1959 WATER POLLUTION SURVEY
in the
EAST RIVER and LONG ISLAND SOUND

INTERSTATE SANITATION COMMISSION

New York

New Jersey

Connecticut

1959 WATER POLLUTION SURVEY
in the
EAST RIVER and LONG ISLAND SOUND*

*Excerpted from
1960 Annual Report
of the
Interstate Sanitation Commission

WATER POLLUTION SURVEY
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EAST RIVER and LONG ISLAND SOUND

INTRODUCTION

The Interstate Sanitation Commission conducted a special water pollution survey in the East River and westerly end of Long Island Sound during the summer of 1959. The East River joins the Upper New York Harbor and the westerly end of Long Island Sound. It is a tidal waterway bounded by the Boroughs of Manhattan and the Bronx on the west and north, and by Brooklyn and Queens on the east and south, respectively. Sampling stations were located throughout the length of the East River and extended into the main channel of Long Island Sound for a distance of about four miles.

There are four secondary sewage treatment plants located along the Upper East River which discharge their effluents directly into the waterway. During 1959, this effluent amounted to 475 million gallons per day. In Manhattan, all the waste is being discharged untreated to the East River from 72nd Street south to the Battery. In Brooklyn, untreated waste is being discharged from Newtown Creek south to the beginning of the East River. The New York City Department of Public Works is completing plans for the Newtown Creek Pollution Control Project which will provide treatment for all the untreated wastes along the East River, and also some of the untreated waste which is presently being discharged either into the Hudson River or into the Upper Harbor. The intercepting sewers for this project have been under construction for the past two years. This plant upon completion will discharge its treated effluent directly into the East River at a point close to Newtown Creek. It is expected to have a flow of 310 million gallons per day and will afford intermediate treatment which is to remove approximately 70 percent of the B.O.D.

This survey and the data presented herein represents the Commission's first intensive study of

this water area. The main purpose was to determine the dissolved oxygen level in these waters during the hot summer months and its tidal variations. This would then serve as a guide in deciding what future work should be considered.

