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Effect of CABIN CRUISER WASTE DISCHARGE on EATONS NECK, LONG ISLAND Harbor Waters

EATONS NECK HARBOR

LONG ISLAND, NEW YORK

EFFECT OF CABIN CRUISER WASTE DISCHARGE

on

EATONS NECK, LONG ISLAND HARBOR WATERS

R E P O R T

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ACKNOWLEDGEMENT

New York University College of Engineering, under the sponsorship of the Interstate Sanitation Commission has conducted a study of the effect of sewage pollution emanating from small boats while at anchor in the protected harbor of Eatons Neck, Long Island during the summer of 1953. This study could not have been conducted without the willing cooperation of the United Stated Coast Guard, and the New York State Department of Conservation. A grateful acknowledgement is made here for those services.

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C O N T E N T S

I L L U S T R A T I O N S

SUMMARY

Pleasure boating requires the presence of waters relatively free from pollution. The introduction of pollution into relatively pure waters can presage the abandonment of individuals and boating organizations using these waters. In addition to the aesthetic repulsion engendered in many individuals by the discharge of raw sewage into boating waters, pollution from small boats while in anchorage is one that can conceivably have an adverse effect on the bathing and shellfish raising qualities of these secluded harbor waters.

A survey to determine the effect of pollution from small boats was made at Eatons Neck Harbor, Long Island during the summer season 1953. Eatons Harbor is a small protected harbor with an approximate water area seven hundred feet wide and three thousand feet long. One thousand five hundred feet of the length is well sheltered behind a sand spit and serves as the principal area of overnight anchorage for cabin cruisers.

Boat concentrations of from twenty-two to fifty-eight were noted at the time of survey.

Eleven surveys were made on either Saturday or Sunday during the summer. One survey was made by the New York State Conservation Department before the season started. One was made mid-week and mid-season. The total number of weekend samples was three hundred and eighty-four. The total number of off-season samples was twenty-three.

Distribution analyses of samples according to tidal cycle show that one hundred sixty-one were taken below mid-tide, one hundred forty-three above mid-tide, and eighty at mid-tide. One hundred sixty-eight were taken at flooding-tide, one hundred sixty-eight on ebbing-tide, thirty-two during low slack and sixteen during high slack. Samples were taken at eight sampling station of which five were in the area normally occupied by boats at anchorage.

The number of samples obtained in off-season surveys is twenty-three - too few to use as an arbitrary base line for establishing a pollution index. However, some indication can be obtained concerning the effect of the boats by comparing results found at Stations 3 and 4 with those at other stations.

During the period of survey 53% of

these samples equaled or exceeded an MPN of 30 per 100 ml. At Station 3, the comparable frequency was 48%; at Station 4, 33%; at Station 5, 71%; at Station 6, 62%; at Station 7, 58%; at Station 8, 48%; and at Stations 1 and 2, 52%.

On the basis of the exploratory survey it appears that boats do have some effect on the harbor waters in which they are anchored. It may be described generally as spotty and related to the particular conditions of boat congestion near a sampling point, condition of tidal flow, and activity on the boats. Higher values were found after 9:00 A.M. at sampling stations closely associated with boat anchorage. Under low ebbing tide conditions, pollution levels were somewhat high and diminished on low flood tide as in-coming water circulated into the anchorage.

A maximum MPN/100 ml. at Stations 1, 2, 3, 4, 5; low tide; and time after 9:00 A.M. coincided on August 16th thus creating at these stations what appears to be the poorest tidal conditions for dispersion combined with much activity aboars boats. On that date there were not as many boats (36) in the harbor as on other dates (maximum 58).

Maximums were recorded at 7 of the 8 stations during the second tidal quarter (low ebbing to slack) and at all of the eight stations after 9:00 A.M. Seven maximum values were recorded in August, two in July and one in May. Maxima occurred three times at Station 3, twice at Station 4 and once at the remaining stations. Station 6 is roughly the central point of anchorage and it was consistently the station showing the greatest degree of pollution.

During the several surveys, toilet paper, feces, bits of food and food preparation wrappings and other debris traceable to boat activity were observed. To be sure, these items were not always seen, but presence of floating feces at any time in water used for swimming and covering the areas from which clams were taken at every low tide during the period of survey is not a condition to inspire confidence in the continuing safety of such water. Debris of boat origin was spotted seventy-five times during the period and on twenty-three occasions fecal matter, vaginal protective material or toilet paper were spotted in the debris.

RECOMMENDATIONS

As a result of the studies conducted in 1953, the following recommendations are offered:

(1) The Eatons Neck Harbor study of 1953 should be continued with the support of an adequate program of sampling at times when little or no pollution from cabin cruisers can occur.

(2) Other harbors in which small craft anchor should be studied on a limited basis.

(3) The tentative findings of the 1953 survey might be discussed with yacht club directors and with the manufacturers of cabin cruisers so that they may be thinking about possible measures for improving the methods of handling wastes while cruisers are at anchor.

THE PROBLEM OF CABIN CRUISER POLLUTION

Sheltered harbors suitable for overnight anchorage of boats of cabin cruiser size abound along the Atlantic Coast from Maine to Florida, along the Gulf Coast, and at many locations along the Pacific Coast. The Great Lakes and the Ohio, Mississippi and the Missouri Rivers with the tributaries also have such craft used for pleasure in summer months. Numerous inland lakes, such as Lake Tahoe, on the California-Nevada border and others of lesser size are used each summer by recreation-minded families.

In the jurisdiction of the Third Coast Guard District, there are 48,800 motor craft under five net tons.(1) It has been assumed that some 25,000 such craft are normally in waters of the Interstate Sanitation Commission jurisdiction.

Persons aboard these small craft normally discharge body waste, galley waste, and other debris into or upon the water on which the craft may be when in use. Such activity taking place while boats are at anchor for some period of hours or overnight constitutes a waste disposal practice that may be challenged on the grounds of potential sanitary hazard.

Specifically: does pollution from small craft, such as cabin cruisers, affect the waters of sheltered harbors and the use of those waters for such purposes as bathing, shellfish culture, or related water use?

POSSIBLE EFFECTS

Cabin cruisers may provide sleeping accomodations for from one to five persons and occasionally extra persons may occupy the craft for short periods of time. A conservative estimate of the normal boat population may be taken as three when in recreational use. Discharges are fresh and pathogenic organisms present in those discharges are viable. The only protection afforded is that offered by dispersion and dilution in the receiving waters.

BATHING

From a public health view point, bathers entering water containing freshly discharged pathogens may be exposed to any of the intestinal diseases normally transmitted directly by fecal discharge. In salt waters, the accidental swallowing of large quantities is exceptional, but approximately 50 ml. may be taken into the mouth and expelled again as a normal practice. Some small portion remains within the body and,

during the course of a swim, several such portions may enter the alimentary canal and the intestinal tract. Drinking water standards presume that waters with a coliform MPN of more than 5/100 ml. are unsafe for drinking. If, during the course of a day, a person drinks 1 liter of water, he would have imbibed 50 coliforms. Hence, it may be advanced that in the ingestion of freshly contaminated water while bathing a probable concentration of 50 coliforms would represent a hazard of equal proportion. A probable concentration of 50 in a mouthful of water would be 1 per ml. It is then reasonable to assume that bathing waters having an MPN/100 ml. of 100 or more are to be viewed with suspicion. Some standards consider that MPN's of more than 50/100 ml. indicates doubtful bathing water quality.

SHELLFISH CULTURE

Pollution standards for water over shellfish beds have been established by the Public Health Service, by the New York State Department of Conservation and by the New York State Water Pollution Control Board. Such standards apply to the waters of Eatons Neck Harbor. The United States Public Health Service Standards are as

follows:

Section 2.3 "APPROVED SHELLFISH AREAS. Approved shellfish areas shall satisfy the following conditions:

"The sanitary survey shall disclose no likelihood that human fecal discharges reach the area in dangerous concentrations or before sufficient time has elapsed to render such discharges innocuous,

"The median bacteriological content of samples of water collected from those portions of the area determined by sanitary survey to be most probably exposed to fecal contamination shall not show the presence of organisms of the coliform group in excess of 70/100 ml. of water expressed in terms of most probable numbers (MPN) in a series of samples from each station sufficient to determine the conditions existing."

Section 2.4 "GROSSLY POLLUTED CLOSED AREAS. If the sanitary survey discloses that the area is either obviously subject to gross pollution by direct discharge of sewage and other wastes, or demonstrably exposed more or less continuously to even slight direct contamination with human fecal discharges from nearby sources ashore, or if an area usually of good quality, is exposed to occasional direct and immediate contamination with human fecal discharges, or if bacteriological examinations indicate that the degree of contamination is greater than that tolerated for moderately polluted areas, then such area may be declared to be a grossly polluted area from which the taking of shellfish for market purposes shall not be permitted."

Section 2.5 "MODERATELY POLLUTED RESTRICTED AREAS. After making sanitary and bacteriological surveys as described in Sec. 2.1, p.4, the area may be declared to be a moderately polluted restricted area if it is shown that:

(1) The area is intermediate between approved and grossly polluted areas as regards exposure to and protection against

fecal pollution.

"(2) The bacteriological survey discloses that the median bacteriological content of the water expressed in terms of the most probable number (MPN) of coliform organisms per 100 ml. lies between 70 and 700.

"(3) The sanitary survey shows that such contamination is probably of human origin."

The New York State Conservation Department Standards are the same as the United States Public Health Standards. The New York State Water Pollution Control Board has adopted the following standard for Class SB Salt Water.

Class SB

Best usage of Waters: Bathing and any other usages except shellfishing for market purposes.

Quality Standards for Class SB Waters

Items	Specifications
1. Floating solids; settleable solids; oil; sludge deposits.	None attributable to sewage, industrial wastes or other wastes.
2. Garbage, cinders, ashes, oils, or other refuse.	None in any waters of the Marine District as defined by State Conservation Law.
3. Sewage or waste effluents.	None which are not effectively disinfected.
4. Dissolved oxygen.	Not less than 5.0 parts per million.
5. Toxic wastes, deleterious substances, colored or other wastes or heated liquids.	None alone or in combination with other substances or wastes in sufficient amounts or at such temperatures as to be injurious to edible fish or shellfish or the culture or propogation thereof, or which in any manner shall

adversely affect the flavor, color, odor or sanitary condition thereof; and otherwise none in sufficient amounts to make the waters unsafe or unsuitable for bathing or impair the waters for any other best usage as determined for the specific waters which are assigned to this class.

AESTHETICS

Water used for recreational purposes should be reasonably free of floating solids such as garbage. Any visible evidence of fecal discharge or of vaginal protection is obnoxious and suggestive of foul water. One does not react favorably to bathing in such water or even to using it for cleaning purposes.

Oil and grease laden waters are of course objectionable for swimming or cleaning and mar the paint of recreational craft.

EFFORTS TO CONTROL POLLUTION BY SMALL CRAFT

Publications dealing specifically with the small craft problem and control of pollution caused by such craft are few in number. Occasionally, one finds reference to allied situations in publications dealing with water pollution and its effect on beaches, shellfish, harbors and bays. Although not of too great specific value, some of these are cited by title in the reference section (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12).

A direct canvass of pollution control agencies has been of much greater value in assessing the status of control at the present time.

Twenty-six State Health Departments, eight Municipal Health Departments, seven Water Pollution Control Units, four University Professors, the Tennessee Valley Authority and the United States Public Health Service Environmental Health Center, and the Division of Medical Sciences of the National Research Council were canvassed on the issue. Replies were received from twenty-three of the State Health Departments and from twenty-one of the balance. Additional letters were also sent concerning the present study. In all, eleven correspondents reported positive information.

