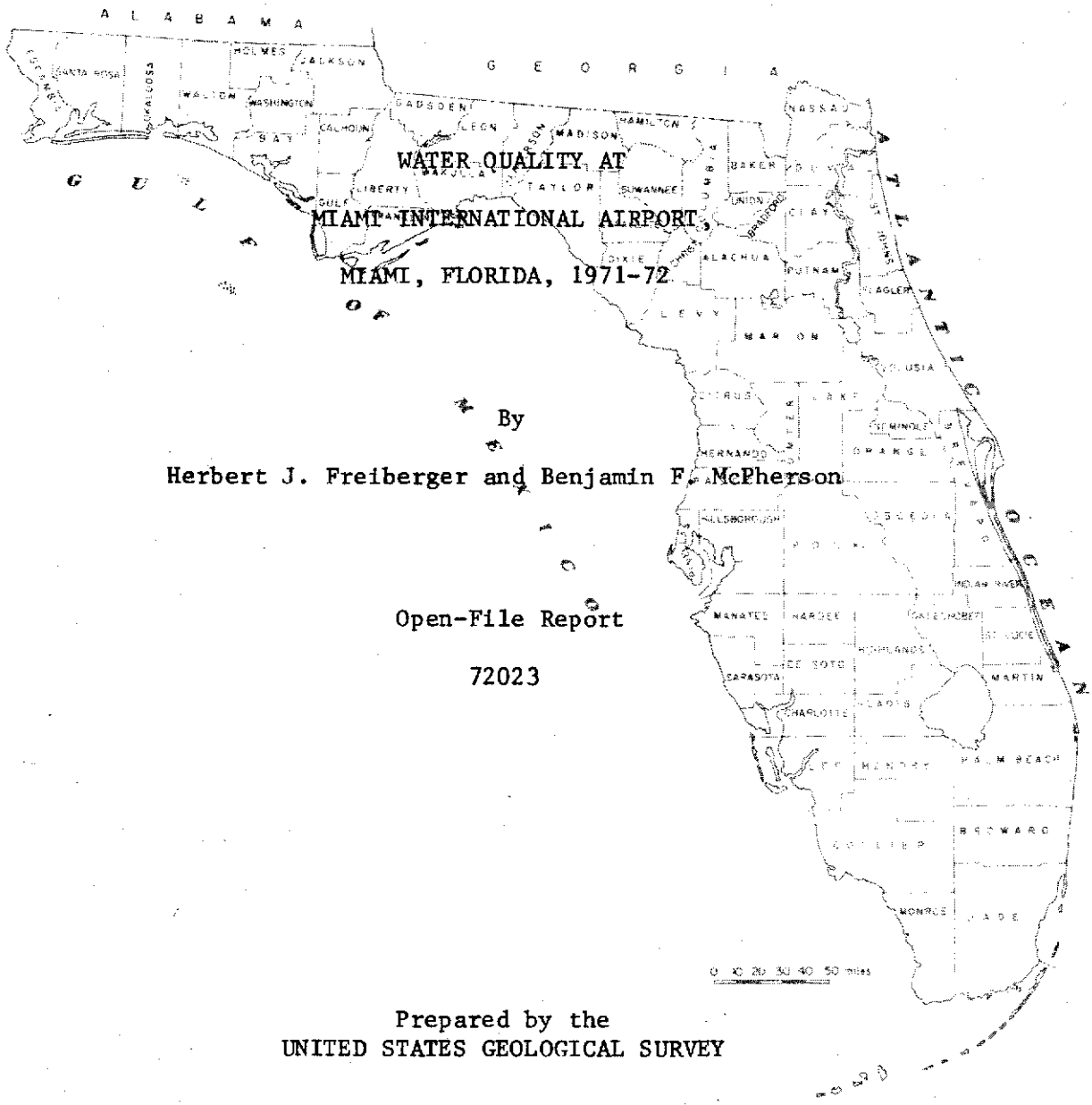
UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

WATER QUALITY AT MIAMI INTERNATIONAL AIRPORT, MIAMI, FLORIDA, 1971-72



By

Herbert J. Freiberger and Benjamin F. McPherson

Open-File Report

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Prepared by the
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Tallahassee, Florida
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ABSTRACT

The quality of water, sediment, and biota was determined at four sites in canals and drainage ditches at Miami International Airport (MIA) during high- and low-water periods and during summer and winter 1971-72. Concentrations of common ions, such as calcium, sodium, chloride, and magnesium, tended to be above average for fresh water because of periodic salt-water intrusion. Nitrogen, phosphorus, and pesticides were in higher concentrations than typical for undisturbed areas of south Florida, but not higher than usual for the urban coastal area, so it is not known to what extent these chemicals are attributable to surrounding urbanization. Heavy metals, oil and grease, and PCB's (polychlorinated biphenyls) were the best indicators of the effects of MIA on water quality. Concentrations of the above were quite variable; high values for each were recorded and were probably associated with recent discharges from industrial sources. Arsenic, lead, iron and chromium all exceeded, in one or more samples, the U.S. Public Health Service's recommended upper limits for metals in water. Only iron normally exceeds these standards in the natural waters of south Florida. PCB's were detected in most samples and were in concentrations up to 1,000 micrograms per kilogram in fish. In addition to pesticides and PCB's, another group of persistant chlorinated compounds, PCN's (polychlorinated naphthalenes) were detected in water, sediment, and fish. This is the first known detection of these compounds in the environment.

INTRODUCTION

The Dade County Port Authority made a site-selection study in 1970 to establish a jetport in south Florida. In Task B-2 of the study, an ecologic survey of MIA (Miami International Airport) was recommended to document current environmental conditions at a busy commercial airport. The U.S. Geological Survey, through the authority of the Secretary of the Interior, agreed to make this survey to provide base-line data on surface-water quality. Because water quality changes seasonally, 1971-72 samplings were made during summer and winter and also during high and low water. The data from the four samplings are presented in this report.

MIA is a commercial airport and industrial complex occupying about 4 square miles in north Dade County. Industries at the airport rebuild and test aircraft engines, wash and repair aircraft, and transport freight. These industries discharge 168,000 gpd (gallons per day) of waste water high in concentrations of oils, greases, heavy metals, and other pollutants into surface drainage canals (Environmental Protection Agency, 1971).

SAMPLING SITES

Four sites were selected to provide water-quality coverage of the major drainage systems near MIA. The locations of the four sites are shown in figure 1, and descriptions of the sites are given in table 1. Water-quality samples were collected and flow measurements were made on May 4, August 12, and November 15, 1971, and February 10, 1972. In addition to the water-quality data from the four samplings in 1971-72, data are available for site 1, sampled in November 1969 and August 1970, and for sites 2 and 3, sampled in November 1969.

Water-quality and streamflow data are also available for the Miami Canal at N.W. 36th Street, which is adjacent to MIA at its northeast corner. Water-quality data have been collected periodically since 1966 and continuous streamflow data since 1959. The location of this site, designated as site 5, is shown in figure 1, and the description is given in table 1.