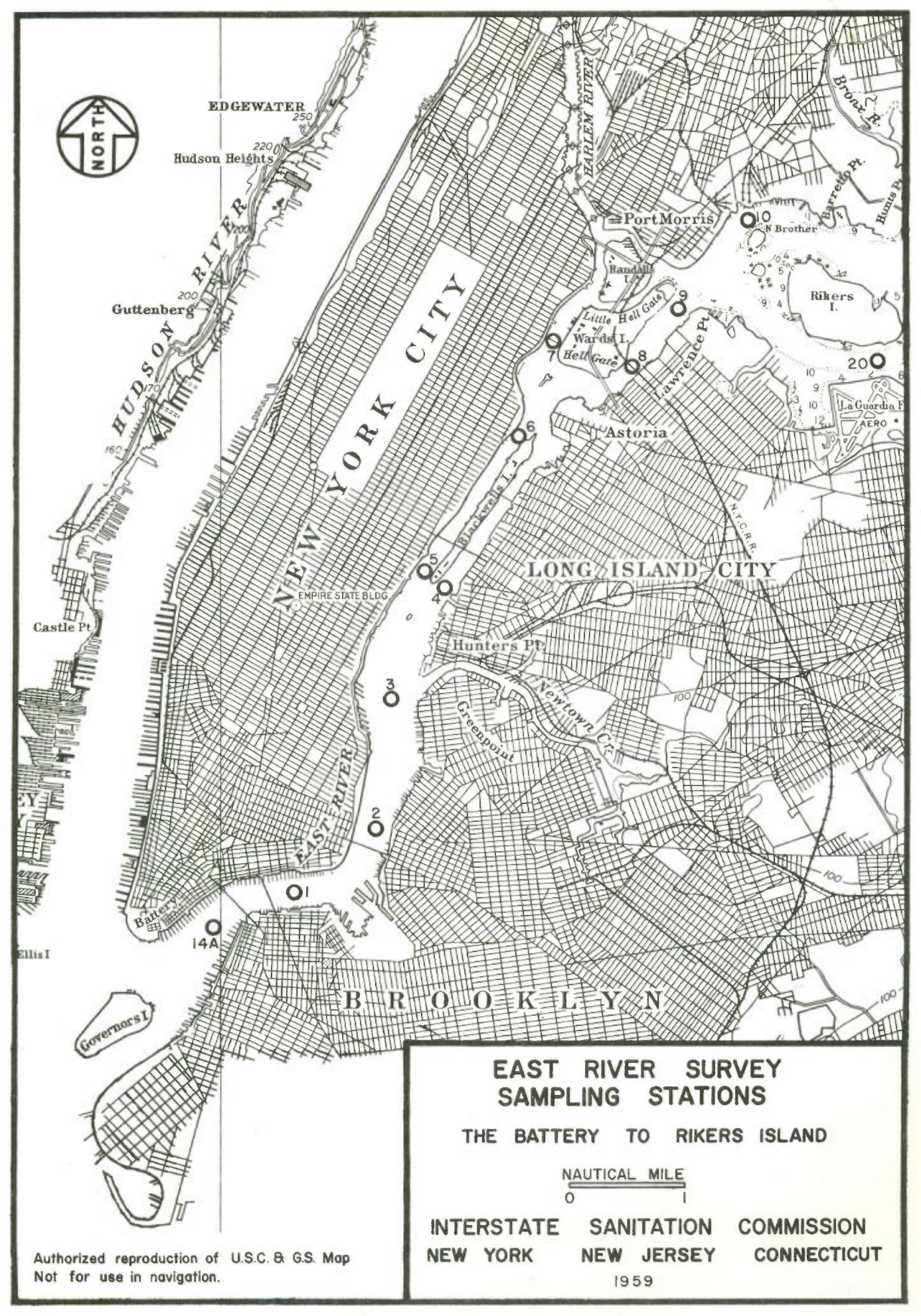
PROCEDURE

In determining the condition of the waters in the East River and west end of Long Island Sound, sampling stations were selected in the main channels beginning at the Battery, Manhattan, and extending out to Gangway Rock in Long Island Sound. These sampling stations are shown on the following two maps titled: "East River Survey Sampling Stations." There is a total of 21 sampling stations covering a distance of 17.6 miles. Those which are located in the principal channels are approximately one mile apart. In Appendix A, a description of the location of each sampling station is given.

Four samples per day were taken, at each station, four days a week, during a period of five weeks. The survey started on July 20, 1959 and terminated on August 20, 1959. Thus, 80 samples were obtained at each station. Chlorides, temperature, pH and dissolved oxygen were determined on each sample. All dissolved oxygen determinations were made aboard the vessel in conformance with "Standard Methods for the Examination of Water and Sewage."

Samples were taken twice daily for the determination of the Most Probable Number of coliform organisms at Stations 7 through 20 during the last four weeks of the survey. All samples were taken in sterile bottles, at a five foot depth and tubes were inoculated immediately aboard the vessels. They were then returned to the Commission laboratory where they were incubated and the test completed according to Standard Methods.

All data was obtained and analyzed, in general, as outlined in Appendix B of the Commission's 1958 Annual Report. The basic curve of best fit describing the distribution of data at individual stations was sinusoidal for dissolved oxygen; however, the