California - Nevada

In California, a study of San Diego Bay is in progress. The Water Pollution Control Board, Region 6, contemplates action to prohibit the discharge of wastes any place on Lake Tahoe since shore resorts and cabins have water intakes immediately off-shore. The Nevada State Health Department has forced one large recreational boat to install water tight storage tanks for all wastes. The tanks are emptied to shore installations under Health Department supervision. Los Angeles City Health Department makes harbor inspections of

eleven yachts and small boat anchorages. A survey made June 29, 1953 is appended. (Appendix A)

District of Columbia

The District of Columbia Health Department has made no quantitative surveys, but has made observations of the floating evidence of boat pollution and has prepared regulations, not yet adopted, that would require the deposition of boat wastes on shore in suitable places.

Maine

The State of Maine has made numerous investigations of the pollution of harbor waters,(13) but none of the work has been directed to the specific effect of cabin cruiser pollution. Standards used for closing an area of salt water were based on MPN of coliforms. For clam digging, water exceeding 70/100 ml. is considered unsafe. For bathing water in which any single sample exceeds 1000/100 ml. the water is immediately subject to re-sampling and the area is closed wherever any single sample shows 3000 or more.

Maryland

The Maryland State Health Department Division of Sanitary Engineering, in 1949, studied the effects of pollution from discharges of pleasure boats in Chesapeake Bay and its tributaries. A circular letter was sent to all State Sanitary Engineers

by George L. Hall, Chief Sanitary Engineer. The information he received was then summarized and that survey is attached as Appendix B. At that time, 20 states considered that sewage discharge from small boats constituted no pollution problem. States that had considered the problem offered 4 recommended measures for control.

1. The use of chemical toilets with disposal of contents in properly maintained pits at least 50-feet from the waterline on shore.

2. Suitable water-tight tanks on boats for receiving solid and liquid waste materials for disposal at other points.

3. Sanitary equipment on boats must be approved at time of boat registration and meet proper specifications.

4. Restriction of use of areas (shellfish) by operators of boats.

Maryland has enlisted the voluntary cooperation of all yacht clubs by discussion of the problem with club members, and by a one-page circular sent with the endorsement of each yacht club's Board of Governors appealing to individual members.

North Carolina

The State Stream Sanitation Committee of North Carolina is presently engaged in a survey of waters around Morehead City. The survey will include the pollution from pleasure craft plying the inland waterway as well as that from other sources.

New Jersey

New Jersey Health Department has some regulatory control of the pleasure craft, however, the control effect at present is confined to the posting of signs inside cabin cruisers. These signs call attention to the need for cooperation in protecting beaches and shellfish.

New York

A local ordinance in Mamaroneck Harbor, Westchester County, prohibits the use of toilet facilities on any boat and prohibits the discharge of refuse or offensive wastes to the harbor waters. Nassau County, Long Island, has had the benefit of some local press editorials calling attention to pollution by small boats and the need for keeping Long Island waters clean.

Oregon

Pollution of harbors with house-boat discharge is a recognized problem, but the differentiation of that pollution effect from that of other sources has not been possible.

South Carolina

Seasonal traffic of pleasure craft on the inter-coastal waterways creates a potential hazard, however, no specific attempt has been made to evaluate that hazard. Waterways, surveyed in connection with shellfish control have shown that heavy fall

and spring traffic may pollute areas that ordinarily are relatively free of contamination.

United States Public Health Service - Lake Michigan Survey.

In 1948, as part of a Tri-State Survey, (14) a study was made at the entrance of each of the small boat harbors along the Chicago Lake front. A portion of correspondence relative to the study is quoted:

> "During this study we took about 35 samples at the entrance of each of the small boat harbors along the Chicago lake front. In general, very little pollution was found in these harbor entrances. Occasionally coliform most probable numbers in excess of 1100 per 100 ml. were determined, but in no location were MPN's in excess of 240 per 100 ml. found in more than 30 percent of the samples.
>
> It should be noted, however, that people did not stay overnight on any of the cabin cruisers in these harbors. The boats are used for daytime trips only and are tied up to individual slips or at moorings leased from the Chicago Park District. Toilet facilities are provided at the yacht clubs or in comfort stations of the Park District."

A STUDY OF EATONS NECK HARBOR

SELECTION OF SITE

Requirements for the harbor to be studied in this survey were:

1. That it be relatively free of external sources of pollution.
2. That it be reasonably well confined so that samples could be taken by small boats at selected sampling locations within a reasonable time period.
3. That it be used by cabin cruisers consistently and in some concentration throughout the summer season.
4. That it be a location where boats would be at anchor with persons aboard for some period of hours.

After examination of several possible areas, Eatons Neck Harbor was selected as the most nearly suitable available site.

THE HARBOR

Eatons Neck Harbor is a small spit protected body of water at N 40° 57' W 73° 24' on Long Island Sound. The only habitation at the Harbor is a United States Coast Guard Station. The surrounding land is in estates. One small tidal arm enters the harbor opposite open water of Huntington Bay and the Sound.

Coast Guard boats are anchored at docks at the closed end of the harbor. All sewage of the Coast Guard Station is treated in septic tanks and effluent is discharged into sands of beach area on the Sound. There was no observable direct discharge of sewage from any source other than boats. Figure 1 shows the harbor configuration, installations and other data pertinent to the present study.

The harbor is within easy cruising distance of many yacht harbors in the New York Metropolitan Area and the Connecticut shore. The distance from the Battery in New York is about 35 miles and from Stamford, Connecticut, about 9 miles.

The tidal range in the harbor is about six feet over a 12-1/2 hour cycle. At periods of low tide, clam beds on the reefs, adjacent Station 3, 4 and 8 are exposed. The shore line from Station 7 around the spit to Station 5 is sand and gravel and lends itself to recreational usage. Bathing from boats at anchor and from the beach is commonplace.

SURVEY METHODS

Two main sampling courses were established for the harbor; one on either side of the harbor center line. Stations 1, 2, 3, and 4 are on Course A. Stations 5, 6, 7 and 8 are on Course B (See

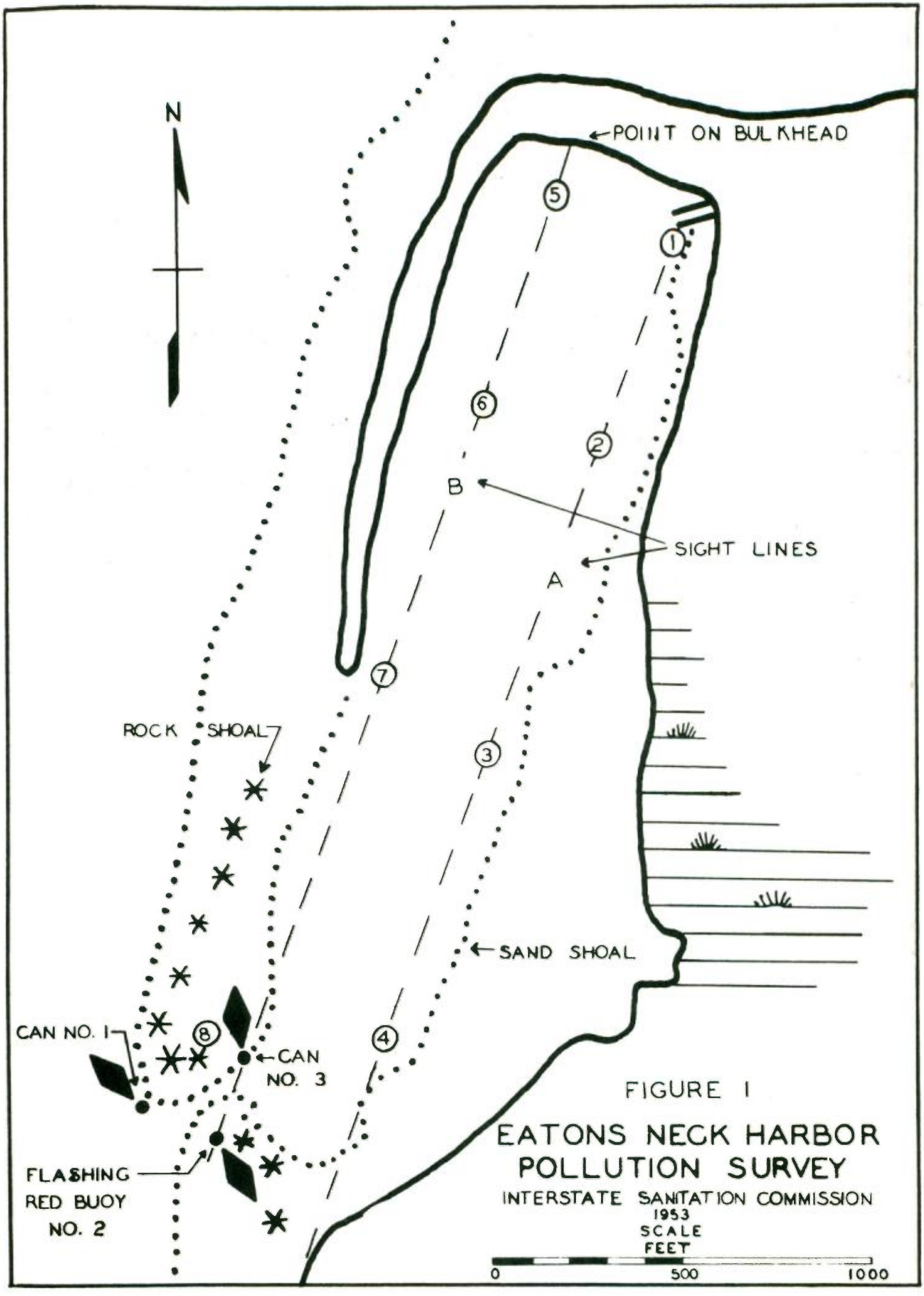


FIGURE 1

EATONS NECK HARBOR POLLUTION SURVEY

INTERSTATE SANITATION COMMISSION

1953

SCALE FEET

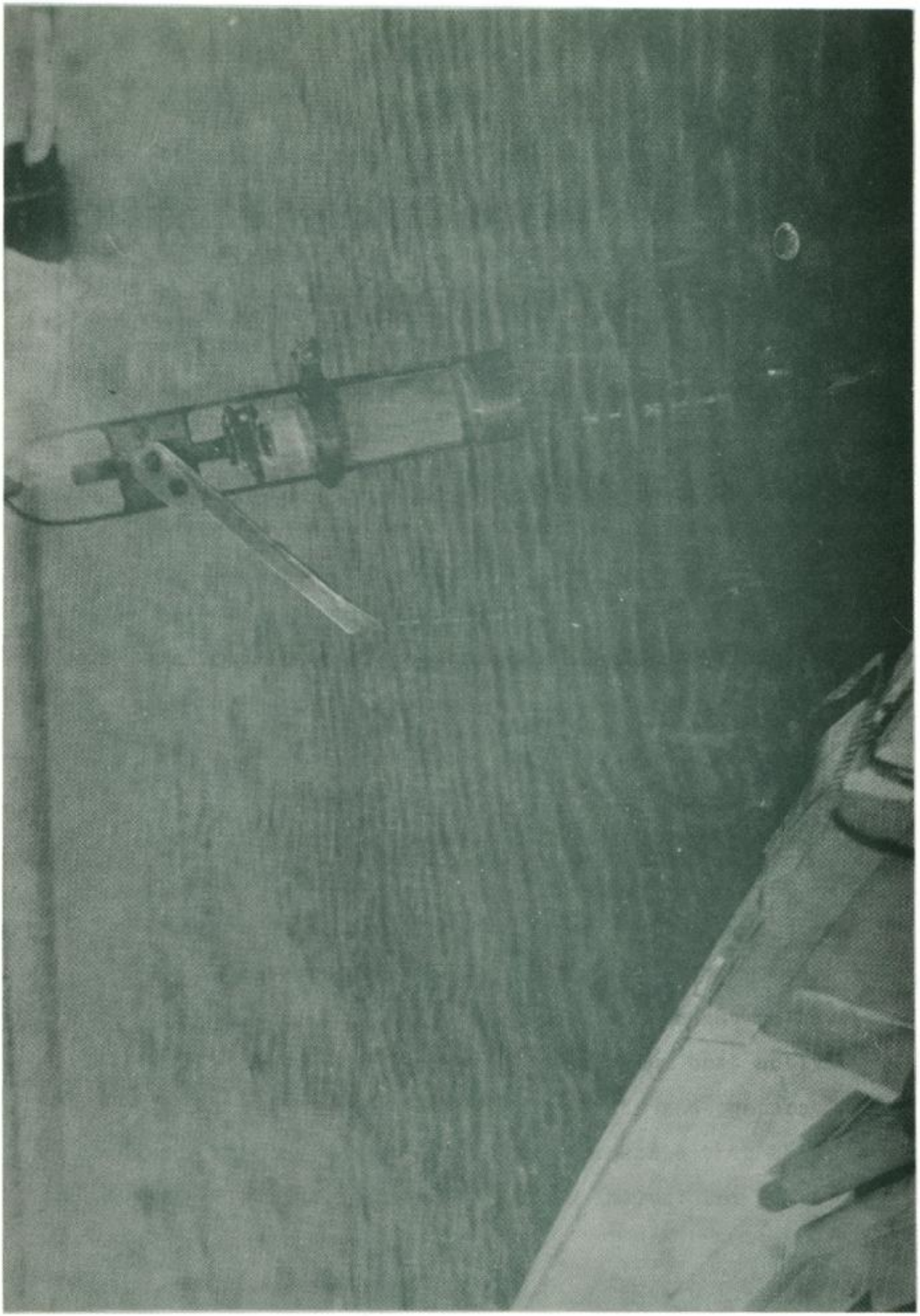
Figure 1). Stations 1, 2, 5, 6, 7, cross-section the protected area of harbor and cover the area of principle anchorage for small craft. Station 1 should reflect the effect of the Coast Guard Anchorage. Stations 3 and 4 are adjacent to the clam beds and straddle the small tidal swamp. Station 8 is just inside the harbor channel and is representative of water over another clam bed. The harbor is comparatively shallow (Maximum depth at low tide USC & GS Datum 21 feet). The surface area of the harbor is estimated at 48 acres. The approximate tidal Prism Volume is 12,000,000 cubic feet. The approximate basin volume is 225,000,000 gallons.

