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an economic inventory of the miami river and its economic and environmental role in biscayne bay

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An Economic Inventory of the Miami River and Its Economic and Environmental Role in Biscayne Bay

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PREFACE

The Sea Grant Colleges Program was created in 1966 to stimulate research, instruction, and extension of knowledge of marine resources of the United States. In 1969, the Sea Grant Program was established at the University of Miami.

The outstanding success of the Land Grant Colleges Program, which in 100 years has brought the United States to its current superior position in agricultural production, helped initiate the Sea Grant concept. This concept has three primary objectives: to promote excellence in education and training, research, and information services in sea related university activities including science, law, social science, engineering and business faculties. The successful accomplishment of these objectives, it is believed, will result in practical contributions to marine oriented industries and government and will, in addition, protect and preserve the environment for the benefit of all.

With these objectives, this series of Sea Grant Technical Bulletins is intended to convey useful studies quickly to the marine communities interested in resource development without awaiting more formal publication.

While the responsibility for administration of the Sea Grant Program rests with the National Oceanic and Atmospheric Administration of the Department of Commerce, the responsibility for financing the Program is shared by Federal, industrial and University contributions. This study, An Economic Inventory of the Miami River and Its Economic and Environmental Role in Biscayne Bay, is published as a part of the Sea Grant Program and was made possible by Sea Grant projects in Economics for Ocean Resource Management.

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INTRODUCTION

This thesis is the summary of an economic inventory completed on the Miami River in June, 1971. The purpose of such an inventory is to classify the economic activities and determine their economic and environmental roles on the river and in the Biscayne Bay area.

The material is divided into seven chapters. Chapter one is a brief description of the geographic, economic, and environmental status of the river. These factors are then considered in a historical context. Chapter two describes the methodology of collecting the data. This clarifies the difficulties of such a project, and exposes the limitations that must be imposed on the data. Chapter three provides the text, tables, graphs, and maps necessary to present the inventory. Chapter four is an analysis of the economic and environmental role of the river in the Biscayne Bay area. Chapter five describes some of the physical aspects of water pollution. Chapter six presents some of the economic aspects of water pollution control. Chapter seven is a discussion of the highlights of pollution controls recommended by the Environmental Protection Agency, Southeast Region, in October, 1970.

CHAPTER I

STATUS OF THE MIAMI RIVER

The Geographic Position

The Miami River is a centrally located urban river. The navigable portion flows, west to east, from the Miami International Airport, 5.5 miles through congested commercial and residential areas, to Biscayne Bay adjacent to the central business district of the city. The navigable portion is a combination of the original river and a dredged portion known officially as the Miami Canal.

The original river was only about 4.5 miles long. The dredged Miami Canal runs south and southeast 81 miles from Lake Harbor on Lake Okeechobee to connect with the end of the original Miami River at N.W. 27 Avenue. The river is a slow moving body with varying degrees of salt and fresh water mixtures. The inflow of salt water is a tidal action from Biscayne Bay. The fresh water discharge depends on the inland fresh water table. Both salt water intrusions and fresh water discharges are controlled through a series of dams.[1]

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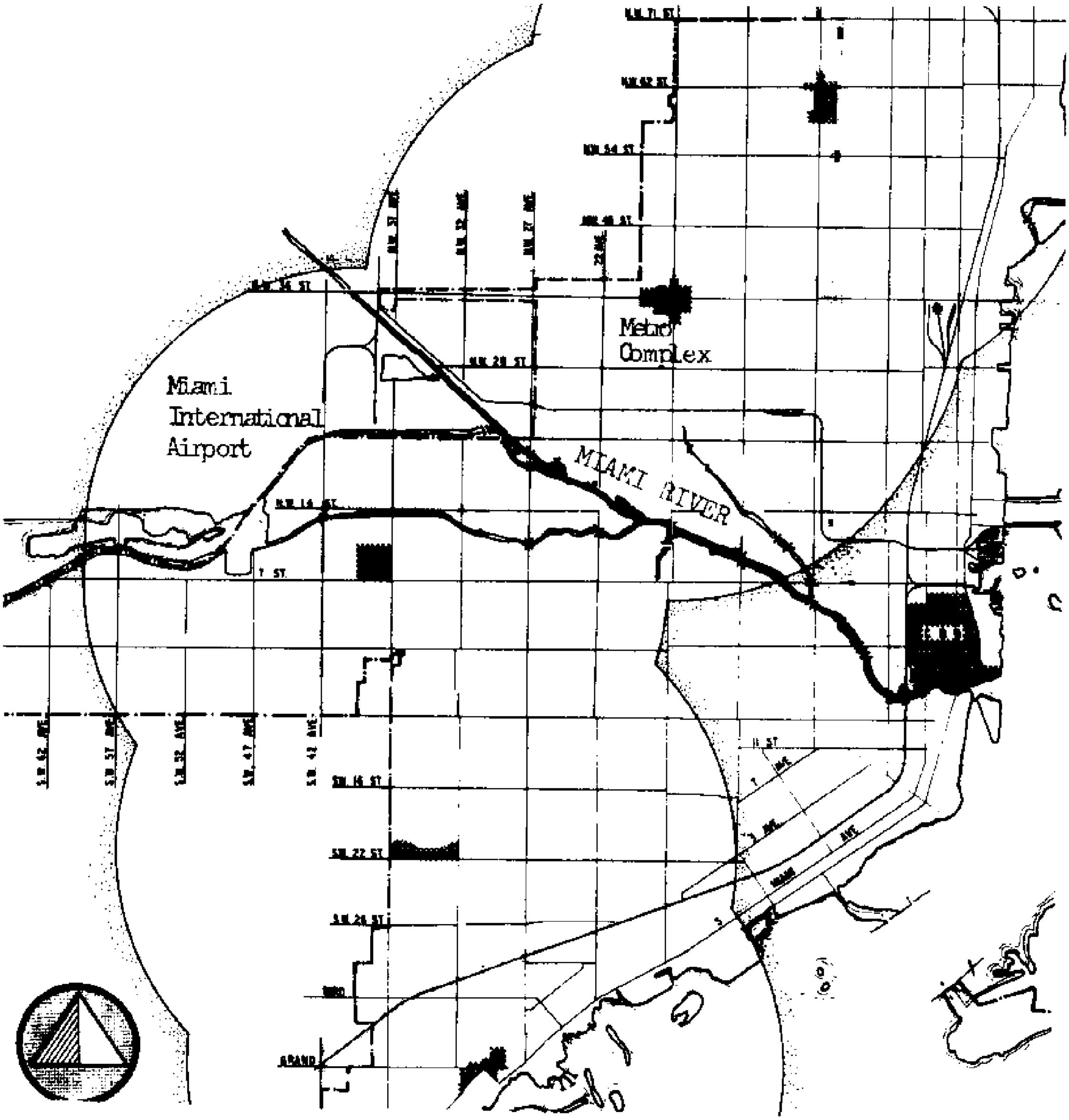
[1]S. D. Leach and R. G. Grantham, *Salt-Water Study of the Miami River and Its Tributaries, Dade County, Florida* (Florida Geological Survey, Rose Printing Company, Tallahassee, Florida, 1966), pp. 1-30.

MAP 1

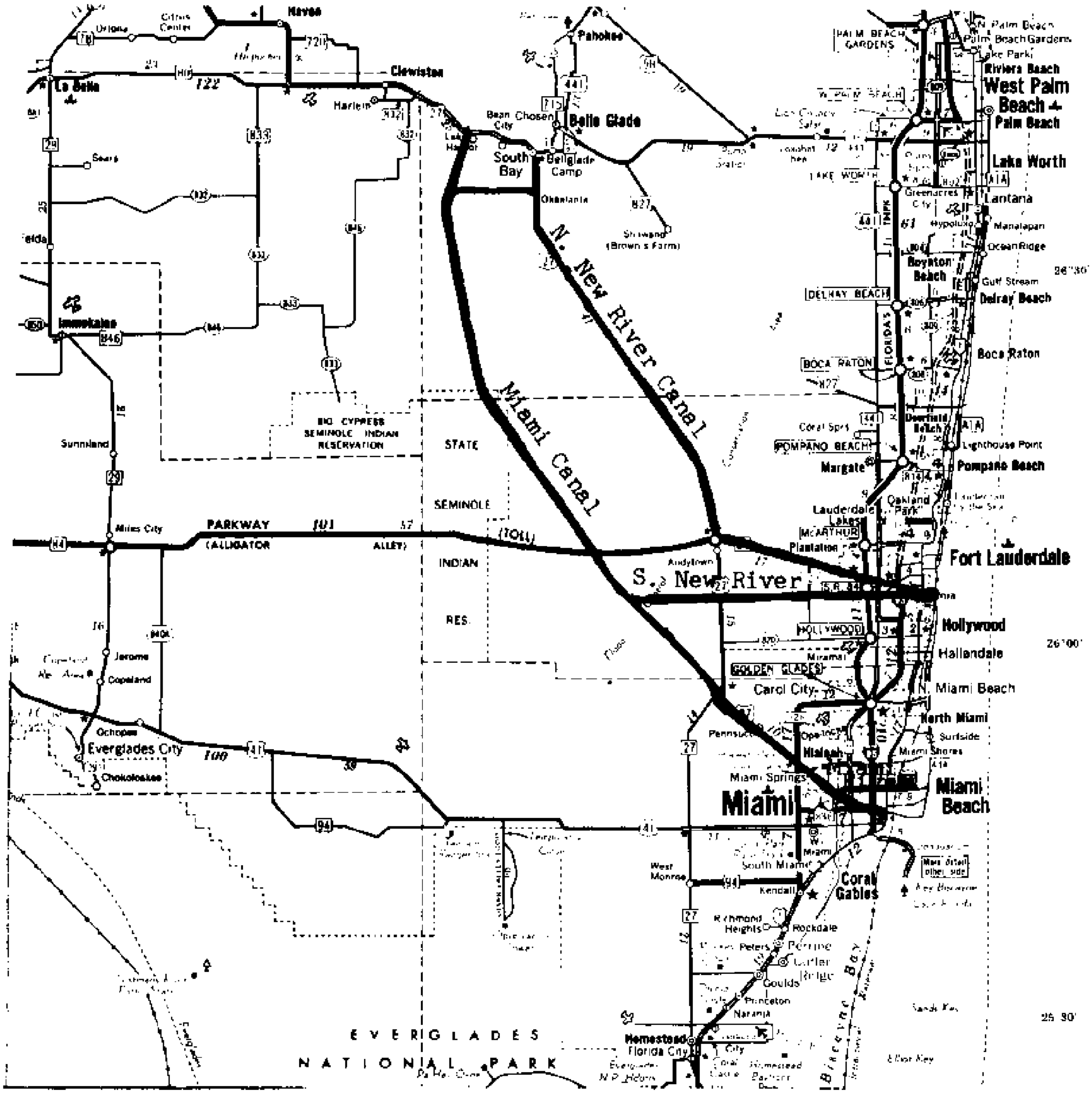
THE MIAMI RIVER
N.W. 36 STREET DAM TO BISCAYNE BAY[1]



[1]Map provided through the courtesy of the City of Miami Planning Department

MAP 2

SOUTH FLORIDA[1]



[1]Map provided through the courtesy of the City of Miami Planning Department.

The Economic Situation

The Miami River runs through the oldest areas of Miami, and the commercial patterns that were established early, remain today. Of the 59 largest marine oriented firms listed on the river in 1939,[1] 47 are still operating in the same location in 1971, while 39 are still operating under the same name and management.

While the river is a commercial waterway, it is not an industrial river. Less than 9 percent of the riverfront and 14 percent of the employment along the river is concerned with manufacturing. Table 1 reflects the slight changes in overall commercial and non-commercial land uses between 1941 and 1971.

The Environmental Condition

The Miami River is polluted by primarily two types of materials. The first, and most important, are untreated and treated sewage effluents. The second are oil, grease, phosphates, and debris that enter the river by gravitational forces or are washed into the river by rainwater.[2]

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[1] Colonel W. C. Weeks, U. S. Corps of Engineers, *1941 Report of the Chief of Engineers, Dade County, Florida.* p. 20.

[2] Dade County Pollution Control Office, *Pollution Sources of the Miami River and Tributaries Flowing Into the Miami River--February, 1970.* Office Memorandum.

TABLE 1

LAND USE ON THE MIAMI RIVER

(DISTANCE IN LINEAR RIVERFRONT FEET)

Riverfront Footage	1941[1] (Zoned Land Use)	1971 (Observed Land Use)
Total	40,340	40,095
Commercial	20,925 (52%)	22,420 (56%)
Non-commercial	19,415 (48%)	17,675 (44%)

Adjusted river-front Footage[2]	57,245	57,245
Commercial	37,830 (66%)	38,420 (67%)
Non-commercial	19,415 (34%)	18,825 (33%)

[1]"Zoning Director Maintains Miami Front Must Be Developed for Best Community Use," *Miami Herald*, May 25, 1941, Section D, p. 1.

[2]The 1941 figures were based on the river from N.W. 27 Avenue eastwardly to Biscayne Bay. West of 27 Avenue had not been developed, but this area was zoned commercial and has subsequently been developed by heavy commercial activities. The adjusted footage includes the riverfront between N.W. 27 Avenue and the N.W. 36 Street dam.

Both the historical evidence and current data presented in this study indicate the water in the Miami River is below the minimum standard necessary to sustain higher forms of marine life.

Historical Development

Before an attempt is made to give an economic description of the existing river, it would be helpful to consider the historical development of the Miami River and Miami Canal.

The Everglades Drainage Projects

Florida was admitted to the Union in 1845. The swamplands known as the Everglades were Spanish Crown lands and remained under the jurisdiction of the Federal Government. In 1847, the State of Florida Treasury Department appointed a drainage project director to develop plans for draining the Everglades with the intentions of converting the land to agricultural uses.

The United States passed the *Swamp Overflow Act* in 1850 that turned the Everglades over to the State. Part of the plan was to lower the level of Lake Okeechobee five to six feet, and drain the Everglades through a series of drainage canals. By 1889 considerable canal construction had been completed. The Everglades Drainage District was created in 1905; by 1929 over eighteen million dollars had been spent on drainage projects.

Flooding was a primary cause of damage in Florida's worst hurricane in 1928 in which 1772 people died. As a result of the hurricane, the Okeechobee Flood Control District was created in 1929. The emphasis shifted from land reclamation to flood and fire controls in the wet and dry seasons with special controls for tropical storms.

The Miami Canal played an important role in the Everglades Drainage District. The canal ran from Lake Okeechobee, through the Everglades, to the Miami River. Between 1916 and 1923, the canal handled shallow draft vessels between Miami and Lake Harbor. After a flood in 1923, a dam was constructed across the canal east of the South New River Canal which prohibited further water traffic between Miami and Lake Harbor.[1]

The 1931 Corps of Engineers Project

The original Miami River was approximately 80 to 100 feet wide and 5 to 7 feet deep at high water. In 1932, the Federal Government appropriated $581,000.00 to expand the river to its present proportions. In 1931, the Corps of Engineers outlined their project that was completed in September, 1933.

> Miami River Florida--The existing project provides for a channel 15 feet deep at high water, 150 feet wide for a distance of 3 miles above the mouth, thence 125

[1]Colonel Weeks, *1941 Engineers Report*. pp. 17-30.

feet wide to a point 4 1/8 miles above the mouth, thence 90 feet wide to a point 5 1/2 miles above the mouth.[1]

The *1931 Report of the Chief of Engineers* probably provides one of the first official statements about the anticipated economic role of the river. The Federal Government had financed the river project for three reasons. First, constitutionally they were responsible for navigable waterways. Second, the river was to be a place of safe refuge for vessels during tropical storms or in case of a military threat. Miami was foreseen as an important future naval installation. Thirdly, the river would provide an excellent place for marine and other commercial activities. From its first dredging, the Miami River was considered to be a commercial waterway.

Salt Water Intrusion

A low fresh water table in 1939 permitted salt water intrusion the length of the river to about one mile northwest of N.W. 36 Street. In 1939, a sheet-piling dam was installed at N.W. 36 Street to protect the municipal Miami Springs-Hialeah fresh water well fields. A pneumatic dam was installed in 1942 and replaced by the present sheet-piling dam in 1946. The dam is operated by removing alternative steel piles (called needles) during wet

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[1]U. S. Corps of Engineers, *1931 Report of the Chief of Engineers, Dade County, Florida.* No. 8 Part 2.

periods and replacing them during dry periods.[1]

The 1941 Corps of Engineers Project

The *1941 Report of the Chief of Engineers* proposed to greatly expand the commercial potential of the river.[2] Portions of the river would be widened, several turning basins created, and an alternative mouth into Biscayne Bay would be dredged. The most significant proposal was the Miami Canal would be dredged all the way to Lake Harbor creating an inland barge canal to connect Miami with the center of the State. The Miami River was expected to develop into an important inland-marine freight terminal. Eventually some dredging was completed to widen and deepen the original mouth, but the other plans were never approved.

Riverfront Zoning

By 1941, there was an obvious and publicised power struggle to rezone the riverfront. Several shipbuilders and drydocks were securing military contracts to handle naval vessels. In order to fulfill these contracts, the firms needed to expand their facilities. In 1941, the

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[1]S. D. Leach and R. G. Grantham, *Salt-Water Study of the Miami River and Its Tributaries, Dade County, Florida* Florida Geological Survey, Rose Printing Company, Tallahassee, Florida, 1966). pp. 6-8.

[2]Colonel Weeks, *1941 Engineers Report.* pp. 2-12.

Miami Herald followed a series of city commission debates over rezoning the river.

> The entire issue of whether, under the pressure of defense needs, the Miami River is to be zoned for industrial development confronts the city commission.[1]

A public opinion poll in the *Miami Herald* on April 12, 1941 indicated the residents of the city were not in favor of the commercial trends.

> <u>Overwhelming Majority in Favor of Zoning Miami River for Parks.</u> Do you favor zoning the Miami River Shorelines for business? Do you favor zoning the river areas for future development as park area?
>
> For Park Areas 80%
> For Business Areas 20%

	Business	Parks
Women	16	84
Men	23	77
Lower income	23	77
Middle income	17	83
Higher income	16	84 [2]

Between 1940 and 1943, several large marine interests accomplished the rezoning of important riverfront footage from N.W. 12 Avenue eastwardly to Biscayne Bay. In 1942, the *Miami Herald* reported the first significant zoning waiver given to the largest drydock and shipbuilding firm on the river.

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[1] "City Considers Opening River to Industry," *Miami Herald*, December 18, 1941. Section A, p. 2.

[2] "Overwhelming Majority in Favor of Zoning Miami River for Parks," *Miami Herald*, April 12, 1941. Section A, p. 1.

Shipyard Wins Battle for Zoning Violation. Miami city commissioners Wednesday permitted the erection of a defense shipbuilding plant in a residential area on the south shore of the Miami River at the 12 Avenue Bridge.

> The breaching of zoning regulations, approved first by the city planning board, was authorized upon the condition that Miami Yacht Storage, Inc., a Merril Stevens subsidiary, use the plant after the war only for dry storage if there has not been a prior rezoning of the river.[1]

Pollution and Boats on the River

Supposedly prior to 1923, the Miami River was a palatabl fresh water stream. Historical evidence questions this reminiscence. Since 1900, the river has been subjected to the pollutants from commercial activities as well ... untreated ... treated sewage from the Miami area. A 1941 article in the *Miami Herald* questioned the value of a river beautification plan as long as the river was officially used as a sewer outlet.

