3-31-1986

Surface sediment composition and distribution in Hillsborough Bay, Florida 1986

City of Tampa Department of Sanitary Sewers Bay Study Group

Surface Sediment Composition and Distribution in Hillsborough Bay, Florida

A Report
Submitted

to

Florida Department of Environmental Regulations
March 31, 1986

by

City of Tampa
Department of Sanitary Sewers
Bay Study Group

Summary

Surface sediments were mapped to determine the approximate boundaries and percent areal coverage of "mud" in Hillsborough Bay. Depth recorder soundings along 29 transects were used in conjunction with sediment grain size analyses from 19 stations to produce a sediment map. For mapping purposes, "mud" was assumed to occur at locations where 50% or more of sediment particles passed through a 63 μm mesh sieve. Grain size analyses revealed that sediment compositions, depending on location, ranged from 95.3% "sand" to 98.9% "mud." The largest expanse of "mud" covered the deeper zones of west-central Hillsborough Bay. We concluded that the areal coverage of "mud" comprised approximately 24% of the total sediment surface area in Hillsborough Bay.

Introduction

The City of Tampa is conducting a study of sediment nutrient release rates in Hillsborough Bay, Florida. The study will supply the FDER Water Quality Analysis Section with information to refine the mathematical modeling of Hillsborough Bay for wasteload allocation.

The initial effort, reported herein, was to produce a map of Hillsborough Bay identifying areas of "sandy" and "muddy" sediments, and to estimate the areal coverage of these sediment types.

Methods

Surface sediment types were distinquished by using depth recorder tracings (King Marine, model 1013 with a 200 KHz transducer) taken during 29 transects (Figure 1) in Hillsborough Bay between January 7 and March 12, 1986. Cruising speeds and transect positions were determined by reference to navigational aids and landmarks. LORAN-C coordinates were recorded at least every two minutes during transect cruises so sediment samples could subsequently be taken at specific transect locations. A one nautical mile long section of transect 3 appeared to encompass a wide range of sediment types based on depth recorder tracings (Figure 2). Three replicate sediment samples using a standard Ekman bottom dredge were extracted at each of five stations (4,5,6,7,8; see Figure 2) along transect 3 to establish a relationship between depth recorder tracings and sediment grain size. Fourteen additional stations were sampled for sediments throughout Hillsborough Bay (Figure 1) to confirm interpretations of depth recorder tracings.

Sediments from 14 stations were analyzed for grain size, total carbon and total nitrogen by the Department of Marine Science at the University of South Florida (USF). Grain size analyses followed standard sieve and pipette methods (Folk 1965) at ½ ϕ (phi) intervals. Particles retained on an ASTM number 230 sieve (63 μm) were defined as "sand," and the fraction passing through was considered "mud" ("silt and clay"). Surface sediments containing $<$50% sand were considered to be "mud" for mapping purposes. Sediment samples were taken at five additional stations and analyzed for grain size by the City of Tampa. These samples were separated into only two fractions, "sand" and "mud." Total carbon and total nitrogen were determined using a Carlo-Erba model 1106 elemental analyzer and reported as percent by weight. Total phosphorous was measured by the City of Tampa, Treatment Division, chemistry

Figure 1. "Mud" sections of 29 sediment transects and 19 sediment sample stations in Hillsborough Bay. "Mud" is defined as those sediments where ≥ 50% of all particles by weight passed through a 63 μm sieve.