EAST RIVER SURVEY SAMPLING STATIONS

THE BATTERY TO RIKERS ISLAND

NAUTICAL MILE

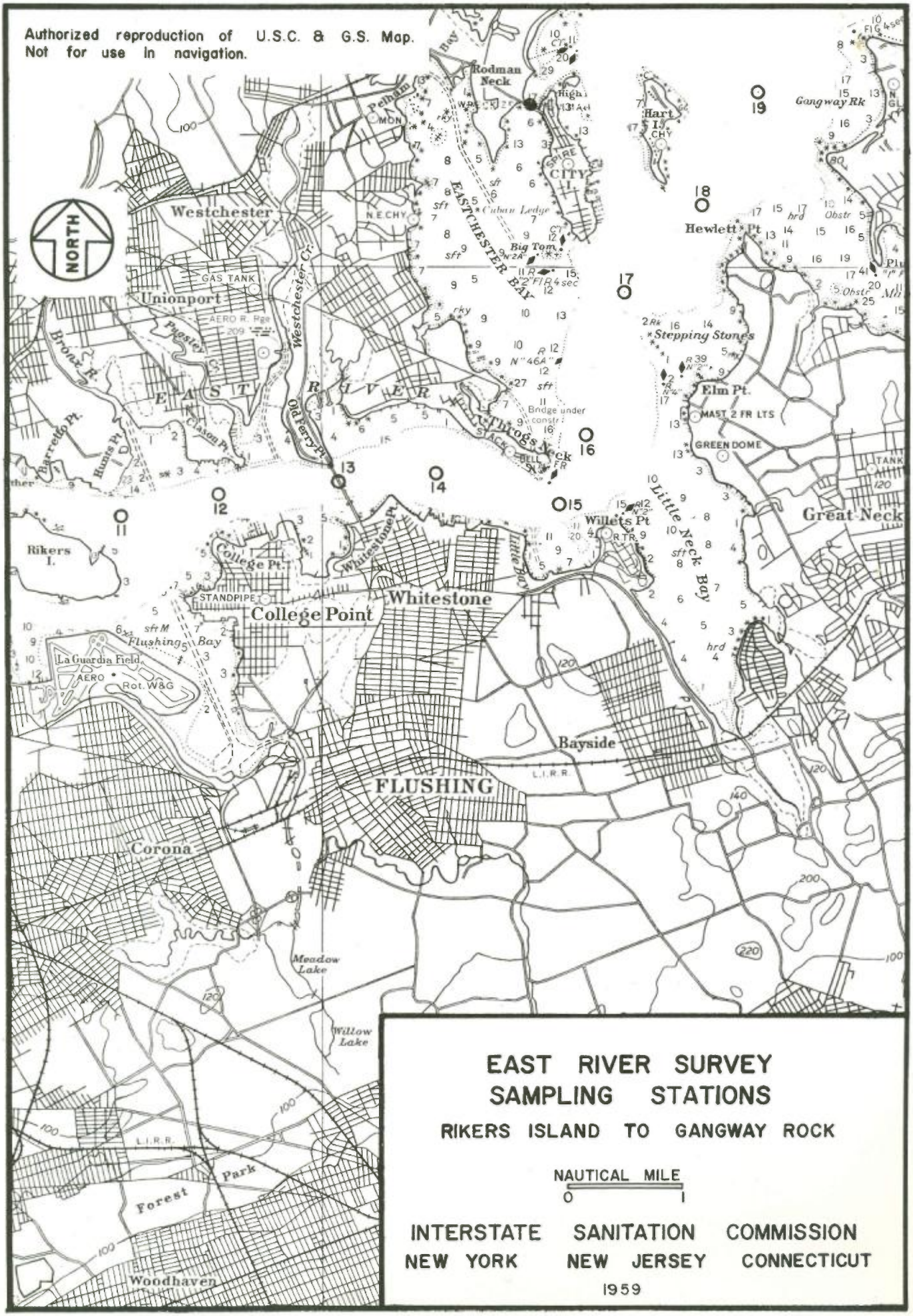
0 1

INTERSTATE SANITATION COMMISSION

NEW YORK NEW JERSEY CONNECTICUT

1959

Authorized reproduction of U.S.C. & G.S. Map
Not for use in navigation.



EAST RIVER SURVEY
SAMPLING STATIONS

RIKERS ISLAND TO GANGWAY ROCK

NAUTICAL MILE

0 1

INTERSTATE SANITATION COMMISSION

NEW YORK NEW JERSEY CONNECTICUT

1959

MPN values failed to demonstrate any uniform distribution produced by tidal currents.

At the end of this special survey, it was decided to conduct a supplementary investigation of the waters in and adjacent to Throggs Neck. This investigation was to demonstrate the transport of pollution through Throggs Neck out into the Sound and to the vicinity of Stepping Stones Beach by tidal currents. Cellulose sponges were used as floats and were released at three points, with a different set of colored sponges being used at each. On September 8, 1959, they were released on each side of Throggs Neck. The third set of floats were released in a streak of sewage observed near Station 12. The movement of the sponges was followed each day for four days during both flood and ebb stages of the current.

DISCUSSION

General

This Commission, after public hearings, classified the waters from the Battery up the East River to a point west of sampling Station 11, as Class "B" waters, and from this point eastward to and including Long Island Sound, as Class "A" waters. The Tri-State Compact requires that in Class "B" waters an average dissolved oxygen content be maintained at the five foot depth of not less than 30 percent saturation during any week of the year. In Class "A" waters this average dissolved oxygen content must be maintained at not less than 50 percent saturation during any week of the year. To be in conformance with the Tri-State Compact requirements, all samples were taken at a depth of five feet below the surface.