Samples for bacteriological analyses were taken with an underwater bacteriological sampler at five feet depth (See photograph 1). Samples were stored in an iced container until delivered at the laboratory. All samples were analyzed according to Standard Methods of Analyses using a series of 3 tubes each at dilutions of 1.0, 0.1, and 0.01 ml. in Lactose Broth. All positive tubes were confirmed in Brilliant Green Bile transplants incubated 24 hours. A detailed description of methods used is attached as Appendix C.

Field data were taken on each run. Runs usually required 10 to 15 minutes to complete. All sampling was done by boat. A sample of the field

data sheet is included as Appendix D. The more important data recorded for each station included: time of sampling, air temperature, wind direction and velocity, weather, tide, presence of floating solids, and water temperature. Boat census, notable facts about appearance and character of water, use of water, use of shore, and activity aboard boats were noted during each period of survey. During the summer, small craft cruise in on Friday night and Saturday. The craft remain at anchor until some time on Sunday. A few boats are entering and leaving over the period, but the outward movement becomes significant after mid-morning on Sunday. In order to have reasonable stable population of boats, most of the surveys were made on Sunday morning.

A second important point considered was that of boat activity. There are always a few early risers. Therefore, it was considered important to have at least one run of a survey period conducted while there was no boat activity (i.e. at or near dawn). It was considered equally important to have the survey cover the period of maximum boat activity (i.e. the time of rising, breakfast, and preparation for the day's events). It was probable that the time from dawn to 10 A.M. would include the major portion of such activity.



Since the surveys were to be made over the summer season, it was apparent that a satisfactory distribution of sampling over the tidal cycle would result if runs were made over a time approximating one-half cycle during the same time of day each week-end.

It was concluded that a series of surveys made from May 30, 1953 through September 6, 1953 would:

1. Span various conditions of tidal movement.
2. Encompass both non-activity and activity aboard boats.
3. Include a fair representation of shore and water use. (Swimming, boating, shellfish gathering, etc).
4. Cross-section weather conditions (heat, cold, wind, storm, sunlight and cloudiness).
5. Cross-section the random choice of the harbor as a week-end anchorage.

Eleven surveys were made between the hours of dawn and 9 to 10 A.M. on week-ends. Three holidays were included in the study.

The Conservation Department of New York State provided a series of three runs to establish some information about the harbor under conditions of non-use by small pleasure craft. The first was made in early May, the second on July 7, following the holiday and the third in October approximately one month after

the cessation of pleasure craft movement.

POLLUTION OBSERVED IN EATONS NECK HARBOR

SURVEY RESULTS, CONSERVATION DEPARTMENT

Twenty-three samples were collected in 3 runs made May 12, July 7 and October 26, 1953. A maximum MPN/100 ml. of 1100 was found in one sample taken at Station 6 on May 12. The second highest MPN of 240 was found in one sample taken at Station 1 on July 7th. The third highest sample having an MPN/100 ml. of 93 was taken at Station 1 on October 26th. The balance (87%) of the samples indicated that water at other times was well within the bacteriological limits for shellfish water (less than 70 MPN/100 ml.) The mean MPN/100 ml. was 77, the mode was 23 and the median group MPN/100 ml. was 23. All mean values given in this report are calculated by using a value of zero for all counts less than 0.30/ml. The mean value recorded is therefore a minimum or lower limiting value. The data from the Conservation Department's sampling are to be found in Tables 1 and 2.

SURVEY RESULTS - WEEK-END SURVEYS

A total of 384 samples was collected at 8 sampling stations during 11 survey periods. Table 3 summarizes the bacteriological data in tabular form. Figure 2 indicates by station the maximum,

TABLE 1

CHEMICAL POLLUTION SURVEY
Eatons Neck Harbor
1953

New York State Conservation Department Surveys

Coliform Density

Date	Day	MPN/ml Station 1	2	3	4	5	6	7	8	Tidal Condition Time after High Tide Hours and Minutes	
12 May	Tues.	0.091	0.023*	0.23	0.23	-	11.00	0.23	0.23	0:18	High Slack
7 July	Tues.	2.40	0.43	0.23	0.091	0.036	0.03	0.091	0.023*	1:20	High Ebb
26 Oct.	Mon.	0.93	0.39	0.23	0.091	0.43	0.23	0.23	0.23	10:39	High Flood
Average		1.14	0.281*	0.23	0.103	0.233	3.75	0.184	0.23*		

* Less than the value shown

TABLE 2

CABIN CRUISER POLLUTION SURVEY
Eatons Neck Harbor
1953

Distribution of Coliform Density

Samples			
MPN/100 ml.	No.	P	Characteristics
2.3*	2	100.0	
3.0	1	91.3	
3.6	1	87.0	
9.1	4	82.6	
23.	9	65.2	Median Group, Mode
39.	1	26.1	
43.	2	21.7	
93.	1	13.0	
240.	1	8.7	
1100.	1	4.4	
Total	23		Mean = 77

* Less than the value shown

P Percent of samples equal to or greater than the value shown.

TABLE 3

CABLE CABLEAN POLLUTION SURVEY
Eatons Neck Harbor
1953

Summary of Bacteriological Studies

Coliform MPN/ml.

Date	Run Beginning	Station 1	2	3	4	5	6	7	8
5-30-53	06:43	0.36	*	0.91	0.36	0.73	*	*	0.36
6-28-53	05:45	0.73	*	*	*	*	*	0.30	*
	07:20	*	*	*	*	*	0.36	*	*
	07:48	*	*	0.30	0.30	*	*	*	*
	08:53	0.36	*	*	0.30	0.72	0.73	0.73	*
	09:31	*	*	0.30	*	0.30	1.50	1.10	*
6-4-53	06:12	*	0.30	0.36	*	0.36	0.36	0.36	*
	07:17	*	*	*	*	0.36	*	0.36	0.91
	07:46	0.36	*	0.36	0.36	0.91	21.00	*	0.36
	08:38	1.50	0.91	0.36	*	0.36	.91	*	0.36
	09:15	0.91	*	*	*	*	2.30	2.30	*
7-19-53	05:53	*	*	0.36	*	0.36	*	0.36	*
	06:26	*	*	*	*	0.91	0.91	0.36	0.36
	07:36	*	*	*	*	*	0.91	*	*
	08:11	*	*	0.36	*	0.36	*	0.36	0.36
	08:57	*	*	*	*	*	*	0.72	0.36
7-26-53	06:12	0.91	0.36	0.36	0.36	0.30	*	0.36	0.91
	06:39	0.36	0.36	0.36	*	0.91	0.36	0.36	0.36
	07:39	*	0.36	*	0.36	0.30	*	*	*
	08:50	*	2.30	0.36	*	0.36	*	*	0.36
	09:12	0.36	*	*	*	0.91	24.00	*	*

TABLE 3 (continued)

Summary of Bacteriological Studies

Coliform MPN/ml.

Date	Run Beginning	Station 1	2	3	4	5	6	7	8
8-2-53	06:54	0.36	*	0.36	0.36	*	0.36	*	*
	07:18	*	0.91	0.91	*	0.36	0.73	*	0.36
	07:15	0.36	*	*	*	*	*	0.30	0.36
	08:54	*	*	0.36	0.36	0.36	4.30	0.30	4.30
	10:12	*	0.36	0.36	0.36	0.36	1.50	0.36	*
8-9-53	06:47	*	*	*	*	0.36	*	*	*
	07:41	*	0.36	*	*	*	*	*	*
	09:25	*	*	*	*	2.30	2.30	0.36	*
	10:12	0.36	0.36	*	*	0.36	0.91	0.36	*
	10:41	*	*	*	*	*	0.36	0.36	*
8-16-53	06:45	0.91	*	0.36	*	0.36	0.36	*	*
	08:22	*	*	0.36	*	2.30	4.30	0.73	2.30
	09:22	9:30	0.36	0.91	0.91	0.36	2.30	0.36	*
	09:52	2.30	0.91	*	*	9.30	9.30	0.73	0.36
	10:31	4.30	9.30	*	0.36	0.73	4.30	*	*
8-23-53	06:17	*	0.36	0.36	*	0.73	0.91	0.91	0.36
	06:55	0.36	0.73	*	0.36	0.91	*	0.36	0.30
	07:46	0.91	1.50	*	*	0.36	*	0.36	*
	08:17	0.91	0.36	*	0.36	0.91	0.36	0.91	*
	08:52	0.91	0.36	0.36	*	0.91	4.30	*	0.36
8-30-53	06:36	0.30	0.36	*	0.91	0.73	*	*	*
	07:40	0.91	0.36	*	*	*	*	0.36	0.36
	08:18	0.73	0.91	0.36	0.36	*	*	*	0.36

TABLE 3 (continued)

Summary of Bacteriological Studies

Coliform M.P.N./ml.

Date	Run Beginning	Station 1	2	3	4	5	6	7	8
9-30-53 (cont.)	09:19	0.36	0.91	*	*	0.36	2.30	*	0.36
	09:46	*	0.36	*	0.36	0.36	2.30	0.91	*
9-6-53	07:02	0.36	0.36	0.36	*	*	0.91	0.36	2.30
	07:40	*	0.36	0.36	*	*	0.36	*	0.36

* Less than 0.30

mean, mode and median MPN grouping found during the season.

A study of these data according to station frequency distribution (Table 4) shows quickly that Stations 3 and 4 are not subject to excessive pollution whereas Station 6 is. The majority of all samples taken at Stations 3 and 4 have an MPN/100 ml. of less than 30 whereas 62% of samples at Station 6 are equal to or greater than 36/100 ml., the median group MPN for the entire basin. 20% of all samples taken had an MPN/100 ml. equal to or greater than 72/100 ml. (i.e. they were above the allowable MPN for approved shellfish waters). (15) (16) Stations 1, 2, 5, 6 and 7 indicated pollution levels that were border line in that they equalled or exceeded an MPN of 36/100 ml. in 50% of the samples taken.