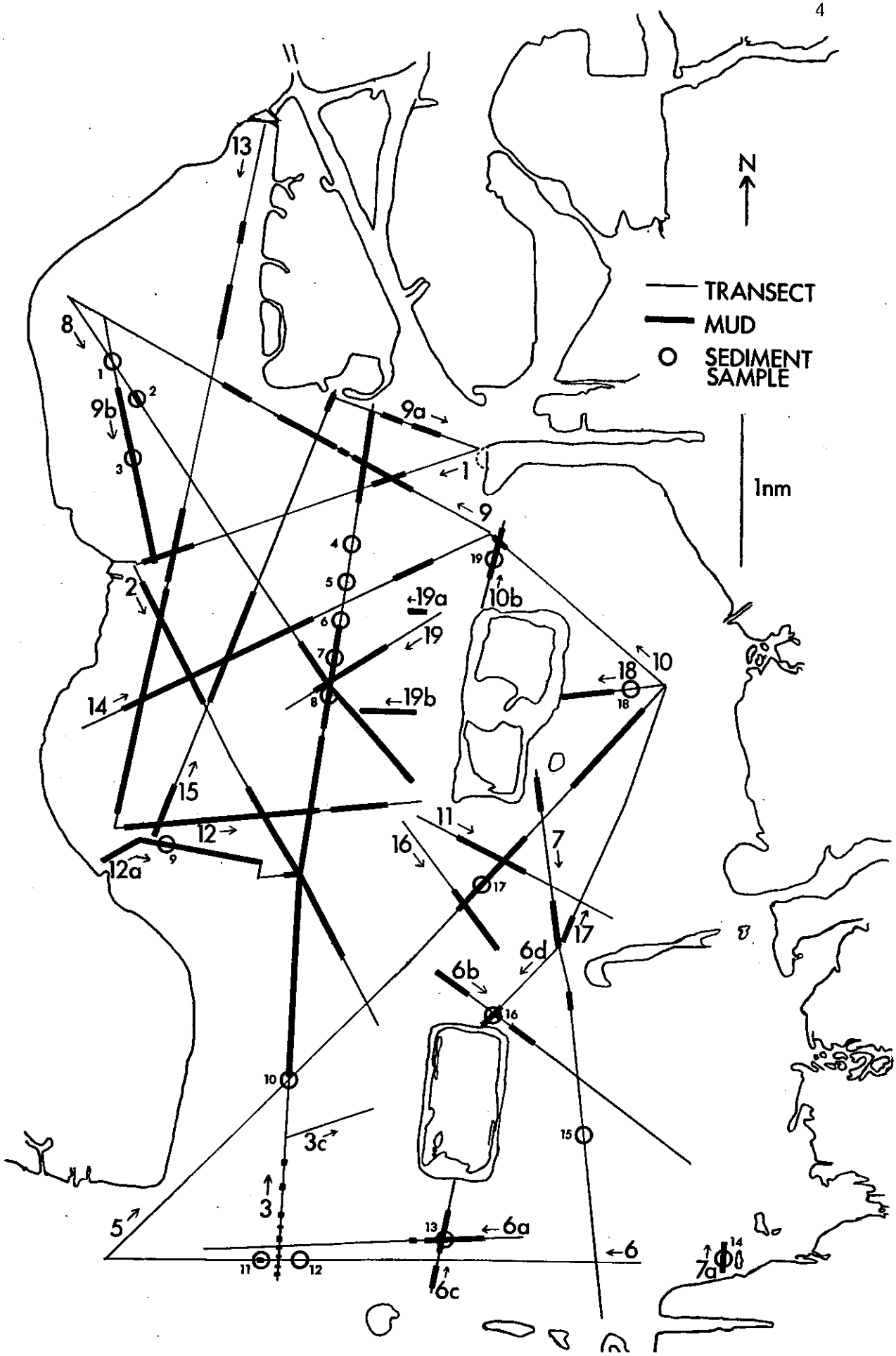
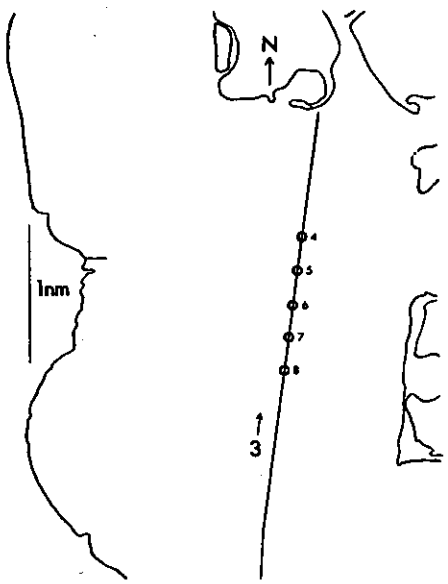
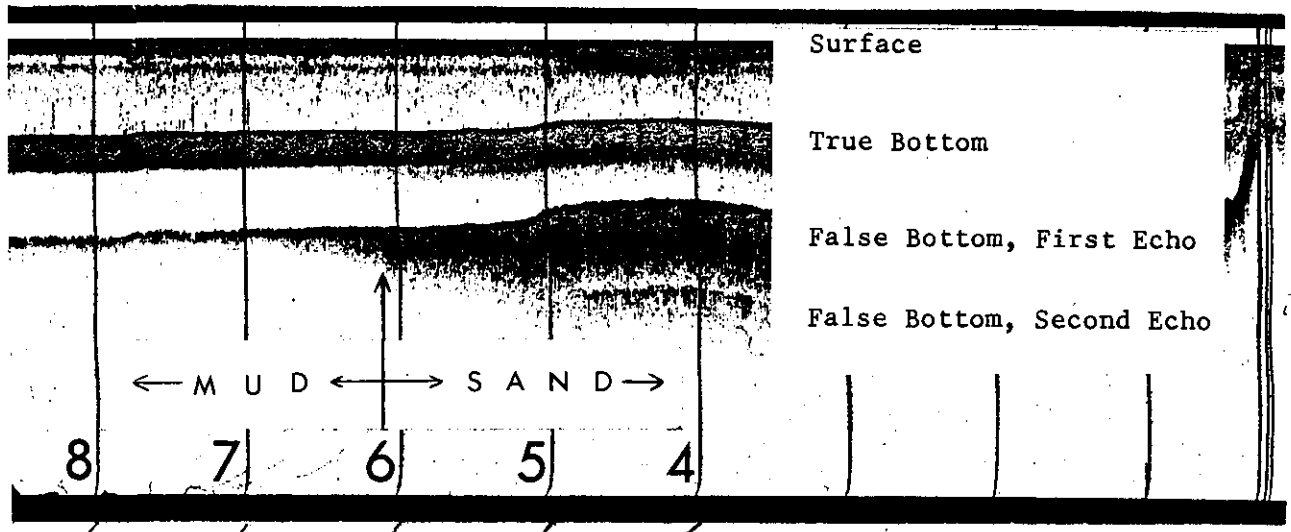