> Many pointed out that until such time as Miami has a sewage disposal plant and eliminates the present practice of using the Miami River as an outlet it would ... be feasable to try extensive beautification along the river. They even go so far ... see a future health hazard in the present method of draining sewage into the river.[2]

---

[1]"Shipyard Wins Battle for Zoning Violation," *Miami Herald*, February ... 1942. Section B, p. 1.

[2]"Overwhelming ... in favor of Zoning Miami River for Parks," *Miami Herald*, April 12, 1941. Section A, p. 1.

It is interesting to note that the first targets of a publicized "environmental campaign" in 1934, are the same targets focused on in 1971, houseboats. Since the river was centrally located, its banks became the mooring place for cheaply built barge-type houseboats then called, "shanties." In 1934, the *Miami Herald* followed a city commission campaign against houseboats on the river.

> Miami's New Zoning Ordinance Will Remove These Shanty Town Scenes. The city commission has allowed houseboat owners until May 1 to move. The work of cleaning up and beautifying the river banks was started a year ago. Drydock walls were built and coconut palms planted.[1]

Note that the emphasis was on unsightly appearances rather than water pollution. Apparently the houseboats were removed to the satisfaction of the Coast Guard according to a favorable report by the *Miami Herald* in 1941.

> Shortly after the adoption of the zoning ordinance, a consistent drive for river beautification was started, and in connection with other improvements along the riverfront, practically all the unseaworthy houseboats and other crafts not capable of being self propelled were removed.[2]

From a historical perspective, the Miami River has developed as a polluted commercial waterway. Any questions about changing the river must wait until after we consider the economic inventory.

---

[1] "Miami's New Zoning Ordinance Will Remove These Shanty Town Scenes," *Miami Herald*, May 24, 1934. Section A, p. 1.

[2] "Coast Guard Reviews the River," *Miami Herald*, May 25, 1941. Section D, p. 1.

CHAPTER II

METHODOLOGY

Before considering the actual data, something should be said about the methodology and terms used in the collection of the data.

Classification of Economic Activities

A broad survey was initially made to determine the most relevant economic categories. Table 2 is a breakdown of the categories. As a broad division, categories one through five are considered commercial, while categories six through eight are classified as non-commercial.

TABLE 2

ECONOMIC ACTIVITIES ON THE MIAMI RIVER

	Categories	Code
Commercial	1. Marine Activities	
	2. Light Manufacturing	
	3. Warehouse, Wholesale, Retail, and Office buildings	
	4. Institutions and Private Clubs	
	5. Junk Yards and Scrap Metal Shops	
Non-commercial	6. Recreational (Parks)	
	7. Vacant property, Parking Lots	
	8. Dwellings	

Geographic Sections

The river is divided into five geographic sections. The sections are convenient for a general analysis of patterns in land use, employment, and pollution along the river. Coincidentally, the Dade County Pollution Control Office located water sampling stations to correspond with four of the sections.

Locations and Geographic Sizes of Activities

The geographic locations and sizes of each activity were constructed from legal boundaries and a visual inspection of each sight on the river. It was necessary to inspect each sight because the legal, *Plate Book of Miami, Florida*,[1] indicates ownership boundaries but not activities conducted at each sight.

Riverfront footage is measured according to the standard United States Coast and Geodetic Survey procedure of plotting an imaginary straight line down the center of the river. This technique is reasonably accurate, but has distorted the total riverfront footage for most of the marine activities. Boatbuilders, drydocks, and marinas have constructed individual inlets and basins to maxamize their waterfronts. If these deviations are considered, the riverfront footage for marine activities would be at least three times larger than with the linear technique.

---

[1]City of Miami Planning Department, *Plate Book of Miami, Florida* (G. M. Hopkins Co., Philadelphia, Pa., 1965).

Data on Individual Firms

Data on individual firms was unusually difficult to obtain. This is probably due to the current publicized environmental campaign being directed against marine interests along the river. In March, 1971, a mail questionnaire was attempted that resulted in less than a ten percent return. As a last resort, either a telephone or personal interview was necessary for each activity.

Employment Data

Total employment figures reflect both full-time employees and contracted individuals. Relative employment figures for marine activities are probably upwardly biased since this is the only category with a significant percentage of contracted people.

Boats on the Miami River

Specific questions about the sizes and types of boats were double-checked by the City of Miami Planning Department's detailed aerial photographs of the river for 1963 and 1969.[1] Approximately 17 percent of the boats on the river are under wet-cover storage and could not be checked by the photographs. Most of these vessels are expensive private yachts from 35 to 70 feet in length. The economic inventory was completed between February and June of 1971.

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[1]City of Miami Planning Department, *Aerial Survey, Miami, Florida* (Abrams Aerial Survey Corp., Lansing, Michigan, 1963 and 1969).

The aerial photographs were taken in May, 1963 and 1969. There was no significant difference between the number of boats observed in the 1969 photographs and the respective number of boats reported on the interview questionnaire.

Water-based Population

Questions concerning the number of people living aboard boats created mixed reactions. This is obviously a touchy subject along the river, often the question was not answered. Most establishments were willing to discuss the number of live-aboard boats in their facility. A separate sampling was necessary to estimate the number of people living on different types and sizes of boats. Six marinas that specialize in live-aboard houseboats, powerboats, sailboats, and professionally maintained yachts, provided the following estimates that were used when the actual population was not provided.[1] See Table 3.

The number of live-aboard crew members on commercial vessels were provided by most of the shipping firms. The numbers are upwardly biased when considering their role in sewage pollution. No account was taken that these commercial vessels are normally away from the dock and out of the river at least 50 percent of the time.

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[1]Houseboats--Just Island Marina, Miami River, Fla.
Powerboats--Dinner Key Marina, Coconut Grove, Fla.
Sailboats--Hardy's Yacht Basin, Miami River, Fla.
Dinner Key Marina, Coconut Grove, Fla.
Yachts--Merril Stevens Dry Dock Co., Miami River, Fla.
Florida Yacht Basin, Miami River, Fla.

TABLE 3

RESIDENTS ON LIVE-ABOARD BOATS

(DADE COUNTY)

Type of Boat	Average Number of Residents
Houseboats 30 feet - 45 feet 45 feet - up	 3.0 3.5
Powerboats 30 feet - 45 feet 45 feet - up	 2.0 2.0
Sailboats 30 feet - 45 feet 45 feet - up	 2.0 2.0
Yachts with crews 40 feet - 70 feet 70 feet - up	 2.0 3.0
Commercial Vessels 65 feet - up	Independently determined
Unattended Boats	0

Effluent and Runoff Pollutants

The categories of pollutants in this study are similar to those used by the Dade County Pollution Control Office. Sewage is measured in gallons per day (GPD). Two methods are nationally used to estimate GPD. First, by dwelling, 150 GPD per bedroom for all sanitary needs. Second, by population, 75 GPD per person for all sanitary needs. With a highly fluctuating population, the first method is normally used. The City of Miami, and this study, bases GPD of wastewater on the population.[1]

Rainwater runoff is computed in cubic feet per second flow. The size and force of the runoff is determined by the area and slope of the runoff basin. We will only attempt to estimate the riverfront footage and location of activities contributing to concentrated oil and grease runoffs.

---

[1]Paul L. McCarthy, City of Miami Department of Water and Sewers, Interview April 4, 1971.

CHAPTER III

ECONOMIC INVENTORY

The map on the following page displays the entire area covered in this study. It was not necessary to follow the tributaries further than their immediate proximity to the main river except in a few cases. These special situations are discussed separately.

Note the various jurisdictional authorities for the river. No less than nine political authorities have some control over less than ten miles of the river.

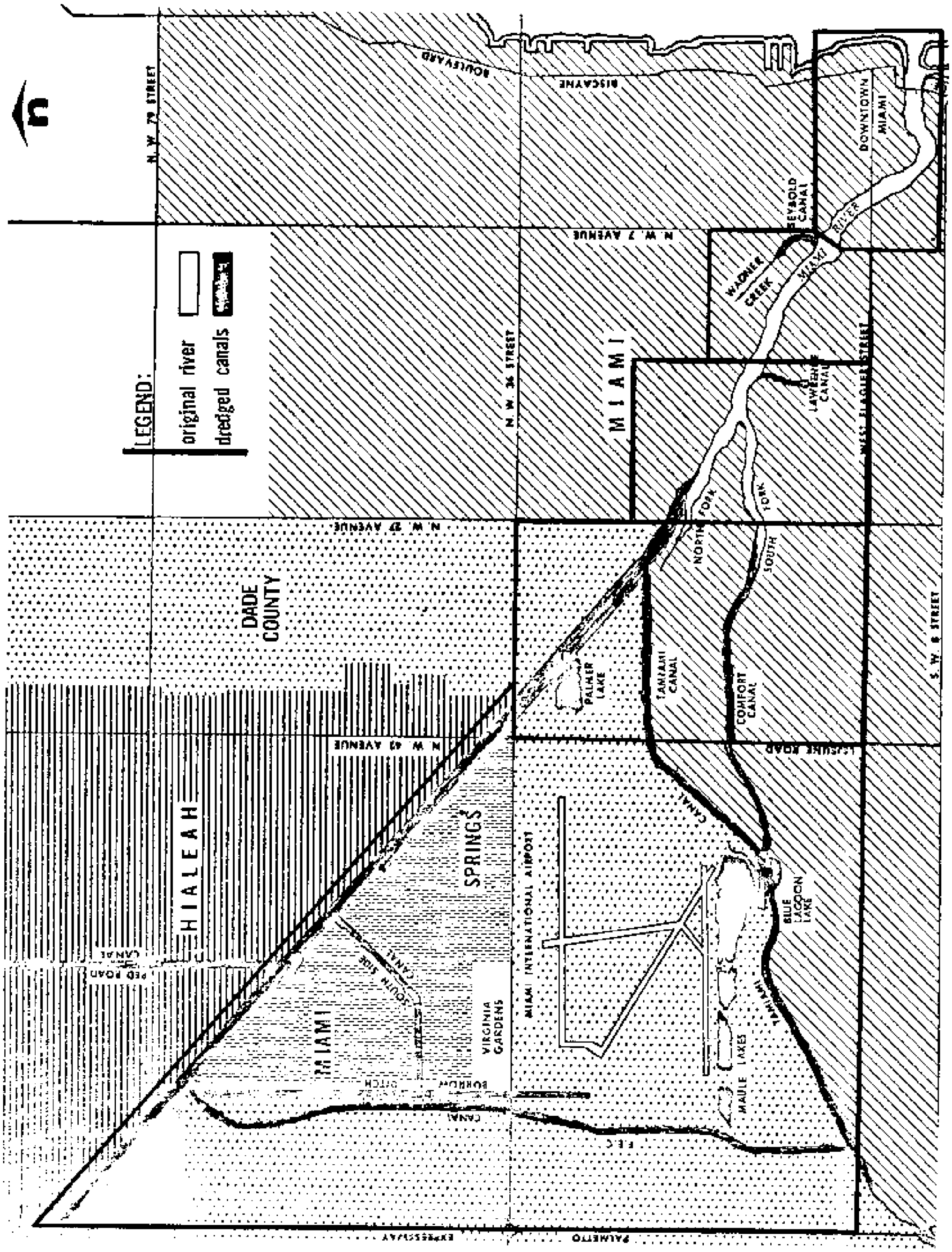
1. Federal Government (U.S. Coast Guard)
2. Central and Southern Flood Control District
3. City of Miami
4. Metropolitan Dade County
5. City of Miami Springs
6. Town of Virginia Gardens
7. City of Hialeah
8. Town of Hialeah Gardens
9. Town of Medley

Geographical Sections of the River

The next five maps and their respective tables describe each section of the Miami River.

MAP 3

AREA COVERED BY THE INVENTORY
PALMETTO EXPRESSWAY TO BISCAYNE BAY[1]



[1]Metropolitan Dade County Planning Department, *A Planning Study of the Miami River* (Metropolitan Dade County Planning Department, April, 1962). p. 20.

Section A

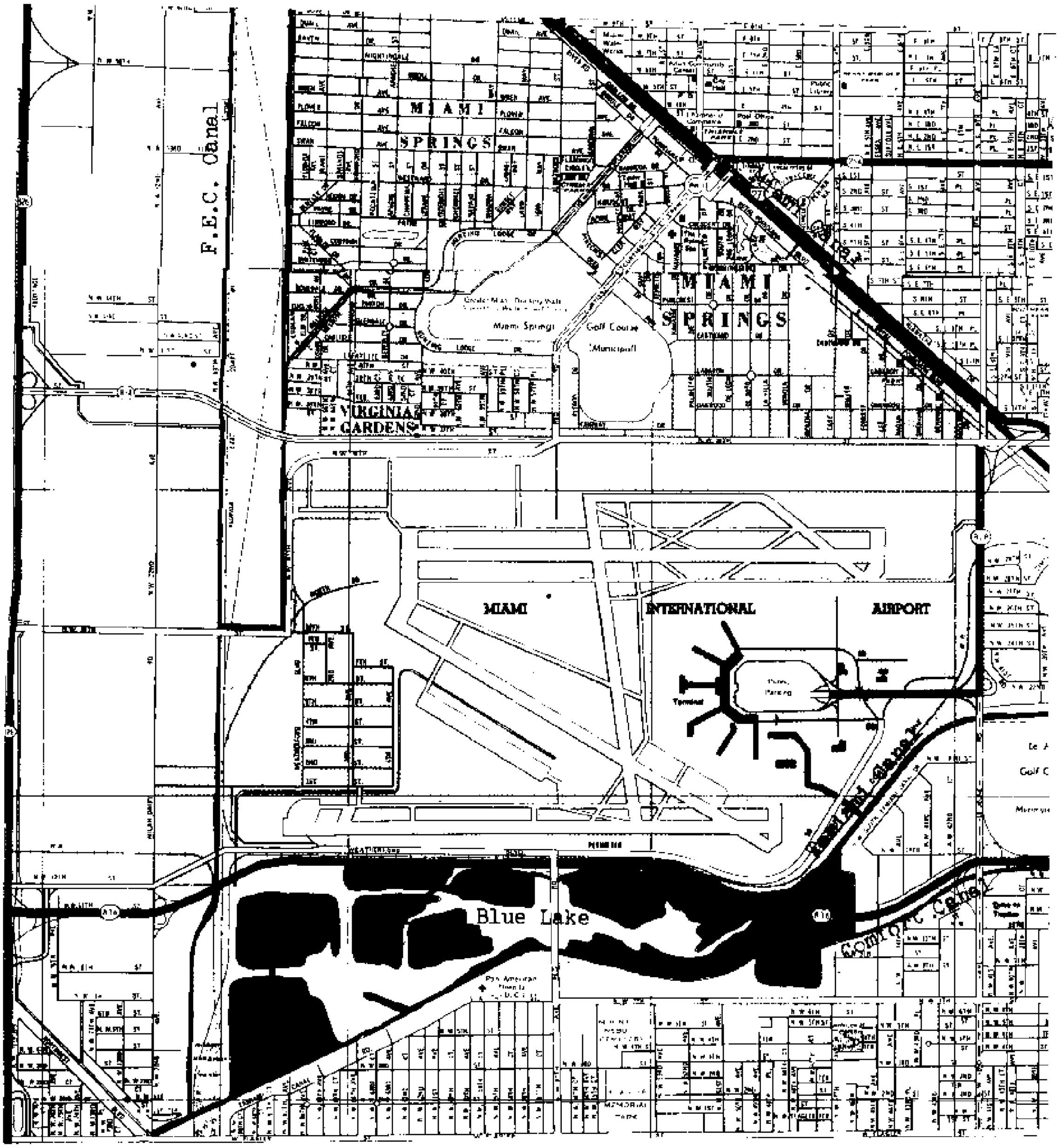
This section is not officially part of the inventory. The economic inventory describes the economic activities along the navigable sections of the river from the N.W. 36 Street dam eastwardly to Biscayne Bay. Northwest of the dam, the Miami Canal is little more than a drainage ditch with an occasional small boat.

There are no commercial activities along the canal in Section A. Apartment houses and single family dwellings line the canal banks in Miami Springs and Hialeah. West of the Palmetto Expressway is vacant property or farm land.

We are primarily interested in Section A because the pollutants from this area have an important impact on the river through the F.E.C. Canal (outlet into the Miami Canal), Tamiami Canal (outlet into Section I), and the Comfort Canal (outlet into Section II). The Miami River is such a slow moving waterway that these tributaries often become virtually stagnant.

MAP 4

SECTION A
PALMETTO EXPRESSWAY TO N.W. 36 STREET DAM[1]



[1] Map provided through the courtesy of the City of Miami Planning Department.

Section I

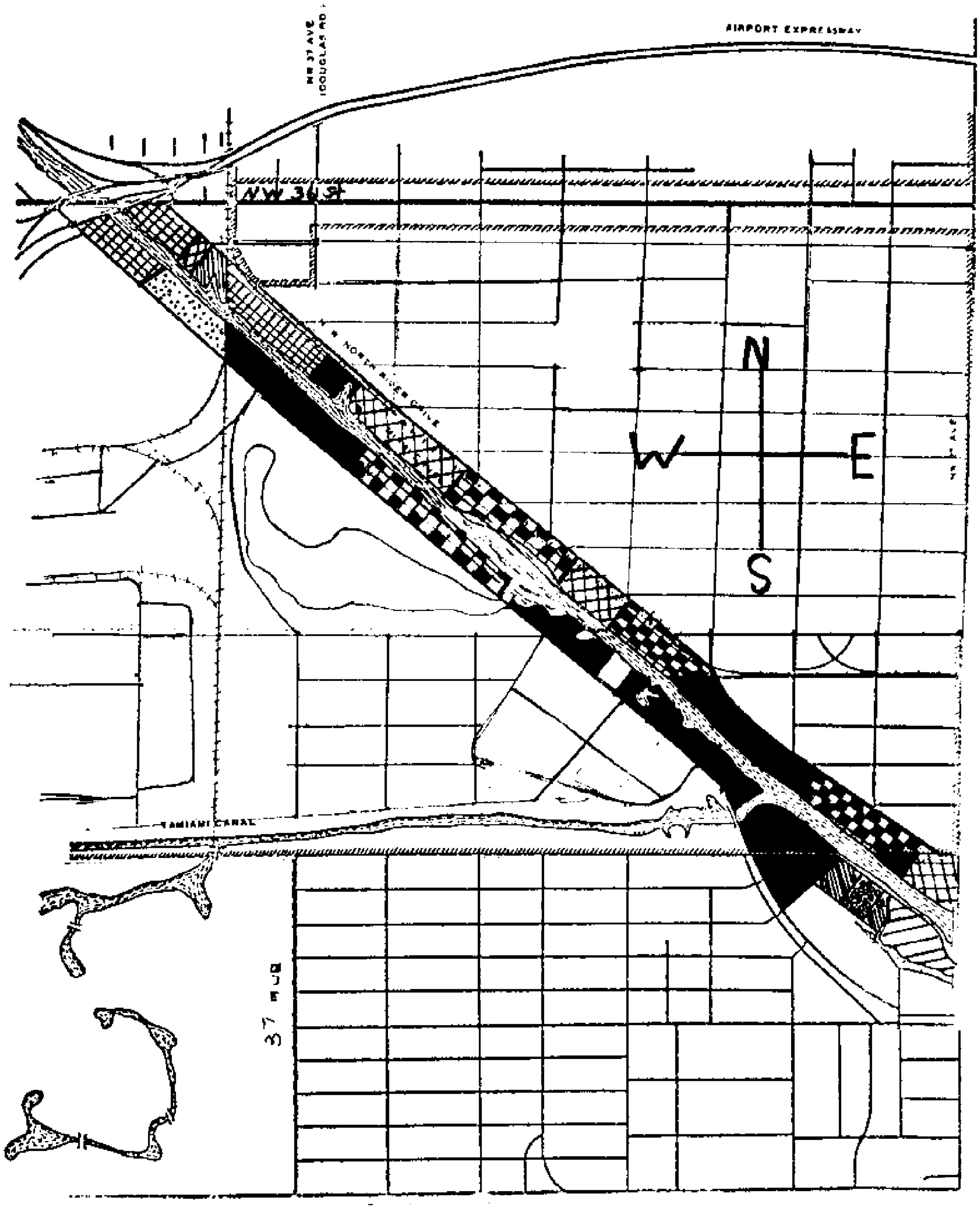
From the N.W. 36 Street dam to N.W. 27 Avenue is the most recently developed section of the river. A 1941 survey did not include this area because it had not been developed. It is the end of the entirely dredged Miami Canal that connects with the original Miami River.