For the purposes of this report, it is not necessary to elaborate on the details of the currents in the East River. Such information is obtainable in articles or publications released by various authors and agencies. However, for this presentation of data, it should be generally stated that when the waters are flooding into and up the Upper Harbor, waters flow into the East River and out through Throggs Neck. When the current reverses its direction and the ebb

phase starts in the Upper Harbor, the water flows from Throggs Neck towards the Battery, into the Harbor and out towards the Narrows.

Results Obtained

The weighted mean percent saturation of dissolved oxygen and chloride values are tabulated in Table I. The locations of these stations can be readily seen by referring to the preceding maps. Plate I shows the variations of the mean percent saturation of dissolved oxygen throughout the East River starting at the Battery and proceeding to Gangway Rock. The values for Stations 4, 7 and 20 are listed in the Table; however, they are not located on the main profile. The mean value drops from 16.3 percent saturation at Station 14A to a minimum at Station 3 of 9.8 percent saturation of dissolved oxygen. This low point occurs directly opposite Newtown Creek. From Station 9 to Station 15, there is a steady increase of the dissolved oxygen level. It should be noted that the Tri-State Compact requirement of 30 percent saturation in Class "B" waters was not being met and that the requirement for Class "A" waters was not met until just before Station 17, which is located in the Sound.

Plate II shows the variation of the mean chloride concentration along the main profile. In general, the chloride concentration increases from a minimum, at Station 14A, of 13,337 to a maximum of 14,797 parts per million at Station 19. It is of interest to note that the chloride concentration of 14,484 ppm at Station 15 is only 310 parts per million below the mean concentration observed at Station 19. This indicates a very uniform chloride concentration and the passage of very little fresh water.

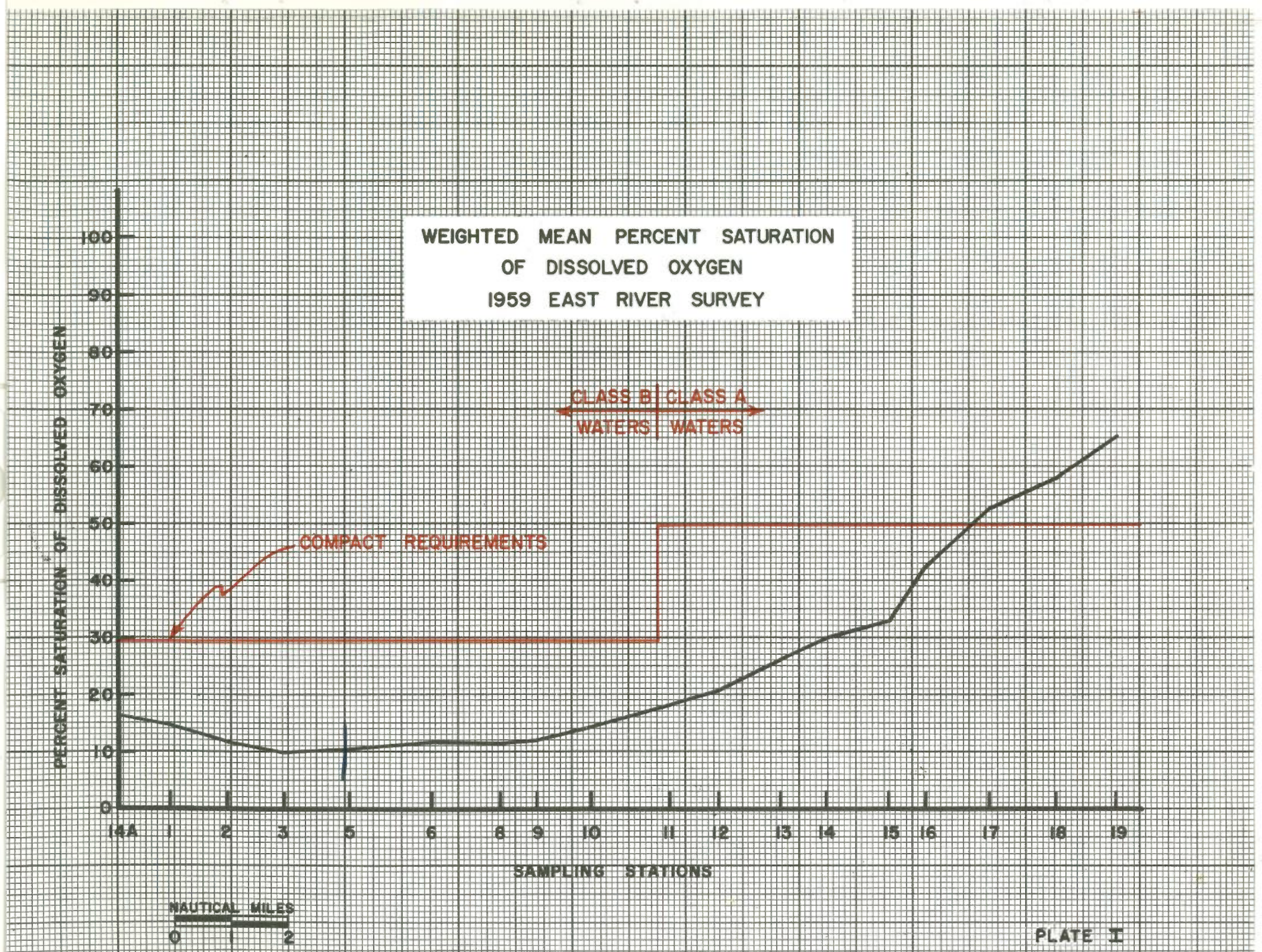
Plate III shows the observed hourly variations of percent saturation of dissolved oxygen values, as determined by curves of best fit, and caused by the flooding current in the East River. The line marked "O" shows the observed variation along the entire profile as the waters began flooding into the East River from the Upper Bay. This line shows a drop from 12.4 percent saturation, at Station 14A, to