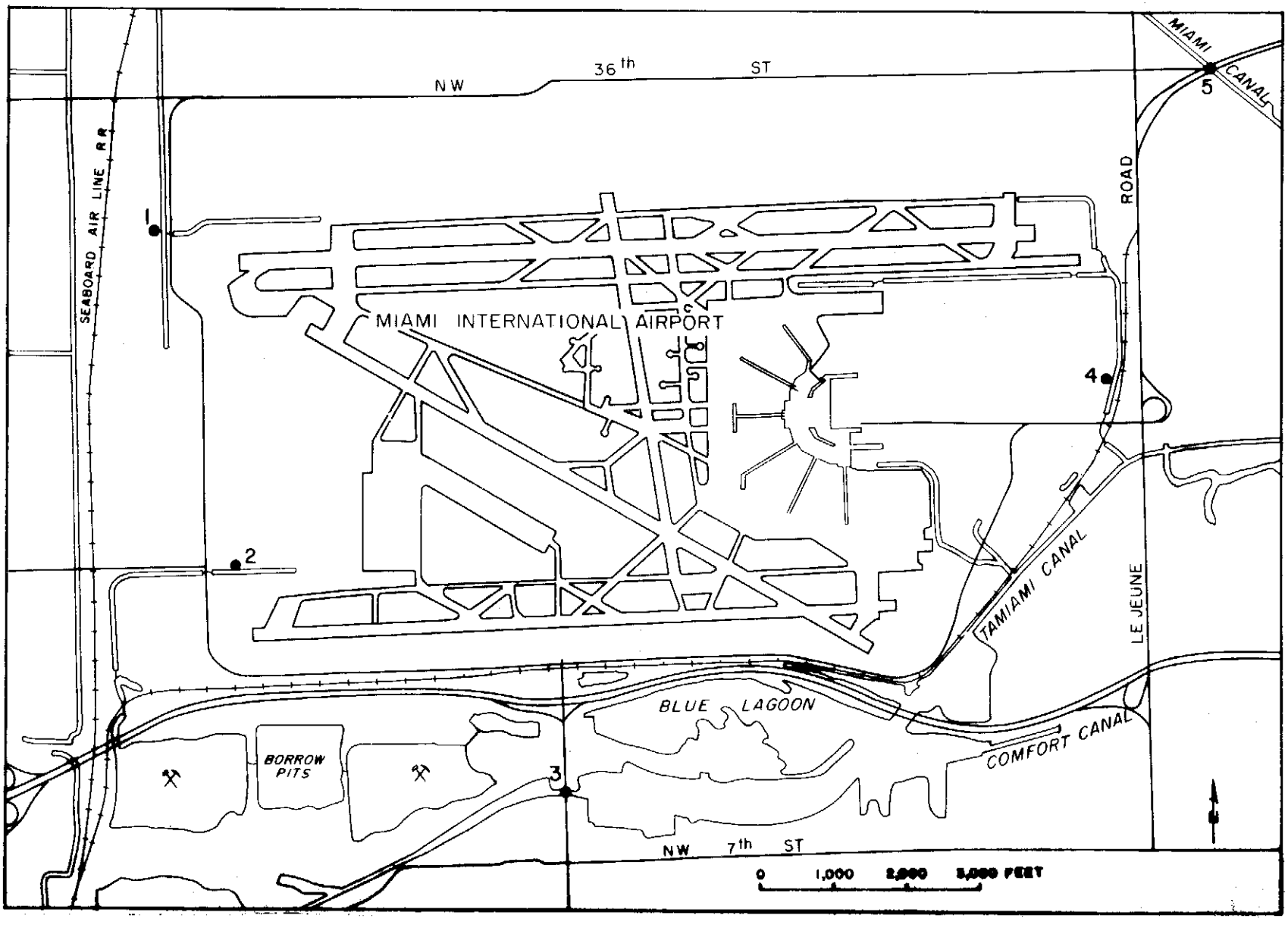

Figure 1. Location of sampling sites at MIA.

Table 1.--Water-quality sampling sites near MIA

1. Borrow-pit Canal at 32nd Street and Ludlum Road, Miami, Florida

   Location: lat 25°48'07", long 80°18'20"

2. Drainage ditch off 1st Street at Miami International Airport, Miami, Florida

   Location: lat 25°47'19", long 80°18'13"

3. 02-2905.00 Tamiami Canal at Red Road, Miami, Florida

   Location: lat 25°46'49", long 80°17'20"

4. Drainage ditch in northeast corner of Miami International Airport, Miami, Florida

   Location: lat 25°47'47", long 80°15'57"

5. 02-2886.00 Miami Canal at N.W. 36th Street, Miami, Florida

   Location: lat 25°48'29", long 80°15'44"

METHODS

Table 2 lists the water-quality parameters measured at MIA in 1971-72. Analyses of common chemical constituents, heavy metals, and nutrients were made at the Geological Survey Water-Quality Laboratory in Ocala, Florida, in accordance with currently recommended procedures (M. Beard, written commun., 1969). Quantitative analyses for pesticides were made at the Geological Survey Water-Quality Laboratory in Washington, D.C. The methods used were those described by Goerlitz and Brown (1972). Using these methods, chlorinated hydrocarbon compounds can be detected in concentrations as low as 0.001 µg/l (micrograms per liter), depending on the specific sensitivity level of each compound. Confirmation of chlorinated hydrocarbon compounds was made by mass spectral analyses. Fish for pesticide analyses were homogenized, so that measured values were representative of the average concentration of all organs. Raw-water samples were collected for plankton analyses, preserved with 3 to 5 percent formalin, and concentrated with a Foerst centrifuge. Plankton counts were made with a Sedgwick-Rafter cell, after the method outlined by Welch (1948).

Table 2.--Chemical constituents determined for samples collected at MIA in 1971-72.

Chemical constituents	Chemical constituents (cont'd)	Pesticides
Ammonia Nitrogen (NH_4)	Potassium (K)	Aldrin
Arsenic (As)	Silica (SiO_2)	Chlordane
Boron (B)	Sodium (Na)	DDT, DDD, DDE
Cadmium (Cd)	Strontium (Sr)	Dieldrin
Calcium (Ca)	Sulfate (SO_4)	Endrin
Chloride (Cl)	Total phosphorus (P)	Heptachlor
Chromium (Cr)		Heptachlor epoxide
Copper (Cu)		Lindane
Dissolved solids		2,4-D
Fluoride (F)		2,4,5-T
Iron (Fe)		Silvex
Lead (Pb)		Toxaphene
Magnesium (Mg)		Diazinon
Manganese (Mn)		Ethion
Nitrate (NO_3)		Malathion
Nitrite (NO_2)		Methylparathion
Oil and grease		Methyltrithion
Organic Nitrogen (N)		Parathion
Orthophosphate (PO_4)		Trithion
Polychlorinated Biphenyls (PCB)		

STREAMFLOW

At each site, streamflow measurements were made when the water-quality samples were collected (table 3). Flow at site 1 was negative (flow to the south) on May 4, 1971, and February 10, 1972 indicating that water levels were higher in the Miami Canal than at site 1. When this occurs, site 1 receives inflow from the Miami Canal.

The measured discharge at site 2 ranged from 0 to 1.9 cfs (cubic feet per second). This flow included water discharged from industrial sources at the sampling site.

At site 3, the discharge on the days of sampling ranged from 62 to 273 cfs. The May and August 1971 measurements may have been affected by tidal inflow. A salinity-control structure was installed on the Tamiami Canal below site 3 previous to the November 1971 sampling, thereby alleviating tidal influence on the last two measurements.

The flow at site 4 is controlled by a rubber dam just below the sampling site. The flow was increased in November 1971 and February 1972, as the dam was lowered.

Table 3.--Streamflow in cubic feet per second at sampling sites at time of water quality samplings at MIA.

