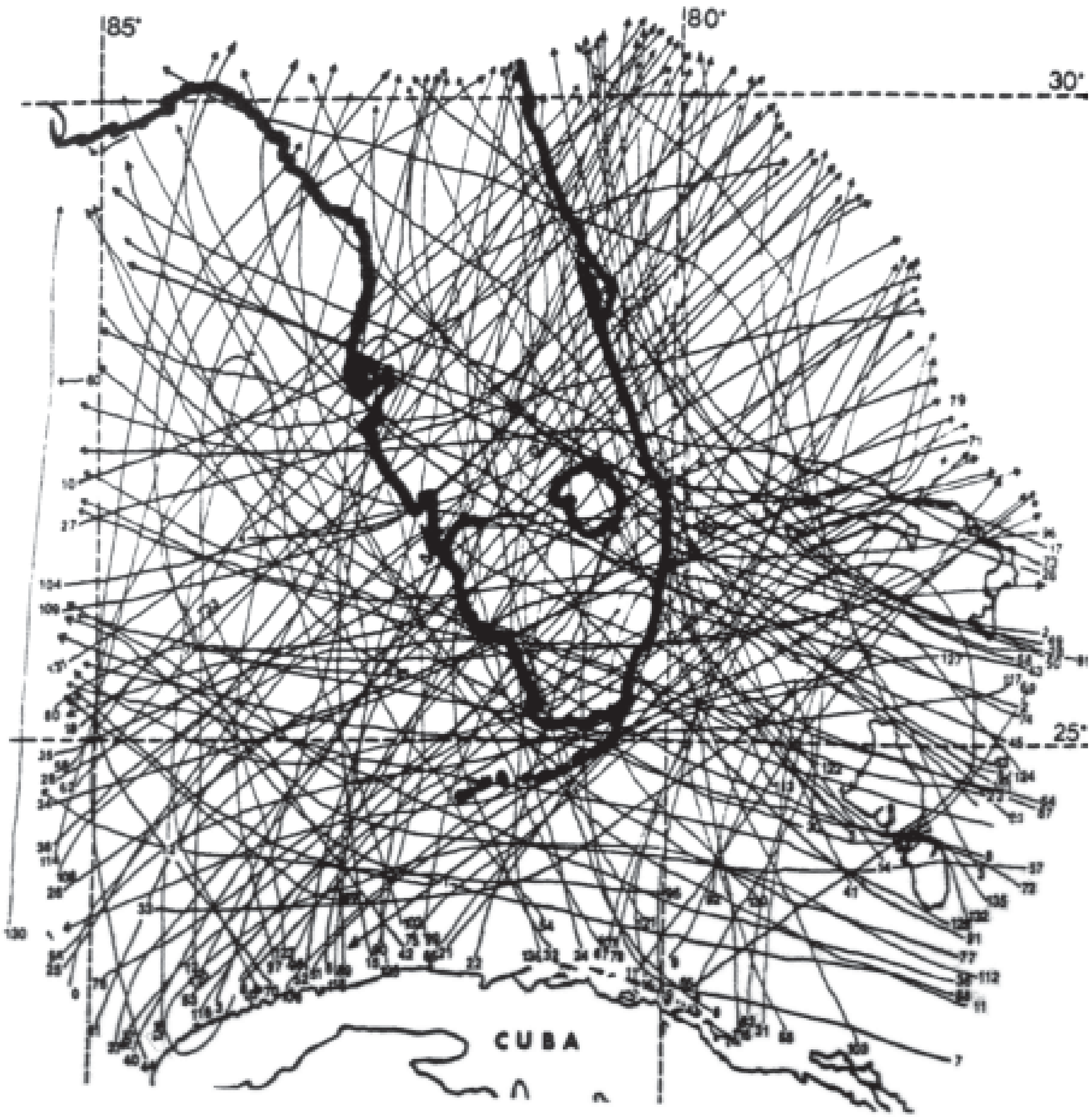
South Floridians learned a lot from Hurricane Andrew. One key lesson: The storm was a natural event, but it was a man made catastrophe. That is, most of the lives lost and much of the $25 billion or more in property damage – could have been prevented.

To Tame a Hurricane, Miami Herald, Editorial, March 23, 1995.

Photo: SFWMD

Hurricane Climax System

Much like in a natural system, an urban system is changed and rearranged by natural disasters. On August 24, 1992, such a rearrangement was made in South Dade by Hurricane Andrew. A similar rearrangement occurred in the floodplain of the Mississippi River as a result of intense rains and flooding in 1994. To avoid future loss of life and property, entire communities of people living along the Mississippi River have been permanently relocated out of the floodplain. In our rush to rebuild South Dade, however, we did not heed the threat of future disaster, and we have rebuilt many of our coastal floodplain communities. In making our plans for the future we must not repeat the mistakes of our past.



There have been 761 North Atlantic storms of at least tropical storm intensity in the 92 year period of record from 1886 through 1977. A large majority of these storms have impacted the climate of South Florida.

South Dade Watershed Project, Workshop, July 1994.

South Florida's Everglades and coastal areas, clearly already under stress, face an unusually difficult problem in the light of global climate change. Both are already vulnerable to sea level rise and intense tropical storms. Climate change could increase the current vulnerability to these events. Climate change may also result in a hotter and drier climate for South Florida. Whatever occurs, the future is likely to be increasingly stressful for South Florida. Cities are likely to continue to grow and will almost certainly be protected from sea level rise, but the expense of protecting them could be immense.

S. Light, L. Gunderson, and C. Holling, **The Everglades: Evolution of Management in a Turbulent Ecosystem**, unpublished manuscript, 1993.