There are no inlets or permanent mooring facilities for private boats. Approximately 25 percent of the riverfront is intensively used by commercial shipping firms with vessels averaging 140 feet in length. These vessels are placed in a rather awkward position since the river is only 90 feet wide. They must be towed sternfirst away from their berths and out of the river.

The riverfront is characterized by large open junk yards, abandoned vessels, and warehouses. More than 70 percent of the riverfront and employment is not connected with the river. The proximity of the railway (north side) has had more influence on these activities than the river.

MAP 5

SECTION I
N.W. 36 STREET DAM TO N.W. 27 AVENUE[1]



[1]Basic map provided through the courtesy of the City of Miami Planning Department.

TABLE 4

SECTION I - N.W. 36 STREET TO N.W. 27 AVENUE

CODE	ACTIVITY				EMPLOYMENT	
Symbol	Type	Number	Feet	% Land	Number	%
	Marine	8	5150	.30	231	.31
	Manufacturing	10	4800	.28	381	.50
	Retail	4	2250	.13	79	.11
	Institutional	1	400	.02	4	-
	Junk Yards	3	3400	.20	60	.08
	Parks	0	0	0	0	0
	Vacant Parking	1	600	.04	0	0
	Dwellings	N/A	550	.03	2	-
Section Totals		27	17150	100	757	100

TABLE 4 (Continued)

CODE	BOATS				POPULATION		SEWAGE		RUNOFF
Symbol	Private L/A	Commercial L/A	Unattended	Total	L/B	W/B	L/B GPD	W/B GPD	Riverfront Footage
	19	22	110	151		109		8175	5150
	1	5	10	16		22		1650	4800
	0	4	2	6		14		1050	2250
	1	1	0	2		5		375	
	0	0	7	7		0			3400
	0	0	0	0		0			
	5	0	4	9		12		900	
	0	0	0	0	130	0			
Section Total	26	32	133	191	130	162	*106500	12150	15600

*Sewage from sources not located along the riverfront.

Section II

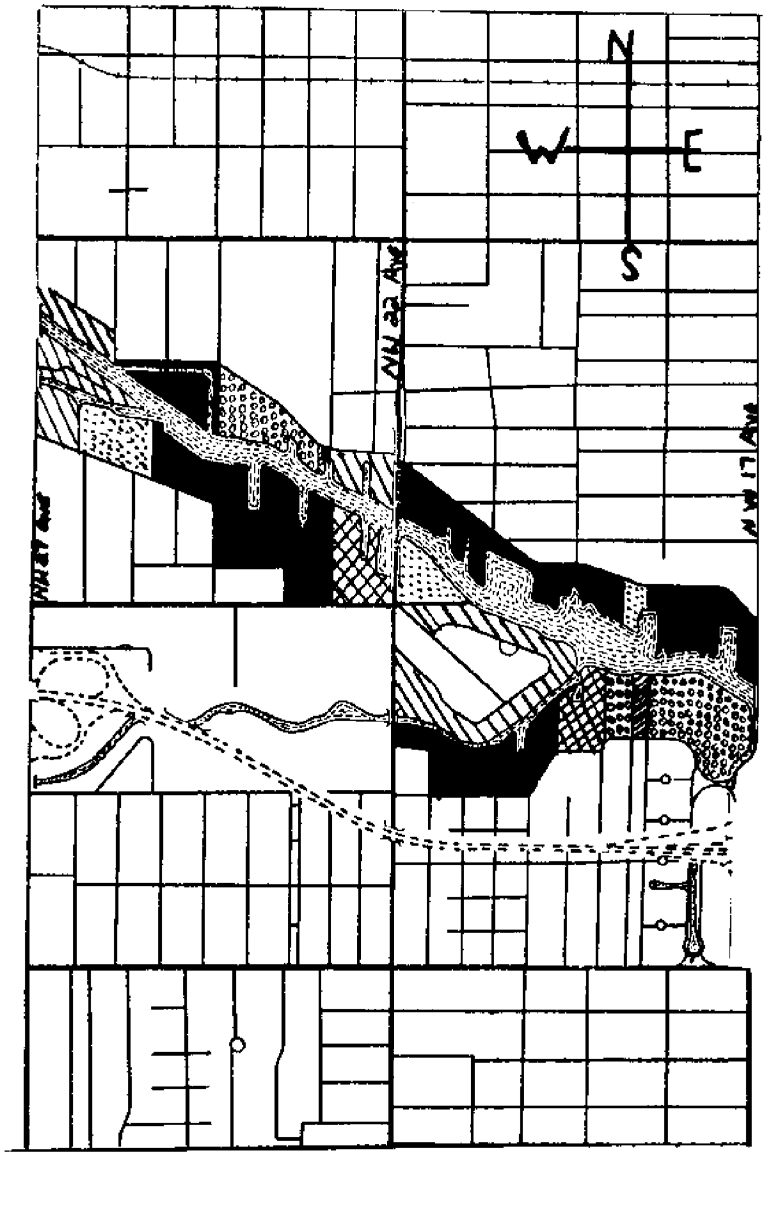
Between N.W. 27 Avenue and N.W. 17 Avenue, the irregularly shaped riverfront is overwhelmingly devoted to the mooring and storage of private boats. Approximately 50 percent of the riverfront is occupied by what might be loosely defined as marinas. There is no heavy marine drydocks or manufacturing in the area. Approximately 30 percent of the riverfront is residential, 13 percent parks, and 8 percent is vacant property.

More than 50 percent of the water-based population, and 80 percent of those living on private boats are located in this section. Two thirds of the live-aboard boats are in commercial marinas, the remainder are moored behind private residences. Except for two locations, the riverfront and boats are well maintained.

Fewer people are employed in this area than in any other section of the river. Approximately 90 percent of the employees are directly concerned with marine activities along the river.

MAP 6

SECTION II
N.W. 27 AVENUE TO N.W. 17 AVENUE[1]



[1]Basic map provided through the courtesy of the City of Miami Planning Department.

TABLE 5

SECTION II - N.W. 27 AVENUE TO N.W. 17 AVENUE

CODE	ACTIVITY				EMPLOYMENT	
Symbol	Type	Number	Feet	% Land	Number	%
	Marine	11	6800	.48	319	.91
	Manufacturing	0	0	0	0	0
	Retail	0	0	0	0	0
	Institutional	1	200	.01	25	.07
	Junk Yards	0	0	0	0	0
	Parks	3	1950	.13	6	.02
	Vacant Parking	2	1100	.08	0	0
	Dwellings	N/A	4250	.30	2	-
Section Totals		17	14300	100	352	100

TABLE 5 (Continued)

CODE	BOATS				POPULATION		SEWAGE		RUNOFF
Symbol	Private L/A	Commercial L/A	Unattended	Total	L/B	W/B	L/B GPD	W/B GPD	Riverfront Footage
	150	4	285	439		233		17475	4650
	0	0	0	0	0	0			
	0	0	0	0	0	0			
	0	0	0	0		0			
	0	0	0	0	0	0			
	0	0	0	0		0			
	0	0	0	0		0			
	48	0	50	98	206	114		8550	
Section Totals	198	4	335	537	206	347	*400000	26025	4650

*Sewage from sources not located along the riverfront.

Section III

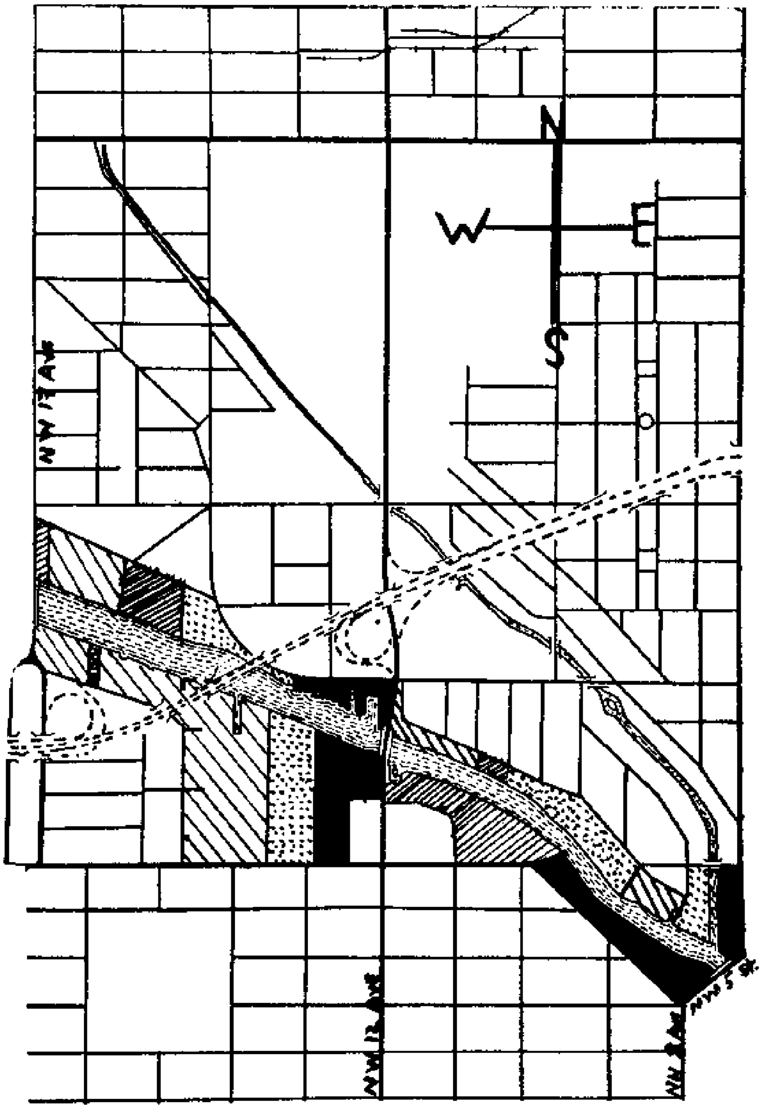
Between N.W. 17 Avenue and N.W. 5 Street, the river traverses a more congested area of Miami. On the north bank, there are several apartment houses, private institutions, and parking lots. This area is being influenced by the large Metropolitan Dade County Complex on N.W. 12 Avenue.

The south bank has a long stretch of private residences that were built when it was fashionable to live on the river. These large homes provide the mooring facilities for two thirds of the private live-aboard boats in this area.

There are actually very few people employed along the riverfront in this section. Recently, the First National Bank of Miami Operations Center moved into the relatively new, but vacated, Miami News Building (south bank) with 739 employees. Only about 28 percent of the riverfront activities and 24 percent of the employees in the area are dependent on the river.

MAP 7

SECTION III
N.W. 17 AVENUE TO N.W. 5 STREET[1]



[1]Basic map provided through the courtesy of the City of Miami Planning Department.

TABLE 6

SECTION III - N.W. 17 AVENUE TO N.W. 5 STREET

CODE	ACTIVITY				EMPLOYMENT	
Symbol	Type	Number	Feet	% Land	Number	%
	Marine	9	3025	.28	219	.24
	Manufacturing	0	0	0	0	0
	Retail	0	0	0	0	0
	Institutional	5	2300	.21	739	.76
	Junk Yards	0	0	0	0	0
	Parks	0	0	0	0	0
	Vacant Parking	4	2050	.19	0	0
	Dwellings	N/A	3350	.32	14	-
Section Totals		18	10725	100	972	100

TABLE 6 (Continued)

CODE	BOATS				POPULATION		SEWAGE		RUNOFF
Symbol	Private L/A	Commercial L/A	Unattended	Total	L/B	W/B	L/B GPD	W/B GPD	Riverfront Footage
	12	4	128	144		34		2550	2225
	0	0	0	0	0	0			
	0	0	0	0	0	0			
	0	0	8	8		0			
	0	0	0	0	0	0			
	0	0	0	0	0	0			
	7	0	12	19		16		1200	
	20	0	35	55	679	49		3675	
Section Totals	39	4	183	226	679	99	*1000000	7425	2225

*Sewage from sources not located along the riverfront.

Section IV

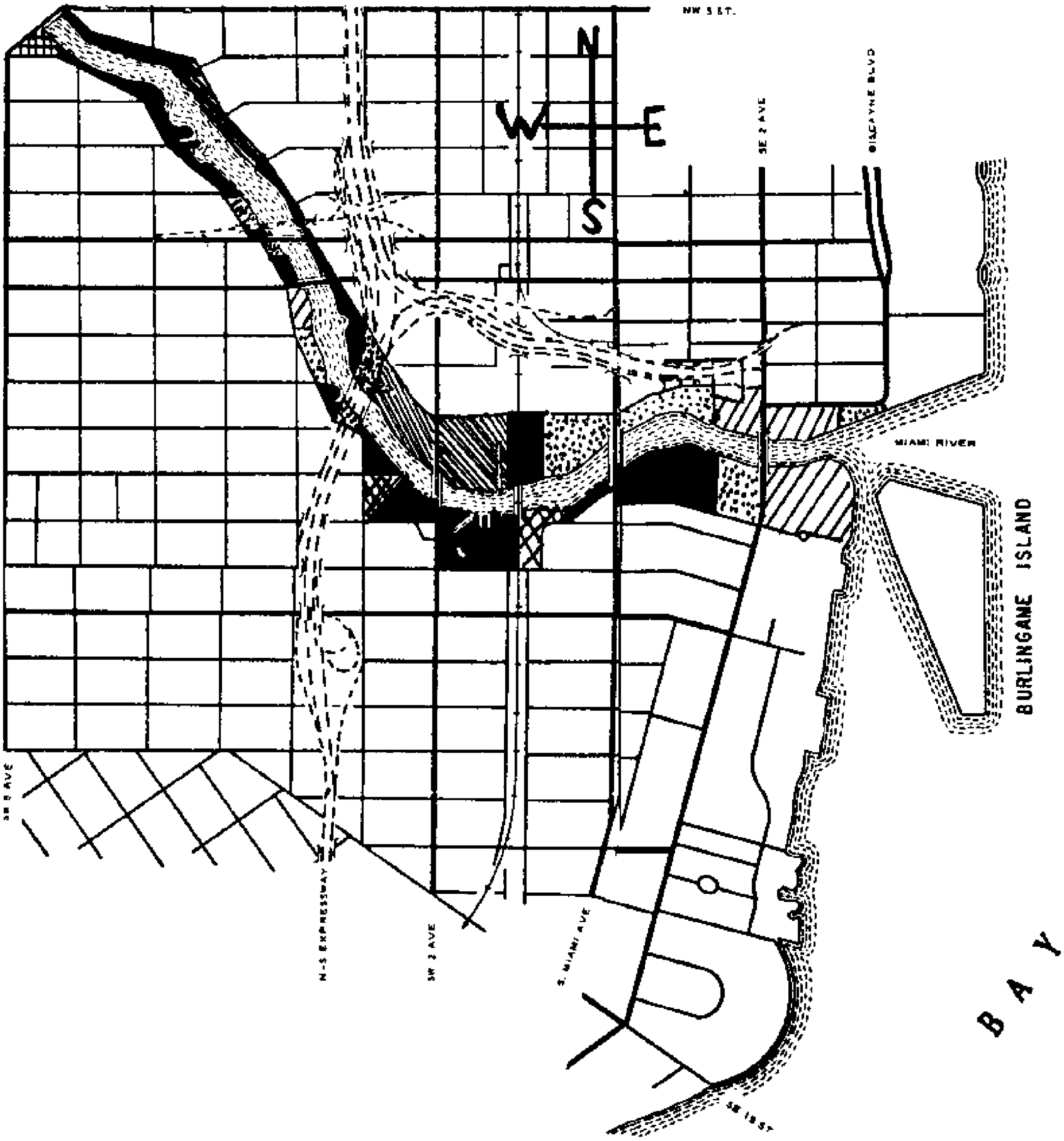
From N.W. 5 Street to Biscayne Bay, the river runs through the highly congested central business district of Miami. Total riverfront footage is approximately the same as Sections I and II, however, the river is wider (150 feet), and there are more individual firms than in any other section.

Approximately 567 people are employed by marine activities. About 80 percent of these employees are concentrated in several large drydocks and fish processing plants. The drydocks and fish processing establishments northwest of South Miami Avenue particularly characterize the river as a cluttered, but colorful, waterway.

The City of Miami Planning Department has an approved proposal to create a riverfront walking and bicycle path along the north bank from S.E. 2 Avenue to the North-South Expressway. Presently this area is occupied by parking lots, a Florida East Coast Railway loading facility, and several Florida Power and Light Company office buildings. None of these activities utilize the riverfront.

MAP 8

SECTION IV
N.W. 5 STREET TO BISCAYNE BAY[1]



[1]Basic map provided through the courtesy of the City of Miami Planning Department.

TABLE 7

SECTION IV - N.W. 5 STREET TO BISCAYNE BAY

CODE	ACTIVITY				EMPLOYMENT	
Symbol	Type	Number	Feet	% Land	Number	%
	Marine	25	7095	.47	567	.58
	Manufacturing	2	375	.02	66	.07
	Retail	3	1825	.12	216	.28
	Institutional	3	800	.06	7	-
	Junk Yards	0	0	0	0	0
	Parks	0	0	0	0	0
	Vacant Parking	6	2825	.19	0	0
	Dwellings	N/A	2150	.14	69	.07
Section Totals		39	15070	100	925	100
River Totals		101	57245	100	3006	100

TABLE 7 (Continued)

CODE	BOATS				POPULATION		SEWAGE		RUNOFF
Symbol	Private L/A	Commercial L/A	Unattended	Total	L/B	W/B	L/B GPD	W/B GPD	Riverfront Footage
	4	13	247	264		59		4425	4140
	0	0	0	0		0			
	0	3	6	9		11		825	
	0	0	18	18		0			
	0	0	0	0	0	0			
	0	0	0	0	0	0			
	1	3	9	13		18		1350	
	18	0	20	38	654	44	*26000	3300	
Section Totals	23	19	300	342	654	132	26000	9900	4140
River Totals	286	59	951	1296	1669	740	1532500	55500	26615

*Sewage directly dumped into the river from dwellings located along the riverfront.