BOAT ACTIVITY

In order to examine the effect of boat activity the sampling has been divided into four time periods.

1. Early morning - first run.
2. 7 to 8 A.M.
3. 8 to 9 A.M.
4. After 9 A.M.

Table 5 summarizes the information found before 7 A.M. and after 9 A.M. respectively with respect to

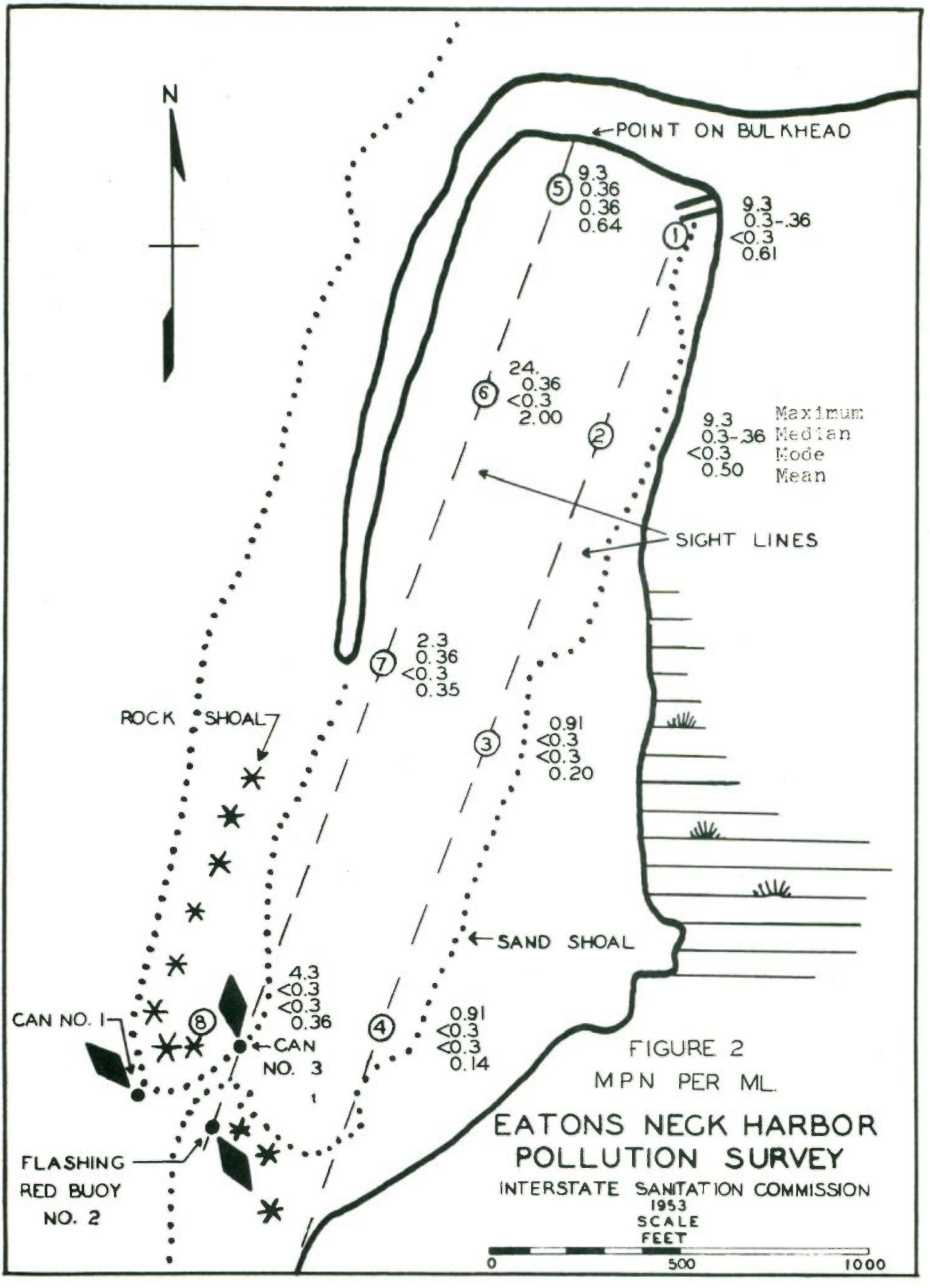

N
POINT ON BULKHEAD
5
9.3
0.36
0.36
0.64
1
9.3
0.3-.36
<0.3
0.61
6
24.
0.36
<0.3
2.00
2
9.3 Maximum
0.3-.36 Median
<0.3 Mode
0.50 Mean
SIGHT LINES
7
2.3
0.36
<0.3
0.35
ROCK SHOAL
3
0.91
<0.3
<0.3
0.20
SAND SHOAL
CAN NO. 1
8
4.3
<0.3
<0.3
0.36
CAN NO. 3
4
0.91
<0.3
<0.3
0.14
FLASHING RED BUOY NO. 2
FIGURE 2
MPN PER ML.
EATONS NECK HARBOR
POLLUTION SURVEY
INTERSTATE SANITATION COMMISSION
1953
SCALE
FEET
0
500
1000

TABLE 4

CABIN CRUISER POLLUTION SURVEY
Eatons Neck harbor
1953

MPN Frequency by Station

	Samples																	
	1		2		3		4		5		6		7		8		Total	Basin
MPN	No.	P	No.	P	No.	P	No.	P	No.	P	No.	P	No.	P	No.	P	No.	P
0.30*	23	100	23	100	25	100	32	100	14	100	18	100	20	100	25	100	180	100
0.30	1	52	1	52	2	48	2	33	3	71			3	58	1	48	13	53
0.36	11	50	15	50	18	44	12	29	16	65	8	63	16	52	17	46	113	50
0.72									1	31			1	19			2	20
0.73	2	27	1	19					4	29	2	46	3	17			12	20
0.91	7	23	5	17	3	6	2	4	7	21	6	42	3	10	2	10	35	17
1.10													1	4			1	8
1.50	1	8	1	6							2	29					4	7
2.30	1	6	1	4					2	6	5	25	1	2	2	6	12	6
4.30	1	4									4	15			1	2	6	3
9.30	1	2	1	2					1	2	1	6					4	2
21.00											1	4					1	1
24.00											1	2					1	0
Total	48		48		48		48		48		48		48		48		384	
Mean**	0.61		0.50		0.20		0.14		0.64		2.00		0.35		0.36		0.597	

* Less than the value shown

P Percent of samples equal to or greater than the value shown

** The means in this table and all subsequent mean values are computed on the basis of assuming a zero value for all counts less than 0.30/ml.

TABLE 5

C.A.I.A. CRUISER POLLUTION SURVEY
Eatons Neck Harbor
1953

Comparison of Pollution Intensity

For Periods of Boat Activity

Percent of Samples Equal to or Greater than MPN 36/100ml.

Period	Station 1	2	3	4	5	6	7	8	Total
Early morning	55	36	73	36	64	45	45	36	48.9
07:00 to 08:00	27	54	27	18	36	45	27	45	35.2
08:00 to 09:00	55	55	64	27	73	55	45	82	55.7
After 09:00	58	58	17	33	75	100	75	17	54.2

Percent of Samples Equal to or Greater than MPN 230/100 ml.

Early morning	0	0	0	0	0	0	0	9	1.1
07:00 to 08:00	0	0	0	0	0	9	0	0	1.1
08:00 to 09:00	0	9	0	0	9	0	0	18	8.0
After 09:00	25	0	0	0	17	67	8	0	15.6

	Percent of Samples Equal to the Maximum MPN									Max. MPN/100ml
Early morning	0	0	0	0	0	0	0	9	1.1	230
07:00 to 08:00	0	0	0	0	0	9	0	0	1.1	2100
08:00 to 09:00	0	0	0	0	0	27	0	9	4.5	430
After 09:00	0	0	0	0	0	8	0	0	1.0	2400

Mean MPN/100 ml.**

Early morning	36	16	31	18	35	26	24	36	28
07:00 to 08:00	20	35	17	9	21	212	10	21	43
08:00 to 09:00	43	44	23	13	57	135	40	83	54
After 09:00	149	105	13	17	128	144	57	6	115

** See Note Table 4

boat activity. Figures 3 and 4 demonstrate conditions at Station 6, 100 % of samples taken after 9 A.M. were equal to or greater than 36/100 ml. MPN. Using 50% as a base the greater periods of pollution were found at Station 1 in the early morning and from 7 A.M., at Station 2 from 7 A.M., at Station 3 in the early morning and again from 8 to 9 A.M. At Station 4 there was little difference except that from 7 to 8 A.M., a lesser percent of samples showed that degree of coliform density. Pollution at Station 5 was greater in the early morning and after 8 A.M. Station 6 became worse after 8 A.M. At Station 7 after 9 A.M. 75% of the samples equalled or exceeded 36/100 ml. and at Station 8, 82% of samples taken between 8 and 9 A.M. were likewise.

The mean MPN/100 ml. for all stations increased with the lapse of time. It was 28, 43, 54 and 115 for the four periods. The mean exceeded 70/100 ml. at Stations 1, 2 and 5 after 9 A.M., at Station 6 after 7 A.M. and at Station 8 between 8 and 9 A.M.

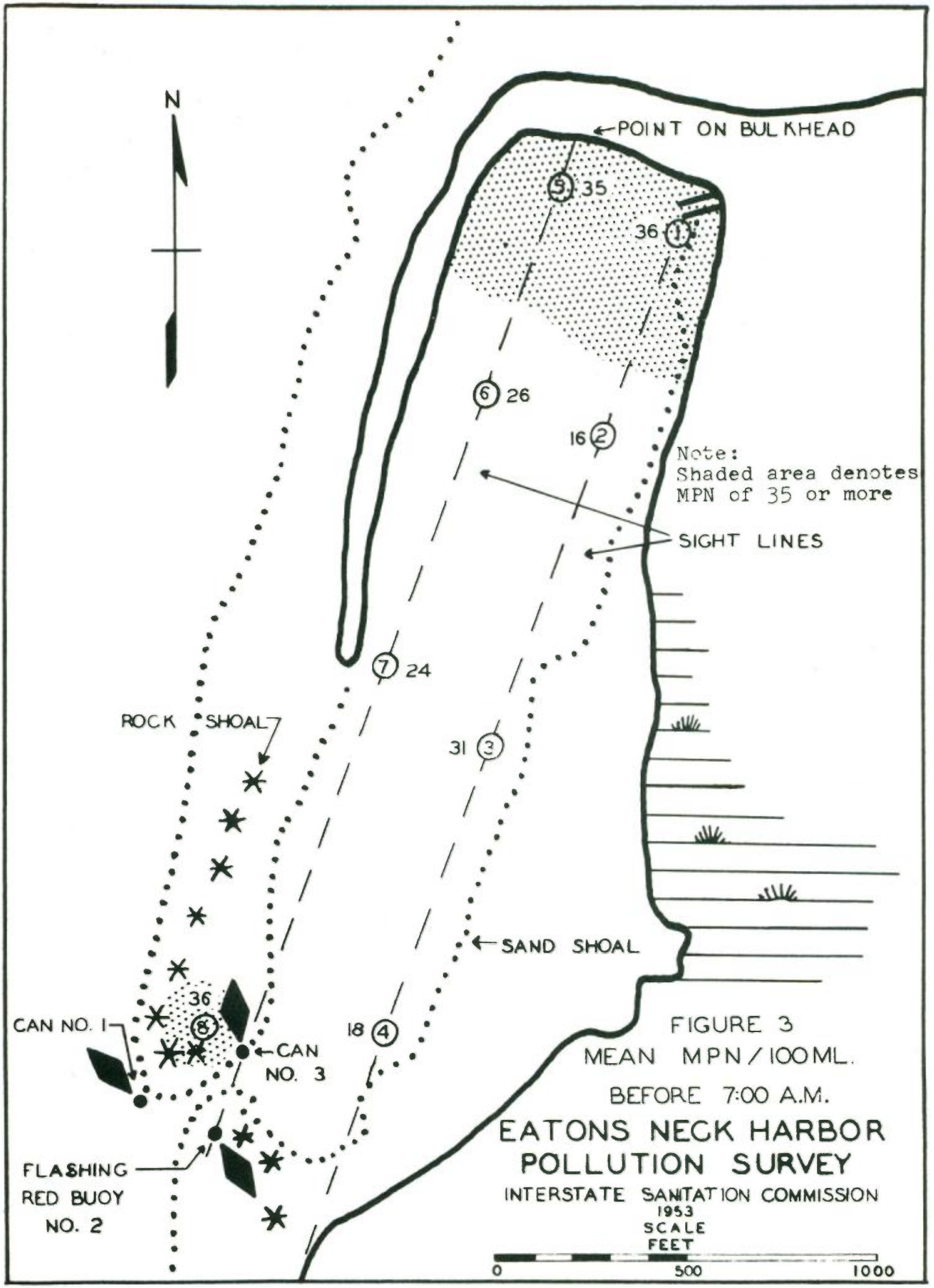
Station 6 is the only station that gave positive samples (12 taken on 7 different days) on all runs made after 9 A.M. The maximum MPN/100 ml. occurred at this station after 9 A.M. during a mid-flood tide. Five boats were clustered about the station and a woman was rinsing laundry on one of the boats. Station 6 is roughly the central station in the anchorage area. It

appears that concentration of boats and boat activity do have some measurable effect on the coliform density in the water.