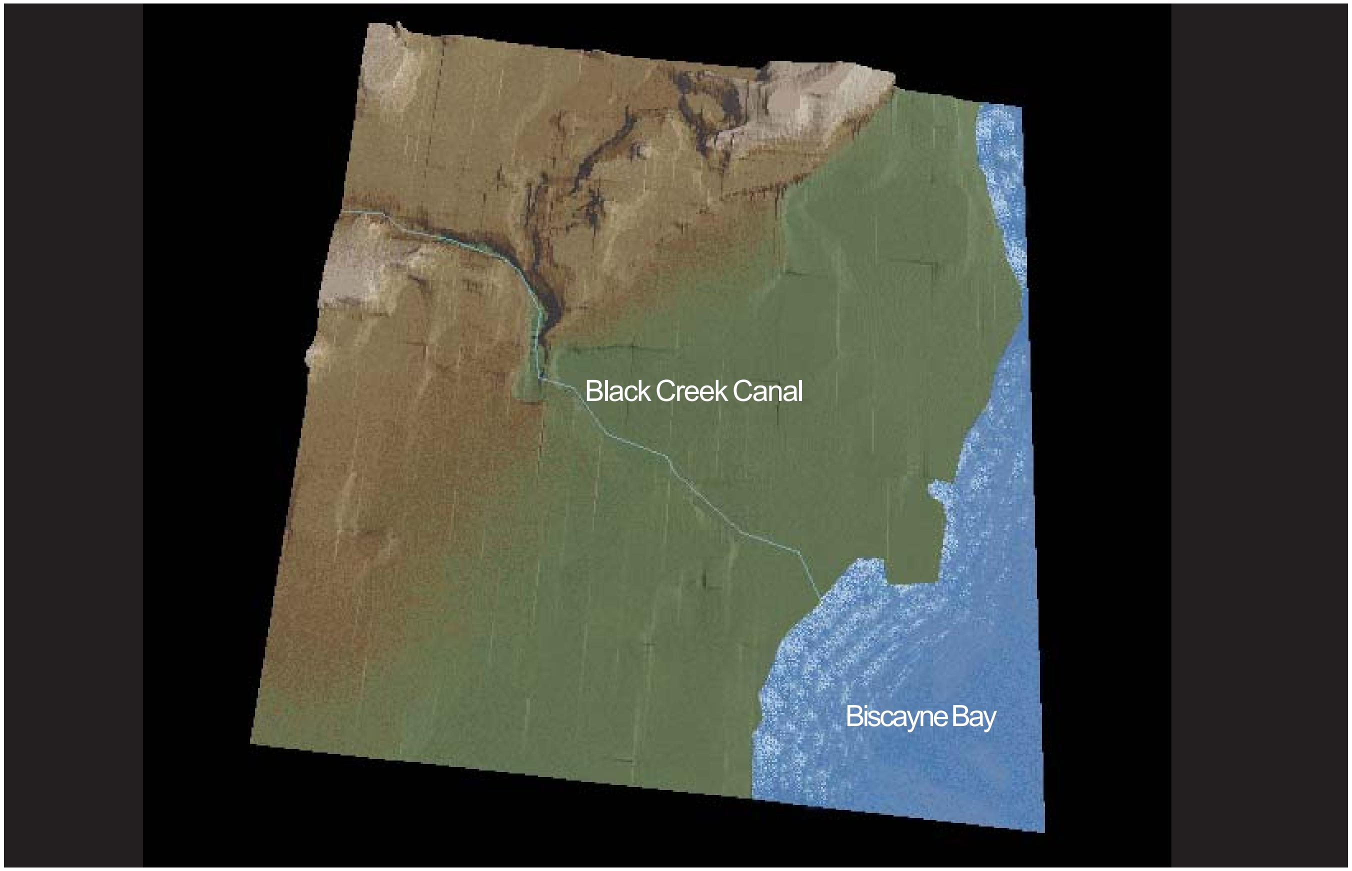


Figure: UM, CUCD

The Rising Sea Level

Two images represent what will happen to the coastal area in South Dade around Black Point if, as predicted, the sea level rises 72" within the next few hundred years (pp. 36,37). As the second graphic shows, if this prediction is realized, over two miles of the coastline will go under water (the dotted line indicates the current coastline) and the areas along the Old Cutler Slough -- today Old Cutler Road -- will be restored as coastal wetlands. This message is not intended to create panic. Our intent is to bring attention to the need to understand our human activities in the context of the larger environment, and to make plans that respect what we have "learned" about the region's naturally occurring systems.

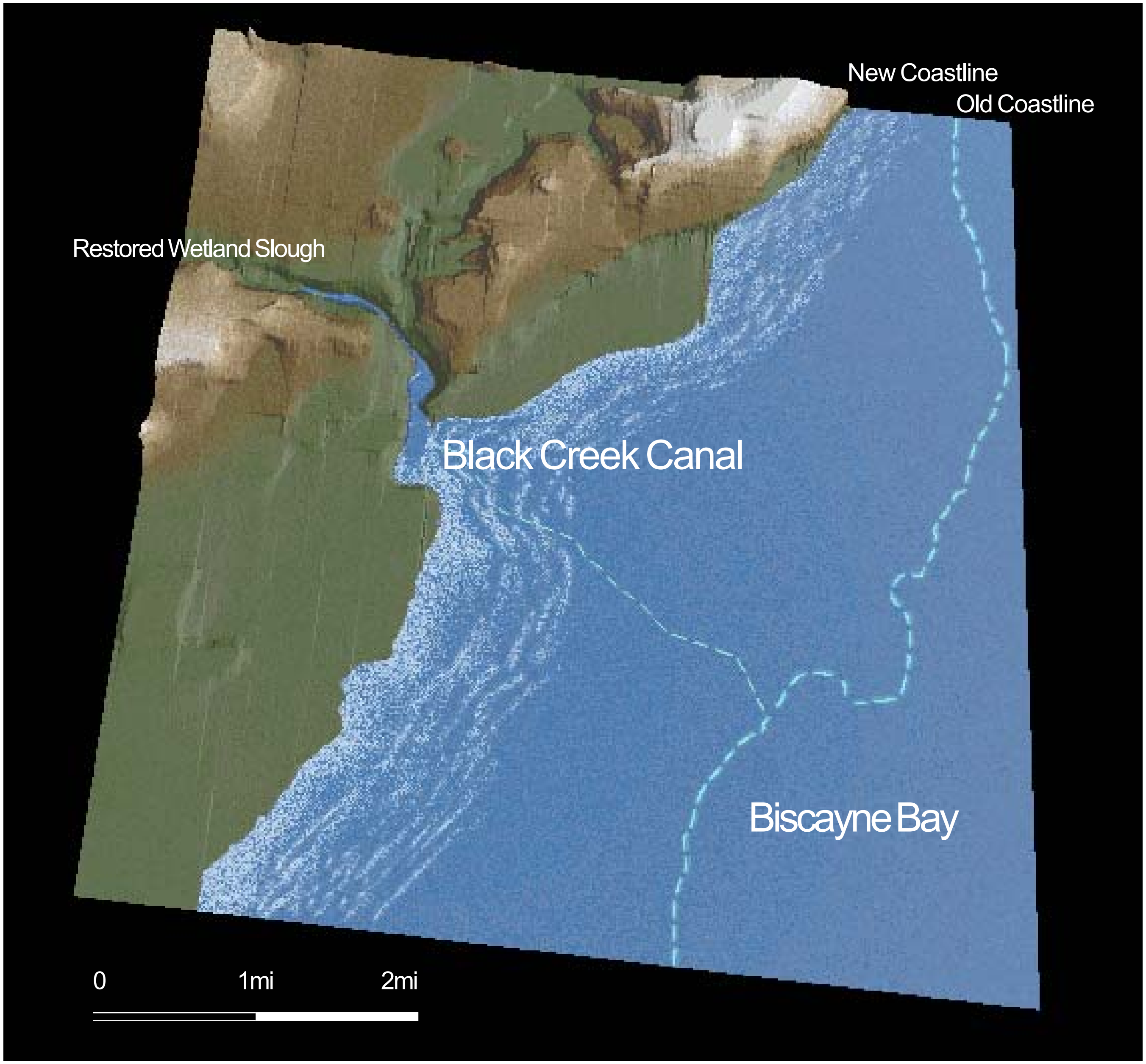


Figure: UM, CUCD

The destiny of humans cannot be separated from the destiny of earth.

Thomas Berry, as quoted in Philip Shabecoff, **A Fierce Green Fire**, The American Environmental Movement, 1993.

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.

Governor's Conference, 1972.

One of the greatest challenges to planning for protection of the Biscayne Bay watershed is the regional population growth expected in the near future. It has been estimated that in the next 15 to 20 years, the population of South Dade may grow by 0.5 to 1.2 million people. The tendency will be for new development accompanying this influx of residents to sprawl towards the southern and western reaches of the county. This sprawling development will increase demands on freshwater supplies and create impervious surfaces contributing to stormwater runoff and sealing off valuable aquifer recharge areas. This growth will also create pressure to expand the Urban Development Boundary (UDB) beyond its present location. However, the area's ability to accommodate growth is limited by the natural environment. For instance, western and southern Dade County are prone to flooding, and the area's freshwater supplies are at risk of contamination. Furthermore, increased urban and agricultural development in the far western reaches of the county may negatively impact water deliveries to Taylor Slough and Florida Bay.