General Land Use Patterns

Approximately 67 percent of the overall riverfront is occupied by commercial activities. The 5.20 miles from the dam to Biscayne Bay contains 85 individual firms and provides employment for 3006 people. About 39 percent of the riverfront (by linear foot) is occupied by directly marine related activities that depend on the river. Residential areas provide the mooring facilities for a large number of boats that would otherwise be necessarily located in commercial marinas. Section I and III have the least utilized riverfronts. Section I is dominated by junk yards, warehouses, and manufacturing that are not connected to the river. Section III has a residential area (south bank) and parking lots or private institutions (north bank) that are not directly connected with the river.

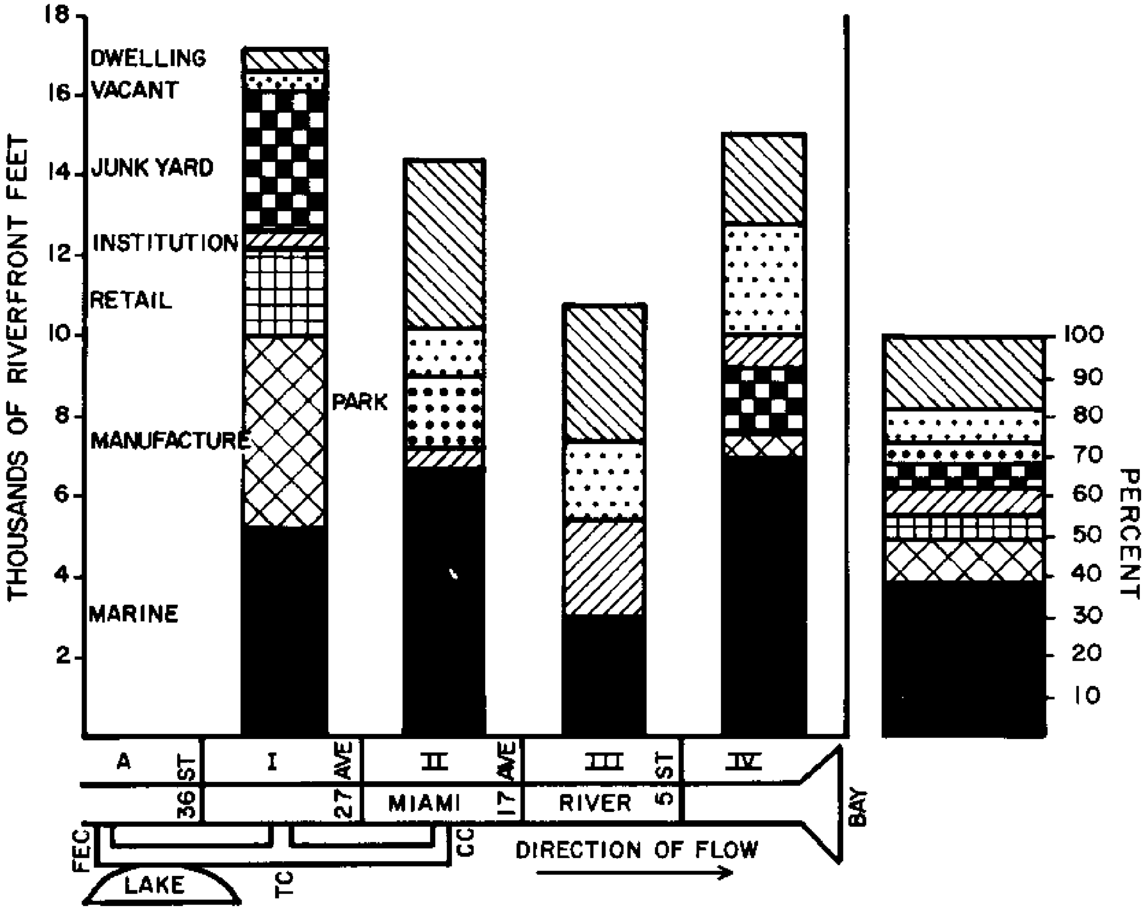
The fact that the well established and utilized riverfront (Sections II and IV) is not consecutive creates planning difficulties for any future comprehensive land use plan for the river. Graph 1 represents land use patterns by section and activity. The graph on the right aggregates total land usage, by percent, for each activity.

Employment on the Miami River

Marine activities are the most important source of employment along the riverfront. The data is somewhat misleading for Sections I and III. In Section I, the

GRAPH 1

LAND USE BY SECTION AND ACTIVITY[1]



[1] The horizontal axis of this graph and several of the following graphs is represented by a schematic diagram of the Miami River and its tributaries. The indicated streets and avenues divide the sections. The main tributaries are the F.E.C. Canal (FEC), Tamiami Canal (TC), and Comfort Canal (CC). Blue Lakes (Lake) connects the tributaries.

the manufacturing category includes one large firm with 200 employees. Section III is dominated by one institution with 739 employees. If we exclude these two firms, employment along the river is overwhelmingly concentrated in marine activities.

Full-Time Employees and Contracted Individuals

Table 8 reflects the number of people employed and contracted by each activity.

TABLE 8

EMPLOYEES AND CONTRACTED INDIVIDUALS

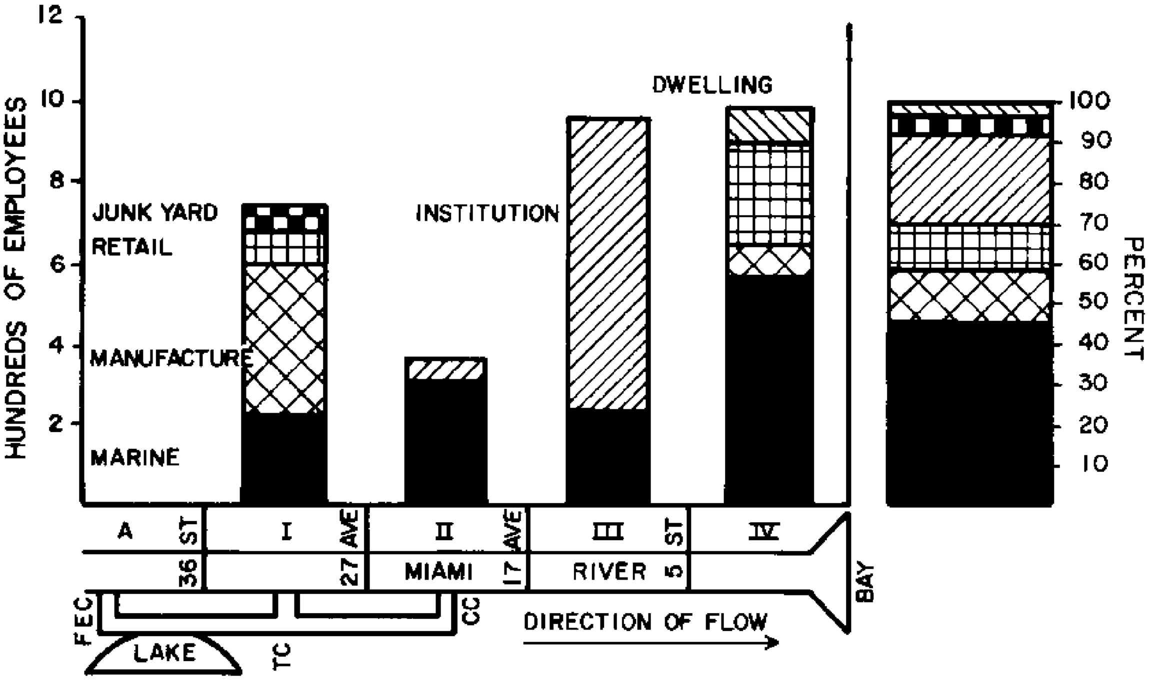
Activity	Employees (Number)	Contracted (Number)	Contracted (percent)
Marine	1088	248	.19
Manufacturing	424	23	.05
Warehouse, Whole-Sale, Retail	355	0	0
Institutions	763	12	.01
Junk Yards	60	0	0
Recreational	6	0	0
Vacant, Parking	0	0	0
Dwellings	87	0	0

Employment by Section and Activity

Graph 2 represents the total number of people employed on the Miami River by section and activity. The graph on the right aggregates total employment, by percent of employment on the river, for each activity.

GRAPH 2

EMPLOYMENT BY SECTION AND ACTIVITY



Indirect Employment in Dade County

The marine activities on the river contribute indirectly to the employment of a great number of people in Dade County. For example, the fish processing plants employ approximately 313 people at their processing locations, however, they process the catch of about 149 fishing boats and 245 independent fishermen, which are not included in the employment estimates.[1]

Local boat building, tourist attractions, and marinas depend on the riverfront firms to haul, service, and repair local and out-of-State boats. Except for Dinner Key in Coconut Grove, which only hauls private boats, the Miami River provides the only drydocks in Dade County. Miami is growing into one of the pleasure craft building centers of the United States. In 1968, there were 72 boat building firms in Dade County.[2] Table 9 represents the growth of boat building in the area.

Boats on the Miami River

In 1968, 12.7 percent of all the boats registered in Florida were in Dade County. There were over 40,000 local pleasure boats and more than 8,000 visiting boats in the area.[3]

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[1] National Marine Fisheries Service, Dade County, Florida, 1969.

[2] Metropolitan Dade County Development Department, *Boats Afloat*, Metropolitan Dade County, Florida.

[3] Ibid.

TABLE 9

BOAT BUILDING IN DADE COUNTY

Year	Number of Plants	Number of Employees
1950	8	62
1954	21	199
1957	38	1162
1962	63	1561
1965	89	2210
1968	122	4296

Types of Boats

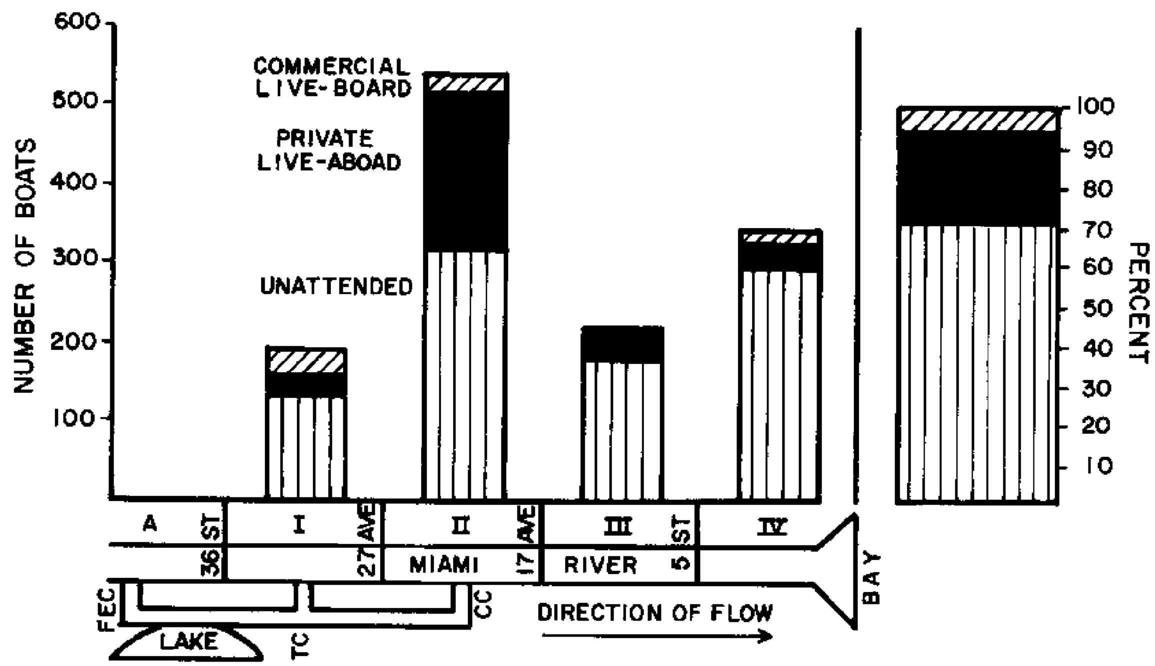
The Inventory divides the boats on the Miami River into three categories, (1) normally unattended boats, (2) private live-aboard boats, and (3) commercial live-aboard vessels. Graph 3 represents the locations of these boats by section of the river. The graph on the right aggregates, by percentage, the types of boats on the entire river.

Seasonal Fluctuation in Boats

Surprisingly, there is very little seasonal fluctuation in the number of boats moored on the river. Only one large wet-storage facility reported more than a 20 percent fluctuation. This facility specializes in large out-of-State yachts. Most of the facilities catering to out-of-State boats reported the same 10 to 15 percent fluctuations that were reported by facilities that only handle local boats. Table 10 represents marinas on the river that

GRAPH 3

TYPES OF BOATS BY SECTION



specialize in local and out-of-State boats. This does not include boats that are not moored in commercial marinas.

TABLE 10

TYPES OF MARINAS ON THE MIAMI RIVER

Type of customer	Number of Marinas	Number of boats
Local boats	19	645
Out-of-State Boats	4	152

Location of Boats

Corresponding to the land use patterns, most of the boats are located in Sections II and IV. All the live-aboard boats are moored at marine activities or private residences. While 20 percent of the total boats are at residences, this represents 34 percent of all the live-aboard boats. Graphs 4 and 5 illustrate the locations of boats by section and activity. The graphs on the right aggregate, by percentage, the location of boats on the river by activity.

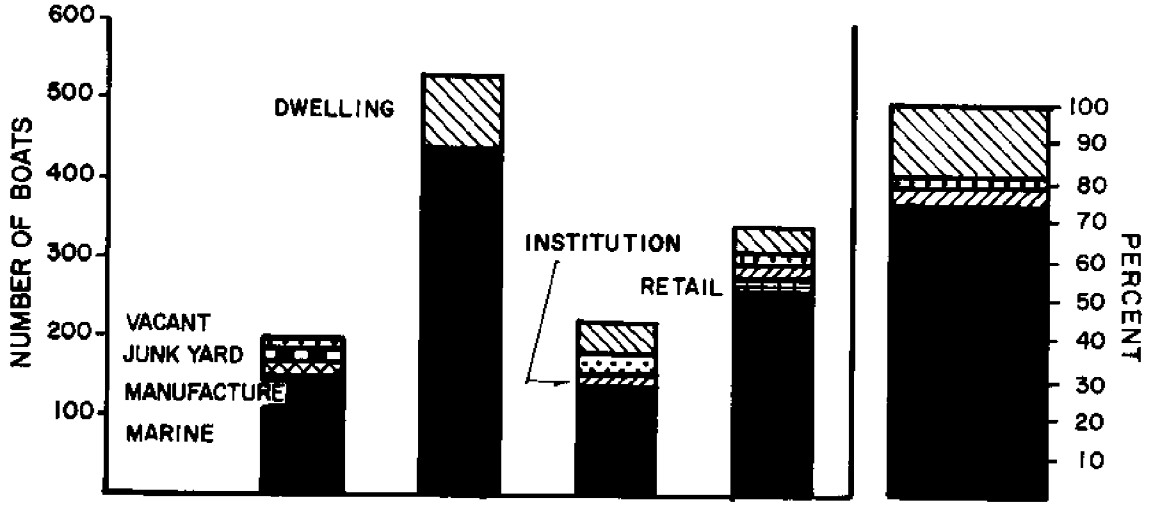
Population on the Miami River

The Land-Based Population

The entire land-based population in Section I is concentrated in one trailor park at N.W. 27 Avenue (south bank). A large portion of the population in Section III

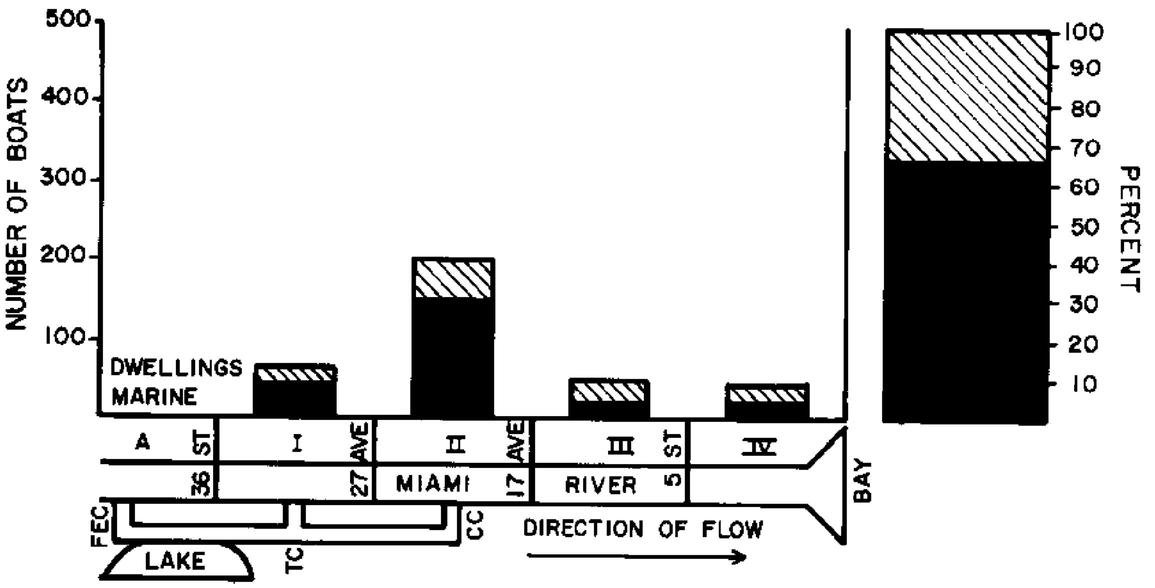
GRAPH 4

TOTAL BOATS BY SECTION AND ACTIVITY



GRAPH 5

LIVE-ABOARD BOATS BY SECTION AND ACTIVITY



is in the Dade County public housing project, Robert King High Towers, that provides apartments for 375 senior citizens. The population in Section IV is attributed to the Granada Hotel-Apartments (111 tenants) and the Dupont Plaza Hotel (average of 330 guests). Most of the remaining riverfront residents are located in single family dwellings.

<u>The Water-Based Population</u>

The water-based population is estimated from the number of live-aboard boats in each section. Graph 6 represents the land-based population, water-based population, and their methods of sewage disposal. All the live-aboard boats discharge untreated sewage. The City of Miami Department of Water and Sewers estimates all the older land-based dwellings along the river are still using individual septic tanks. Notable exceptions are the Dupont Plaza Hotel and the Robert King High Towers which accounts for the population along the riverfront utilizing the central sewage system.

Pollution on the Miami River

Pollutants on the river can be divided into two broad categories. First, sewage effluents, and second, oil, grease, and phosphate runoffs. Table 11 lists the major types and sources of pollution on the Miami River.