N
TRANSECT
MUD
SEDIMENT SAMPLE
1nm
13
8
9b
9a
1
9
2
19a
19
10b
10
18
14
19b
15
12
11
16
7
12a
17
6d
6b
3c
3
5
6a
6
6c
7a

Figure 2. Depth recorder tracing and grain size results from five sediment sample locations along transect 3 in central Hillsborough Bay. Depth recorder settings are also shown.





LOCATION	8	7	6	5	4
MEAN % SAND	11.7	14.8	56.0	82.9	87.7
MEAN % MUD	88.3	85.2	44.0	17.1	12.3

Depth Recorder Settings

Depth Range	3
White Line	10
Fine Echo	None
Shift	None
Power & Gain	5
Paper Speed	0.65 in/min
Marker Interval	2 min
Boat Speed	7.5 knots

laboratory (Standard Methods 14 ed., Method 425F). Carbon, nitrogen and phosphorous analyses are in progress, therefore those results will be included in a subsequent report.

Results and Discussion

The amount of "mud" found among 19 Hillsborough Bay sediment sample locations ranged from 4.7% at station 12 to 98.9% at station 13 (Table 1). All except two stations, 2 and 10, were clearly either "mud" or "sand" based on the 50% criteria. (This 50% criteria, as described in our methods, has also been used by Boynton et. al. (1981)). Replicates at stations 2 and 10 overlapped the two categories, therefore those sediments may be borderline between "sand" and "mud."

A section of transect 3 was used to compare sediment grain size results with a depth recorder tracing (Figure 2). Grain size analyses revealed a change from "mud" to "sand" between stations 6 and 7. A point was chosen along the false bottom-first echo tracing between stations 6 and 7 where "mud," by definition, was assumed to begin. The thickness of the false bottom-first echo tracing at that point was measured and later used to delineate "mud" boundaries for all transects. Grain size analyses from samples taken at 14 additional stations along transects were used to confirm interpretations of depth recorder tracings. All sediment samples, except at station 14 (transect 7a), conformed to sediment types previously determined by depth recorder tracings. Sediments from station 14 were examined because of an irregular tracing of transect 7a which was different from other tracings of "sand" or "mud." A dense layer of drift macroalgae overlying "mud" (79.4% mud, Table 1) apparently caused the irregular tracing.