TIDAL MOVEMENT

A division of samples according to tidal cycle has been made in order to examine the relationship that might exist. The division of tidal quarters was as follows: High Ebbing, Low Ebbing, Low Flooding and High Flooding. The relationships comparable to those for boat activity are expressed in Table 6. Figures 5 and 6 show the conditions for Low Flooding and Low Ebbing tide. 61.5% of all samples taken on low ebbing tide are equal to or greater than 36 MPN/100 ml. According to that standard, high flooding was next with 50%, high ebbing with 46.2% and low flooding with 43.3% to follow.

At individual stations the greatest percentage of samples equal to or greater than 36/100 ml. is in the following order: 1, 2, 3, 4, Low Ebbing; 5, 6, 7, High Flooding; 8, High Ebbing. It is interesting to note that Stations 4 and 8 were affected very little during high flooding tide. Maximum tidal quarter MPN's were recorded for Stations 1, 2, 5, 6, during low ebbing tide, for Station 6 during high ebbing tide, for Station 8 during low flooding tide, and for Station 6 during high flooding tide.


N
POINT ON BULKHEAD
9 35
36 1
6 26
16 2
Note:
Shaded area denotes
MPN of 35 or more
SIGHT LINES
7 24
ROCK SHOAL
31 3
SAND SHOAL
36
8
CAN NO. 1
18 4
CAN
NO. 3
FLASHING
RED BUOY
NO. 2
FIGURE 3
MEAN MPN / 100 ML.
BEFORE 7:00 A.M.
EATONS NECK HARBOR
POLLUTION SURVEY
INTERSTATE SANITATION COMMISSION
1953
SCALE
FEET
0
500
1000

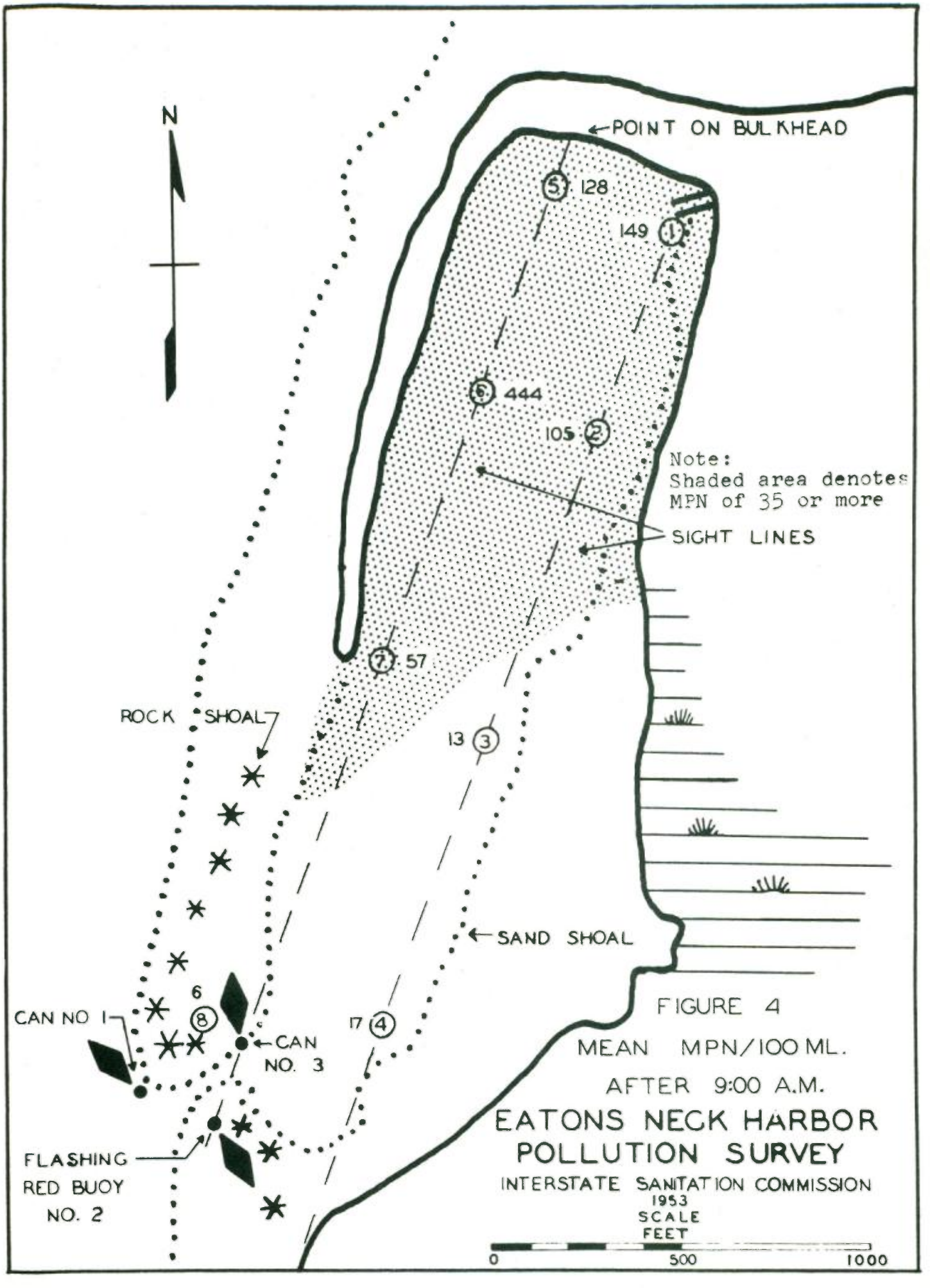

N
POINT ON BULKHEAD
5 128
149 1
6 444
105 2
Note:
Shaded area denotes
MPN of 35 or more
SIGHT LINES
7 57
ROCK SHOAL
13 3
SAND SHOAL
6
CAN NO 1
8
17 4
CAN
NO. 3
FLASHING
RED BUOY
NO. 2
FIGURE 4
MEAN MPN/100 ML.
AFTER 9:00 A.M.
EATONS NECK HARBOR
POLLUTION SURVEY
INTERSTATE SANITATION COMMISSION
1953
SCALE
FEET
0
500
1000

TABLE 6

CABIN CREEK POLLUTION SURVEY
Eatons Neck Harbor
1953

Comparison of Frequency of Pollution Intensity

For Tidal Cycle

Percent of Samples Equal to or Greater than MPN 36/100

Tidal Quarter	Station 1	2	3	4	5	6	7	8	Total
High Ebbing	46	23	46	23	62	62	38	62	46.2
Low Ebbing	67	67	50	58	75	67	50	58	61.5
Low Flooding	37	62	38	23	31	62	54	39	43.3
High Flooding	50	50	40	10	90	70	70	20	50.0

Percent of Samples Equal to or Greater than MPN 230/100 ml.

High Ebbing	0	0	0	0	0	15	8	0	2.9
Low Ebbing	25	0	0	0	17	58	17		15.6
Low Flooding	0	0	0	0	0	0	0	8	1.0
High Flooding	0	10	0	0	10	30	0	0	6.2

Percent of Samples Equal to the Maximum MPN

										Max. MPN/3.00ml.
High Ebbing	0	0	0	0	0	8	0	0	1.0	2100
Low Ebbing	8	8	0	0	8	8	0	0	4.2	930
Low Flooding	0	0	0	0	0	0	0	8	1.0	230
High Flooding	0	0	0	0	0	10	0	0	1.2	2400

Maximum MPN/100 ml.

High Ebbing	150	91	91	91	91	2100	230	91
Low Ebbing	930	930	91	91	930	930	91	430
Low Flooding	91	73	36	36	91	150	110	230
High Flooding	91	230	36	36	230	2400	91	36

TABLE 6 (continued)

Comparison of Frequency of Pollution Intensity

For Tidal Cycles

	Mean MPN/100 ml.**								
	Station								
	1	2	3	4	5	6	7	8	Total
High Ebbing	36	17	21	12	33	216	35	26	48
Low Ebbing	158	112	27	26	124	255	34	70	101
Low Flooding	20	25	16	13	32	42	32	35	27
High Flooding	35	51	14	4	68	326	31	7	67
Mean of all samples **	61	50	20	14	64	200	35	36	60

** See Note Table 4

The maximum MPN/100 ml. exceeded 70 at Station 1, 2, 5, 6 and 7 during all quarters. Means equal to or exceeding that limit were found at Stations 1, 2, 5, 6 and 8 during low ebbing tide. The mean at Station 6 was also in excess for the first and fourth quarters of tidal flow. The mean for all stations during low ebbing flow was 101 MPN/100 ml. and for high flooding flow 67. The overall most favorable condition of water was evident during low flooding flow when the mean was 27 MPN/100 ml. and even Station 6 had a mean of only 42.

From the above, one would anticipate that the poorest conditions of water in Eatons Neck Harbor would be found generally during a period of low ebbing tide.