GRAPH 6

LAND-BASED POPULATION, WATER-BASED POPULATION, SEWAGE DISPOSAL SYSTEMS

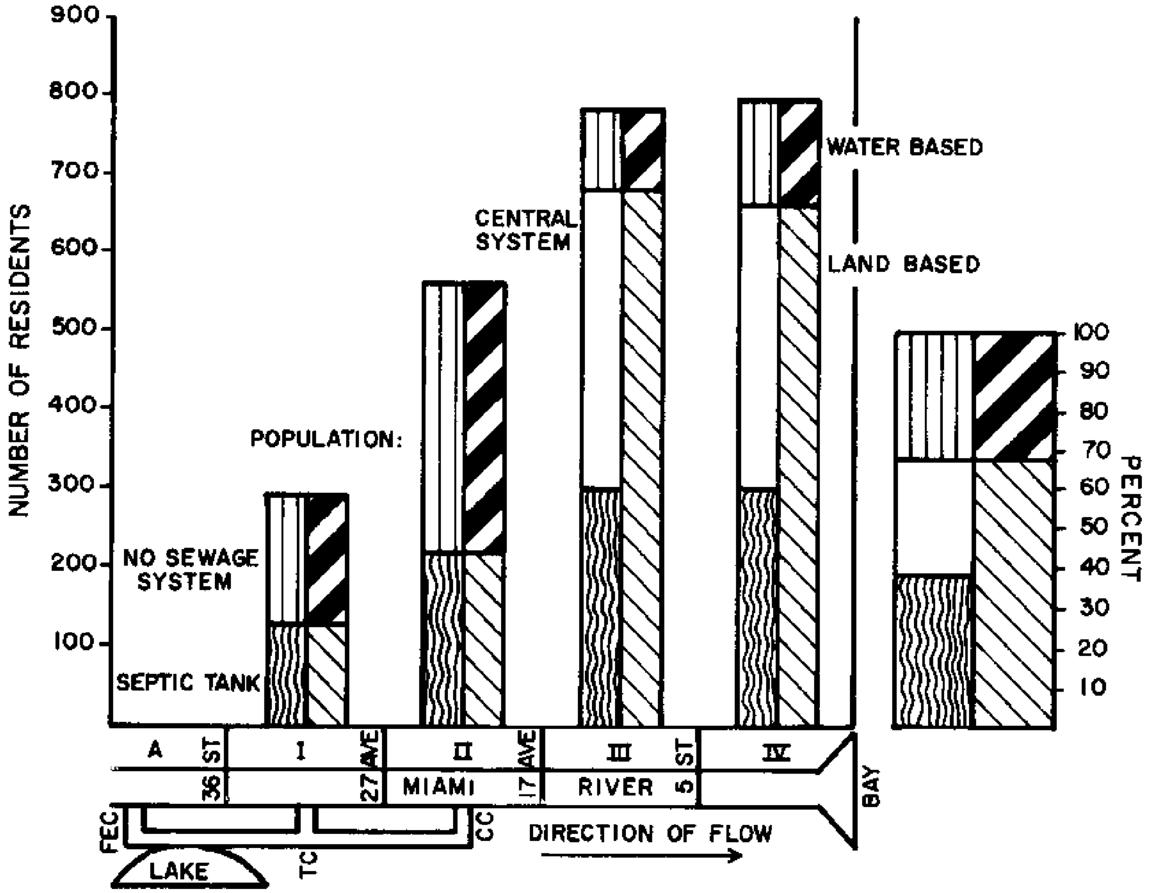


TABLE 11

TYPES AND SOURCES OF POLLUTANTS ON THE MIAMI RIVER

EFFLUENTS
1. Untreated Sewage a. Municipal outlets b. Private outlets c. Boat discharges 2. Treated Sewage a. Private sewage treatment plants b. Private individual activities 3. Miscellaneous Effluents a. Fish Processing wastes b. Other production wastes

RUNOFF
1. Storm Sewer Runoff (Urban Areas) a. Normal street runoff b. Concentrated oil, grease and debris runoff c. Detergent and phosphate runoff 2. Land Runoff (Rural Areas) a. Agricultural fertilizer runoff b. Soil and debris runoff

Major Known Sources of Untreated Sewage in 1970

1.	One City of Miami sewer overflow at N.W. 27 Avenue and 11 Street into Comfort Canal (leads to Section II). Approximate constant discharge	400,000 GPD
2.	One City of Miami life station emergency overflow into a storm sewer at N.W. 13 Avenue (Section III) Approximated discharge during rainy periods	1,000,000 GPD
3.	Granada Motel-Apartments, S.E. 2 Avenue (north bank, Section IV). Approximate constant discharge	10,000 GPD
4.	Brickell Point Apartments, Brickell Avenue Bridge (south bank, Section IV). Approximate constant discharge	16,000 GPD[1]
5.	286 private live-aboard boats and 57 commercial live-aboard vessels with a water-based population of 740 people. Approximate constant discharge	56,000 GPD
	Known untreated sewage effluents discharged into the Miami River in 1970	1,482,000 GPD

[1]Dade County, *Pollution Sources of The Miami River--1970.*

Major Known Sources of Treated Sewage in 1970[1]

1.	Atomic Sewerage Co. (outlet into F.E.C. Canal leading into the Miami Canal, Section A). Approximately 30,000 GPD of collected sludge from septic tanks	30,000 GPD
2.	Holiday Inn (Section A) outlet into Miami Canal (Section A). Approximate constant discharge	24,000 GPD
3.	Pan American Hospital (Section A) outlet into Tamiami Canal (leading to Section I). Approximate constant discharge	60,000 GPD
4.	Howard Johnsons Hotel (Section A) outlet into Tamiami Canal (Leading to Section I). Approximate constant discharge	24,500 GPD
5.	Congress Crossways Inn (Section A) outlet into Tamiami Canal (leading to Section I). Approximate constant discharge	22,000 GPD
	Known treated effluents discharged into the Miami River in 1970	160,500 GPD

Graph 7 relates the known gallons per day of sewage discharged into the Miami River by section. The graph on the right aggregates, by percentage, the untreated sewage discharged from land-based and water-based sources.

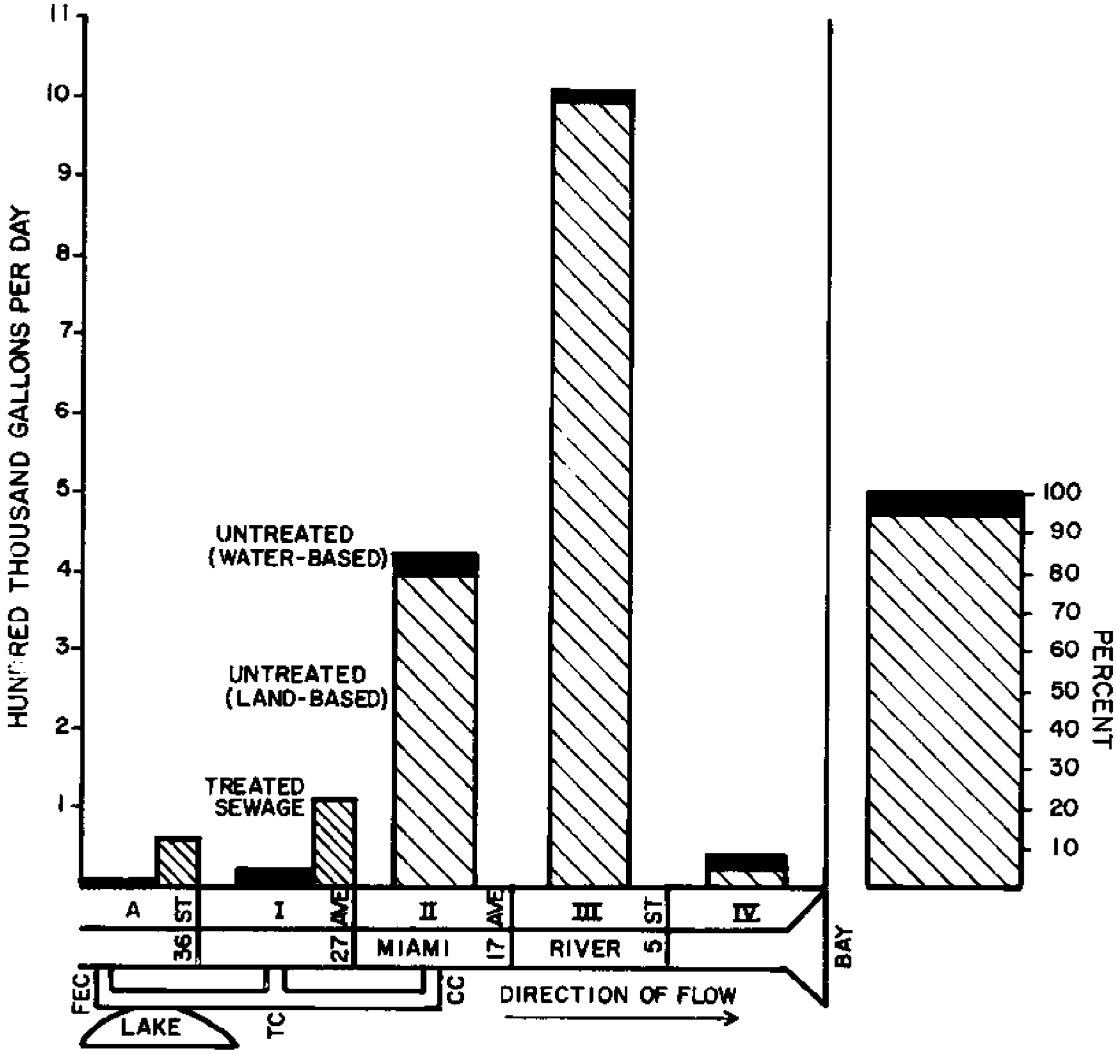
Fish Processing Wastes

The finfish and shellfish processing plants are located in Section IV between the North-South Expressway and N.W. 5 Street. This is an old section of Miami, three of the five processors have been operating in the same location for

[1] Ibid.

GRAPH 7

UNTREATED AND TREATED SEWAGE EFFLUENTS
(THOUSANDS OF GALLONS PER DAY)



over 40 years. The old buildings are constructed on pilings over the river. The processing wastes are swept out the "backdoor" into the river. This inventory has not attempted to quantify these effluents, however, these wastes represent a substantial input into the river.

Unknown Sources of Untreated and Treated Effluents

1. There are at least 30 outfalls into the Miami River east of the dam that have not been identified. There are an undetermined number of outfalls west of the dam. Unenforced sewer regulations over the past 30 years have provided an opportunity for many people to construct clandestine sewer and overflow lines to the river. Many of the outlets are below the mean low water mark and are therefore difficult to detect.

2. There are many sewers in the City of Miami sewer system that lead to the river. All of these older outlets are supposed to be plugged, however, investigations have shown that many of these outlets are still active. One City of Miami emergency sewer outlet at 6 Avenue and N.W. North River Drive was discharging approximately 1,000,000 GPD when it was discovered and closed in 1970.[1]

3. According to the inventory, 1669 people live in dwellings along the riverfront. Most of these dwellings use septic tanks that have overflow lines or natural seepage into the river.

Phosphate Runoffs

We can probably assume that those activities with concentrated oil and grease runoffs use detergents. Most detergents contain phosphoric acids. Agricultural

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[1] *Ibid.*

fertilizers usually consist of calcium phosphate and other minerals. Graph 8 relates yearly average concentrations of phosphates in the water to sections of the river. The highest concentrations are in the Miami Canal (Section A) near the F.E.C. Canal, which is the primary storm sewer for the Miami International Airport. Northwest of the F.E.C. Canal, the Miami Canal has negligable traces of phosphates indicating that agricultural activities are only a minor source of phosphate runoffs into the Miami River.

Oil and Grease Runoff

It has been estimated that the runoff basin for the Miami River creates over 2,713 cubic feet per second flow into the river during rainy periods.[1]

There are two problems with measuring oil and grease runoffs. First, diversity in the size and intensity of the runoff from each activity makes it impossible to simply compute the total square foot area of these activities to obtain an accurate indication of the runoff. Secondly, there is no existing water quality standard that accurately measures oil and grease concentrations. For example, *The Delaware Estuary Comprehensive Study*, given certain objectives as constraints, set the maximum oil and grease concentrations at, "negligible," for lack of

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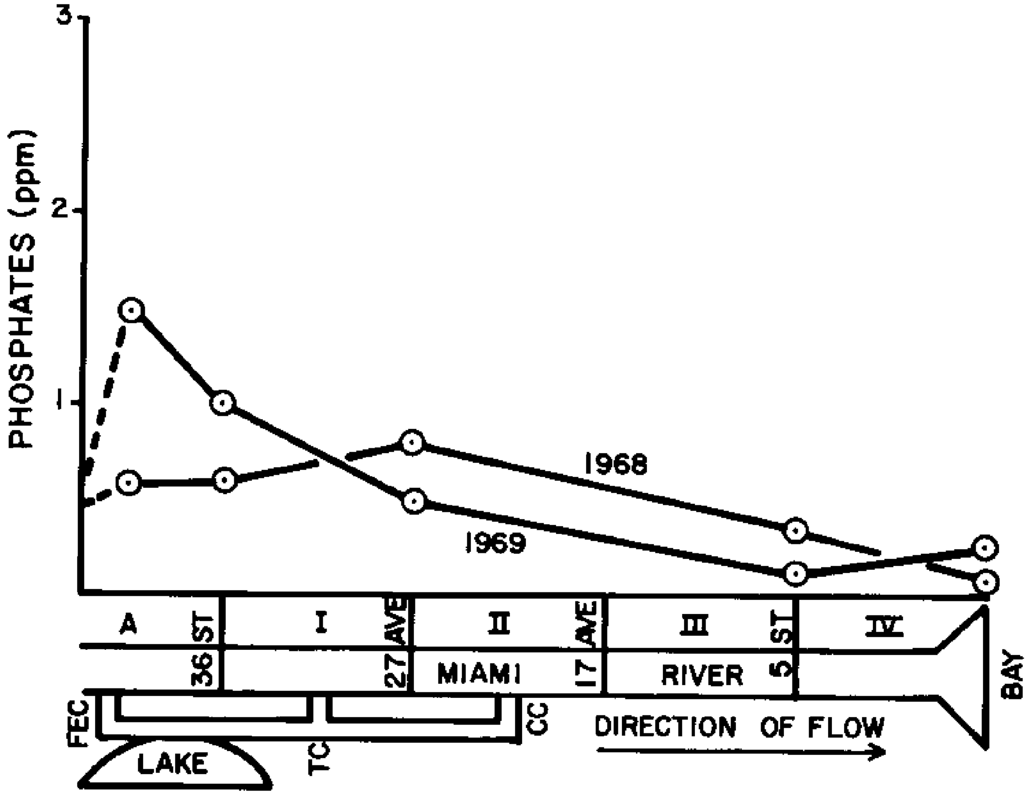
[1] Ibid.

GRAPH 8

PHOSPHATE CONCENTRATIONS IN THE RIVER[1]



[1]Yearly average phosphate concentrations at different locations on the Miami River were provided through the courtesy of the Dade County Pollution Control Office.

a more quantitative standard.[1] This study will simply enumerate those activities that definitely generate oil and grease runoffs.

Sources of Oil and Grease Runoffs

1. Miami International Airport runways and service areas. The normal fuel deposits and cleaning wastes are carried by storm sewers to the F.E.C. Canal, Borrow Ditch, Maule Lake, Tamiami Canal, and Comfort Canals.

2. Approximately 5 junk yards (Section I), 4 warehouses (Section I), 10 manufacturers and metal shops (Section I), and 34 marine drydocks and repair facilities (Sections I through IV).

3. Normal street runoff carrying the normal deposits of oil and grease through approximately 68 storm sewers with outlets into the river.

4. Another source, while not technically a runoff, is the oil and grease deposits from the decks and bilges of boats, particularly large commercial vessels.

No attempt has been made to quantify the oil and grease runoffs from the Miami International Airport (Section A). The airport is more than one square mile in area with over 500,000 jet flights per year which would suggest that this is the largest source of runoffs.[2]

Graph 9 indicates the riverfront footage, by section, that is occupied by activities that have concentrated oil

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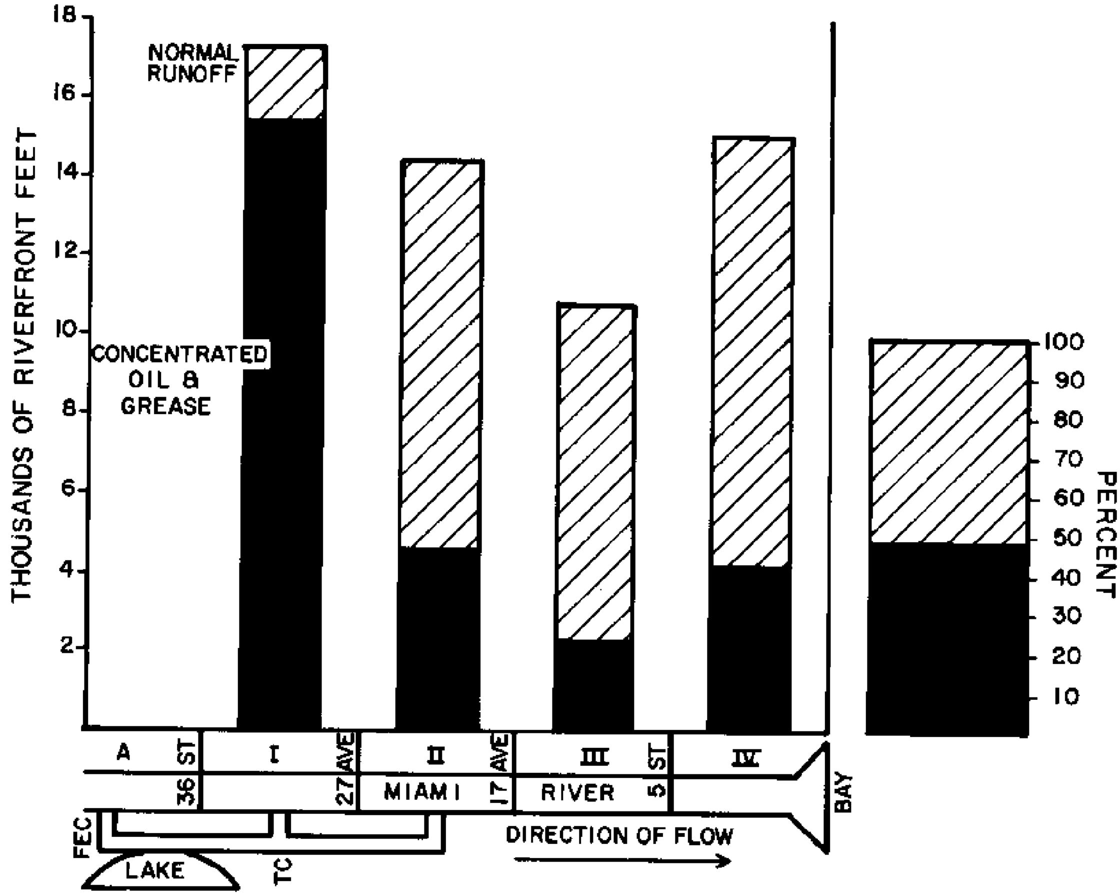
[1]Federal Water Pollution Control Administration, *Delaware Estuary Comprehensive Study* (Department of the Interior Publication, 1966). pp. 56-58.

[2]Colin Morrissey, Chief Pollution Control Inspector, Dade County Pollution Control Office. Legal Seminar on Pollution, University of Miami, April, 1971.