The extremely variable bottom relief in deeper areas at the mouth of Hillsborough Bay precluded the demarcation of sediment types shown by depth recorder tracings. Station 11, located in a deep "muddy" trough (25 feet deep, 95.7% "mud"), is only 1/4 mile from station 12, which is at a shallow "sandy"

Table 1. Grain size of surface sediments at 19 locations in Hillsborough Bay.

Station	Replicates	Composition			
		% Sand (> 63 μm)		% Mud (≤ 63 μm)	
		mean	range	mean	range
1	2*	60.7	58.3 - 63.0	39.3	37.0 - 41.7
2	3	41.5	32.8 - 55.6	58.5	44.4 - 67.8
3	2*	48.5	48.0 - 49.0	51.5	51.0 - 52.0
4	3	87.7	85.9 - 87.9	12.3	10.7 - 14.1
5	3	82.9	80.0 - 87.8	17.1	12.3 - 20.0
6	3	56.0	53.8 - 59.7	44.0	40.3 - 46.2
7	3	14.8	13.9 - 16.4	85.2	83.4 - 86.1
8	3	11.7	4.2 - 17.9	88.3	82.1 - 95.8
9	3	4.4	3.2 - 5.7	95.6	94.3 - 96.8
10	3**	41.1	28.3 - 55.3	58.9	44.7 - 71.8
11	3**	4.3	2.4 - 6.0	95.7	94.0 - 97.6
12	3**	95.3	95.1 - 95.6	4.7	4.4 - 4.9
13	3	1.1	0.0 - 2.1	98.9	97.9 -100.0
14	2*	20.6	20.3 - 20.9	79.4	79.1 - 79.7
15	3**	91.0	89.0 - 92.5	9.0	7.5 - 11.0
16	2*	31.2	27.5 - 34.9	68.8	65.1 - 72.5
17	3**	10.6	9.0 - 11.8	89.4	88.2 - 91.0
18	3**	66.1	59.5 - 71.6	33.9	28.4 - 40.6
19	2*	4.1	3.6 - 4.6	95.9	95.4 - 96.4

* Analyzed by City of Tampa

** Analyzed by USF, Dept. of Marine Science and City of Tampa for comparison of methods

mound (8.5 feet deep, 95.3% "sand"). Evidently, several "mud" pockets are separated by "sand-shell" mounds at the mouth of Hillsborough Bay.

"Muddy" sections along the 29 transects (Figure 1) were interconnected based on bottom topography and dredging information. An areal representation of "muddy" sediments in Hillsborough Bay was produced (Figure 3).

The major area of "mud" in surface sediments is generally located at depths exceeding ten feet in the west-central region of Hillsborough Bay surrounding Long Shoal (Figure 3). "Muddy" areas in eastern Hillsborough Bay are primarily confined to deep circulation cuts (>15 feet) created by the U.S. Army Corps of Engineers between 1979 and 1981 (Figure 3).

Shipping channel sediments were not assessed in the sediment mapping effort (Figure 3). However, several Ekman dredge samples were taken along cut C of the main channel. Visual inspections of those sediments revealed "mud" north, and "sand" mixed with shell fragments south, of the Alafia River channel.

In 1984 and 1985, Doyle et. al. (1985) surveyed surface sediments as part of a hydrocarbon study of the Tampa Bay system. Six of their stations within the Hillsborough Bay complex (14,15,17,18,19,22) were within our study area. Fifteen of their stations are plotted on our sediment distribution map (Figure 4). Sediment grain size analyses from their study (Table 2) were generally in agreement with our sediment type distributions in Hillsborough Bay.

Based on the areal coverage illustrated in Figure 3, about 24% of Hillsborough Bay's surface sediments are "mud."

Figure 3. Estimated areal coverage of "mud" in the surface sediments of Hillsborough Bay.