DeGrove, Regalado, **South Dade Watershed Project**, 1994.

With little or no [water] resources available from outside sources, the carrying capacity in South Dade is probably more on the order of 70,000 people. With moderate availability of outside [water] resources, the carrying capacity is probably on the order of 350,000 people. And under full development to intensities characteristic of Dade county, the population level would be over 1.7 million people. Which scenario is appropriate for South Dade, depends on global and national economies, and the degree to which the area is integrated into them.

Mark Brown and Sergio Lopez, **Carrying Capacity of South Dade County**, 1994.

Understanding the Limits

The various maps, graphs, models, drawings, and photos discussed so far have been presented to establish a better understanding of the science that drives our region: to understand the limits imposed by our natural environment.

These limits have been significantly redefined by the development of South Florida, in particular the re-engineering of hydrological systems and the overdraining of the Everglades and coastal land forms.

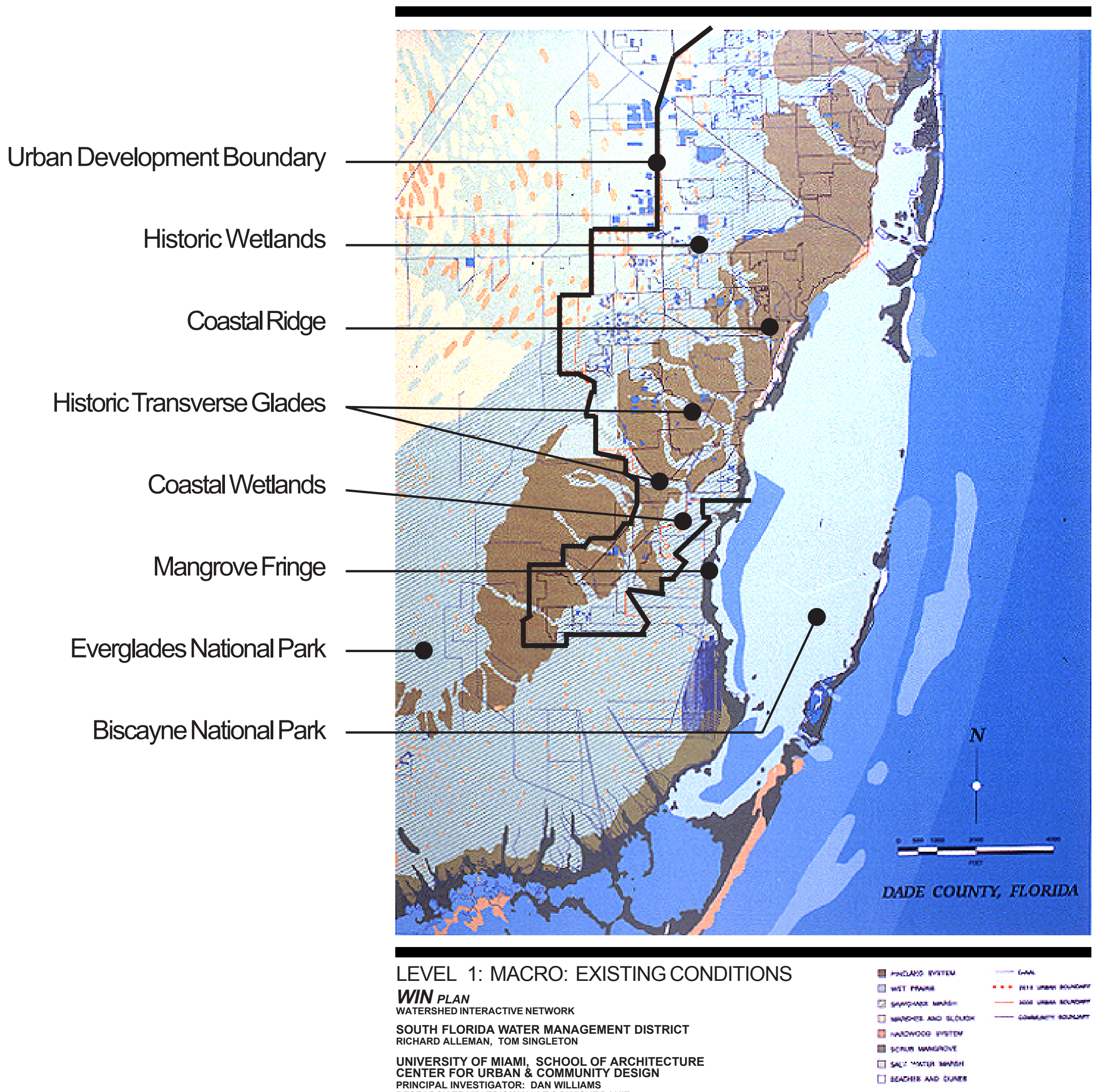
Regional Connections and Local Opportunities

This next section of the *New Construct* will apply the regional principles of land and water that we have discussed so far to the project study area of South Dade. To understand the forces that drive South Dade, we will start once again with the Davis Vegetation Map.

The map to the right shows the Dade county portion of the Davis Map. The broad dark (brown) area, running almost the full length of the county, is the pine upland that characterizes the coastal ridge of South Florida. This well-drained area was the only "high and dry" land in Dade County suitable for development at the turn of the century. It is along the coastal ridge that the early settlement of Miami began, where Flagler built his railroad, and where U.S. 1 is located today. The lighter (green and orange) areas depict various low-lying wetland vegetation systems that were once part of the historic Everglades system. These areas are poorly drained and, even today, periodically flooded. The thin dark (green) area running along the coastline, and encompassing the barrier islands, including Key Biscayne and Miami Beach, represent coastal mangrove communities that once dominated the Florida coastline.

You will note the lighter (green) areas transect the coastal ridge at various points in the county and especially South Dade. These wetland areas, known as "transverse glades," historically provided a hydrological connection between the Everglades and Biscayne Bay. Collecting rainwater from the coastal ridge, and from time to time, floodwaters from the Everglades, these areas contributed to the surface (overland) and sub-surface (aquifer) flows of freshwater necessary to sustain the coastal estuary of Biscayne Bay. Today, the transverse glades are transected by water management canals that were designed to provide flood protection for agriculture (*i.e.,* pervious/porous undeveloped land as opposed to impervious/nonporous developed land characteristic of urban development). Besides disrupting the historic flow of freshwater to Biscayne Bay and over-draining valuable groundwater resources stored in the Biscayne Aquifer, these canals provide limited flood protection for the existing residents of South Dade. They are not, however, designed to provide flood protection for the intensity of urban development that is likely to overtake South Dade in the next 15 years (Miami Herald quotation, p. 43).

Overlaid on the Davis Map is the Metro-Dade County 2010 Urban Development Boundary (UDB), which is shown as a solid black line. This line defines where urban development can and cannot occur. Since the UDB was first adopted by the County in 1975, population growth has continuously pushed the line further and further west to the Everglades and south into South Dade. This line will expand even further with predicted growth in Dade County. By overlaying the Davis Map and the UDB line you can see that almost two-thirds of the development in North Dade has occurred in historic Everglades; and in South Dade you can see where development is encouraged even today along the coastal wetlands of Biscayne Bay.



Existing conditions at a regional (macro) scale: UM, CUCD

Think we're overcrowded?