GRAPH 9

RUNOFFS FROM ACTIVITIES ALONG THE RIVERFRONT



and grease runoffs. The graph on the right aggregates, by percentage, the riverfront occupied by activities with concentrated and normal runoffs.

Pollution Control on the Miami River

The Dade County Pollution Control Office presently has some type of surveillance, control, or court action involving the previously mentioned sources. Pollution control inspectors have had a tedious job in attempting to locate and identify the sources of pollution. It should be reemphasized that the above sources were only the known identified sources in 1970. It is a mamouth task to identify, much less measure, the pollutants in even a small geographical area such as that covered by the Miami River.

Some Preliminary Conclusions About the River

This economic inventory has focused on land use, employment, boats, population, and pollution along the Miami River. Perhaps now we can draw some preliminary conclusions about the river.

Economic Activities on the Miami River

1. Marine Activities

Marine activities depend on the river. This is the largest single category by land use, employment, boats, and water-based population. These activities are an important source of oil and grease runoffs, but the total runoff from these activities is probably far less than the runoffs from the Miami International Airport.

Marine activities are not primarily responsible for the sewage pollution. All of the live-aboard boats on the Miami River account for about 55,000 GPD of untreated sewage which is only approximately 4 percent of the known untreated sewage, and only about 3 percent of the known untreated and treated sewage being dumped into the river.

Fish processing is a notable source of pollution. Fish processing plants deposit processing wastes into Section IV of the river.

2. Manufacturing

Except in Section I, manufacturing is a minor activity that does not have a significant environmental impact. The most significant fact is that these activities do not utilize the river as a source of water or for transportation. They have located at their present sites for reasons other than the utility of the riverfront.

3. Warehouses, Office buildings, Wholesale, and Retail Activities

Section I has the warehouses and wholesale activities, Section IV has the office buildings and retail firms. These are also a small component of the activities on the riverfront. They do not utilize, or have a significant environmental impact on the river.

4. Institutions

Institutions occupy only six percent of the riverfront, yet they have a large employment role due primarily to one large banking facility. The private institutions such as the Miami Pioneer's 250 Lodge, Masonic Lodge, and Mahi Shrine Temple were established before 1950 and located at their present sites because these were the older established areas of Miami. None of these institutions are connected with the river.

5. Junk Yards

All of the junk yards and scrap metal shops are located in Section I. According to land usage and employment, these are minor activities. They are particularly noticeable however, because of their unsightly character and concentration in one area. The junk yards do not utilize the river, most of the scrap metal is transported by railway. Only one out of the five large yards reported using the river occasionally for transportation. The junk yards located at their present sites before the city expanded from the central business district westwardly towards the airport. Though these activities have concentrated oil and grease runoffs, they do not seriously contribute to sewage pollution.

6. Recreational

Public or private recreational areas are scarce on the river. The only large public access to the river is the City of Miami's Sewell Park in Section II, which does not provide any marine related recreational facilities.

7. Vacant Property and Parking Lots

In Sections I and II, this category designates vacant property. In Section III (north bank), it is parking for the Metropolitan Dade County Complex. In Section IV, it is parking for the central business district. Parking lots do not appear to be an effectual utilization of the riverfront, but these lots temporarily utilize the riverfront until rezoning determines the ultimate uses for the areas.

8. Dwellings

Residential areas represent the second largest category for land use along the riverfront. Historically there has been a constant battle to rezone the residential areas, but there have been only a few changes since 1940. Approximately 20 percent of all the boats are moored in residential areas. Many homes have actually become "mini-marinas" with four to eight boats per dwelling. Their role in water-based sewage pollution is about one-third as large as that of commercial marine activities. Except for two notable buildings, most of the dwellings along the river use individual septic tanks that have overflow lines or natural seepage into the river.

Land Use

Approximately 22,070 linear riverfront feet are occupied by marine activities that require a sheltered harbor or river. Considering the inlets and basins, a more realistic approximation is at least 66,210 waterfront feet or about 12.6 waterfront miles. These activities are indispensable to boating in Dade County. If the character of the Miami River is to be seriously altered, a suitable place would have to be found for these activities. Only a few of the other commercial activities on the river utilized the riverfront.

Pollution

By far the most damaging form of pollution on the Miami River is from sewage. Municipal, rather than private activities, are the main sources of sewage pollution. Activities along the riverfront are not primarily responsible for the polluted condition of the river. Marine activities, particularly boats, have been found guilty by association with a polluted river.

Oil and grease enter the river from marine and other heavy commercial activities, however, these are only minor pollution factors. Boats discharge untreated sewage, but this is only a minute fraction of the untreated and treated sewage discharged into the river by land-based sources that do not have any connection with, or even proximity to, the Miami River.

CHAPTER IV

MIAMI RIVER AND BISCAYNE BAY

This chapter places the Miami River in an economic and environmental perspective with Biscayne Bay. The Bay area is defined for this study as being in Dade County, boarded on the north by Broward County and on the south by Monroe County. The west shore is the Peninsular of Florida. The bay is protected from the Atlantic Ocean on the east by Miami Beach, Virginia Key, Key Biscayne, and a long stretch of shoal waters leading to the upper Florida Keys.

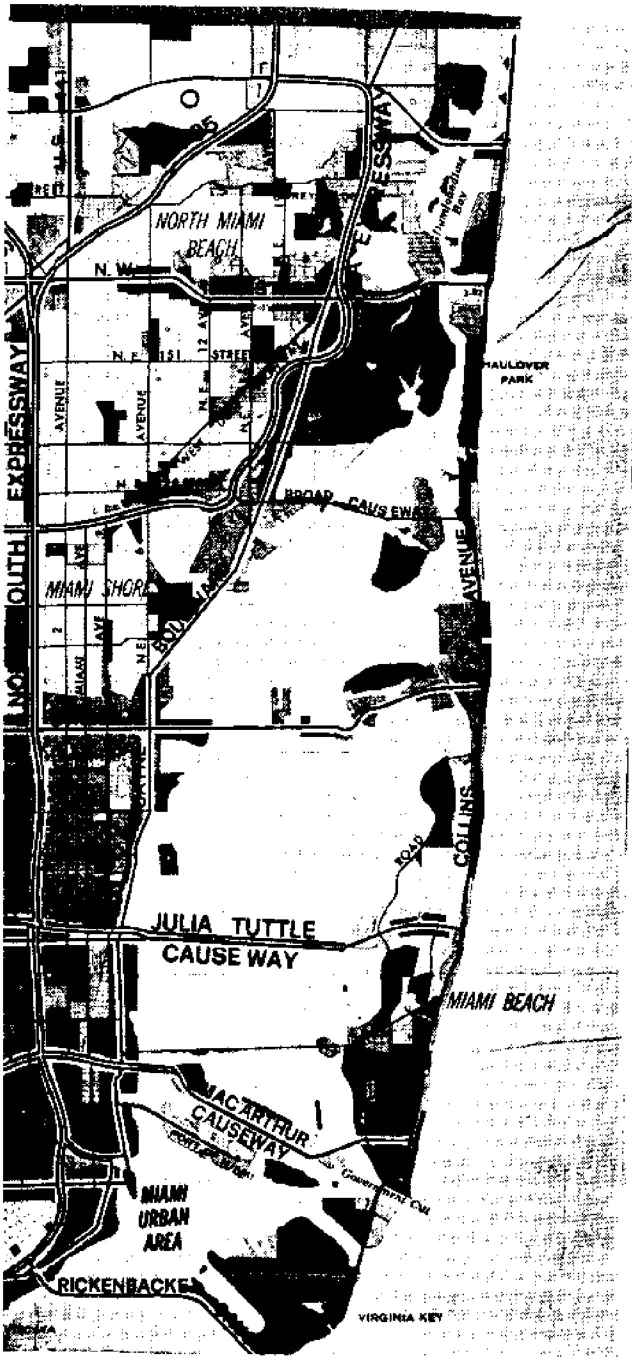
Land Use

Residential and Recreational

Perhaps the most striking characteristic of Biscayne Bay is that most of the bayfront is residential or recreational. The lightly shaded bayfront on Maps 9 and 10 represents residential areas. The darker areas are mostly public recreational facilities. The large public parks and recreational centers from north to south are, (1) Interama, (2) Haulover Park, (3) Bayfront Park, (4) Virginia Key, (5) Crandon Park, (6) Cape Florida Park, (7) Matheson Hammock Park, (8) Chapman Field Park.

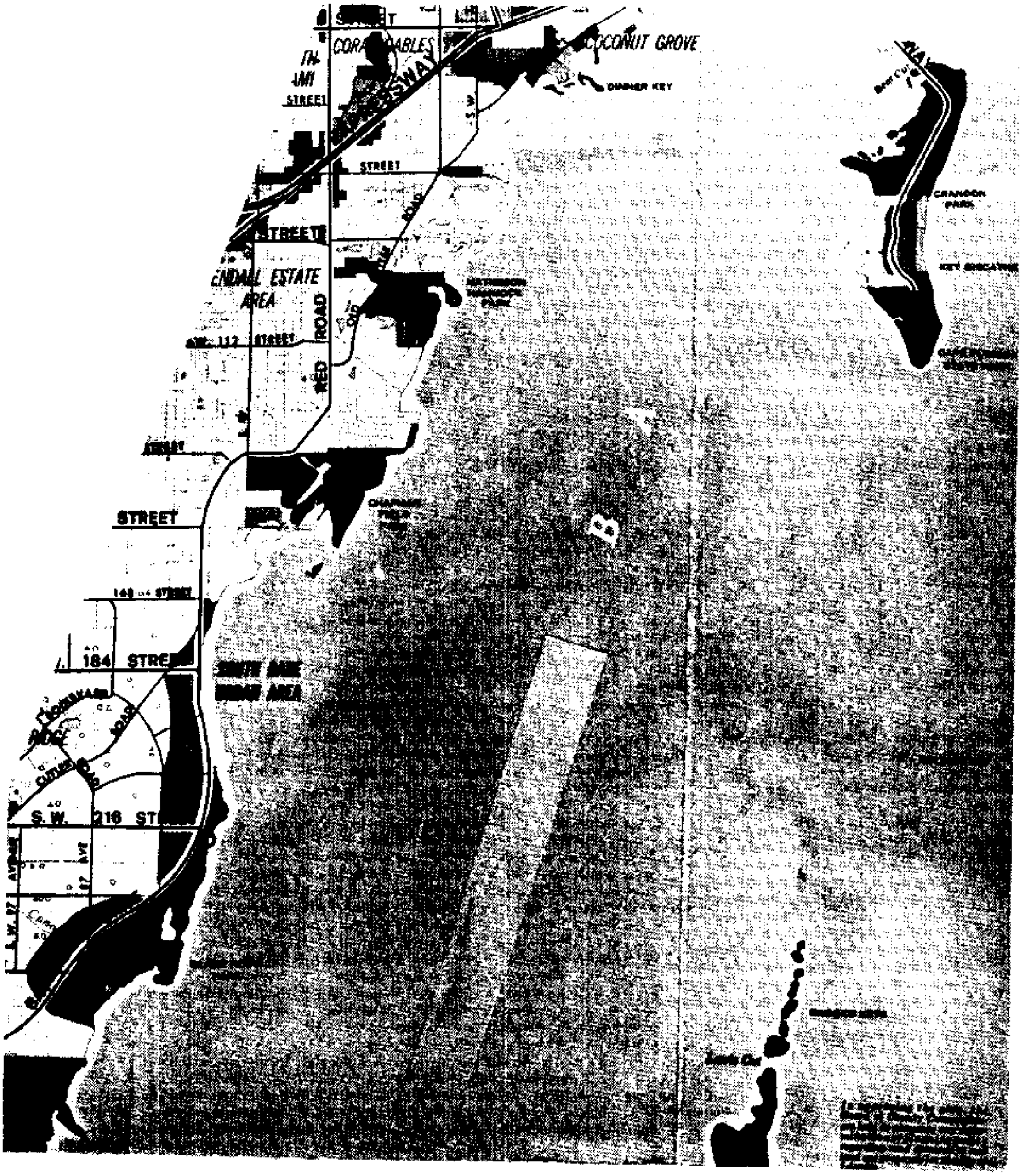
MAP 9

UPPER BISCAYNE BAY



MAP 10

LOWER BISCAYNE BAY[1]



[1]Map provided through the courtesy of the Metropolitan Dade Planning Department.

Marine Activities and Boats

Biscayne Bay is the water-oriented recreational center of Dade County. Most of the residential bayfront areas moore private boats. The largest public marinas for private pleasure boats are from north to south, (1) Haulover Marina, (2) City of Miami Marina, (3) Crandon Park Marina, (4) Dinner Key Marina, (5) Matheson Hammock Marina. Dinner Key is the only marina outside the Miami River that permits permanent residents on live-aboard boats (120 boat capacity).[1] There are 18 commercial marinas and 20 private boating and yacht clubs in Dade County.[2]

The City of Miami docks and the Port of Miami provide the facilities for passenger and cargo ships. There is a Coast Guard installation on Macarthur Causeway to service Coast Guard and Naval ships.

Retail and Office Buildings

Almost all of the commercial activities on the bayfront are concentrated near the mouth of the Miami River in the central business district of Miami. Both north and south of the business district is residential.

Tourist Hotels

Most of the tourist hotels are located on the east side of Miami Beach facing the Atlantic Ocean.

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[1]Dockmaster, Dinner Key Marina, City of Miami, Interview June 20, 1971.

[2]Metropolitan Dade County Development Department, *Boats Afloat*.

The foregoing illustrates the non-industrial character of Biscayne Bay. The Miami River represents the only significant commercial waterfront in Dade County (excluding tourist hotels).

Pollution

The Dade County Pollution Control Office has recorded water samples in the waterways of Dade County for the past three years, but has not regularly tested the water in Biscayne Bay. There is a growing concern that the Bay is becoming polluted. If the bayfront is primarily residential and recreational, what are the pollutants and where are their sources?

In June, 1971, the Environmental Protection Agency, Southeast Region, compiled an inventory of the sources of water pollution in Dade County, *Report of Waste Source Inventory and Evaluation Dade County, Florida.*[1] The conclusions of this report are similar to the conclusions drawn from the Miami River.

Industrial Wastes

The report estimated there were 583 waste producing firms in Dade County, of which 89 were considered important sources of water pollution. Fifteen of the 89 discharged

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[1]Environmental Protection Agency, Southeast Region, *Report of Waste Source Inventory and Evaluation Dade County, Florida* (Southeast Water Laboratory Technical Programs, Athens, Georgia. June, 1971).

into surface water (12 into the Miami River), 36 discharged into ground water through seepage pits, and 38 discharged into sanitary sewer systems.[1] The following general conclusions were drawn about industrial wastes.

1. Industrial wastes may be contaminating the Miami Springs-Hialeah well field.[2]

2. Industrial wastes may have a detrimental effect on the performance of sewage treatment systems.

3. Further study of industrial waste sources is needed to determine the full extent and nature of pollution from these sources.[3]

Sewage Wastes

As with the Miami River, the report on Dade County found municipal sewage the primary source of water pollution. The following conclusions were enumerated in the report.

1. Municipal wastes are contaminating the waters of Dade County.

2. Twenty one percent (21%) of the municipal waste volume from Dade County receives inadequate treatment and 77% receives no treatment.

3. Small plants require disproportionally higher labor and maintenance and in that respect are less efficient than larger conventional treatment plants.[4]

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[1] *Ibid.*, p. 32.

[2] This field is a primary source of fresh water for Dade County. The Miami International Airport is considered the primary industrial polluter of the well field and the Miami River.

[3] *Ibid.*, p. 11.

[4] *Ibid.*, p. 11.

Map 11 represents the sewage drainage areas in Dade County. Each area is identified by a major river, canal, or creek emptying into Biscayne Bay.

The following is an approximation of the millions of gallons per day (MGD) of treated wastewater from treatment plants entering the surface and ground waters of Dade County.

Snake Creek Drainage Area	7.04 MGD
Biscayne Canal and Little River Canal Drainage Area	1.14 MGD
Miami River Drainage Area	.69 MGD[1]
Coral Gables Waterway Drainage Area	2.62 MGD
Snapper Creek Drainage Area	5.97 MGD
Black Creek Drainage Area	3.53 MGD
South Bay Drainage Area	3.21 MGD[2]

Some Final Conclusions About the Miami River and Biscayne Bay

The brief foregoing description of Dade County and Biscayne Bay allows us to draw some final conclusions about the Miami River and Biscayne Bay.

1. The Miami River represents the only significant commercial waterfront in Dade County except for tourist hotels.

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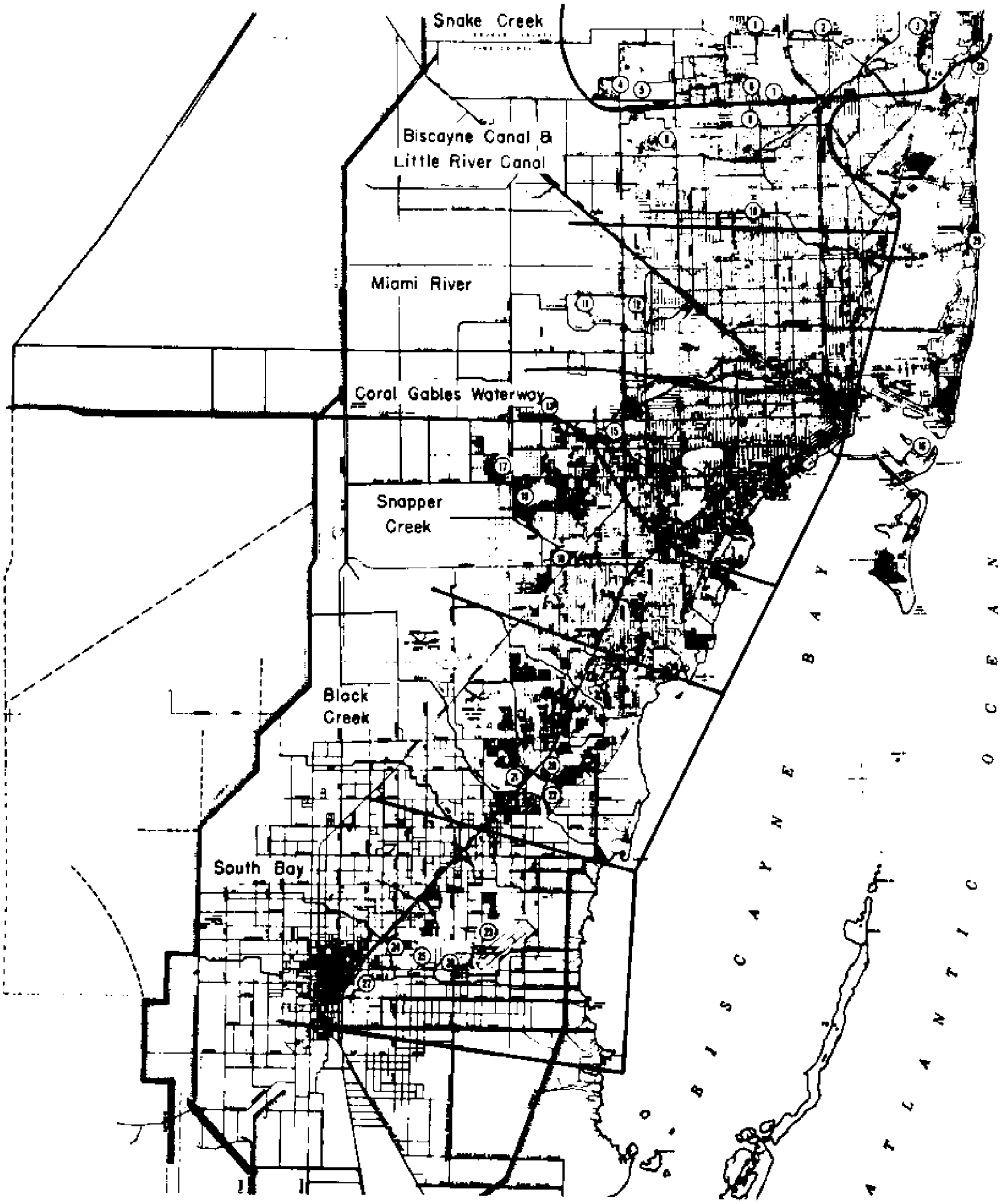
[1] In 1970, the Dade County Pollution Control Office had discovered 160,500 GPD of treated sewage being dumped into the Miami River and its tributaries. The Environmental Protection Agency's Report estimated .69 MGD were entering the Miami River drainage area which includes sewage being pumped into ground water.