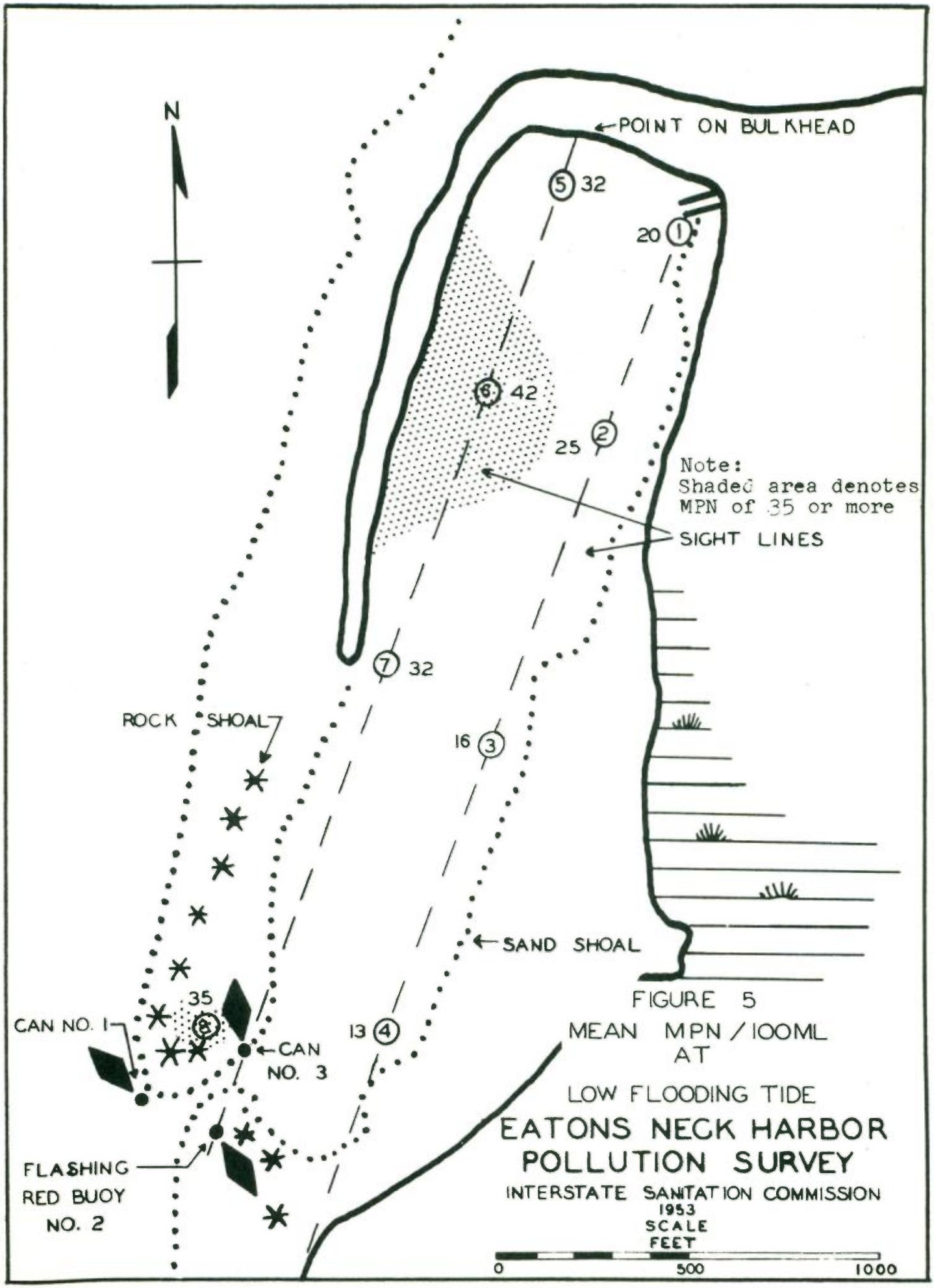
THE COMBINED EFFECT OF TIDAL CONDITION AND BOAT ACTIVITY

The number of samples per station is insufficient to permit valid conclusions regarding the predominant influence on coliform density. When the season's sampling is divided into tidal quarter and time period, every quarter and every period of time has at least one sample per station and some have six per station. The average number of samples per station by tidal quarter and by time period is:

Grouping	By Quarter	No Samples /Station	By Time Period	No Samples /Station
1	High Ebbing	3.25	Before 7:00	3.25
2	Low Ebbing	3.0	7 - 8	3.00
3	Low Flooding	3.5	8 - 9	3.25
4	High Flooding	3.0	After 9	2.75

It will be observed from Table 7 that there are some indications of the effect of boat activity. Using Station 6 as an example, regardless of tidal condition the MPN/100 ml. of 70 appears to be exceeded in a greater percentage of samples taken as the activity aboard boats increases. When low ebbing tide and the time period coincided after 9 A.M., this station was above the MPN of 70/100 ml. in all samples. However, the maximum MPN recorded for this station during the season occurred after 9 A.M. during a mid-flood tide condition (High + 9 hours).

Using Stations 3 and 4 located somewhat outside the area of boat anchorage it will be observed that during inflowing tide from low to high there were no samples in excess of 70 MPN/100 ml. On the ebbing tide there were some samples equalling or exceeding that figure before 8 A.M. and after 9 A.M. During the period from 8 to 9 there were no samples exceeding under any tidal condition. There is possibly an indication here that tidal conditions are a greater influence on the general body of water, whereas boat


N
POINT ON BULKHEAD
5 32
20 1
6 42
25 2
Note:
Shaded area denotes
MPN of 35 or more
SIGHT LINES
7 32
ROCK SHOAL
16 3
SAND SHOAL
35
8
CAN NO. 1
13 4
CAN
NO. 3
FLASHING
RED BUOY
NO. 2
FIGURE 5
MEAN MPN / 100ML
AT
LOW FLOODING TIDE
EATONS NECK HARBOR
POLLUTION SURVEY
INTERSTATE SANITATION COMMISSION
1953
SCALE
FEET
0
500
1000

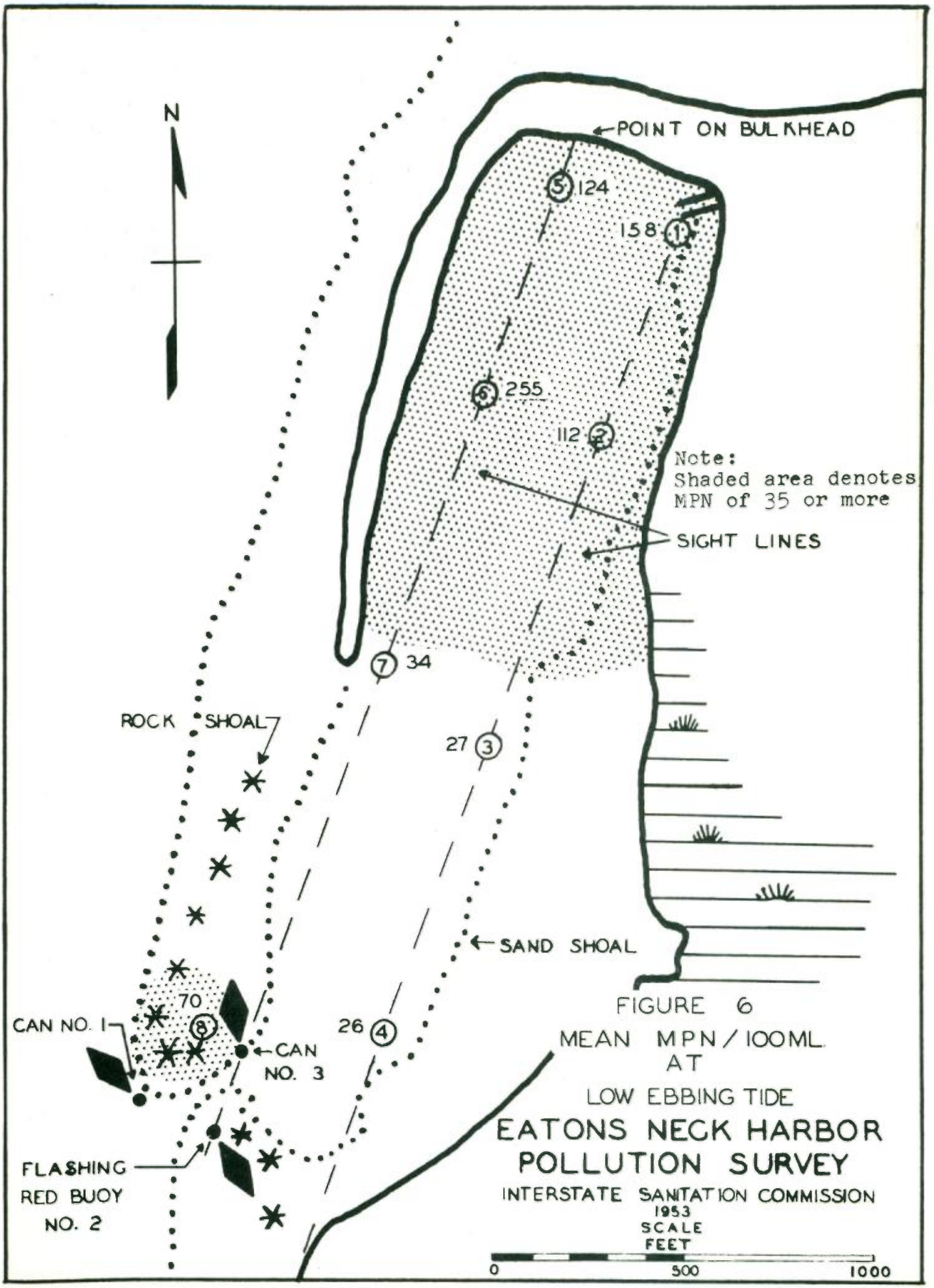

N
POINT ON BULKHEAD
5 124
158 1
5 255
112 2
Note:
Shaded area denotes
MPN of 35 or more
SIGHT LINES
7 34
ROCK SHOAL
27 3
SAND SHOAL
70
8
CAN NO. 1
CAN NO. 3
26 4
FLASHING
RED BUOY
NO. 2
FIGURE 6
MEAN MPN / 100ML.
AT
LOW EBBING TIDE
EATONS NECK HARBOR
POLLUTION SURVEY
INTERSTATE SANITATION COMMISSION
1953
SCALE
FEET
0
500
1000

Table 7

CABIN CREEK POLLUTION SURVEY
Eatons Neck Harbor
1953

Collection of Coliform Density Data

Stated Conditions of Tidal Cycle and Sampling Period

Percent of Samples Equal to or Greater than 70/100 ml.

Tidal Quarter	Time Period	Station 1	2	3	4	5	6	7	8	No. Samples Per Station
1	Before 7:00	25	0	0	75	50	25	0	0	4
High Ebbing	7:00 - 8:00	0	25	25	0	25	75	0	25	4
	8:00 - 9:00	25	25	0	0	0	25	25	0	4
	After 9:00	100	0	0	0	0	100	100	0	1
2	Before 7:00	50	0	50	0	50	0	0	0	2
Low Ebbing	7:00 - 8:00	100	0	0	0	0	0	0	0	1
	8:00 - 9:00	33	33	0	0	67	67	33	67	3
	After 9:00	50	50	17	17	33	100	33	0	6
3	Before 7:00	20	20	0	0	60	20	20	20	5
Low Flooding	7:00 - 8:00	0	0	0	0	0	17	0	17	6
	8:00 - 9:00	0	0	0	0	100	100	100	0	1
	After 9:00	0	0	0	0	0	100	100	0	1
4	Before 7:00	0	0	0	0	0	0	0	0	2
High Flooding	7:00 - 8:00	100	100	0	0	0	0	0	0	1
	8:00 - 9:00	67	33	0	0	67	33	33	0	3
	After 9:00	0	0	0	0	50	75	0	0	4

activity influence is more on the immediate waters at the area of boat concentration.

Examination of conditions at each station at the time of occurrence of the maximum observed coliform density gives some further indication of the possible effect of tide and boat activity on the water. Maximum station pollution coincided with low ebbing tidal conditions eight times and with period after 9 A.M. six times. Both conditions occurred coincidently six times. At only one station was the maximum observed on other than an ebbing tide. At only two of the stations did a maximum occur at a time other than after 9 A.M.

EFFECT OF TOTAL NUMBER OF BOATS

The actual number of boats as such seems to be of little significance other than the fact that when there are more boats there is a chance of more activity. There were from 22 to 58 boats noted at time of survey. It will be noted from Table 8 that maximum MPN's were found at five of the eight stations when the boat count was 36, at two when the count was 43, and at each of five stations when the boat count was 22, 30, 49 and 58.