Just wait

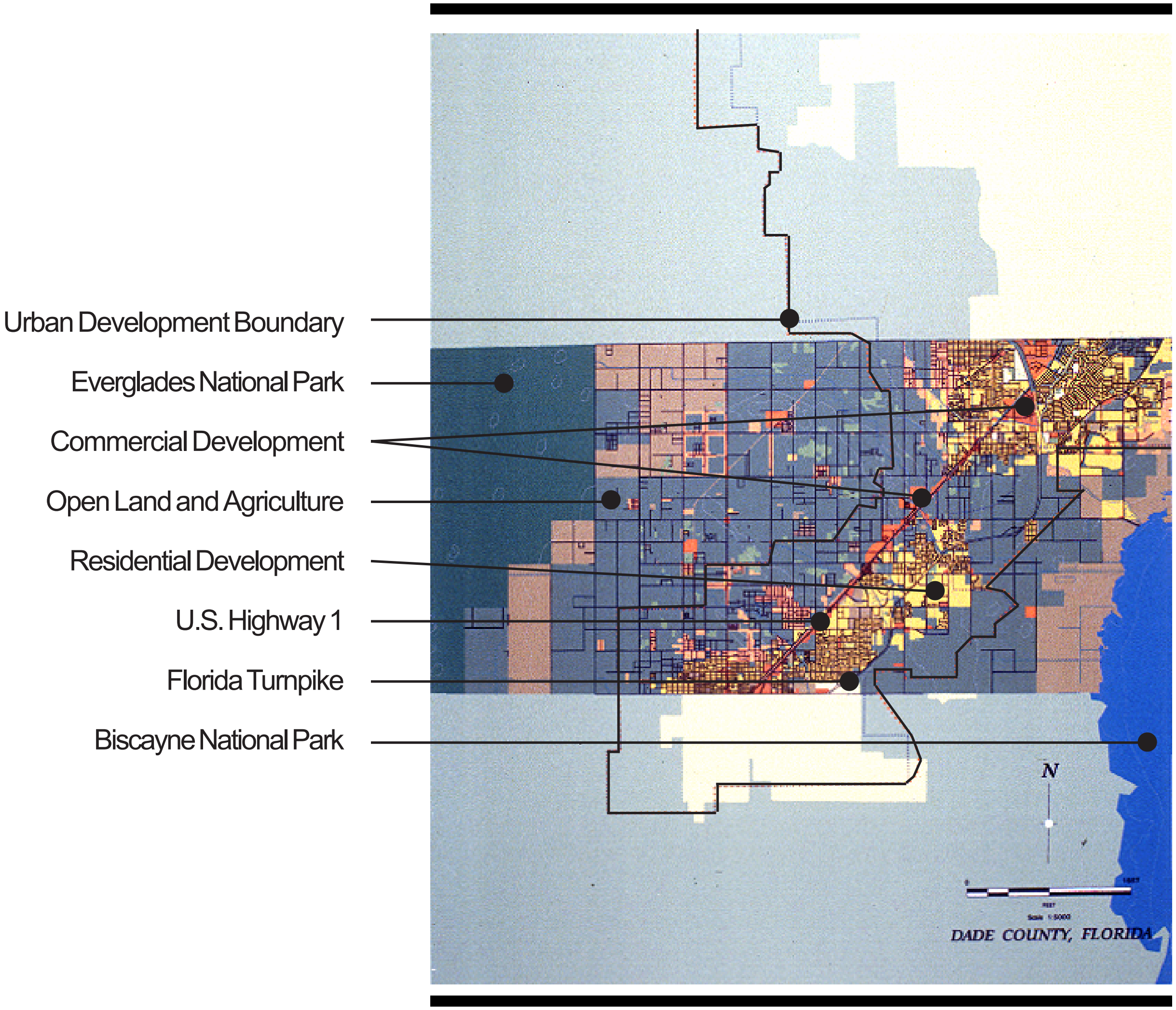
Dade Study predicts 35% growth by 2010...The projections forecast 700,000 more residents by the year 2010, an increase of 200,000 over previous calculations. It reflects the demographers new belief that the only constant in Dade's future will be change...Each of the 700,000 new residents is expected to use an average of 179 gallons per day, or together about 125 million gallons a day...Given the current restrictions on the Biscayne Aquifer, said Tony Clemente, director of the Miami-Dade Water and Sewer Department, "The cost of water is going to double in 2010."

The Miami Herald, March 23, 1995.

South Dade Watershed Project - Study Area

The map on the facing page illustrates the study area of the South Dade Watershed Project. Encompassing approximately 160 square miles, the northern and southern study boundaries correspond roughly with the path of Hurricane Andrew. The map details existing landuse, roads, and the 2010 Urban Development Boundary (UDB). The lighter areas located along U.S. 1 and proximal to the Florida Turnpike represent commercial (red) and residential (yellow) development. These two developed areas comprise approximately 20% of the study area. The balance of the study area consists of open land and agriculture (green). It is this undeveloped land -- some of the last remaining vacant land in Dade county -- that is expected to receive the largest percentage of the predicted 700,000 new residents who will move to Dade by the year 2010. As cited previously in the *Preface,* these new residents will consume an additional 125 million gallons of freshwater from an already stressed aquifer; build over much of the agricultural heritage of the Redland; require additional flood protection; and further impair the quality of water flowing to the Biscayne Aquifer and Biscayne National Park.

Without proper planning, the demands of future development on the land and water resources of South Dade could create the “Frog Ponds” and “Florida Bays” of tomorrow. Therefore, as we plan for the eventual buildout of South Dade, we must build solutions rather than problems. We must respect the connectedness of all things. We must look for a natural “fit” between all uses of land and water.



LEVEL 1: MACRO: STUDY AREA

WIN ***PLAN***

WATERSHED INTERACTIVE NETWORK

SOUTH FLORIDA WATER MANAGEMENT DISTRICT
RICHARD ALLEMAN, TOM SINGLETON

UNIVERSITY OF MIAMI, SCHOOL OF ARCHITECTURE
CENTER FOR URBAN & COMMUNITY DESIGN
PRINCIPAL INVESTIGATOR: DAN WILLIAMS
RESEARCH TEAM: ERICK VALLE & DWIGHT DANIE

Study area: UM, CUCD

As Lewis Mumford once insisted, the new turn of events means that "all thinking worthy of the name must now be ecological, in the sense of appreciating and utilizing organic complexity, and in adapting every kind of change to the requirements not of man alone, or of any single generation, but of all his organic partners and every part of his habitat.

Donald Worster, **The Wealth of Nature**, Environmental History and The Ecological Imagination, 1993.

Falling freely from the sky, water has deluded us into believing it is abundant, inexhaustible, and immune to harm. The challenge now is to put as much human ingenuity into learning to live in balance with water as we have put into controlling and manipulating it.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

Photograph of the Everglades: SFWMD

Integrating Landuse and Water: Connecting Our Human Needs with the Workings of Nature

The inextricable connection of our human activities to the workings of Nature can be both positive and negative. As with most things, this difference depends a lot on our perspective.. Yet at the same time, the extreme complexity of a problem can virtually defy definition, let alone resolution.

Integrating the use of land with the management of water to produce benefits instead of damage is an example of such a problem. And yet this is the problem we face as we prepare to receive the ever-growing number of people who want to move to South Florida.

Photograph of urban development in South Florida: SFWMD

Why has so much of modern water management gone awry? And why is it that ever greater amounts of money and ever more sophisticated engineering have not solved [our] water problems? In part, we are trying to meet insatiable demands by continuously expanding a supply that has limits, both ecological and economic.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

How do we solve the conflicting problem of too much and too little water? How do we solve the most basic problem of preserving and protecting our sources and our supplies of water? These are but two of the many questions that must be answered to beneficially connect our human needs with the workings of Nature.