[2] Ibid., p. 10.

MAP 11

DADE COUNTY DRAINAGE AREAS[1]



[1]Environmental Protection Agency, *Report of Waste Source Inventory and Evaluation Dade County, Florida.* p. 16.

2. Marine activities on the Miami River provide the only facilities (except for a small dry dock at Dinner Key) to service, haul, and repair the large number of boats in the Biscayne Bay area. There appears to be no other waterfront locations in Dade County that would be suitable for these activities.

3. Marine activities, junk yards, and several other commercial activities contribute to industrial pollution, most notably through oil and grease runoffs. However, the Miami International Airport is considered to be the largest industrial polluter of the Miami River and of Dade County.

4. The Miami River is polluted primarily by municipal and other sources of untreated sewage. Boats and other activities located along the riverfront are presently only minor polluters.

5. The other important waterways leading into Biscayne Bay are polluted by municipal sewage. In fact, estimates indicate that more treated sewage enters each of the other previously mentioned important waterways than the Miami River. There is only an approximation of the untreated sewage entering the Miami River and its tributaries. There is no official approximation of the amount of untreated sewage entering the other waterways in Dade County or Biscayne Bay. However, it is well known that there are a great number of unidentified sources dumping untreated sewage and industrial wastes into the waters of Dade County.

6. Activities on or near the waterfront (including boats) have often been cited for water pollution. Actually these activities have had a much smaller role in polluting the waters of Dade County than many activities that are not located near the waterfront.

7. In order to seriously improve the quality of the water in the Miami River, other waterways, and Biscayne Bay, the authorities must improve their control over municipal sewage treatment facilities and locate the unknown sources of untreated sewage.

CHAPTER V

SOME PHYSICAL ASPECTS OF WATER POLLUTION: THE MIAMI RIVER CASE

This chapter is a brief examination of the interrelationships that affect a body of water. The following terms are often found in economic articles concerned with theoretical and applied water quality controls.

Waterborne Residuals

Degradable Residuals

Degradable materials are chemical compounds whose composition is easily changed by the environment. Sewage and food processing wastes are the most common forms of degradable pollutants. When sewage is discharged into an otherwise clean river, aerobic degredation begins immediately. Bacteria feed on the wastes and break-down the degradable compositions into inorganic forms of nitrogen, phosphorous, and carbon. During this process, the bacteria use some of the oxygen normally dissolved in the water.

Non-Degradable Residuals

Non-degradable materials are primarily synthetic compounds which include many modern chemicals. These compounds do not readily breakdown in the environment. In water, they normally remain as suspended materials.[1]

Dissolved Oxygen

Dissolved oxygen (DO) is the amount of oxygen dissolved in any given body of water. As previously mentioned, bacteria draw upon the oxygen when degradable compounds are decomposed. DO is measured by parts of oxygen per million parts of water, which is an important water quality standard. For example, the Dade County Pollution Control Office has set the DO level at 3 PPM (parts per million) as the minimum necessary to sustain higher forms of marine life in the Miami River. DO is only one water quality criterion, it does not measure bacteria, turbidity, toxic non-degradable compounds, or floating debris. Therefore, DO levels would not be a sufficient criterion for drinking water or swimming standards.[2]

The *Delaware Estuary Comprehensive Study* set the following DO levels to attain defined objectives in Table 12.[3]

When an anaerobic condition exists, degradable compounds are still decomposed. However, this occurs

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[1]Allen V. Kneese, "Background for the Economic Analysis of Environmental Pollution," *The Swedish Journal of Economics* (Vol. 73, March, 1971), pp. 1-24.

[2]Allen V. Kneese, *The Economics of Regional Water Quality Management* (Resources for the Future, Inc., Johns Hopkins Press, Baltimore, Maryland, 1964), pp. 1-20.

[3]Federal Water Pollution Control Administration, *Delaware Estuary Comprehensive Study*, pp. 54-58.

TABLE 12

DISSOLVED OXYGEN CRITERIA

Water Use	Minimum Average DO Level (Summer)
Sport and commercial fishing	7.5
Guarantee anadromous fish passage	6.0
Likelyhood of andromous fish passage	4.0
Does not maintain fish	2.5
Minimum to prevent an anaerobic condition	1.0

anaerobically, that is, through the action of bacteria which do not use free oxygen (dissolved oxygen) but organically bound oxygen. The result is gaseous by-products such as carbon dioxide, methane, and hydrogen sulfide that cause the putrid oders that characterize an anerobic river.

Biological Oxygen Demand

Biological oxygen demand (BOD) measures degradable wastes in terms of the dissolved oxygen used during the decomposition of the material.

First Stage BOD

During the first 5 days, the highest BOD occurs when bacteria use dissolved oxygen to break down the carbonaccous compounds. This is referred to as first stage BOD (BOD_1) or 5-day BOD. Most water sampling only measures this first stage. The normal sampling procedure is to inject a given amount of degradable wastes into a given amount of receiving water and record the change in dissolved oxygen over a 5-day period.[1]

Second Stage BOD and Ultimate Oxygen Demand

A second stage oxygen demand (BOD_2) occurs after the first 5 days due to the oxidation of the nitrogenous compounds. BOD_1 plus BOD_2 is referred to as the ultimate oxygen demand (UOD) of any degradable waste.

Oxygen Sag

Oxygen sag (known as the Streeter-Phelps function) refers to the characteristic shape of the curve relating the DO level to consecutive downstream sections of a river over time. When degradable wastes are discharged into a river, the DO level falls due to the above mentioned degradation of the compounds by bacteria. Later the DO level tends to rise due to the regeneration of dissolved oxygen through the air-water interface, and also as a consequence of photosynthesis by plants in the water.

Graph 10 illustrates the normal oxygen sag. In a rapidly moving river, BOD_1 can be detected near the source

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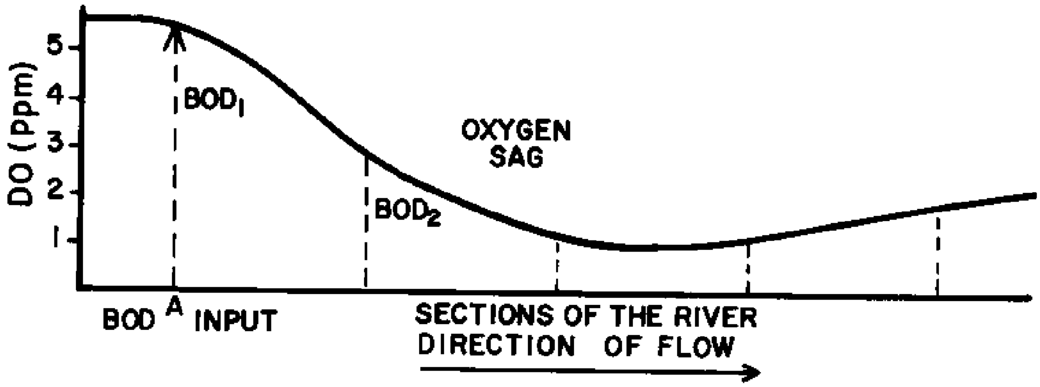
[1]The Dade County Pollution Control Office uses the standard 5-day BOD test.

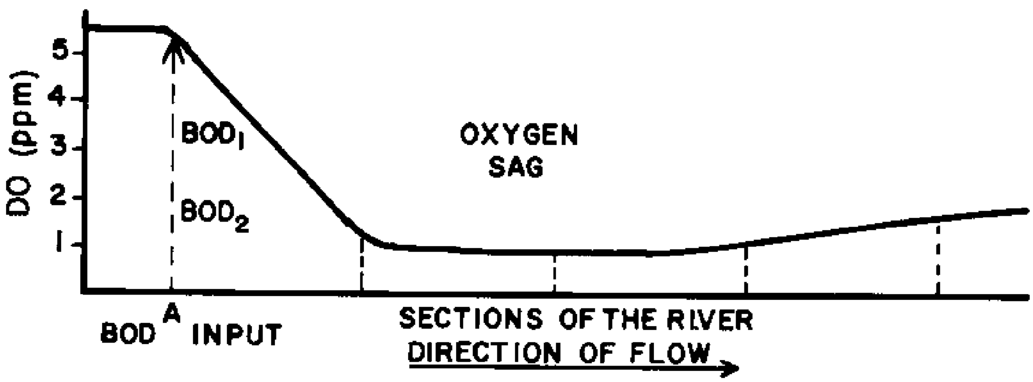
GRAPH 10

OXYGEN SAG DUE TO A BOD INPUT
(RAPIDLY MOVING RIVER)



GRAPH 11

OXYGEN SAG DUE TO A BOD INPUT
(SLOW MOVING RIVER)



of the BOD input (point A), but BOD_2 occurs later down the river.[1]

In an extremely slow moving waterway such as the Miami River, a compounding of BOD_1 and BOD_2 occurs in the same area as the original BOD input. This generates a steeper oxygen sag and compounds the potential damages and measurement techniques as illustrated in Graph 11.

Runoff Lag-Time

Land surface pollutants "runoff" into a river due to gravitational forces, or they are washed into the river during a rainfall. Lag-time refers to the time between the center of a rainfall, and the center of the runoff into the river. Lag-time varies with the urbanization of the drainage basin. The peak runoff is higher, and the lag-time shorter, when a larger amount of the basin is sewered or under concrete. A quicker runoff increases the probability of land surface pollutants being washed into the river over a shorter period of time. This does not give the river enough time to handle waste inputs that it might otherwise be able to handle over longer periods of time.

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[1]Allen V. Kneese, *The Economics of Regional Water Quality Management* (Resources for the Future, Inc., Johns Hopkins Press. Baltimore, Maryland, 1964), p. 14.

Graph 12 illustrates the lag-time for urban and rural basins. The implication is, given similar pollutants and rainfall, that the runoff from an urban basin has a larger environmental impact than the runoff from a rural basin.

Diagram of a River

The following diagram on page 82 illustrates the factors determining the dissolved oxygen content of the Miami River. The physical-climatological-biological factors (shaded boxes) determine the capacity of the river to handle pollutants. The wastes entering the river (striped boxes) are the human inputs. All the factors effect the dissolved oxygen level (center box).

A Mathematical Model of a River

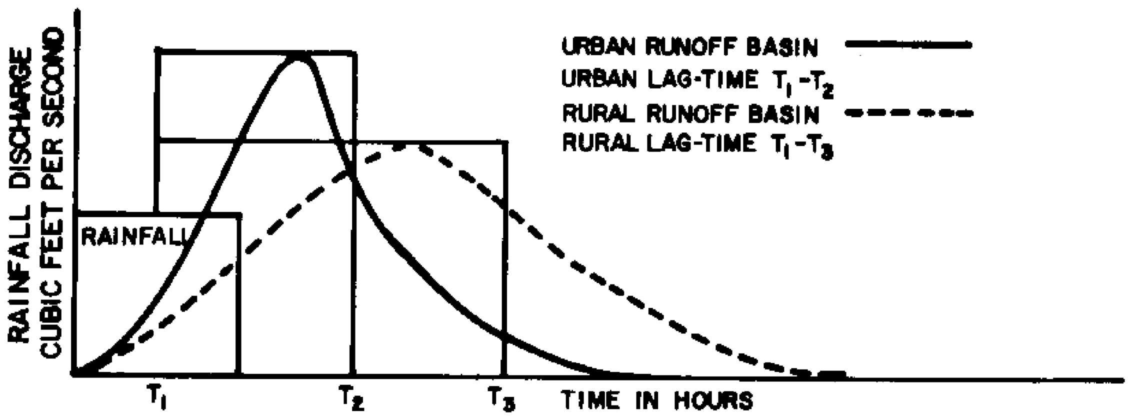
Several attempts have been made to express the foregoing relationships mathematically. One of the most successful models was developed by Robert Thorman and employs a marginal approach to consecutive sections of a river.[1] This is the most versatile technique because it approaches each section individually which allows for adjusting the variables for the changing characteristics of each section.

The equation is expressed as a differential equation relating changes in the dissolved oxygen to changes in time.

[1]Robert V. Thorman, "Mathematical Model for Dissolved Oxygen," *Journal of the Sanitary Engineering Division, American Society of Civil Engineers*, Vol. 89 (October, 1963).

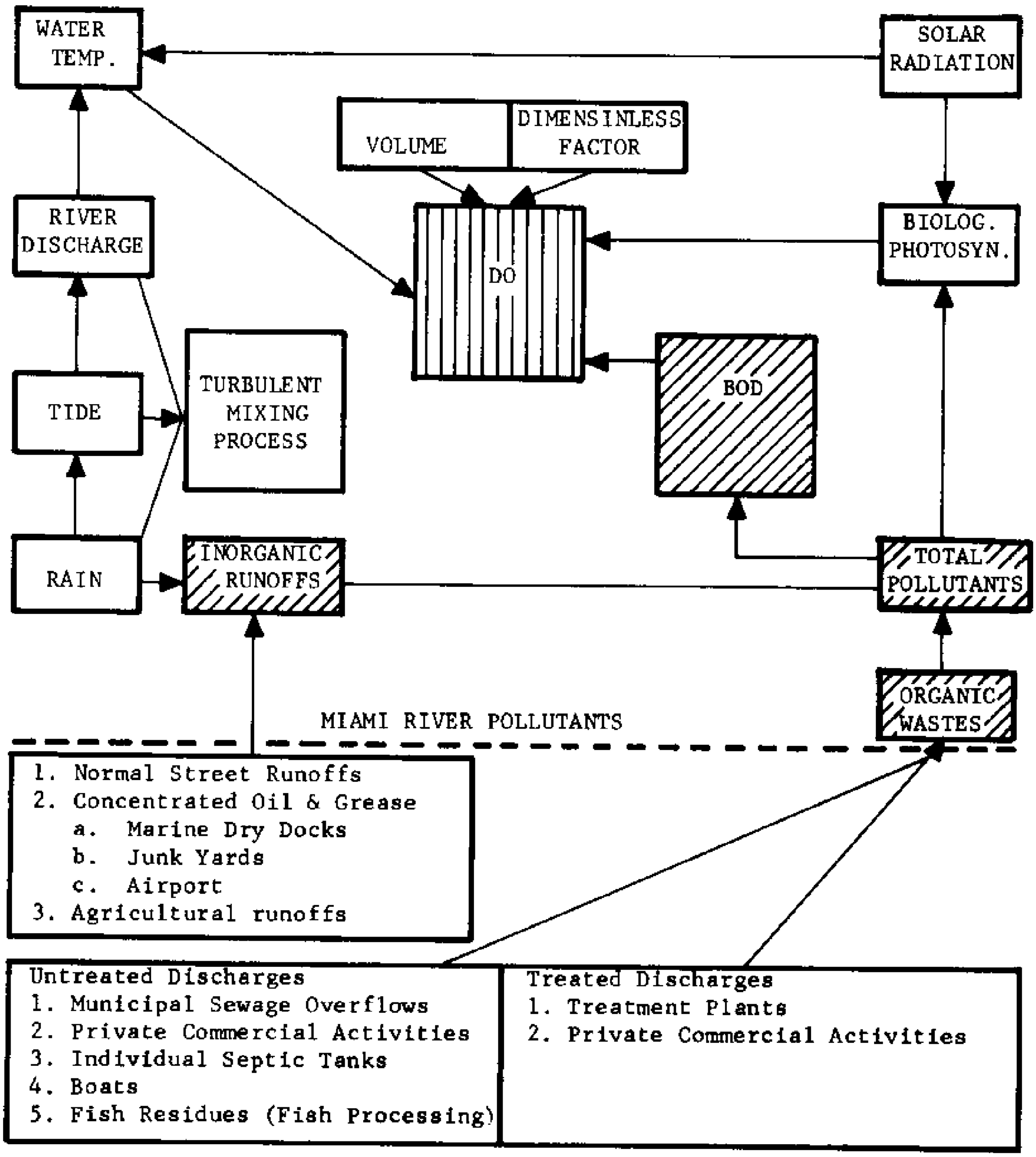
GRAPH 12

RUNOFF LAG-TIME FOR URBAN AND RURAL BASINS[1]



[1]Luna B. Leopold. "The Hydrologic Effects of Urban Land Use," *Man's Impact on Environment*. Editor, Thomas R. Detwyler (MacGraw-Hill Book Company, New York, 1971).

DIAGRAM OF A RIVER[1]



[1]Robert Davis, *The Range of Choice in Water Management* (Resources for The Future, Inc., The Johns Hopkins Press, 1968). p. 61.