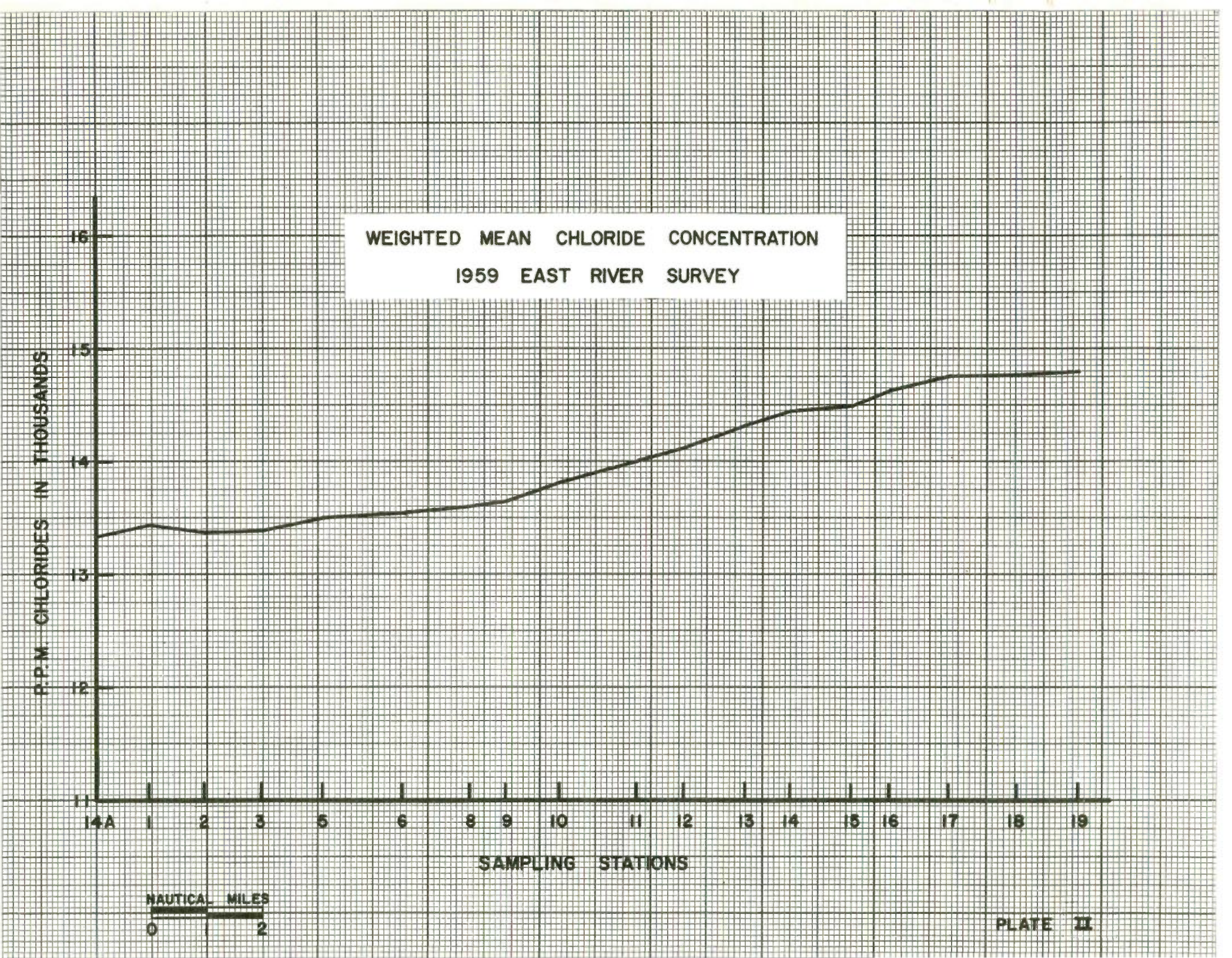
Table I

MEAN VALUES
of
PERCENT SATURATION OF DISSOLVED OXYGEN
and
CHLORIDE CONCENTRATIONS

STATION	MEAN PERCENT SATURATION	MEAN CHLORIDES (ppm)
14A	16.3	13337
1	14.6	13438
2	12.2	13375
3	9.8	13385
4*	8.6	13354
5	10.3	13489
6	10.8	13539
7*	13.2	13400
8	11.2	13595
9	12.4	13643
10	14.1	13810
11	18.1	14006
12	20.6	14142
13	26.0	14320
14	29.7	14441
15	32.8	14484
16	42.2	14637
17	52.6	14758
18	57.8	14767
19	65.2	14794
20*	14.7	13810

* Values not used in Profiles


WEIGHTED MEAN PERCENT SATURATION
OF DISSOLVED OXYGEN
1959 EAST RIVER SURVEY
CLASS B WATERS
CLASS A WATERS
COMPACT REQUIREMENTS
PERCENT SATURATION OF DISSOLVED OXYGEN
100
90
80
70
60
50
40
30
20
10
0
14A
1
2
3
5
6
8
9
10
11
12
13
14
15
16
17
18
19
SAMPLING STATIONS
NAUTICAL MILES
0
2
PLATE I


WEIGHTED MEAN CHLORIDE CONCENTRATION
1959 EAST RIVER SURVEY
P.P.M. CHLORIDES IN THOUSANDS
16
15
14
13
12
11
14A
1
2
3
5
6
8
9
10
11
12
13
14
15
16
17
18
19
SAMPLING STATIONS
NAUTICAL MILES
0
1
2
PLATE II