What, then, is the composite solution for successfully integrating the needs of the Everglades with the frequently divergent needs of our residents? Where do we begin? What will it look like? How do we get there? The answers to these questions will be addressed in the balance of this report.

The use of land in southern Florida began with both courage and ignorance -- courage to inhabit a land that appeared to favor fish and wildlife, and ignorance that led to the destruction of parts of the richness of the region by indiscriminate clearing, draining, and filling.

Albert R. Veri, William W. Jenna, Jr., and Dorothy Eden Bergamaschi, University of Miami, **Environmental Quality by Design: South Florida**, 1975.

Wetland Functions

Two photographs capture the often overlooked magnificence and beauty of natural wetlands (pp. 20-21). We are just beginning to appreciate how valuable these environmental resources really are. Providing a natural system of flood control, water conservation/aquifer recharge, water purification, and climate moderation, wetlands play an important role in the natural cycling of water. They provide critical habitat for wildlife and, in the case of coastal estuaries, these systems support the base of the marine "food chain." Only today do we recognize the profound impact that the destruction of the vast wetland resource of South Florida has had on man and nature.

The restoration of historic wetland functions is recognized by the South Dade Watershed Project as a viable strategy for protecting our water resources from the negative impacts of urban development. Using the physical land form as a guide (vegetation, soils, and topography), this strategy seeks to reconnect existing hydrologic features in a way that mimics the natural system's ability to capture, cleanse and store stormwater runoff. By designing with nature instead of against nature, both our human needs and the natural resources that sustain us can be preserved.

Photo: "Over Florida"

Wetlands are a classic example of market failure; the wetland owner generally cannot capture the benefits of his resources for his own use or sale. The flood protection benefits of wetlands accrue to others downstream. Many of the fish and wildlife that breed in and inhabit the wetlands migrate, and are captured or enjoyed by others. The ground water recharge and sediment trapping benefits cannot be commercially exploited. For the owner of a wetland to benefit economically from his resource, he usually has to alter it, convert it, and develop it. This is the basis of the problem of the excessive development of wetland habitats.

Michelle Edwards Correia, FAU/FIU Joint Center for Environmental and Urban Problems, **The Role of Economics in the Valuation of Wetlands**, March 1995.

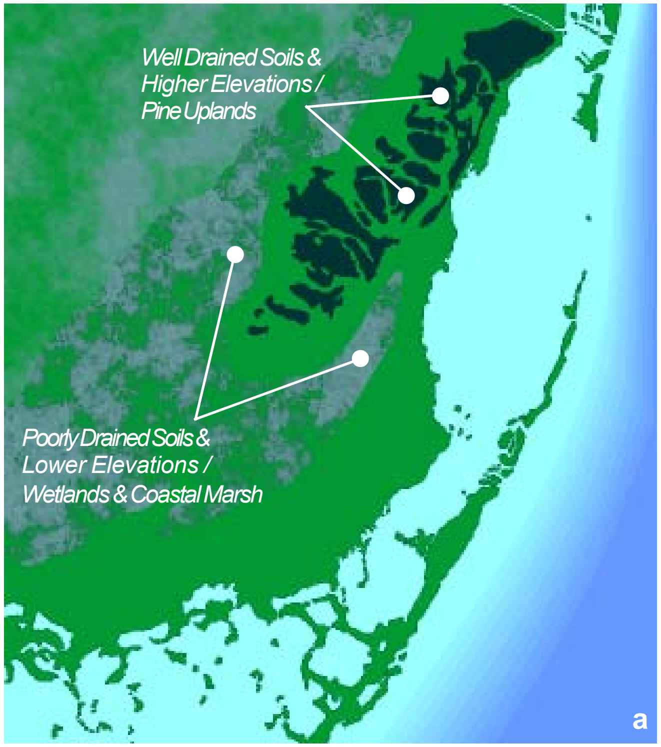
Photo: "Over Florida"

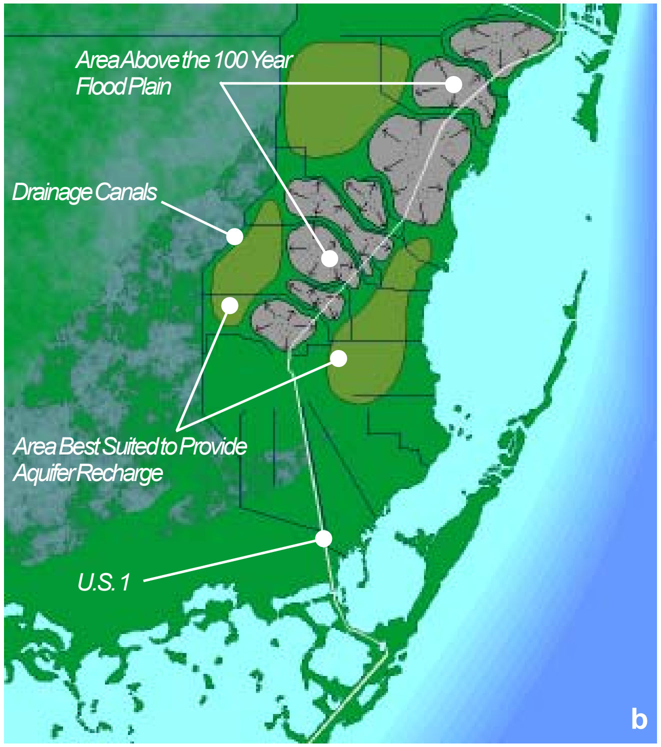
As we learn more about the complexities of environmental systems and how environmental and economic systems are linked, it becomes increasingly difficult to define and assess environmental economic trade-offs. This lack of understanding has led to the undervaluing of natural resources. In turn this has led to heavy depletion of, and stress on, remaining wetland ecosystems.

Michelle Edwards Correia, FAU/FIU Joint Center for Environmental and Urban Problems, **The Role of Economics in the Valuation of Wetlands**, March 1995.

In any endeavor, good design resides in two principles. First, it changes the least number of elements to achieve the greatest result. Second it removes stress from a system rather than adding it. Bad design is pinning our hopes for environmental and cultural survival on a change in human consciousness and behavior alone, because we therefore depend on the highest number of uncontrollable elements – people – to undergo a great change. Likewise, bad design is having to institute several hundred thousand rules and restrictions under the jurisdiction of the government and expecting business to know them all, much less obey them.

The Ecology of Commerce: A Declaration of Sustainability, Paul Hawken, 1993, p. 166.