Site No.	May 4, 1971	August 12, 1971	November 15, 1971	February 10, 1971
1	-0.7	0	4.4	-1.1
2	0	1.6	.7	1.9
3	169	273	62	136
4	(a)	0	6.6	.5[b/]

a Incoming tide prevented measurement.

b Estimated

RAINFALL

The monthly rainfall at MIA in 1971-72 is shown in figure 2. Rainfall for May 1971 was about 65 percent of average. However, most of the precipitation occurred after May 4, the day of sampling. Rainfall was well below average in the 4 months preceding the sampling. The rainfall for August 1971 was just below average. Rainfall in November 1971 again was low, about 30 percent of average. Only during February 1972 was the monthly rainfall above average, when about 3 inches of rain fell at MIA.

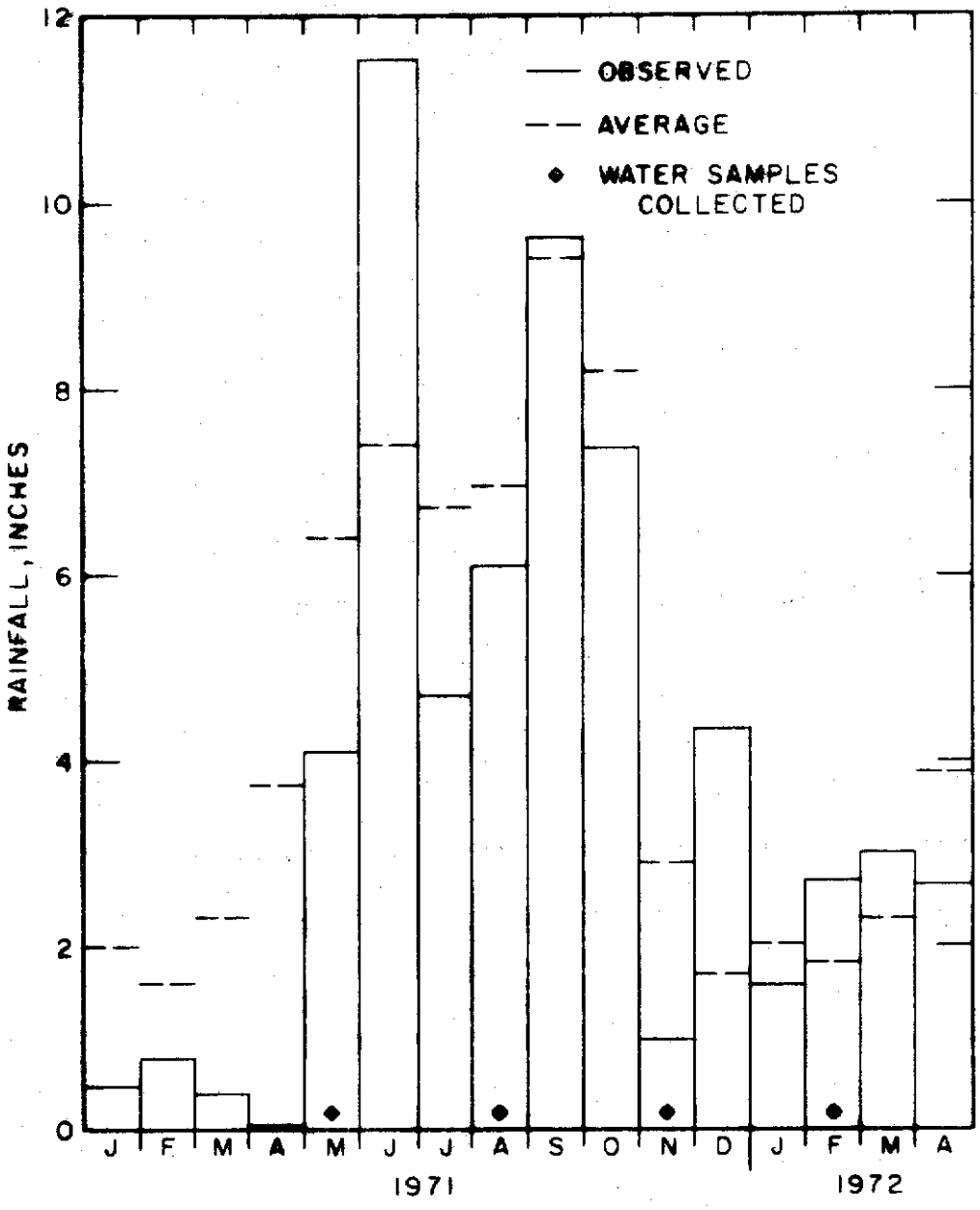

Figure 2. Monthly rainfall at MIA, January 1971 to April 1972.

WATER QUALITY

Common Chemical Constituents

The data on the common chemical constituents at sites 1-4 near MIA are given in table 15 at the end of the report, and the mean and ranges of concentration of the constituents at sites 1-5 are shown in figure 3. Concentrations of calcium, chloride, magnesium, and sodium, were generally higher at sites 3, 4, and 5 than at sites 1 and 2 because of periodic salt-water intrusion. Sites 1 and 2 are farther from salt-water sources and are thereby less affected by salt water. Table 4 lists mean concentrations of some chemical constituents at MIA and in an undisturbed area of south Florida. Mean concentration of these chemical constituents are only slightly higher at MIA. This is probably caused by salt-water influence, either by salt-water intrusion through the ground-water system or by direct tidal inflow.