The data in this study is not complete enough to permit us to work the equation, however, it is presented here to illustrate the type of variables that must be quantified in order to construct a complete model. Note that the variables in the equation correspond to the variables in the foregoing diagram.

$$
\begin{aligned}
V_i \frac{dC_i}{dt} &= Q_i \; [Z_i C_{i-1} + (1-Z_i \quad)C_i] \\
&- Q_{i+1} \; [Z_{i+1} C_i + (1 - Z_{i+1}) C_{i+1}] \\
&+ E_i (C_{i-1} - C_i) + E_{i+1} (C_{i+1} - C_i) \\
&- d_i V_i L_i + r_i V_i [C_{sc} - C_i] \\
&+ P_i
\end{aligned}
$$

where:

L_i = Mean concentration of BOD in the i^{th} segment
C_i = Mean concentration of DO in the i^{th} segment
t = Time
V_i = Volume of the i^{th} segment
Q_i = net waterflow across the upstream boundary of the i^{th} segment
Z_i = Dimensionless advection factor
E_i = Turbulent exchange factor for the upstream boundary of the i^{th} segment
d_i = The BOD decay rate constant in the i^{th} segment
J_i = Rate of BOD loading to the i^{th} segment from external sources
r_i = The reaeration rate of the i^{th} segment
C_{sc} = The saturation DO value
P_i = Any other source or sink of the DO in the i^{th} segment

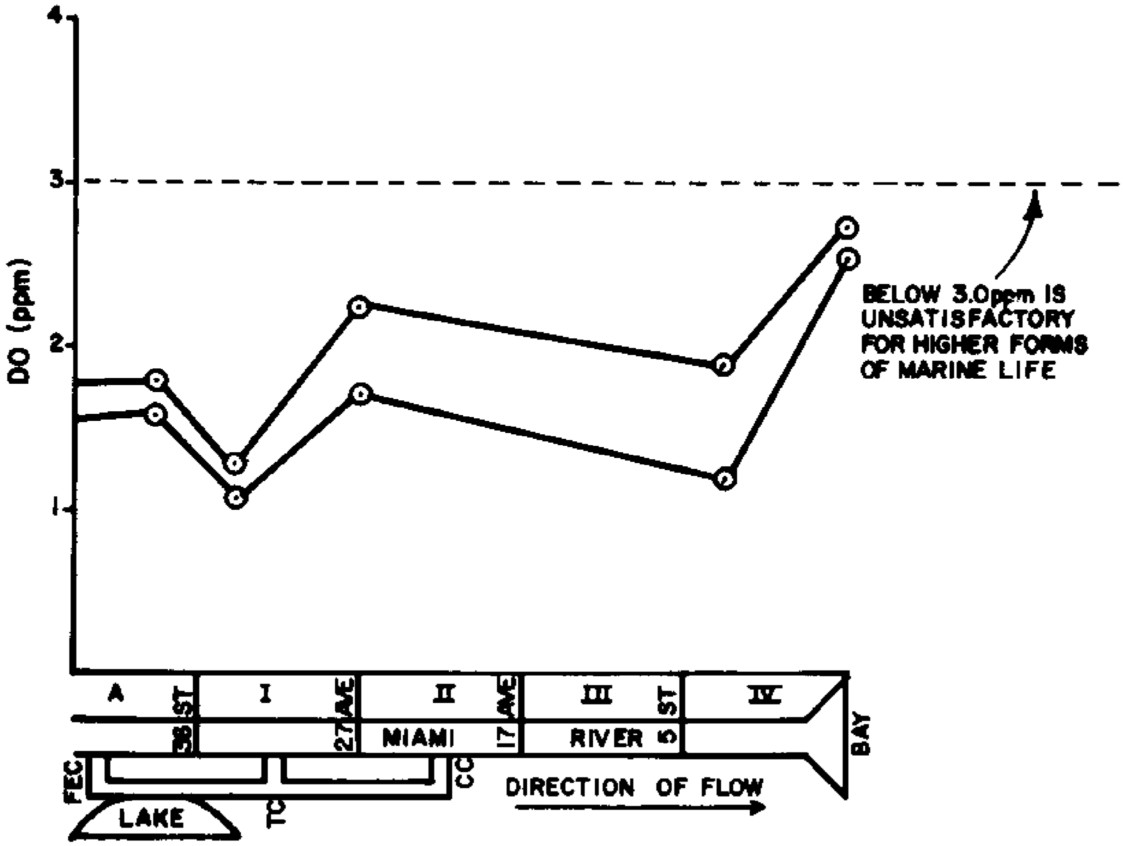
Specific DO Levels in the Miami River

Graph 13 relates yearly average DO levels to sections of the Miami River. These yearly averages only provide a

[1]Davis, *The Range of Choice in Water Management.* p. 145.

GRAPH 13

DO LEVELS IN THE MIAMI RIVER FOR 1968 AND 1969[1]



[1]Yearly average DO levels for different locations of the Miami River were provided through the courtesy of the Dade County Pollution Control Office.

general basis for judging the water quality of the Miami River. Averaged data does not accurately reflect the potential damages when a standard is not maintained on specific occasions. For example, the average yearly, monthly, or weekly DO level might well be above the minimum required to sustain higher forms of marine life, yet on specific days the level might drop well below the required minimum, killing all the fish in the river. A similar situation would hold for other water quality standards. Measurements must be recorded daily (The Dade County Pollution Control Office presently records DO levels monthly) in order to assure the daily fluctuations are within a given range.

Graph 13 clearly indicates that the dissolved oxygen in the Miami River is not sufficient to sustain higher forms of marine life. At certain times and places, the river borders on being anerobic.

CHAPTER VI

SOME ECONOMIC ASPECTS OF WATER POLLUTION: THE MIAMI RIVER CASE

The following is an analysis of current economic approaches to water quality control. These approaches will be considered in the context of the Miami River as far as applicable.

The Market Economy

The following concepts are predicated on a decentralized market economy. Theoretical market models, given their highly stylized assumptions, imply an efficient allocation of resources in the economy. Neoclassical static general equilibrium theory expresses the basic mechanisms that allocate resources. There is not enough space here to seriously consider general equilibrium conditions or the necessary conditions to attain a Pareto maximum. A thorough analysis can be found in most intermediate microeconomic textbooks.[1] These conditions are important because, while the theoretical assumptions are highly unrealistic, market economists discuss environmental controls in terms of how they would affect theoretical equilibrium conditions.

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[1]C. E. Ferguson, *Microeconomic Theory* (Richard D. Irwin, Inc., Homewood, Illinois, 1969).

External Diseconomies

Externalities exist when a producer is not held accountable for the total costs (private and social costs) of production. Private costs are normally borne by each producer and thus the consumer, while externalities are usually in the form of social costs borne by other individuals or the society.

External diseconomies are clearly exemplified by water pollution. Consider a simplified example. A drydock hauls and services boats, and in the process deposits oil and grease in the river. Disposing of the oil and grease is a cost of production. However, if the drydock freely uses the river, it is not accounting for this cost, therefore, the owner of the hauled boat is not paying for this cost in the price of the drydock's service. The cost may be borne by a downstream firm that utilizes the river as a source of water, which increases his production costs. The cost might be borne by the public in the forms of decreased wildlife or recreational resources such as swimming or fishing. Perhaps the cost is the potential health hazard of a polluted river.

Water Quality Controls

1. The Market

Market mechanisms might theoretically determine the water quality standard if the individual decision making units and damages were clearly identifiable and measurable. If there were only two parties involved, a cost-minimizing downstream firm might be willing to pay a polluting upstream firm, for not polluting, an amount up to the net value of costs saved if the stream was not polluted. Of course, this assumes the upstream polluter has the "right" to pollute the stream. If the downstream party has the "right" to a clean stream, then the roles would be reversed. The cost-minimizing upstream polluter might be willing to pay the downstream damaged party an amount up to the cost of treating the pollutants. The important point is that a water treatment level is set, or compensatory damages paid, according to the damages caused by the pollutants.

The foregoing oversimplified example is a far cry from reality. For example, consider the case when the public bears the cost of pollution in the forms of decreased recreational or aesthetic resources. The following are some complicating factors on the Miami River.

1. There are a large number of polluters, each generating varying amounts and types of pollutants at different times. This creates a great deal of difficulty in measuring and keeping track of the polluters and pollutants.

2. Damages do not necessarily have a linear relationship with the quantity of pollutants. Damages vary according to the pollutants as well as the ability of the river to handle pollutants due to climatic and hydrological factors. Rainfall, water temperature, and the speed of the river are three important varying factors.

3. Pollutants may combine to create damages greater or less than they would alone (synergistic effects). For example

sewage, oil and grease, and phosphates might combine to cause greater damages than each separate pollutant might individually create. This makes it difficult to assign damages to each specific polluter.

4. Most of the damage from water pollution in the Miami River and Biscayne Bay is to public goods such as wildlife, recreational, and aesthetic resources. It is difficult (if not impossible) to place an acceptable value on these resources that do not readily lend themselves to market values. Consider the case of fish in the river. The live fish in the river are not worth the same per pound as similar dead fish in the supermarket because they are not substitutes for each other and provide very different utilities.

5. The damaged party is a large and not specifically identifiable "public." Each person would probably have a different evaluation of the damages. Also, there is no existing communications apparatus for each person to effectively express the damages or benefits.

The production costs of firms along the Miami River are not affected by pollution. This seems to be verified by the fact that none of the firms are active in changing the polluted condition of the river. The inventory points out that only the marine activities utilize the river, and then only to provide an access to their premises for boats. In fact, a particular case can be made for the fact that the polluted water offers a relative benefit to boats and thus marine activities. Boat hulls are not fouled by marine growth as easily on the river as in a clean tropical salt water environment. Before the recent advent of highly effective anti-fouling bottom paints, larger vessels were specifically moored in the river because their bottoms were less easily fouled than at any other location.[1]

[1]Elias Safie, Owner, Florida Yacht Basin, Miami River, Florida. Interview in March, 1971.

2. Legal Controls Based on Private Damages

Legal controls theoretically operate like the foregoing two party market model. The law determines that the downstream firm has a "right" not to be damaged by the pollutants from the upstream polluter. The damaged party, through adversary proceeding, is able to sue the upstream polluter according to the damages.

We have previously mentioned the difficulties in identifying polluters and measuring damages. There is, however, a more fundamental problem with controls being based on damages to private individuals. The problem can be stated in terms of public resources.

At one time, economics treated air and water (rivers and oceans) as "free goods," that is, relatively inexhaustable goods for which we do not have to pay. Today, particularly with the environmental crisis, it would be difficult to find anyone who still believes air and water are free goods. Any water quality controls, such as legal adversary procedures, that are based on proving damages to private individuals continue to treat scarce public resources (such as the Miami River) as a free resource as long as other private resources are not damaged. Private firms along the river have not taken the initiative to clean up the river because the polluted water does not seriously affect their private interests. Concern focuses on the damage to private property and less attention is given damaged scarce public resources, such as the river itself.[1]

These procedures also work in favor of the polluter and to the disadvantage of the potentially damaged party. First, normally the damages must occur before their source can be controlled. Secondly, the damaged party is left with the burden of proof which is extremely difficult with existing measurement techniques.

3. Internalizing Externalities

If the decision making units that pollute, and that are being polluted, were one "accountable unit" then externalities would be internalized. The inventory indicated the Miami River is primarily polluted by municipal sewage. If we consider the municipal sewage treatment facilities as "public producers" we might be able to stretch our analysis to internalize all the costs of sewage treatment.

The direct production costs of sewage disposal are reduced to the public when the sewage is freely dumped into the river. However, the same public is paying in terms of a polluted river. In this case, the externality (water pollution) is internalized so that the producer (the public) is ultimately held accountable for the total costs of sewage treatment (treatment costs plus the costs of water

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[1] Allen V. Kneese, "Environmental Pollution: Economics and Policy," *The American Economic Review Papers and Proceedings of the 83 Annual Meeting* (May, 1971), pp. 153-177.

pollution). The public is forced to trade-off lower treatment costs for more polluted water. The optimal level of treatment is up to the point where the marginal costs of sewage treatment are equal to the marginal costs of water pollution.

4. Arbitrary Water Quality Standards Administratively Enforced

Administratively enforced standards are presently used by most pollution control authorities (see Chapter VII). Legal arbitrary effluent standards are used by the Dade County Pollution Control Office. These types of controls have particular economic inefficiencies.

First, there is no consideration of the least-cost methods of achieving a given overall water quality level. If we are resolved to reduce aggregate pollutants by 50 percent, it is uneconomic to require each polluter to reduce his pollutants by 50 percent. Each firm may have a different marginal cost for reducing pollution. Given the total reduction necessary, the optimal economic adjustment is when each polluter reduces his pollutants to the point where the marginal costs of further reductions are the same for each polluter.

Secondly, no account is taken that both the resources to prevent pollution and the damages caused by pollution are alternative uses for scarce resources. Arbitrary water standards do not make any attempt to weight the marginal costs of water treatment against the marginal benefits (reduction in damages) from the treatment. In terms of the allocation of resources, too few or too many resources may be devoted to water treatment. Thirdly, it may be cheaper to have the damaged party readjust to a given level of pollution rather than force polluters to maintain a given level of pollution abatement.

5. Taxing According to Social Costs

Allen Kneese is a leading proponent for taxing polluters to control externalities.[1] The tax levied against each firm would be equal to the marginal social costs generated by the pollutants from that firm. This procedure would be the most exact in that costs would be accurately internalized and prices would then accurately reflect the total costs of production for each activity. Firms would have to choose between treating their effluents or paying the tax. Cost minimizing firms would be willing to undertake pollution abatement up to the point where the marginal costs of treatment were equal to the marginal costs generated by the pollutants (amount of the tax).

This technique appeals to many economists. First, it corrects the obvious failure of the market economy to deal with externalities. Secondly, the results are in keeping with the theoretical conditions necessary for the optimal allocation of resources.

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[1] Kneese, *The Economics of Regional Water Quality Management*, pp. 54-98.

The Miami River exposes the practical shortcomings of this approach when we consider the complicating factors previously mentioned. We are not able to determine the damaging role of each polluter or measure the damages ensuing from the pollutants. The proposal is theoretically sound, but existing measurement techniques make such a plan difficult to implement at this time.

6. Taxing According to an Arbitrary Standard

William Baumol is an advocate of imposing taxes to maintain a given arbitrary water quality standard.[1] For example, a standard is set where the dissolved oxygen level must be at least 4.0 PPM 95 percent of the time.[2] Tax rates are then imposed on pollutants to maintain this dissolved oxygen level.

Interestingly enough, this same procedure is used in macroeconomic monetary policy with respect to interest rates and the level of employment. A given arbitrary level of economic activity ("acceptable" level of unemployment) is set. The interest rate and money supply is then adjusted (through the discount rate, reserve requirements and open-market operations) to expand or contract the rate of investment which affects the level of employment.

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[1]William Baumol and Wallace Oates, "The Use of Standard and Prices for the Protection of the Environment," *The Swedish Journal of Economics* (Vol. 73, March, 1971), pp. 42-54.

[2]See Chapter V for an explanation of dissolved oxygen.

This proposal has some of the benefits and deficiencies of the last two proposals. First, it is not necessary to define and measure externalities. We have seen this is the major practical difficulty with Kneese's proposal. Secondly, it would probably be cheaper and more responsive than a strictly administrative procedure. The needed administrative aparatus could possibly be financed from the tax revenues.

Economically more important, unlike the administrative proposal, it is the least-costly technique given the arbitrary water standard as a constraint. With tax rates based on the types and grades of effluents, the marginal costs of reducing similar pollutants would be the same for all the firms being taxed. Given a rate of taxation that would maintain a given water standard, each firm would choose between treating their pollutants (by the most efficient combination of methods) or paying the tax. Cost minimizing firms would be willing to treat pollutants up to the point where the marginal cost of pollution abatement was equal to the marginal cost of the tax. Paying the tax should not be construed as a license to pollute. If any given tax rate did not achieve a predetermined water standard, the tax would be increased. Polluters would have to be informed that the tax and standards were only temporary constraints to which they must adjust their economic behavior. Polluters would be forced to change as the pollution criteria changed.

The primary objection of taxation to achieve an arbitrary water quality standard is the theoretical objection that arbitrary standards (through taxation or administrative enforcement) do not guarantee the most efficient allocation of resources. If the marginal costs of water treatment are not weighed against the marginal benefits (reduction in damages) from the treatment, too few or too many resources are likely to be devoted to pollution control.

Arbitrary environmental standards may not be conducive to the optimal allocation of resources, however, they are better than nothing while further research is being done to develop a more complete model for pollution control. In the meantime, the difficulties faced in measuring social costs imply that the expediency of arbitrary standards far outweight their theoretical shortcomings.

CHAPTER VII

REPORT ON BISCAYNE BAY: A CRITIQUE OF RECENT PROPOSALS

In July, 1970, the Governor of Florida and the Florida Department of Air and Water Pollution Control requested assistance from the Environmental Protection Agency in planning water pollution controls for Dade County. The following points highlight the recommendations of a Federal-State Enforcement Conference held on October 20, 21, and 22, 1970.

1. The cessation of all waste discharges into the inland canal system of Dade County, Florida, shall be accomplished as rapidly as possible but not later than January 1, 1973.

2. A minimum of secondary treatment, providing at least 90 percent BOD removal and year-round chlorination of the effluent, shall be provided for all waste, as required by the State of Florida before discharge to the ocean, as rapidly as possible but not later than January 1, 1974.

3. All new construction shall be connected to adequate sewage collection and treatment systems. The conferees will meet not later than February 1, 1971 to consider the question of Dade County's building permit program with a view towards controlling additional pollution sources. . . .

4. Additional waste discharges to Lower Biscayne Bay, including the Biscayne National Monument, and its tributaries shall be prohibited. This same prohibition shall apply to discharges to canals in Dade County which drain to the Everglades National Park. Removal of existing municipal and industrial waste discharges from these waters shall be accomplished as rapidly as possible but not later than January 1, 1974.

5. All wastes from vessels used as domiciles or business establishments shall be discharged to onshore facilities.[1]

The above five recommendations are examples of arbitrary water quality standards that would be administratively enforced. Each recommendation implicitly makes certain economic assumptions.

The first recommendation assumes the damages from pollutants in inland canals are so high as to justify the cessation of all waste discharges. This implies the damages from the discharges are such that at any level of treatment; further treatment, or even the prohibition of any discharges, would be cheaper than the damages generated by the pollutants. It seems very unlikely that the damages from discharges are so high. At some level of treatment, probably further treatment would cost more than the benefits derived from the treatment.

The second recommendation follows a State of Florida effluent standard. This sets a minimum of 90 percent BOD removal for all wastes being discharged into the ocean. Requiring the same standard for each area (each canal in Dade County or each ocean outfall in the State) assumes the damages from a given amount of pollutants are the same in each area. We have seen that the damages generated by pollutants are a function of the pollutants as well as

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[1]Environmental Protection Agency, *Report of Waste Source Inventory and Evaluation Dade County, Florida.* pp. 1-6.

the ability of the environment to handle the pollutants. With a given amount of pollutants, the damages will vary greatly from one area to another due to the environmental conditions of each area.

Recommendation three is simply a convenient method of controlling sewage pollution from septic tanks by preventing the further construction of buildings that use septic tanks. This makes the same assumptions as the previous examples. Recommendation four might be justified if the total abstention of discharges into lower Biscayne Bay and the Everglades National Park was necessary to protect these public recreational areas. However, as with the foregoing recommendations, no attempt has been made to determine the damages from pollution or the potential benefits from pollution abatement.

The fifth recommendation creates serious problems for people who live on boats. Of the 740 people living aboard boats on the Miami River, approximately 540 are living on private live-aboard boats either moored in marinas or in residential areas. All of the commercial marinas indicated that less than 10 percent of their revenue was dockage fees from live-aboard boats. The marina owners indicated they would eliminate their live-aboard docking facilities before going to the expense of installing onshore sewage facilities for boats.[1] This would place a rather severe hardship on

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[1]Elias Safie, Owner, Florida Yacht Basin, Miami River, Florida. Interview in March, 1971.

those people who cannot find a new mooring place for their floating homes. Considering the minor role boats play in water pollution, and the difficulties there would be in enforcing this regulation (34 percent of all the private live-aboard boats on the Miami River are moored at private residences), it would appear that the authorities could better utilize their enforcement efforts in controlling more serious individual municipal and industrial polluters.

SUMMARY

The purpose of this study has been to provide an economic description of the Miami River and consider the river in terms of the Biscayne Bay area. The description includes land usages, employment, boats, and water pollutants. This effort did not attempt to test or develop an economic hypothesis. The data, however, provide some interesting insights into some existing techniques for water quality control. The material provides the type of data needed to quantify the variables that must be considered if a more complete model is to be attempted.

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