The total number of boats at anchorage apparently has no observable relation to pollution at a particular station. Station 6 was examined specifically since it

TABLE 8

CABIN CREEK POLLUTION SURVEY
Eatons Neck Harbor
1953

STATION CONDITIONS AT TIME OF OCCURRENCE
OF
MAXIMUM MPN

Station	MPN/100ml.	Date	Time A.M.	Condition at Station: Quarter Tidal	Weather	Wind MPH	Boat Count No.	Remarks
1	930	16 Aug.	09:22	2	Clear	0	36	
2	930	16 Aug.	10:32	2	Clear	1-3	36	Clamming Party
3	91	30 May	07:00	2	Clear	5-10	22	
	91	2 Aug.	07:24	1	Overcast	0	43	4 boats near station
	91	16 Aug.	09:27	2	Clear	0	36	
4	91	16 Aug.	09:32	2	Clear	0	36	
	91	30 Aug.	06:52	1	Clear	1-3	58	Natural Scum
5	930	16 Aug.	10:19	2	Clear	0	36	Swimming & Fishing near station
6	2400	26 July	09:31	3	Clear	3-5	30	5 Boats near station, woman rinsing laundry
7	230	4 July	09:30	2	Clear	5-7	49	4 Boats near station
8	430	2 Aug.	09:07	2	Overcast	5-7	43	

represented the most heavily contaminated area of water in the harbor. MPN s of 36/100 ml. or less were recorded for boat counts of 22, 30, 36, 43, 49, 50, 55 and 58. Seven negative samples were obtained when boat counts were 30 or less, but eight negative samples were found when boat counts were 50 or more. A maximum MPN/100 ml. of 2400 was recorded with a boat count of 30 while a maximum of 230 was found with a boat count of 58, and a maximum of 2100 occurred when the boat count was 49.

EFFECT OF SEASONAL BUILD-UP

It is not apparent from the data that any marked cumulative residual effects occur. Heavy pollution at specific stations occurred in August, July and May.

On 16 August, five of the eight stations had the maximum coliform density recorded at the station. These stations were 1, 2, 3, 4 and 5. Only two maximums were exceeded in July, those for stations 6 and 7. One maximum was recorded for station 3 on 30 May. Station 4 is representative of least pollution and Station 6 of most pollution. A seasonal comparison of these two stations is shown in Table 9. Nine consecutive periods of sampling were divided into those occuring in June and July and those occuring in August. The second period shows

TABLE 9

CABIN CRUISER POLLUTION SURVEY
Eatons Neck Harbor
1953

Comparison of Two Stations
to show
Observed Effect Due to Month of Sampling

Station	Period under study	No. Samples	Percent Distribution of MPN			
			30*	36-70	71-230	230+
4	4 Surveys 6/28-7/26	20	85	15	0	0
	5 Surveys 8/2-8/30	25	60	32	8	0
	% Decrease or Increase		-15	+ 7	+8	0
6	4 Surveys 6/28-7/26	20	45	15	25	15
	5 Surveys 8/2-8/30	25	32	16	16	36
	% Decrease or Increase		-13	+ 1	- 9	+11

Note - Period 1 : 6/28-7/26 Includes two Ebbing Tides and two Flowing Tides.

Period 2 : 8/2-8/30 Includes three Ebbing Tides and two Flowing Tides.

The total period covers 9 consecutive surveys.

* Less than or equal to value shown.

some increase in pollution density, but there appear to be possible reasons for that increase other than that of the date of sampling. The percentage of negative samples is less in August than in July by about the same percentage at both stations (15 and 13% for Stations 4 and 6 respectively). Since a shift of value in one sample could change the observed effect by 8 to 10%, these data do not appear to show even a trend.

DIRECT EFFECT OF BOAT WASTE DISCHARGES

During the several surveys, toilet paper, feces, bits of food and food preparation wrappings and other debris traceable to boat activity were observed. To be sure these items were not always seen but the presence of floating feces at any time in water used for swimming and covering the areas from which clams were taken at every low tide during the period of survey is not a condition to inspire confidence in the continuing safety of such water. Debris of boat origin was spotted 75 times during the period and on 23 occasions fecal matter, vaginal protective material or toilet paper were spotted in the debris.

The New York State Water Pollution Control Board standards for tidal salt waters used for bathing specify that there should be no floating solids,

settleable solids, or sewage or waste effluent not effectively disinfected. The Public Health Service recommended provision for approved shellfish areas states "The sanitary survey shall disclose no likelihood that human fecal discharges reach the area in dangerous concentrations or before sufficient time has elapsed to render such discharges innocuous. The record at Eatons Neck shows the following observed conditions by station.

Station	No. of Times Solids Observed: Debris of Any Kind of Boat Origin	No. of Times Solids Observed: Feces, Toilet Paper or Vaginal Protection
1	9	4
2	7	4
3	11	2
4	6	2
5	8	2
6	15	5
7	15	4
8	4	0
Total	75	23

It seems extraneous to point out that the observed materials were all relatively fresh and easily recognizable. They represent a positive potential hazard to health that is of greater significance than coliform density measurements. There could be no question of their source. Their presence is directly related to boat activity. Their dispersion and eventual disappearance from the harbor are a function of tidal currents and volume displacement. That some concentration of pollution

eventually finds its way to the outer channel is shown by the observance of floating matter near Station 8 and in the channel itself. That the dispersed material still may remain in the outgoing waters is shown by the occasional positive results observed in Station 8 samples. (Maximum MPN 430/100 ml. after 9 A.M. on an ebbing tide, seasonal mean MPN 36/100 ml.)

On the week-end of 9 August there was an opportunity to observe any effect of storm on the water. The effect was negligible. Although the water was dirty in appearance and contained much natural floating solids of marine origin, there was no increase in coliform density. It is probable that there may have been some benefit. On that day Stations 4 and 8 had no positive samples. Stations 1, 2, 3 and 7 had no concentration above 36/100 ml. MPN. Coliform densities above 70/100 ml. occurred at Stations 5 and 6 after 9 A.M. on a flooding tide.

SUMMARY OF INTERPRETATIONS

Transfer of these survey data into generalized observations is manifestly impossible. The control data on the harbor are too meager to permit a conclusive statement as to whether the harbor is more polluted because of the presence of small craft

than it was before. Stations 3 and 4 were sampled throughout the survey and seem to be comparatively free of pollution. The mean MPN s at these stations are of the same magnitude as those obtained by the New York State Conservation Department. The following shows the relation between week-end surveys and "off-season" surveys for both maximum and mean results.

Station	Max. MPN/100 ml.		Mean. MPN/100 ml.	
	Offseason	Weekends	Offseason	Weekend
3	23	91	23	20
4	23	91	10	14
1	240	930	114	61
2	43	930	28	50
5	23	930	23	64
6	1100	2400	375	200
7	23	230	13	35
8	23	430	23	36

During the period of survey 53% of the samples equalled or exceeded 30/100 ml. At Station 3 the comparable frequency was 48%; at Station 4, 33%; at Station 5, 71%; at Station 6, 62%; at Station 7, 58%; at Station 8, 48%; and at Stations 1 and 2, 52%. There is reasonable evidence to show that boats at anchorage and in use in small harbors do have some effect on the harbor water at Eatons Neck. The effect appears to be closely related to levels of boat activity, and particular types of activity; to boat concentration about a particular sampling point; and to the direction of tidal flow. The trend of excessive coliform density is toward higher

values following boat activity and on ebbing tide below mid-tide. Periods after 8 A.M. during ebbing tides show consistently high levels of pollution. All but Station 8 show some percentage of samples in excess of New York State Water Pollution Control Standards when sampled after 9 A.M. on a low ebbing tide.

Certain stations associated with boat congestion show higher levels of pollution than do others outside of anchorage area. The inference is that specific boat activity at or near a sampling station affects the coliform density of water in the station area.

Normal changes in weather condition do not appear to have any measurable effect on water pollution, since boat activity continues while the boat is at the anchorage. A severe storm could not be shown to have had any outstanding effect. Possible flushing action in the basin might be inferred but this effect could not be singled out from other variables known to have influence.

There was no apparent building up of residual pollution in the basin. Minor increases have been demonstrated but these, too, may have been the result of other influencing factors.

Probably one of the most significant measures of the effect of cabin cruiser waste discharge on

the basin is the repeated observance of refuse and wastes from boats in the harbor. Of 75 times boat originated debris was spotted, fecal matter, vaginal protective material or toilet paper was found on 23 occasions. If any conclusion may be drawn, it is that because of the presence of fresh fecal discharges emanating from boats, immediate waters are unsafe for bathing. For the same reason it may be concluded that the waters are not approvable as shellfish areas. In addition 20% of all samples taken during the season showed an MPN in excess of that recommended for approved shellfish waters. Even in the cleanest water station area sampled, that standard was exceeded in 4% of the stations sampled.

RECOMMENDATIONS

Enough of an indication of small harbor pollution by wastes emanating from cabin cruisers at anchor has been demonstrated so that the following measures are recommended:

1. The Eatons Neck Harbor studies of 1953 should be continued with the support of an adequate program of sampling at times when little or no pollution from cabin cruisers can occur.

2. Other harbors in which small craft anchor should be studied on a limited basis. It is

suggested that these limited studies can be made in sheltered harbors having characteristics similar to Eatons Neck by

a. Taking samples on high incoming and low outgoing tides occurring between 8 and 10 A.M.

b. Making careful observations of boat activity and of the presence of solids of any kind that may have been discharged from cabin cruisers.

c. Selecting carefully one or two stations within the anchorage and at least one clearly outside the anchorage.

3. The tentative findings of the 1953 survey might be discussed with yacht club commodores and with the manufacturers of cabin cruisers so that they may be thinking about possible measures for improving the methods of handling wastes while cruisers are at anchor.

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APPENDIX A

HEALTH DEPARTMENT

CITY OF LOS ANGELES

GEORGE M. UHL M. D.
Health Officer

INTER-OFFICE COMMUNICATION

Mr. C. L. Senn, Engineer - Director

Date June 30, 1953

A. C. Shogrin, Supervisor - Harbor District

Survey made by W. L. Tamulinas, R.S., Sanitation Inspector Harbor June 29, 1953

We have 11 Yacht and small boat Anchorages within the harbor as follows:

Berth 39	Hanchette Boat	97 boats	3 living on board
Berth 40	Fleitz Bros.	400 boats	3 living on board
Berth 38	California Yacht	250 boats	6 living on board
	Cabrillo Beach	100 boats	0 living on board
Berth 268	L. A. Yacht	40 boats	0 living on board
Berth 213	Wright's	28 boats	0 living on board
Berth 202	Yacht Centre	175 boats	2 living on board
Berth 203	Colonial Yacht	90 boats	0 living on board
Berth 204	Light House Anchorage	62 boats	0 living on board
Berth 205	Cerritos Yacht	125 boats	0 living on board
Berth 206	Island Yacht	210 boats	0 living on board
SO. Fries	John's Boat	6 boats	0 living on board
	Total.....	1,583	14

Each anchorage operator is responsible for enforcement of the law which prohibits depositing of anything in harbor waters such as cans, rags, paper, garbage or other debris including offal, feces or any thing which might pollute the waters.

There is no open anchoring permitted.

Regular inspection of the areas are made by my inspections division to see that they comply with regulations.

Toilet facilities are available on shore at each anchorage.

Eating establishments are available at the larger anchorages.

Garbage cans and trash cans are provided by the management and all waste is disposed of on shore. Rules are set up and strict compliance is required of all boats.

Permanent tenancy is discouraged and not permitted in the majority of anchorages.

As a result of strict enforcement of regulations by the operators there is no problem from pollution by them. In fact on our inspections very little if any discarded material is in evidence.

Yacht anchorage survey report of October 14, 1948 and Harbor Water Pollution Survey Report of December 15, 1953 shows pollution neglible.

APPENDIX B

October 15, 1949

CONTROL OF SEWAGE DISCHARGES FROM SMALL BOATS

Regulations governing sewage discharge from small boats, particularly in or near the water areas of anchorage harbors, bathing beaches and oyster bars appear desirable. In order to determine regulations now in effect in other states governing this condition, a circular letter was sent to all state sanitary engineers requesting information on existing regulations and enforcement procedures. The following is a brief review of the information resulting from this inquiry.

Replies received from 45 of 48 states indicate that in 20 states, control of sewage discharge from small boats constitutes no pollution problem at present and no regulations are necessary. In five states, the general health laws are sufficient to adequately control the situation; however, enforcement of these laws presents a perplexing problem. Ten states confronted with the problem to some degree have not attempted to enforce specific regulations for control. Undoubtedly, all of these have general health laws under which specific regulations could be enacted should they become necessary.