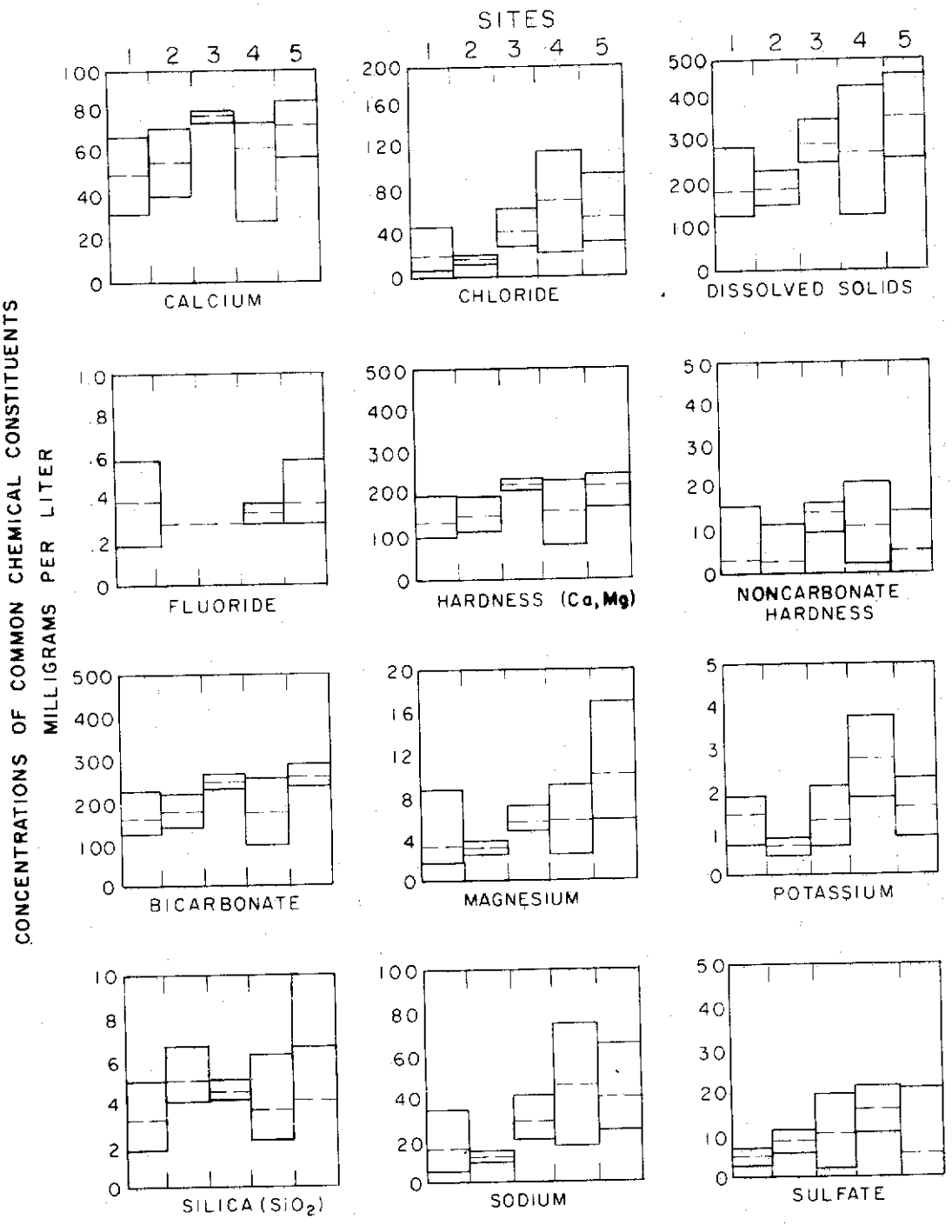

Figure 3. Mean concentrations and ranges of common chemical constituents at five sampling sites at MIA.

Table 4.--Comparison of mean concentrations of common chemical constituents, in milligrams per liter, at eight sites in undisturbed areas and five sites at MIA.

	Undisturbed Area	MIA
Calcium	61	63
Chloride	27	42
Dissolved solids	240	260
Fluoride	.2	.4
Hardness (Ca, Mg)	168	176
Noncarbonate hardness	16	7.0
Bicarbonate	192	210
Magnesium	3.6	5.6
Potassium	1.2	1.6
Silica (SiO_2)	3.1	4.2
Sodium	15	28
Sulfate	8.1	8.1

Nitrogen and Phosphorus

Nitrogen and phosphorus are key elements in biologic processes. Although many other elements are essential for life, nitrogen and phosphorus most often control the rate of biologic productivity.

Concentrations of the nitrogen species for sites 1-4 at MIA are given in table 15 at the end of the report, and the mean concentrations at sites 1-5 are shown in figure 4, along with mean concentrations of the nitrogen species of 26 samples in the Big Cypress Watershed, a natural area (from Klein and others, 1970).

Organic nitrogen at sites 1-4 was by far the most prevalent form of the element. The mean concentration was 2.1 mg/l as N. Ammonia was second in abundance, averaging 0.24 mg/l (NH_4-N). Mean concentrations of nitrate (NO_3-N) and nitrite (NO_2-N) were less than 0.1 mg/l at sites 1-4. The mean concentration of nitrate (NO_3-N) was considerably higher at site 5, 0.27 mg/l. This is probably due to higher concentrations of nitrate in agricultural water routed down the Miami Canal to the urban areas. The average concentration of total nitrogen (4.6 mg/l as N) at site 1 was more than twice that at the other stations. The high value at site 1 resulted from the large amount of organic material in the water.

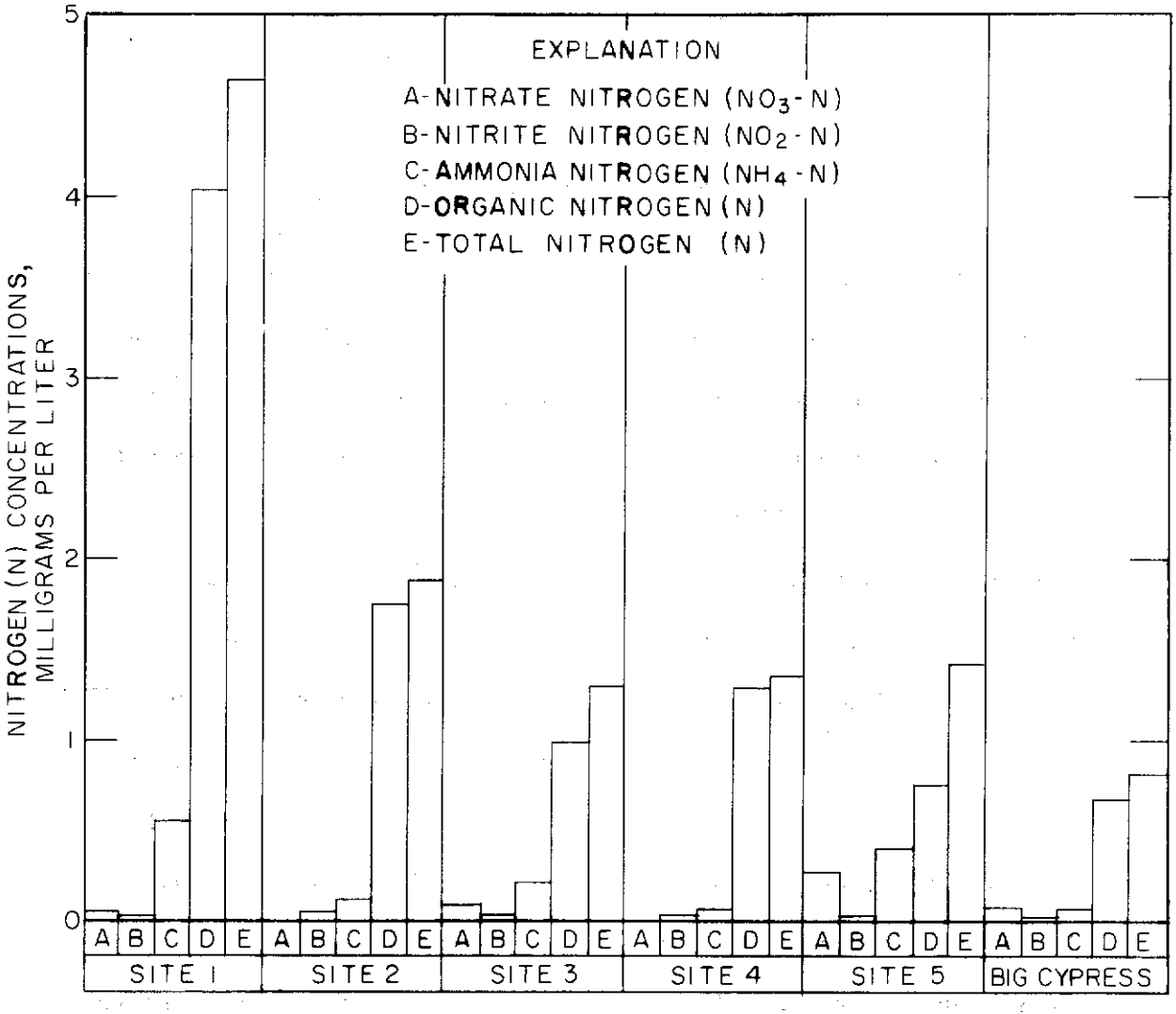

Figure 4. Mean concentrations of the nitrogen family at five sampling sites at MIA and 26 sites in the Big Cypress Watershed.

Nitrogen was generally higher near MIA than in relatively undisturbed environments. For example, the average concentration of total nitrogen as N for 26 samples in the Big Cypress was 0.82 mg/l (from Klein and others, 1970), while that at MIA was 4.6 mg/l. (See fig. 4.)