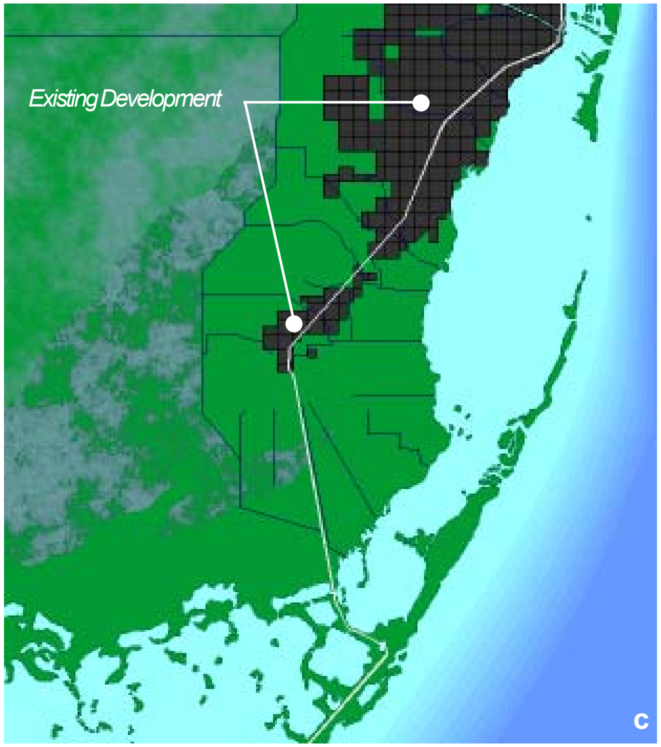


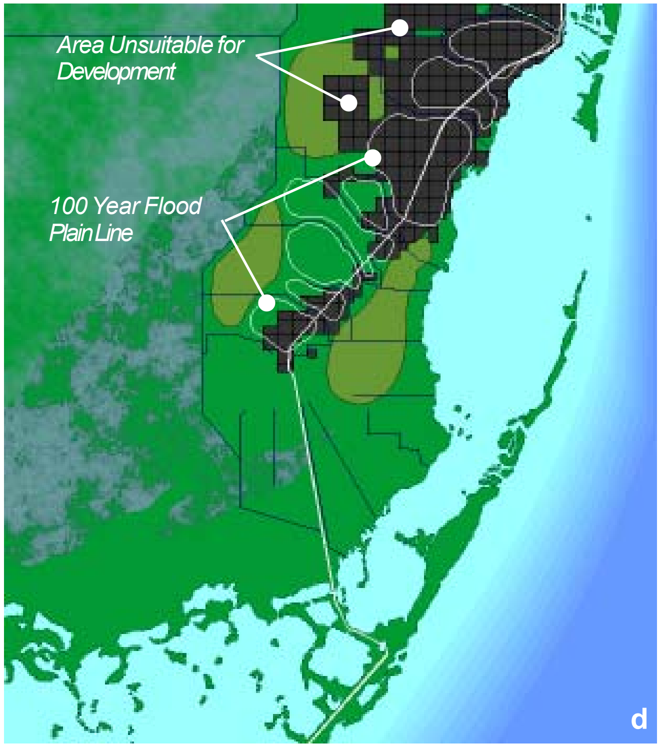
Figures: UM, CUCD

A Regional Sytems Approach to Sustainable Development

The following images explain a "regional systems" approach to establishing a proper fit between landuse and water. In the first image (**a**) we have consolidated the information from the Davis Map to differentiate well-drained and poorly drained soils . The dark (black) areas, representing the "higher" well-drained soils of the coastal ridge, are more suitable for development. The lighter (green) areas, representing the "lower" poorly drained soils of the Everglades, the transverse glades, and coastal marsh, are not suitable for development.

The next image (**b**) shows conceptually how the land and water interact naturally in South Dade. The lighter (grey) areas generally represent land areas located along the coastal ridge that are at topographic elevations above the 100-year flood plain. The small arrows show that stormwater flows off the coastal ridge from areas of higher land elevation to areas of lower land elevation. This water eventually flows to the drainage canals and ultimately Biscayne Bay. The light (green) areas, located on either side of the coastal ridge, are open pervious/porous land areas that provide critical water recharge to the Biscayne Aquifer.





Figures: UM, CUCD

These next two images show the existing pattern of development (**c**) and some of the conflicts that exist between the natural land form and our man-made environment. In both images, the existing development is shown as a dark (brown) grid; the drainage canals, cutting through the coastal ridge , are shown as black lines; and highway U.S. 1, running along the coastal ridge, is shown as a white line. The second image (**d**) overlays the 100 year flood plain on the existing development grid. As can be seen, much of the development in South Dade has occurred in areas that are less suitable for development These areas include historic Everglade wetlands, valuable coastal marshes, and critical recharge areas for public wellfields. Continued development within these areas will cause more local flooding, pave over critical aquifer recharge areas, and destroy valuable natural resources.

Given the limited land area that is suitable for development and the water resource limits of South Dade, how do we create a system that will insure the viability of the region in the face of predicted population growth?

Conservation, once viewed as just an emergency response to drought, has been transformed in recent years into a sophisticated package of measures that offers one of the most cost-effective and environmentally sound ways of balancing urban water budgets. Just as energy planners have discovered that it is often cheaper to save energy—for instance, by investing in home insulation and compact fluorescent lights–than to build more power plants, so water planners are realizing that an assortment of water efficiency measures can yield permanent water savings and thereby delay or avert the need for expensive new dams and reservoirs, groundwater wells, and treatment plants. Slowly the idea is spreading that managing demand rather than continuously striving to meet it is a surer path to water security – while saving money and protecting the environment at the same time.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

Water pure enough to drink serves many functions that do not require such high quality–including irrigating crops and lawns, manufacturing many kinds of industrial products, and flushing human waste into a sewer. By better matching supplies of varying quality to different uses, more value can be derived from each liter taken from a river, lake, or aquifer–and the economic and environmental costs of developing new freshwater sources can be lessened. The challenge, in a nutshell, is to take the "waste" out of wastewater.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

Using the physical features of South Dade as a guide – the soils, topography, vegetation and hydrology – and our knowledge of their interactive connections, we can re-create the historic hydrologic functions of the region. This approach, illustrated in the final image (**e**), is designed to use the workings of nature to efficiently collect, store, clean-up, and distribute water for all users – urban, agricultural, and natural.

This image shows the canals replaced by broad wetland systems similar to what had historically typified the transverse glades. These topographic low points are an integral part of the region's natural flood protection. The north-south canal, separating the developed part of Dade County from the Everglades, is expanded to provide valuable storage and cleansing of water. This will improve the quality of water while preserving a sustainable water supply for future users. The coastal canals become "spreader" canals to enhance the distribution, timing, quantity, and quality of that water which flows to Biscayne Bay while protecting the food chain of the eco-tourism based fishing industry.

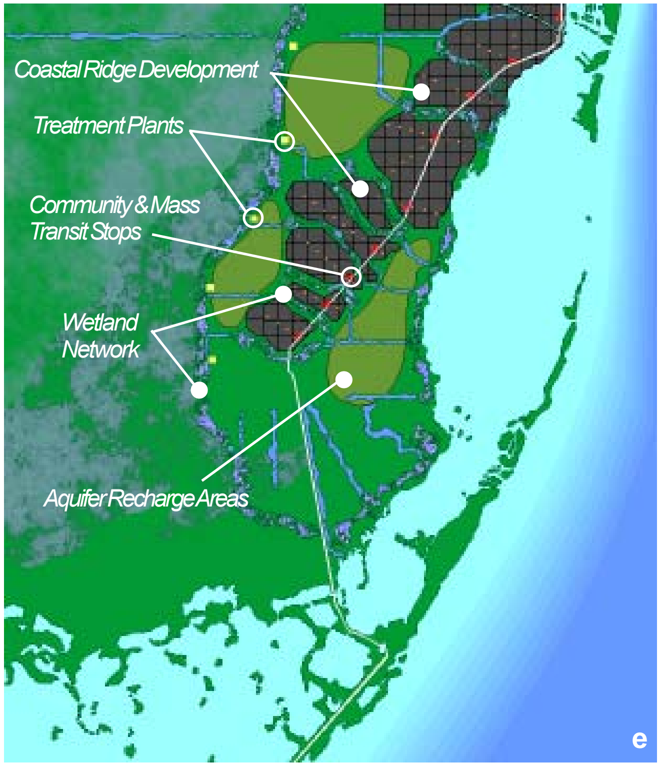


Figure: UM, CUCD

The light (yellow) points in west Dade represent sub-regional wastewater treatment plants that will provide for 100% re-use of the waste effluent. This requires enhanced water quality treatment, provided by technology supplemented with natural cleansing of the water in the newly created wetland areas. By ultimately recycling this water to the aquifer we can replenish much of the water that we use everyday without extensive use of pumping and other fuel driven systems.