Some of the state sanitary engineers doubt that enforcement of local regulations would be adequate to control the problem. Many boat anchorages are not located in municipalities with police forces adequate to enforce local regulations. Cooperation of the owners and operators of boats is difficult to secure and is a major problem.

The remaining ten states have either Statewide or local regulations to control such situations. Most of these local regulations are enforced by the local health officers and in many cases have been passed to protect lakes used as sources of public water supplies. Such regulations are not applicable to bodies of water not used as sources for public water supplies.

B - ODD P24

Some of the states have considered the problem to some extent and have recommended the following measures:

1. The use of chemical toilets with dispcsal of contents in properly maintained pits at least 50-feet from the waterline on shore.

2. Suitable water-tight tanks on boats for receiving solid and liquid waste materials for disposal at other points.

3. Sanitary equipment on boats must be approved at time of boat registration and meet proper specifications.

4. Restriction of use of areas (shellfish) by operators of boats.

The problem of control of sewage pollution originating from toilet facilities on boats is a definite one in many states. No conclusive evidence is given for the best method of regulation and control. Enforcement of regulations presents the greater problem in the consideration of such regulations and none was able to indicate how enforcement may be accomplished.

Maryland is planning to enlist voluntary cooperation of all yacht clubs in the State by discussions of the sewage disposal problem with club members, and to observe the adequacy of a recent town ordinance to control overboard sewage discharges from all boats tied up at public or private docks within the corporate limits for the purpose of recommending to other tidewater municipalities passage of a similar ordinance, if control is effective.

George L. Hall
Chief Engineer.

APPENDIX C

RECOMMENDED PROCEDURES

for

CABIN CRUISER POLLUTION SURVEY

May 19th, 1953

INTERSTATE SANITATION COMMISSION

TABLE OF CONTENTS

I. INTRODUCTION

The purpose of these recommended procedures is to reduce the error in the measure of the pertinent variables to a minimum by exercising due care in the collection and analysis of samples. Data obtained by either the New York State Conservation Department or the New York University - Interstate Sanitation Commission group should have equal validity and for this purpose, the field and laboratory procedures actually practiced should adhere closely to those mutually agreed upon and listed below.

In general, the procedures to be used are in accord with those listed in the 9th Edition of "Standard Methods. *

II. SAMPLING AND FIELD ANALYSES

A. Bacteriological. Samples are to be collected at each of eight sampling stations in Eaton's Neck Harbor at a depth of five feet below the water surface and at other additional or alternate points as may be subsequently designated. Samples are to be obtained hourly, probably starting at 5:00 A.M. and continuing to 11:00 A.M. when samples are obtained on the weekend. Check samples of the relatively unpolluted waters obtained occasionally during the

* Standard Methods for the Examination of Water and Sewage, Ninth Edition (1946) Amer. Public Health Assn., New York, N.Y.

week are to be obtained only for one one-hour sampling of the eight stations.

The number and frequency of the samples obtained (both bacteriological and others) are to be re-evaluated upon the completion of the initial surveys.

Bacteriological samples are to be collected by means of a sampler similar to that used by the Conservation Department.

The sampler bottle is to be of approximately 4 ounce capacity fitted with a ground glass stopper (similar to Fisher 2-920). The bottles are to be acid-washed and rinsed prior to sampling and the stopper and upper half covered with aluminum foil of heavy grade. The bottles are to be sterilized either by dry heat at 170°C. for one hour or by steam at 15 pounds for one-half hour.

Immediately after collection, the aluminum foil is to be replaced and the bacteriological sample bottles placed in an ice-chest whose temperature is maintained at 6-10°C. The iced samples are to be transported to the laboratories of New York University or the Department of Conservation, there to be planted as soon after their arrival as is practicable. The samples are to remain in the ice-chest until they are planted if the temperature is maintained at 6-10°C. in the ice-chest.

Samples are to be well-packed in the ice-chest to avoid any tipping or spilling of the sample bottles. The melted ice should be drained periodically so as to prevent the entry of ice-water into the sample bottles. Samples are to be chilled prior to placement in the ice-chest.

Sample bottles are to be properly marked by tags or by crayon on the aluminum foil and the sample bottle number indicated on the proper data sheets.

B. Temperature and Density

Samples for the measurement of temperature and density are to be collected separately by either a"Foerst" water sampler or a dissolved oxygen sampler.

The temperature of the sample is to be determined by means of a suitable thermometer. Either a Weston Dial Thermometer, Model 2261, range 0-50°C. 1/2°C. increments, or a standard mercury element thermometer, 0-60°C. Range in 1 or 1/2°C. increments is acceptable. All thermometers to be used are to be compared for agreement and at least one thermometer is to be certified as accurate by the Bureau of Standards or any other suitable agency.

The sampler for temperature determination is not to be left in the sun; it is to be

maintained at approximately water temperature or immersed ten minutes prior to sampling.

Specific gravities are to be measured by means of hydrometer-Fisher 11-522 or similar. The various hydrometers to be used are to be checked against each other and at least one hydrometer checked against standard solutions of known specific gravities.

C. Other Samples

No other samples for other than the determination of the MPN, temperature and density are to be collected routinely.

At such times and locations when samples for the determination of dissolved oxygen concentration are collected, a "Foerst" water sampler or a sampler similar to that used by the Conservation Department is to be used. Samples are to collected at a depth of five feet. Dissolved oxygen samples will be obtained or placed in standard glass dissolved oxygen bottles of approximately 300 ml. capacity.

As soon as possible after collection two droppers full of one ml. capacity or an equivalent amount of $MnSO_4$ should be added below the water surface in the D.O. bottles

avoiding the entrainment of air bubbles, followed by two droppers full of alkaline potassium iodide azide in like manner. After shaking the sampler bottle, the floc formed should be allowed to settle approximately half the depth of the bottle. After settlement, three droppers full of sulfuric acid, concentrated, are to be added below the surface and the bottle shaken again. The dissolved oxygen samples are then to be stored for return to the laboratory.

Should the occasion arise, samples for other analyses are to be collected in accordance with the procedures recommended in "Standard Methods .

III. LABORATORY ANALYSES

A. Bacteriological Analyses Samples are to be analyzed to determine the MPN of the coliform group.

(1) Preparation of Materials

(a) Dilution Water. Dilution tubes will be regular 16 X 150mm bacteriological tubes equipped with cotton plugs or aluminum caps. The dilution tubes will be cleaned with acid cleaning solution and well rinsed. They shall be filled with the proper amount of phosphate buffer dilution water so that after sterilization

at 15 pounds pressure for 15 minutes they shall contain 9.0 ml + .18 ml. This will have to be determined for the particular autoclave being used. The dilution water shall be prepared as follows:

For each liter of distilled water, the following chemicals shall be added in the amount specified:

(a) Ferric Chloride, $FeCl_3$, .25 g/l liter dist H_2O - 0.5 ml.

(b) Calcium Chloride, $CaCl_2$ (anhyd.) 11.0 g/l liter dist. H_2O - 2.5 ml.

(c). Magnesium Sulfate, $MgSO_4$ $7H_2O$, 10.0 g/l liter dist H_2O - 2.5 ml.

(d) Phosphate Buffer stock Solution

The phosphate buffer stock solution shall be prepared by dissolving 34 g. of Potassium acid phosphate, (KH_2PO_4), in 500 ml. of distilled water and adding 1 N. NaOH until the pH reaches 7.2 (approximately 175 ml) then add 1.5 g. of $(NH_4)_2SO_4$ and dilute to one liter.

(b) Fermentation Tubes

All lactose and BGB tubes shall be 16X150 mm bacteriological tubes without lip paired with 10X75 mm tubes without lip as gas collectors. All tubes shall be acid washed and well rinsed and dried before filling with media. The

presumptive media shall be Difco's Bacto Lactose Broth, dehydrated prepared as follows:

Dissolved in 1 liter of distilled water 13.0 grams of the dehydrated media and fill tubes with 10 ml. of solution. Place inverted vial tube inside larger tube and place aluminum cap over large tube. Sterilize in racks for 15 minutes at 15 pounds pressure. The total time in the sterilizer shall not exceed 30 minutes to prevent breakdown of the media. Cool and place in refrigerator until time of innoculation. One or two tubes from each sterilization batch shall be tested for pH and this value recorded in the record book as well as the date. The value of the pH should be 6.7.

The condirmatory media shall be Difco's Bacto Brilliant Green Bile 2%, dehydrated prepared as follows:

A solution of 1 liter of distilled water and 40 grams of BGB shall be prepared. Tubes will be filled with 10 ml. of this solution and sterilized similar to the Lactose Broth. The pH of this media should be 7.26. Two tubes from each preparation of media are to be tested for sterility by an uninnocultated

incubation. All media used is to be from the same dated batch. The Interstate Sanitation Commission will supply media to both the New York University and Department of Conservation laboratories.

(c) Pipettes

Pipettes for the formation of the proper dilutions shall be one milliliter pipettes of good quality with an accuracy of ± 2%. They shall be washed in acid cleaning solution, well rinsed and dry sterilized in cannisters at 170°C. for 1 hour prior to using.

(2) Dilutions, Planting and Inoculation of Tubes.

(a) The presumptive test shall consist of three tubes each of a seried of decimal volumes of 1 ml. At least 3 volumes of a sample should be examined so that the larger volumes shall be found positive and the smaller negative. The largest volume to be used shall be 10 ml. during the pre-season and post-season surveys and 1 ml. during the remainder of the study.

All dilution transfers are to be made aseptically by the use of sterile pipettes for each dilution and the exercise of other precautionary techniques.

Incubation of the lactose fermentation tubes is to be at 36°C.± 1°C. for a period of 48 hours. Fermentation tubes showing any amount of gas production in 24-48 hours shall be considered positive, presumptive tests.

(b) Confirmed Test

All tubes showing evidence of gas are to be transferred at the end of the 24 and 48 hour presumptive incubation periods by means of a 3 mm platinum innoculating loop into BGB tubes. The loop is to be sterilized by flame and allowed to cool prior to each innoculation and the mouths of the tubes are to be flamed. The BGB tubes are to be incubated for 48 ± 2 hours at 36 ± 1°C. Any BGB tube showing gas formation in this period is to be considered as "positive confirmed."

All tubes used are to be sterilized prior to washing as a precautionary health measure.

The results of the bacteriological tests are to be computed from Hoskin's Tables (attached)

B. Other Analyses. All other analyses are to be in accordance with Standard Methods.

IV. RECORDING OF DATA

All pertinent data is to be recorded either separately or on combined field and laboratory

record forms.

At each sampling, the following data are to be recorded:

(1) Date and Time

(2) Station Number and sample indentification number for bacteriological bottle (and D.O. bottle if necessary)

(3) Temperature of water

(4) Specific gravity of water

(5) Physical observations such as presence of fecal matter, oil, etc.

For each cycle of samples and at such other times as is required - weather conditions, tide conditions (tide and tidal currents), and the number of boats in Eaton's Neck Harbor are to be recorded. If possible, the population count should also be recorded.

Laboratory work sheets are to be used to record the results of the bacteriological and chemical analyses.

AND:b

APPENDIX D

INTERSTATE SANITATION COMMISSION

CABIN CRUISER POLLUTION SURVEY

Eaton's Neck Harbor

FIELD DATA SHEET

OBSERVER: _____ DATE: _____

STATION NUMBER							
TIME							
AIR TEMPERATURE							
WIND DIRECTION							
WIND VELOCITY							
WEATHER							
TIDE							
FLOATING SOLIDS							
Feces							
Refuse							
Wood Wastes							
Contraceptives							
Oil or Grease							
AREA OF SOLIDS							
Size of Area							
Distance from Station							
ODOR							
Type							
Intensity							
WATER TEMPERATURE							
SPECIFIC GRAVITY							
SAMPLE NO.							
P.P.M.							
D.O.							

REMARKS

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