Concentrations of total phosphorus as P for sites 1-4 at MIA are shown in figure 5. Values for sites 1, 2, and 4 were highest in February; site 3 showed little seasonal change. As with nitrogen, concentrations of phosphorus were consistently greater at site 1 than at the other sites.

Phosphorus was also higher at MIA than in relatively undisturbed environments of south Florida. Concentrations of phosphorus as P averaged 0.54 mg/l for 20 samples at sites 1-4 at MIA, as compared with 0.02 mg/l for 27 samples in the Big Cypress (Klein and others, 1970). It is not known whether the larger amounts of nitrogen and phosphorus at MIA are, in general, attributable to airport operations or the surrounding urbanization. However, the larger amounts of nitrogen and phosphorus in water at site 1 indicate that the industry associated with aircraft operations does have an adverse effect on water quality, as the concentrations of these elements are more than twice the amounts at the other three sites.

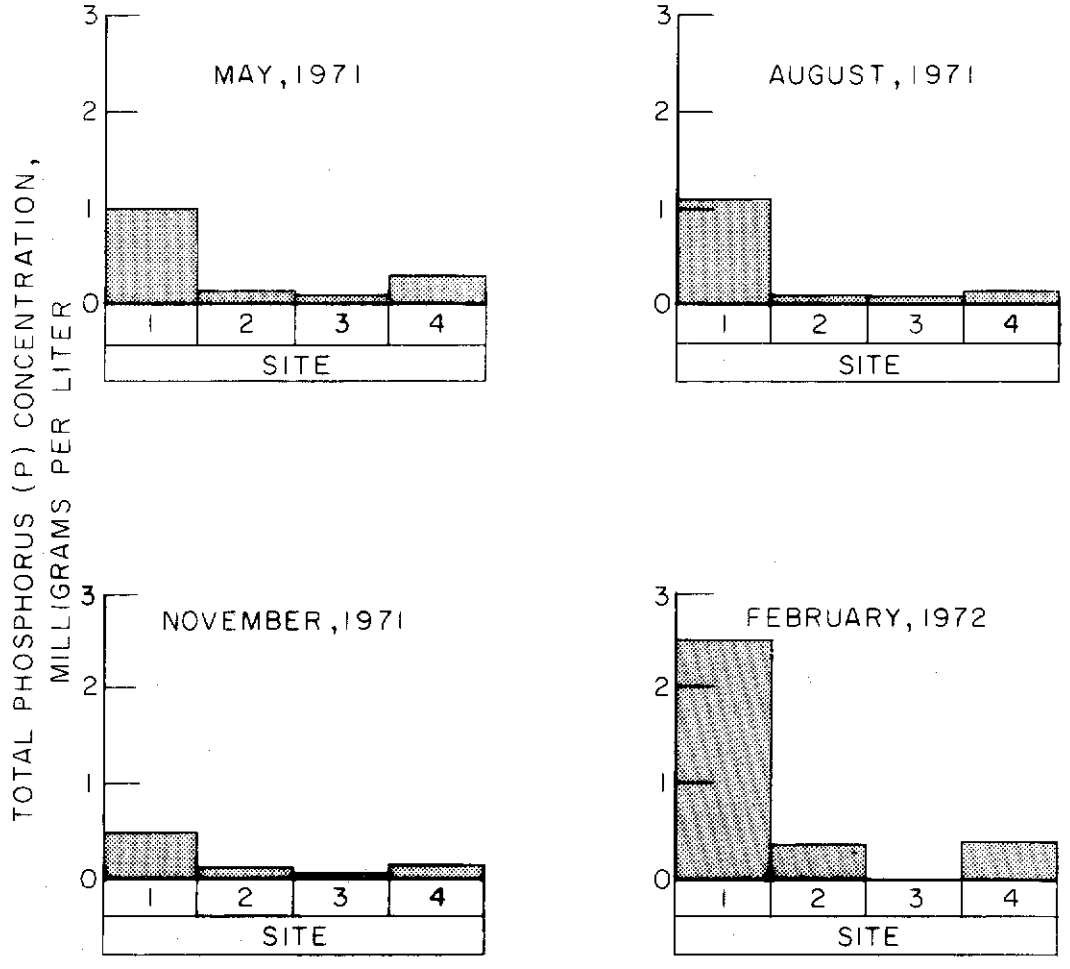

Figure 5. Concentrations of total phosphorus (as P) at four sites at MIA.

Heavy metals

In addition to nitrogen and phosphorus, many other elements, some in trace quantities, are essential for life processes. Excessive amounts of these elements, however, can be toxic.

Table 5 shows concentrations of dissolved heavy metals and trace metals (o.45 µ filter) along with the U.S. Public Health Service's recommended upper limits for metals in drinking water. Drinking-water standards are shown because the water from the sampling sites eventually infiltrates into the ground and acts as recharge for the city of Miami well field, just north of MIA.

Table 5.--Concentrations of heavy metals (0.45 μ filter), in milligrams per liter (mg/l), in water samples from four sites at MIA.

Sites	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
USPHS Drinking Water Standards	0.01	0.01	0.05	1.00	0.30	0.050	0.05	0.0050	5.00
				May 1971					
1	.01	.000	.000	.03	.60	.054	0.01	.0005	.19
2	.01	.001	.000	.00	.13	.002	.02	.0000	.07
3	.01	--	.000	.03	.19	.000	.02	.000	.08
4	.01	.002	.000	.00	.42	.018	.02	--	.11
				August 1971					
1	.04	--	.001	.01	.26	.28	.01	.0000	.09
2	.00	--	.00	.01	.15	.002	.01	.0006	.07
3	.01	--	.00	.01	.08	.003	.01	.0005	.05
4	.01	--	.00	.02	.05	.002	.01	.0000	.05
				September 1971					
1	--	--	.00	.01	.07	.004	.01	.0000	.03

Table 5.--Concentrations of heavy metals (0.45 μ filter), in milligrams per liter (mg/1) in water samples from four sites at MIA.

Sites	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Zinc
				November 1971					
1	.01	--	.00	.00	.03	.009	.00	--	.03
2	.01	.002	.00	.01	.13	.002	.04	--	--
3	.01	--	.00	.00	.08	.003	.01	.0000	.03
4	.01	--	.00	.02	.04	.008	.01	.0000	.03
				February 1972					
1	.02	.00	.00	.00	.03	.005	.00	.0008	.06
2	.02	.00	.00	.01	.02	.009	.02	.0008	.01
3	.02	.00	.00	.00	.05	.000	.00	.0011	.02
4	.01	.00	.00	.01	.03	.005	.01	.0000	.05

Concentrations of arsenic, lead, and iron exceeded the Public Health Service's recommended upper limits. Arsenic, which is contained in weed killers, insecticides, and industrial effluents, exceeded the standards at site 1 in August 1971 and February 1972 and at sites 2 and 3 in February 1972. Iron exceeded the standard at sites 1 and 4 in May 1971. Lead exceeded the standard at site 1 in May and August 1971. As a result of the high lead content in August (0.28 mg/1) a second sample was collected on September 14, 1971, to see if concentrations remained high. The concentration of lead at that time, however, was only 0.004 mg/1. Presumably, the sample in August was collected during a discharge of effluent particularly high in lead. According to the Environmental Protection Agency (1971), seven industries at MIA in 1971 were discharging wastes that contained lead in amounts greater than the recommended upper limits, and five of them discharged wastes containing lead in concentrations greater than the 0.28 mg/1 found in August 1971.