In this plan, open pervious land uses that provide valuable recharge to the aquifer, are preserved. This will also provide for the preservation of the agriculture and quality of life that exists in the Redland today. To support this objective , development must be directed to the higher ground of the coastal ridge . Mass transit and community based transit centers, the lighter (red) dotted lines within the developed areas, must be established. These will encourage the development of tightly knit communities with strong regional connections, and reinforce the opportunity to provide for our future water needs.

Collectively, then, these graphics describe the Watershed Interactive Network, the "WIN" Vision, illustrated on the facing page.

Watershed Interactive Network

Everglades-Agricultural Zone: *water storage and aquifer recharge area. Sub-regional wastewater treatment plants with 100% reuse will recharge the aquifer at the "rate of use" creating a sustainable supply of water for Dade County.*

Coastal Ridge Development Zone and Transverse Glades: *urban development area. This zone receives the highest amount of rain in the region. The collection, storage, and cleansing of this water will significantly increase the total available supply of water.*

Biscayne Bay Coastal Zone: *coastal resource protection area. Provides natural buffer from hurricane storm-surge. Enhanced distribution, timing, quantity, and quality of freshwater flows through this zone will significantly improve the estuarine values of the Bay.*

Figure: UM, CUCD

Linear "hydric parks" combine the recreational and aesthetic benefits of "greenways" and "blueways" with the realization of water resource objectives. They create strong edges that define neighborhoods and communities.

The greatest potential for additional water storage lies within the coastal ridge. The development of neighborhood "hydric parks" increases local aquifer recharge, reduces local flooding, and enhances community identity.

Water storage areas located within communities recharge local wellfields.

Recreation of historic wetland sloughs for the collection, storage and biological clean-up of stormwater restores the regions image and identy.

It's simple! At least ten percent of the gross land area must function as wetlands – this will establish regional and local storages and recharge while providing for additional flood protection. The added fact, that these areas can serve as local and regional hydric parks while cleaning the water up makes it even more palatable to the tax payers.

South Dade Watershed Project, **Workshop**, July 1994.

Creating Water Storages in South Dade

In an effort to better understand the relationship of landuse and water, the University of Florida Center for Wetlands and Water Resources was asked to estimate the amount of stormwater pollution associated with the use of land in South Dade. To give greater meaning to the raw data generated in this effort, the Center was also asked to estimate the area of wetland that would be required to cleanse the polluted stormwater run-off so that it could be released to Biscayne Bay without causing negative impacts. The results of this study are summarized in the table on the facing page (p. 51).*

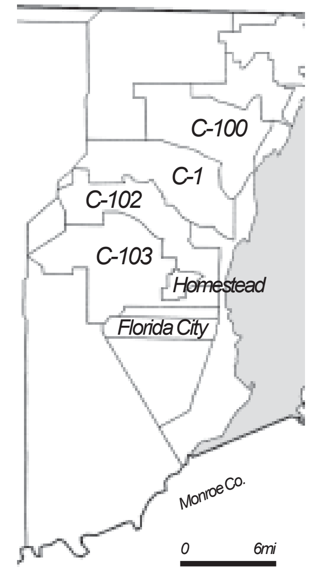
What the table shows us is that approximately 5% to11% of the total land area in the basins needs to be set aside for flood protection and water quality treatment. In some basins (C-1, C-102, C-103 and Florida City Canal) there is sufficient open land to meet this requirement, however, in other basins (C-100 and Homestead / Military Canal) there is insufficient land.

The implication of this information, is that guidelines must be developed to mitigate the impacts of existing and new development. In the case of existing development this may require guidelines for retro-fittting existing communities and the creation of large regional wetland treatment areas; and in the case of development, guidelines must be developed that require the development to be 100% responsible for the water resources associated with the site.

* The methodology and the final results of these efforts are detailed fully in the *Support Documents* attached to this report (see Wetland Stormwater Requirements p.129)

Drainage Basin	Total Land Area	Open Land	% of Total Land	Land Req. for Wetland Treatment	% of Total Land	% of Open Land
C-1 Black Creek	25,152	10,478	42%	2208	9%	21%
C-100	25,688	571	2%	2887	11%	506%
C-102	21,304	13,896	65%	978	5%	7%
C-103	31,502	16,910	54%	2124	7%	13%
Florida City	7,605	2,981	39%	462	6%	15%
Homestead / Military	2,157	101	4%	136	5%	134%
	113,768*	44,937*	39%	8796*	8%	20%

Table showing Drainage Basins of South Dade and Required Wetland Areas for Water Storage: UF, Center for Wetlands & Water Resources
*acres



Canal Basin Boundaries, Dade County: UF, Center for Wetlands & Water Resources

According to the Maryland Institute for Ecological Economics, even more jobs can be created by investing in "natural infrastructure", through the restoration of wetlands, streambeds, fisheries habitat, and other essential components of aquatic ecosystems. These economists predicted that investments in aquatic ecosystem restoration would produce an average of thirty jobs per million dollars spent, a job creation rate 37 percent higher than generated through public investment in roads, 24 percent higher than through water and sewer systems, and 28 percent higher than through major defense contracting. The National Academy of Sciences (NAS) proposes a long-range program to restore badly degraded aquatic resources. Investment in such a program could generate tremendous long-term ecological as well as economic benefits.

Robert W. Adler, Jessica C. Landman, Diane M. Cameron, **The Clean Water Act, 20 Years Later**, 1993.

Incident piled on incident no more makes life than brick piled on brick makes a house.

Edith Ronald Mirrieles (1878 - 1962), American educator and writer.

Photo: Dan Williams

Existing

The heritage of South Dade is captured within this scenic view of an agricultural landscape. This historic community is expected to receive a large percentage of the 700,000 new residents that are predicted to settle in Dade County by the year 2010 -- this is also the area that will supply Dade's future well fields. If protective steps are not taken, this landscape might not exist at all within 15 years.

The depicted flood control canal -- dug within the transverse glades -- is not designed to provide the flood protection needed to accommodate future development and a change of landuse from agriculture to urban. Building over of this area will constitute a loss of essential public water recharge.

Photo: Dan Williams

Trends are not visions.

Daniel Williams AIA, 1995.

Altered Urban

The above image shows a typical South Dade development -- built right up to the edge of the canal. By doing this we have lost the areas' natural ability to capture, store, and cleanse water; and we have built communities that are prone to flooding. Providing flood protection for these low areas has required the over draining of the coastal ridge -- resulting in the loss of critical ground water resources.

This canal edge condition presents an opportunity for an amenity rather than the ditch that exists today. The re-creation of the transverse glade would create identity and image for the community while increasing flood protection and neighborhood open spaces. This combined water storage area and open space not only defines better neighborhoods through quality edges but increases property values at the same time.

How can this work? All use and ownership of land changes over time. The following images show the gradual (50-100 years) reclaiming of the transverse glades as "hydric" parks.