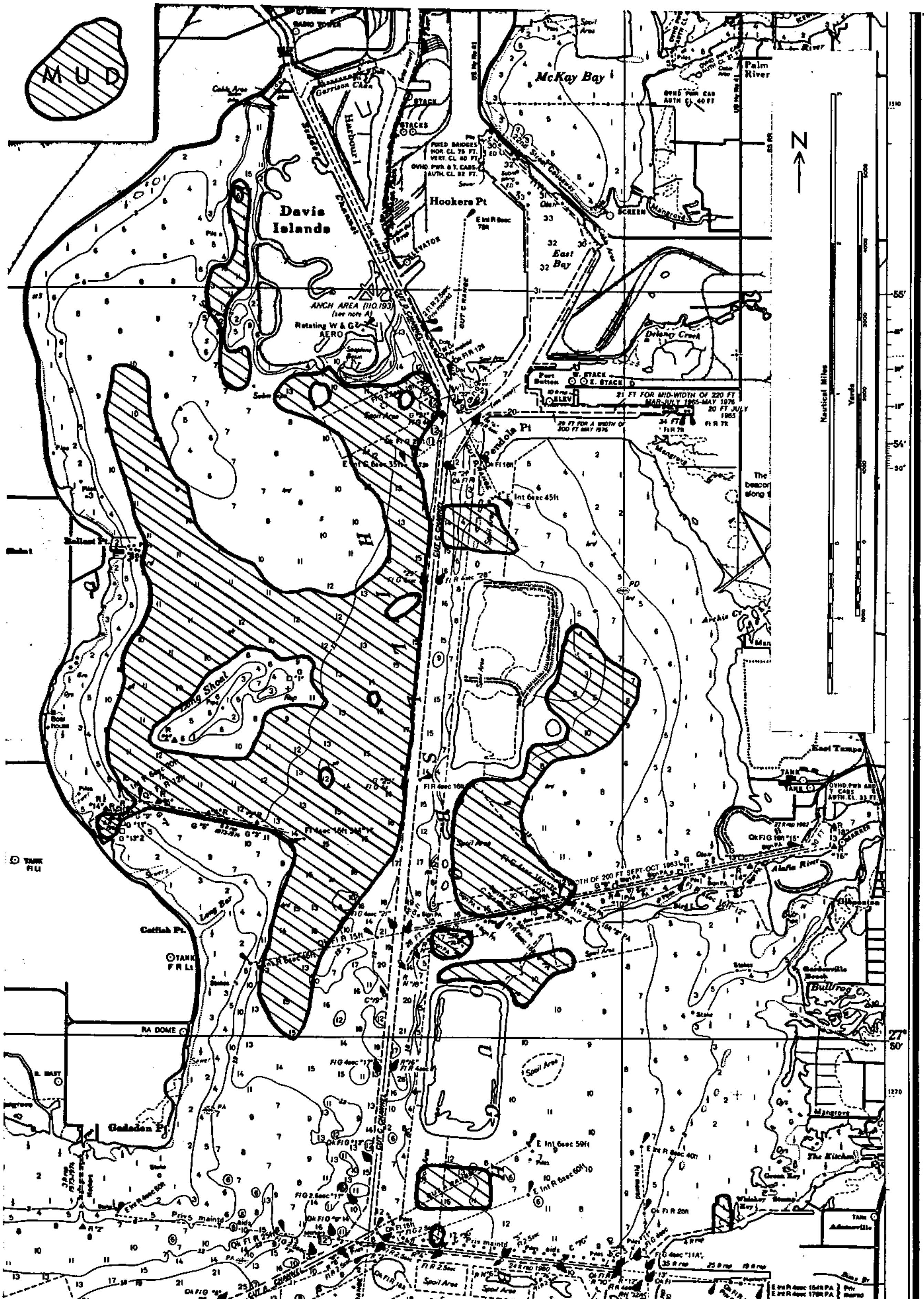

MUD
McKay Bay
Palm River
Davis Islands
Garrison Chan
Hookers Pt
East Bay
ANCH AREA (110.193)
Delaney Creek
Pendola Pt
Long Shoal
Ballast Pt
Long Bar
Catfish Pt
RA DOME
Gadsden Pt
East Tampa
Alafia River
Bullfrog Cr
Mangrove
The Kitchen
Spoil Area
N
Nautical Miles
Yards

Figure 4. Sediment sample station locations used by Doyle et. al. (1985) in Hillsborough Bay plotted on the City of Tampa sediment map showing areal coverage of "mud."