Concentrations of total recoverable metals (unfiltered) in November 1969 and 1971 and in February 1972 are listed in table 6. Values for total recoverable metals were significantly higher than those for dissolved metals at the same time. In half the samples collected, iron content was in excess of the recommended upper limit: iron is naturally high in Florida waters. Three of the eight samples contained lead in excess of the recommended limits, and chromium exceeded the recommended level in one of the eight.

Table 6.--Concentrations of total recoverable metals (unfiltered), in milligrams per liter (mg/l), in water samples from four sites at MIA.

Site	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Zinc
			November 1969				
1	--	0.14	0.20	0.68	0.700	0.02	0.08
3	--	.00	.00	.07	.000	.00	.00
			November 1971				
1	.003	.00	.00	.19	.045	.01	.00
2	.002	.00	.00	1.8	.023	.10	.00
3	--	--	--	--	--	--	--
4	--	--	--	--	--	--	--
			February 1972				
1	.006	.00	.02	.17	.07	.01	.02
2	.003	.00	.01	.45	.021	.02	.06
3	.000	.00	.00	.46	.003	.01	.01
4	.002	.00	.02	.25	.063	.01	.05

In bottom sediment, the average concentrations of cadmium, copper, lead, and zinc were higher, and those of iron and manganese were lower at MIA than the average from six sites remote from the urban industrial environment (table 7). However, the differences at the two locations between the average concentrations of both iron and manganese were not large. Cadmium, copper, lead, and zinc are considerably more abundant in sediment at MIA than at the remote stations as a result, at least in part, of industrial discharge from MIA and adjacent areas. The sediment near MIA serve as a reservoir for toxic metals.

Table 7.--Concentrations of metals, in micrograms per gram (µg/g), in bottom sediment at MIA in May 1971 and March 1972 and the average at six sites in south Florida remote from industrial operations (February 1972).

	Miami International Airport (MIA)									
	May 1971				March 1972				Average for MIA	Average for 6 non-urban sites in South Florida
SITES	1	2	3	4	1	2	3	4		
Arsenic	45	0	2.2	0	--	--	--	--	11.8	--
Cadmium	--	--	--	--	4.4	0	.8	0	1.3	0.2
Chromium^{+6}	0	0	0	0	0	0	0	0	0	0
Copper	140	24	20	17	46	8.8	7.2	7.2	33.8	5.6
Iron	1,300	680	680	300	120	100	930	75	523	725
Lead	1,100	23	12	8	500	0	14	.8	207.2	1.8
Manganese	--	--	--	--	4	4	12	4	6	16
Zinc	170	48	16	4	80	16	4	12	43.8	8

Organic Carbon

Table 8 shows the concentrations of organic carbon in water for the sample sites at MIA. Average concentrations were lowest in November 1971 and highest in August 1971; the overall average for the 16 samples was 27 mg/l. Individual samples ranged from 4 to 208 mg/l. The maximum concentration of 208 mg/l occurred at site 1 in August 1971, a time of high concentration of oil and grease and a large biomass from the filamentous blue-green algae Oscillatoria sp. The algae and the oil and grease probably contributed to the high organic carbon.

Table 8.--Concentrations of organic carbon, in milligrams per liter (mg/l), at sampling sites at MIA.

Site No.	5-4-71	8-12-71	11-15-71	2-10-72
1	37	208	5	15
2	23	24	4	10
3	9	13	6	15
4	23	16	8	17

Oil and Grease

Concentrations of oil and grease in water at sites 1-4 are shown in table 9. Most concentrations were less than 20 mg/l; one sample, however, had a concentration of 720 mg/l (site 1; August 1971). Oil and grease were visible on the water surface during each sampling period, particularly at site 1.

Oil and grease in bottom sediments at sites 1-4 ranged in concentration from 0 to 700,000 mg/kg (milligrams per kilogram), with highest values consistently at site 1 (table 10). The bottom sediment at site 1 was a black oily material that could be only partly digested during analysis and thus, the oil and grease measurement there represents the minimum value present.

The highest concentrations of oil and grease, expecially in bottom sediment, were usually found at site 1. These high concentrations are most likely the result of industries around this canal discharging effluent high in oil and grease content. Numerous industries near site 1 at MIA rebuild, clean, and service aircraft engines and discharge the effluent into a drainage ditch canal that flows into the canal at site 1 and is its principle source of surface water.

Table 9.--Concentrations of oil and grease in water, in milligrams per liter, sampling sites at MIA.

Site No.	May 1971	August 1971	November 1971	February 1972
1	14	720	11	6.0
2	6.0	4.7	11	3.6
3	-	15	13	4.3
4	19	0	12	11

Table 10.--Concentrations of oil and grease in sediments, in milligrams per kilogram (mg/kg), at sampling sites at MIA.

Site No.	May 1971	August 1971	November 1971	March 1972
1	20,000	700,000	5,700	1,800
2	50	18,000	4,100	800
3	0	51	2,400	820
4	0	19	1,200	620

Pesticides and Related Compounds

At MIA most water samples did not contain detectable amounts of pesticides (table 11). In some, the DDT family, dieldrin, 2, 4-D, silvex, parathion, diazinon, and methylparathion were detected in water from a trace to 0.27 µg/l (micrograms per liter).

Concentrations of pesticides in bottom sediments were greater than those in water (table 12). The DDT family was found in 10 of the 16 samples, and concentrations were as high as 133 µg/kg at site 1 in February 1972. Dieldrin was found in over half the bottom-sediment samples; the maximum concentration was 7.8 µg/kg.

Table 11.--Concentrations of pesticides and related chlorinated hydrocarbon compounds, in micrograms per liter (µg/l), in water samples from four sites at MIA.

	Site Number															
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	May 1971				August 1971				November 1971				February 1972			
Aldrin	*	*	0.00	0.00	*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DDD	*	*	.00	.00	*	.00	.00	.00	.00	.00	.00	.00	.08	.00	.00	.00
DDE	*	*	.00	.00	*	.00	.00	.00	.00	.00	.00	.00	.04	.00	.00	.00
DDT	*	*	.00	.00	*	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Dieldrin	*	*	.00	.00	*	.00	.00	.00	.00	.08	.00	.00	.00	.02	.00	.00
Endrin	*	*	.00	.00	*	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Heptachlor	*	*	.00	.00	*	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Lindane	*	*	.00	.00	*	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2,4-D	0.01	0.00	.00	.00	.00	.00	.04	.00	.00	.00	.27	.00	.00	.00	.01	.00
2,4,5-T	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Silvex	.00	.00	.01	.00	.00	.00	.05	.01	.00	.00	.01	.01	.01	.00	.01	.00
Diazinon	.00	.00	.00	.02	#	.03	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Ethion	.00	.00	.00	.00	#	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Malathion	.00	.00	.00	.00	#	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Methylparathion	.00	.00	.00	.00	#	.00	.00	.00	.00	.03	.00	.00	.00	.00	.00	.00
Methyltrithion	-	-	-	-	#	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Parathion	.00	.00	.00	.00	#	Trace	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Trithion	-	-	-	-	#	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
Chlordane	-	-	-	-	#	-	-	-	-	-	-	-	.00	.00	.00	.00
PCB	-	-	-	-	-	Trace	-	-	.10	.00	.00	.04	+	Trace	Trace	.00

* Not determined due to interference from PCB's.

\# Not determined due to sulfur interference.

\+ Halowax (PCN) = 5.7 µg/l.

\- Not measured.

Table 12.--Concentrations of pesticides and related chlorinated hydrocarbon compounds, in micrograms per kilogram (µg/kg), in sediment samples from four sites at MIA.