Poison runoff impairs more water bodies, surface and ground, urban and rural, than any other pollution source in the country. Poison runoff is the contaminated storm water and snowmelt that runs off of, or leaches through, land used and abused for human purposes without regard to ecological needs. Although poison runoff (nonpoint source water pollution) was widely acknowledged as a water quality problem even before 1972, in general we have failed to create and implement effective programs that protect and restore our nation's waters that are subject to this threat.

Robert W. Adler, Jessica C. Landman, Diane M. Cameron, **The Clean Water Act, 20 Years Later**, 1993.

Image: UM, CUCD

Computer Altered Image

In the image, above, we see the flood plain restored through the reclamation of senescent and storm-damaged structures. These areas were previously wetlands that functioned as storage and recharge for the region -- the soils are compatible with reclaiming that use. This first step reclaims the land area for lineal parks and recreation while slowly moving toward reclaimed wetlands that historically functioned as a regional water supply storage.

Image: UM, CUCD

Reclaimed Image

In this fully altered image, portions of the transverse glades have been reclaimed as regional water storage areas while providing increased flood protection for the neighborhoods. This exemplifies the concept of multi-agendas being solved simultaneously, *i.e.*, the need for additional water storage coupled with the requirement for water quality treatment. Also resolved are the urban requirements of stormwater collection, increased flood protection, and the pervasive need for additional open space.

Individual neighborhoods now have small "hydric parks" creating or reinforcing community ideals while complying with local flood and water storage needs.

Where excessive diversions have already caused ecological damage, as with central Asia's Aral Sea or Florida's Everglades, new laws and regulations will be needed to restore ecosystems to health. One such instrument is a legal principle called the "public trust doctrine," which asserts that governments hold certain rights in trust for the public and can take action to protect those rights from private interests. Widespread application of this doctrine could have sweeping effects, since even existing water rights could be revoked in order to prevent violation of the public trust.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

Moving toward more efficient, ecologically sound, sustainable patterns of water use requires major changes in the way water is valued, allocated, and managed.

Sandra Postel, **Last Oasis**, Facing Water Scarcity, 1992.

Guidelines for Regional Systems Planning:

- *treat South Dade as a whole, rather than a patchwork of small settlements;*
- *concentrate rebuilding efforts in infill areas, rather than expanding into undeveloped areas;*
- *question quick fixes that bring short term, local benefits, rather than long term, regional benefits;*
- *discontinue the spread of urban growth toward the west and east that is unsympathetic to the natural and agricultural systems;*
- *preserve the long-term natural resources of the region (i.e., Everglades National Park, Biscayne National Park, and Redland);*
- *protect the environment to insure the future of the national parks as well as the economic vitality of the area;*
- *protect water quality and quantity in order to sustain fresh water supplies for the natural system as well as for urban and agricultural land uses; and*
- *provide a "spine" of rapid transit to act as an anchor for future growth and "density centers"*

Daniel Williams, **The New South Dade Planning Charrette**, 1992.

Challenges and Opportunities

U.S. 1 Corridor in South Dade

The **South Dade Watershed Project** strives to provide for a sustainable water supply and natural resource protection. Critical to achieving this objective is the restoration of the hydrologic functions of the watershed. Such a plan must link transportation, land use, and natural resource protection in a strategy that directs new development and redevelopment into appropriate infill sites along the U.S. 1 corridor. This will reduce development pressures to expand the UDB further to the west, east, and south into sensitive agricultural and natural resource areas. The current location of the 2010 Urban Development Boundary should be re-assessed, and possible retraction of the boundary -- especially along the Krome Avenue corridor -- should be considered

Krome Avenue: Emergency Evacuation Corridor

Metro-Dade County has determined that Krome Avenue provides the most direct route to persons in South Dade and the Florida Keys for emergency evacuation and for post-disaster recovery efforts. The county has proposed a comprehensive plan amendment that would allow widening Krome Avenue from South Dade to the Dade-Broward county line. Widening Krome Avenue would promote commercial development and urban sprawl along its length. To protect the water resources of the region, a plan must be created for the development of the Krome Avenue corridor that is consistent with water supply, flood protection, and Everglades restoration objectives. The lack of such controls would seriously undermine the efforts to redirect growth to infill areas within the U.S. 1 corridor.

Water Resource Overlay Zoning

Overlay zones apply a common set of standards to a designated area. These zones “overlay” existing zoning districts, and in doing so, apply additional development standards to those of the existing (underlying) district. These zones would be applied to the protection of wellfield areas, critical water recharge areas, and the network of canals. The Wellfield Protection Ordinance adopted by Dade County in 1981 is an example of the overlay zoning principle. These special protections must be established and adopted today, prior to the build-out of South Dade.

Homestead Airforce Base Redevelopment Area

The redevelopment of this area is critical to the economic future of South Dade As an existing Super Fund Site, this area provides to opportunity to serve as a highly visible example of development that is responsive to water and natural resource protection.

Principles for Sustainable Water Resource Planning

- *The total rainfall within the region is that region's water budget* -- supplies from outside the region are “borrowed or leased” and cannot be counted on during drought or after build out. The aquifer “storages” allow us to average the variations in rainfall and should not be used to calculate the allocation of water for public use.
- *Each landuse must spatially contribute its share to the region's water budget* -- the loss of recharge that is associated with “typical” development must be restored and protected *i.e.*, the post development hydrologic condition must equal the pre development hydrologic condition.
- *Stormwater, greywater and wastewater must be recycled and recharged at a rate commensurate with use* -- the storage and recharge of such must be achieved at the regional, community, and neighborhood scale.
- *The location of surface and groundwater storage areas for water resource sustainability must be integrated in urban and community design* -- the development of “hydric parks” and the preservation of open space will create strong edges for communities and create a sense of “place.”

THE WIN VISION

Watershed Interactive Network

***S**ustainable development is about how we may use the natural resources of our environment, and pass them on to future generations. But the limiting factors nearly always reside not in the environment, but in human societies.*

Martin Holdgate, **Partnerships in Practice**, Department of the Environment, UK.

We must foster intuition to anticipate changes before they occur; empathy to understand that which cannot be clearly expressed; wisdom to see the connection between apparently unrelated events; and creativity to discover new ways of defining problems, new rules that will make it possible to adapt to the unexpected.

Mihaly Csikszentmihalyi, **The Evolving Self**, A Psychology for the Third Millennium, 1994, p.42.

CONCLUDING COMMENTS

The shuttle image on the right can be viewed as a glass half full or a glass half empty. But science tells us that it is neither. **It is not working!** There is:

- a tremendous amount of water,
- but not enough water;
- a tremendous amount of land,
- but not enough land;
- too many people,
- yet, more people are coming;
- too much sprawl,
- but, more housing is needed.

These contradictions can be successfully addressed by understanding their connections -- land to water...land to people....people to water.

When we look at the places we love, ones we want to visit, we must recognize that the "postcard" qualities that make these communities desirable, are possible within our community.

Thus we must create a vision of our community's tomorrow and we must take the incremental steps to preserve, protect, and define our future.

Hurry up please, it's time. T. S. Eliot

Photo: NASA

*"**B**ig" solutions, which I would like to think of as those that show breadth of imagination, length of time horizon, and depth of commitment, are surely only attainable when many different kinds of people are involved. It is often the alliances between the most unlikely partners that are most effective. And it is difficult to think of any kind of development that is likely to be sustainable unless all the interests in a community -- poor as well as rich; young as well as old; women as well as men; labour as well as employers; industry as well as environmentalists – are brought together and contribute first to policy and then to implementation.*

Martin Holdgate, **Partnerships in Practice**, Department of the Environment, UK.