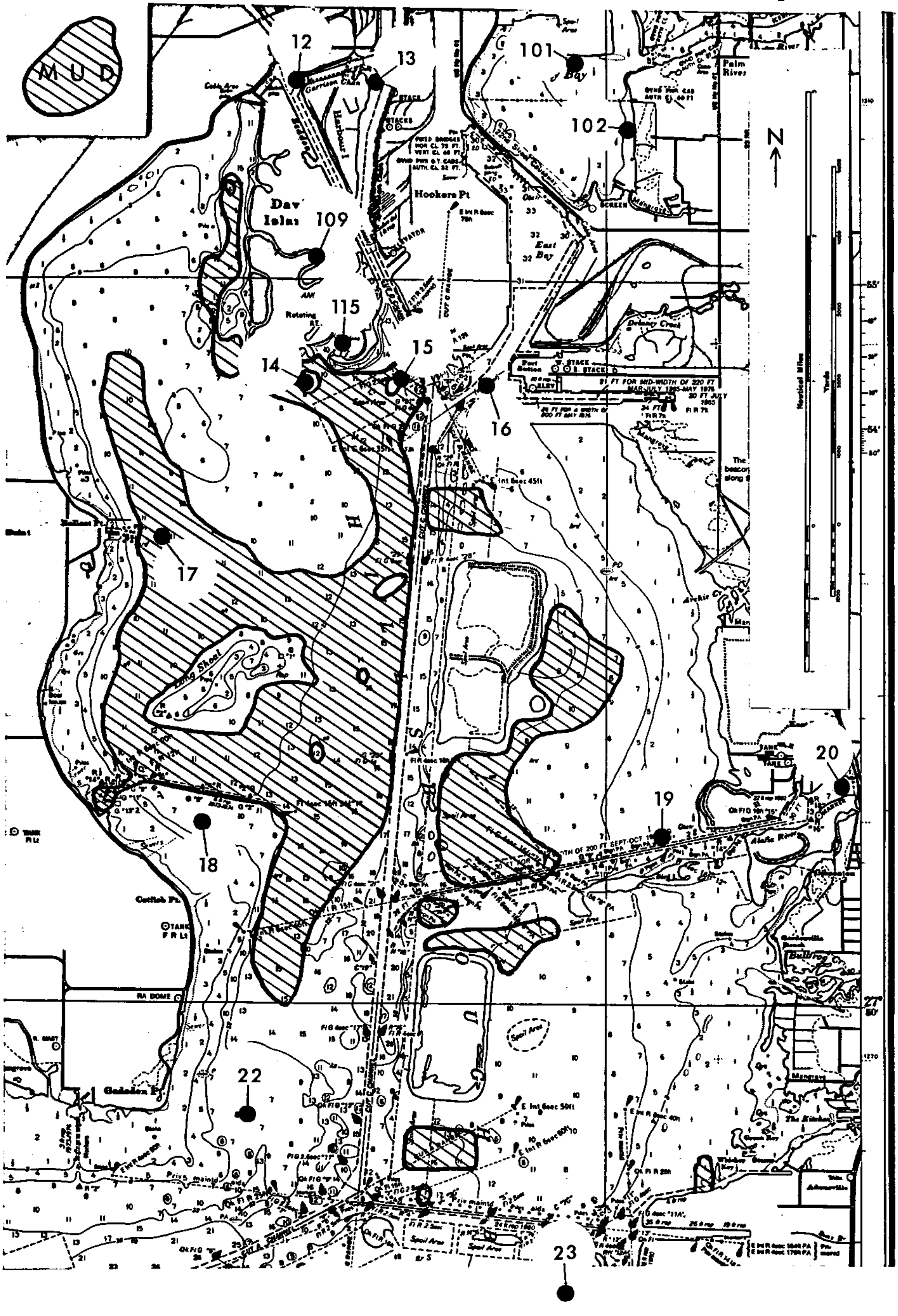

MUD
12
13
101
102
109
115
14
15
16
17
18
19
20
22
23
N
Hookers Pt
East Bay
Long Shoal
Catfish Pt.
Gadsden Pt.
Spoil Area
Nautical Miles
Yards

Table 2. Grain size of surface sediments in Hillsborough Bay, 1984 and 1985. Data taken from Doyle et. al. 1985.

Station*	Composition	
	% Sand (>63 μm)	% Mud (≤ 63 μm)
12	11.83	88.17
13	92.30	7.70
14	91.98	8.02
15	14.76	85.24
16	11.89	88.11
17	50.83	49.11
18	96.24	3.76
19	97.23	2.77
20	96.92	3.08
22	98.68	1.32
23	99.76	0.24
101	85.78	14.22
102	98.00	2.00
109	86.20	13.80
115	89.74	10.26

* See Figure 4

References

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