	Site Number															
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
	May 1971				August 1971				November 1971				February 1972			
Aldrin	*	0.0	0.0	0.0	*	*	0.0	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DDD	*	.0	15	3.0	*	*	55	*	39	2.8	3.2	.0	93	.6	22	1.0
DDE	*	.0	5.5	2.2	*	*	34	*	-	2.5	12	.0	40	.3	31	.9
DDT	*	.0	2.6	.0	*	*	23	*	.0	.0	16	.0	.0	.0	6.1	.0
Dieldrin	.0	.0	.0	.0	*	.0	3.1	.0	.4	6.9	2.3	Trace	2.5	7.8	.9	.3
Endrin	.0	.0	.0	.0	*	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Heptachlor	*	.0	.0	.0	*	*	.0	*	.0	.0	.0	.0	.0	.0	.0	.0
Lindane	*	.0	.0	.0	*	*	.0	*	.0	.0	.0	.0	.0	.0	.0	.0
2,4-D	*	-	-	-	*	*	.0	*	*	.0	.0	.0	.0	.0	.0	.0
2,4,5-T	*	-	-	-	*	*	-	*	*	.0	.0	.0	.0	.0	.0	.0
Silvex	*	-	-	-	*	*	-	*	*	.0	.0	.0	.0	.4	7.2	.0
Chlordane	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0
PCB	250	-	-	-	#	40	0	40	+	50	0	10	+	20	45	10
PCN	-	-	-	-	#	-	-	-	1250	-	0	-	5000	-	-	-

* Not determined due to PCB interference.

\- Not measured

\# Sample contained chlorinated naphthalenes and PCB's.

\+ Not determined due to presence of large amounts of polychlorinated napthalenes.

Concentrations of pesticides were generally higher in fish than in bottom sediments (table 13). Concentrations of the DDT family ranged from 94 µg/kg (Lepomis macrochirus at site 2) to 264 µg/kg (Lepisostius platyrhincus at site 1). Dieldrin was found in 11 of 12 fish samples; one sample of mosquitofish from site 2 had a concentration of this insecticide of 2,400 µg/kg. The Food and Drug Administration recommends an upper limit of 300 µg/kg of dieldrin for edible parts of smoked, frozen, or canned fish (oral commun., John Craig, Food Residue Laboratory, Florida Department of Agriculture, Miami, Florida).

PCB's were detected in most samples from all sites at MIA (table 11, 12, and 13). Maximum concentrations were 0.4 µg/l in water, 250 µg/kg in sediments, and 1,000 µg/kg in fish. PCB's are widely used in industry. Like DDT they are persistent compounds that enter the food chain and become concentrated at higher nutritional levels.

Table 13.--Concentrations of pesticides and related chlorinated hydrocarbon compounds, in micrograms per kilogram (µg/kg), in fish samples from three sites at MIA.

Site No.	Type of Fish	Date	Aldrin	DDD	DDE	DDT	Dieldrin	Endrin	Heptachlor	Lindane	Chlordane	PCB	PCN	Heptachlor Epoxide	Toxaphene
1	Florida gar *Lepisosteus Platyrhinus*	3-21-72	0.0	150	53	19	10	0.0	0.0	0.0	0	400	100	0.6	0
1	Blue gill *Lepomis Macrochirus*	3-21-72	0.0	68	51	6.5	5.7	0.0	0.0	0.0	0	360	50	0.9	0
1	Florida gar *Lepisosteus Platyrhincus*	3-21-72	0.0	120	120	24	6.7	0.0	0.0	0.0	0	400	0	0.6	0
2	Mosquito fish *Gambusia Affinis*	5-4-71	*	*	*	*	0.0	0.0	*	*	-	200	-	-	-
2	Mosquito fish *Gambusia Affinis*	8-12-71	0.0	67	61	50	6.9	0.0	0.0	0.0	260	1000	-	-	-
2	Mosquito fish *Gambusia Affinis*	11-21-71	0.0	46	41	31	2400	0.0	0.0	0.0	100	500	-	-	-
2	Mosquito fish *Gambusia Affinis*	2-10-72	0.0	55	85	5.8	125	0.0	0.0	0.0	0	500	-	-	0
2	Spotted sunfish *Lepomis Punctatus*	3-21-72	0.0	73	83	79	1400	0.0	0.0	0.0	0	800	0	0.9	0
2	Blue gill *Lepomis Macrochirus*	3-21-72	0.0	26	49	19	200	0.0	0.0	0.0	0	150	0	0.0	0
2	Spotted sunfish *Lepomis Punctatus*	3-21-72	0.0	15	70	30	120	0.0	0.0	0.0	0	300	0	0.0	0
3	Freshwater glass-minnow *Menidia Berylline*	5-4-71	*	*	*	*	4.3	0.0	*	*	-	150	-	-	-
3	Freshwater glass-minnow *Menidia Berylline*	2-11-72	0.0	23	64	14	4.0	0.0	0.0	0.0	0	20	-	-	0

* Not determined due to PCB interference.

\- Not measured.

Another group of chlorinated compounds, PCN's (polychlorinated naphthalenes) were detected in water, sediment, and fish samples at site 1 and were later confirmed in sediments by gas chromatography/mass spectrometry analyses. This is the first known report of their presence in an environmental sample in the United States. PCN's are used in cleaning agents and electrical insulating compounds and as additives in automobile and industrial gear oils. Like PCB's and DDT, they are persistent compounds that can be expected to enter the food chain.

Concentrations of PCN's at site 1 were lowest in water (5.7 µg/1) and highest in bottom sediments (1,250 and 5,000 µg/kg). Concentrations in fish (0, 50, and 100 µg/kg) were intermediate. Persistent chemicals, such as DDT, are usually more concentrated in fish than in water and bottom sediments. The lower concentrations of PCN's in fish compared with sediments at site 1 are probably related to the mobility of the fish. The fish may be exposed to high concentrations of PCN's for only a relatively short period.

Pesticides and related chlorinated chemicals were generally in higher concentrations near MIA than in the undisturbed environments of south Florida. For example, the DDT family in 20 sediment samples from the Big Cypress Swamp had an average concentration of 5.1 µg/kg, while 12 samples from MIA had an average concentration of 34 µg/kg. Even more striking was the amount of PCB's in samples near MIA compared with those in undisturbed areas. Only occasionally are PCB's detected in undisturbed environments and then usually in low or trace concentrations. In contrast, at MIA, PCB's were present in most sediment and fish samples, and concentrations were as high as 1,000 µg/kg.

Phytoplankton

Concentrations of phytoplankton at the four stations at MIA ranged from a few cells per milliliter to more than 100,000 per milliliter. The most abundant forms were minute coccoid cells (1-5 microns in diameter), probably blue-greens (table 14). These and other blue-green algae were the most abundant in 10 of 16 samples.

Filamentous blue-green algae were dominant at stations 1 and 4 in August 1971. Oscillatoria sp. was the dominant form at station 1; Anabaena sp. was dominant at station 4. Both genera are considered to be pollution tolerant. (Palmer, 1969)

Table 14.--Concentrations of phytoplankton, (number per ml) at four sites at MIA. "N" indicates none observed. "P" indicates present but not enumerated because of low numbers.

Sites	May 1971				August 1971				November 1971				February 1972			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Minute (1-5 μ) coccoid cells[6]	290	P	P	64,000	P	N	N	N	N	P	N	72,000	100,000	P	P	P
Blue green algae	P	10,900	7,900	P	2,400[1]	P	P	570[2]	960[1]	P	N	N	P	P	P	5,400[3]
Green algae	28	5,445	N	76	N	60	17	P	N	645[3]	P	N		P	P	P
Diatoms	34	3,470	P	N	N	P	P	N	N	P	50[4]	P	P	P	162[4]	56
Eugleroids	N	N	N	N	P	N	N	P	N	P	N	84	N	160	N	64
Dinoflaglates	N	N	P	N	N	N	36	P	N	N	N	N	N	N	P	N

1/ Oscillatoria sp. (100 μ length units)

2/ Anabaena sp. (100 μ length units)

3/ Several "types" of coccoid cells (8-10 μ diameter)

4/ Coscinodiscus sp.

5/ Probably Anacystis sp.

6/ Minute coccoid cells are probably blue greens

SUMMARY AND CONCLUSIONS

An ecologic survey of MIA was made by the U.S. Geological Survey between May 1971 and February 1972. Water samples were collected quarterly at four sites around the airport, and additional water-quality data for samples collected at the Miami Canal at N.W. 36th Street were available for comparison.

A comparison of mean concentrations of common inorganic chemical constituents from an undisturbed area and the airport sites show no significant differences, indicating that urbanization and industry have not seriously affected this facet of water quality. However, concentrations of nutrients, heavy metals, and pesticides and related chlorinated compounds were much higher at the airport sites than in undisturbed areas.

Sampling site 1, a borrow-pit canal in the northwest corner of the airport, showed the highest mean concentrations of both total nitrogen and total phosphorus as P, 4.64 and 2.5 mg/l, respectively. The most prevalent form of nitrogen at all sites was organic nitrogen. The high values of both nitrogen and phosphorus are probably due to industrial operations around the airport.

Concentrations of most heavy metals were below the U.S. Public Health Service's recommended limits. However, arsenic, lead, and iron concentrations exceeded the limits several times at various sites. Samples of total recoverable metals showed higher concentrations of lead and iron than samples of dissolved metals.

Pesticides were common in samples collected at the airport. Concentrations of pesticides were lowest in water samples. They were greater in sediment samples and were highest in fish samples. The highest concentration of the DDT family was 264 µg/kg in a fish sample at site 1. A fish sample at site 2 contained 2,400 µg/kg of dieldrin. Concentrations of PCB's as high as 1,000 µg/kg and PCN's as high as 5,000 µg/kg, both polychlorinated compounds used mainly in industrial operations, were found in the water, sediment, or fish collected at the sampling sites at the airport.

The presence of high concentrations of nutrients, heavy metals, pesticides, and other chlorinated compounds in environmental samples collected at MIA are probably due to industrial wastes discharged into drainage ditches and canals. Many industries around MIA are associated with the maintenance, washing, and painting of aircraft or the rebuilding of aircraft engines. All these operations require the use of the sampled contaminants.

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Table 15.--Chemical analyses of water samples at sites 1-4 at MIA. Results are in milligrams per liter.

Site Number	Date	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3-N)
1	11-17-69	5.1	45	2.0	17	1.7	142	3.6	18	0.6	.00
	8-17-70	4.2	48	2.4	15	1.5	169	6.4	16	.5	.00
	5-04-71	3.5	62	8.4	33	1.8	228	6.0	51	.4	.00
	8-12-71	2.0	56	2.0	5.1	1.9	163	6.2	9.0	.3	.09
	11-15-71	2.0	38	1.9	7.5	.8	126	3.5	11	.2	.00
	2-10-72	1.9	45	3.9	17	1.4	154	4.0	24	.3	.00
2	11-17-69	-	-	-	-	-	-	-	-	-	.00
	5-04-71	5.6	60	3.8	12	.9	204	10	21	.3	.00
	8-12-71	4.3	47	2.7	9.0	.5	153	8.4	14	.3	.00
	11-15-71	6.8	71	3.7	14	.8	220	11	21	.3	.00
	2-10-72	4.1	41	2.2	11	.9	142	6.0	14	.3	.00

Table 15.--Chemical analyses of water samples at sites 1-4 at MIA. Results are in milligrams per liter (continued).

Site Number	Date	Nitrite (NO_2-N)	Ammonia (NH_4-N)	Organic Nitrogen (N)	Ortho-phosphate (PO_4-P)	Total phosphorus (P)	Dissolved solids (calculated)	Dissolved solids (residue)	Hardness (Ca, Mg)	Non Carbonate Hardness	Specific Conductance
1	11-17-69	0.015	0.20	2.50	2.30	2.40	171	189	121	5.0	293
	8-17-70	.000	-	-	1.2	1.2	181	189	131	0	330
	5-04-71	.012	.07	3.0	.82	1.0	286	324	200	16	540
	8-12-71	.006	2.4	12	1.1	1.1	163	198	150	15	358
	11-15-71	.006	.11	.44	.36	.49	128	140	100	1.0	250
	2-10-72	.006	.03	2.3	.95	2.5	177	220	129	3.0	330
2	11-17-69	.16	.12	2.0	.31	.33	-	-	-	-	-
	5-04-71	.003	.09	1.6	.10	.15	215	239	170	0	408
	8-12-71	.003	.09	.85	.029	.052	161	188	130	2.5	290
	11-15-71	.006	.23	.63	.072	.10	237	244	190	12	430
	2-10-72	.006	.02	3.7	.27	.36	151	172	112	0	280

Table 15.--Chemical analyses of water samples at sites 1-4 at MIA. Results are in milligrams per liter (continued).

Site Number	Date	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3-N)
3	11-17-69	5.0	75	4.7	20	0.8	232	1.6	33	0.3	0.04
	5-04-71*	2.5	140	200	1600	60	254	400	2800	.5	.00
	8-12-71	4.8	84	17	30	10	243	72	474	.3	.02
	11-15-71	5.2	80	7.2	41	2.1	260	19	67	.3	.14
	2-10-72	4.2	78	5.0	23	1.1	252	11	36	.3	.25
4	5-04-71*	2.2	63	76	600	26	108	150	1100	.3	.00
	8-12-71*	3.9	78	70	600	25	177	153	1070	.4	.00
	11-15-71	6.4	76	9.4	73	3.8	252	21	120	.3	.00
	2-10-72	2.9	29	2.2	1.7	1.9	98	10	23	.4	.00

Table 15.--Chemical analyses of water samples at sites 1-4 at MIA. Results are in milligrams per liter (continued).

Site Number	Date	Nitrite (NO_2-N)	Ammonia (NH_4-N)	Organic Nitrogen (N)	Ortho-phosphate (PO_4-P)	Total phosphorus (P)	Dissolved solids (calculated)	Dissolved solids (residue)	Hardness (Ca, Mg)	Noncarbonate hardness	Specific Conductance
3	11-17-69	0.006	0.39	1.40	0.055	0.055	255	286	207	17	449
	5-04-71*	.012	.08	1.1	.036	.046	5330	-	1200	970	9700
	8-12-71*	.006	.12	.09	.049	.049	1083	-	281	82	2000
	11-15-71	.030	.32	1.9	.016	.029	351	392	230	17	645
	2-10-72	.009	.12	.52	.007	.020	284	320	216	10	520
4	5-04-71	.003	.05	2.5	.14	.30	2070	-	470	380	3830
	8-12-71*	.006	.08	1.9	.11	.15	2090	-	480	340	3700
	11-15-71	.003	.11	.34	.11	.17	435	468	230	22	830
	2-10-72	.009	.02	.45	.21	.39	135	136	82	2.0	260

* Sample not used in determination of mean concentrations of common chemical constituents because of excessive salt water influence.