OBSERVED HOURLY VARIATIONS OF PERCENT SATURATION OF DISSOLVED OXYGEN — FLOOD CURRENT PHASE — 1959 EAST RIVER SURVEY

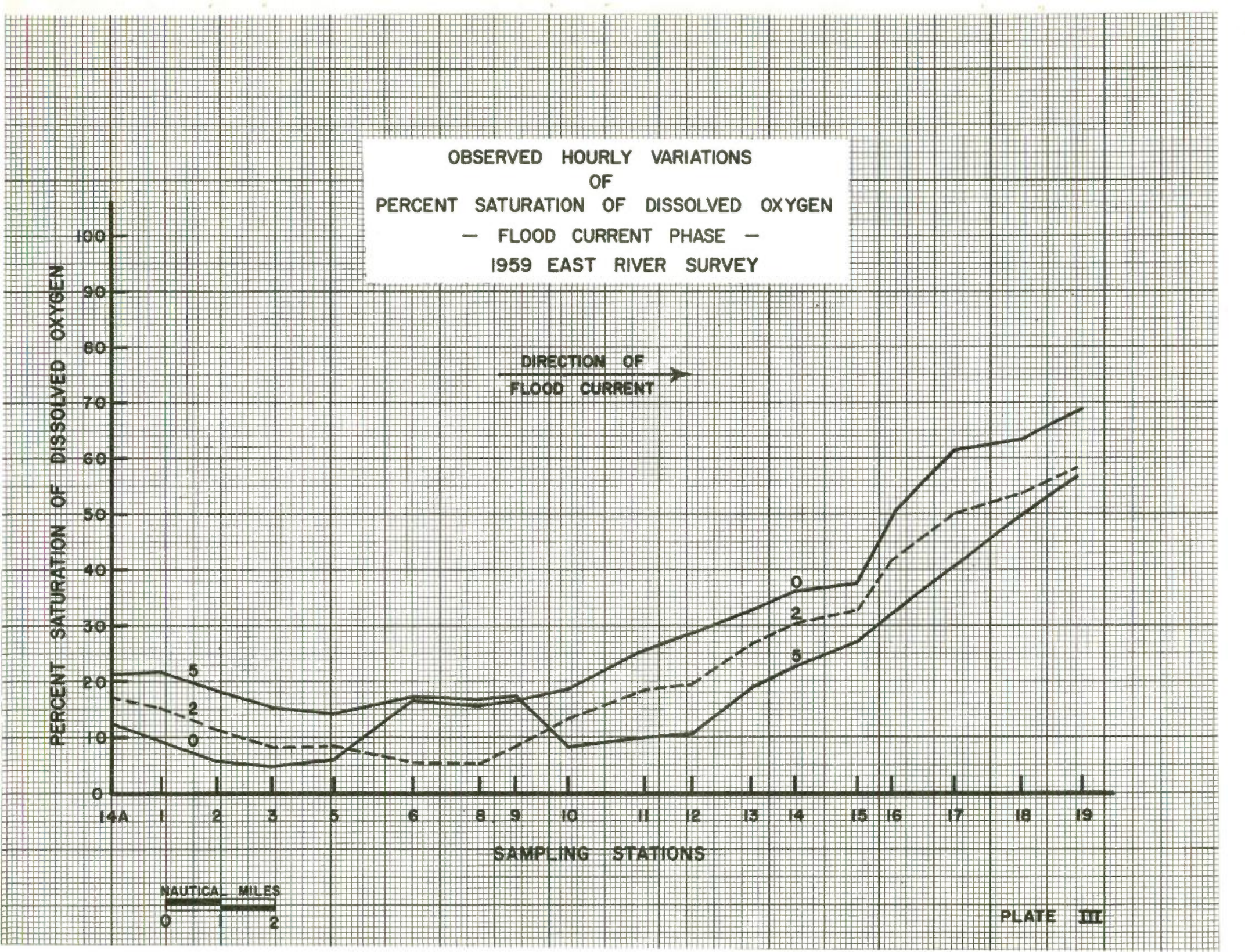


PLATE III

4.7 percent at Station 3. It should be noted that a sharp increase of approximately 10 percent occurs between Stations 5 and 6. It then increases to 37 percent at Station 15. From Stations 15 through 19, the increase is much sharper in the presence of better waters from the westerly end of Long Island Sound.

The line marked "2" shows the variation of the percent saturation values along the profile two hours after the conditions in Line "O". It should be noted that the saturation values have increased at the section from Station 14A through Station 5. From Stations 5 through 9, the percent saturation values have dropped to a low point similar to that over Station 3 at time "O". The sharp increase in saturation values occurs for Line "2" between Station 9 and 10. Thus, the section of comparatively badly polluted water is moved from Stations 2, 3 and 5 to Stations 6, 8 and 9, and caused the low point to shift from Station 3 to Station 8. As this section of water is moved up the East River, it is displaced by the better waters entering from the Upper Harbor. The values from Station 10 through Station 19 form a sloping line describing a variation in percent saturation very similar to that shown by Line "O"; however, the values at these stations are uniformly below those shown by Line "O".

Line "5" represents the conditions along the profile near the end of the flood phase. This shows how the percent saturation values have continued to rise in the section from Station 14A to Station 9. There is a sharp drop in the percent saturation profile between Stations 9 and 10, with the low point for this fifth hour variation being 8.2 percent saturation, at Station 10. Now, the sharp increase occurs between Stations 12 and 13, and outlines the upper end of the section of badly polluted water. Line "5" also shows how the continual flooding from the Upper Harbor has caused the percent saturation of dissolved oxygen values to drop between Stations 14 and 19. Thus, the upper end of the "slug of polluted water," as outlined by the slope of the lines, has moved from its initial position between Stations 5 and 6 to its intermediate position between Stations 9 and 10, and then, stops near the end of the flood at its position between Stations 12 and 13. For the sake of clarity, lines are not being shown for variations produced during

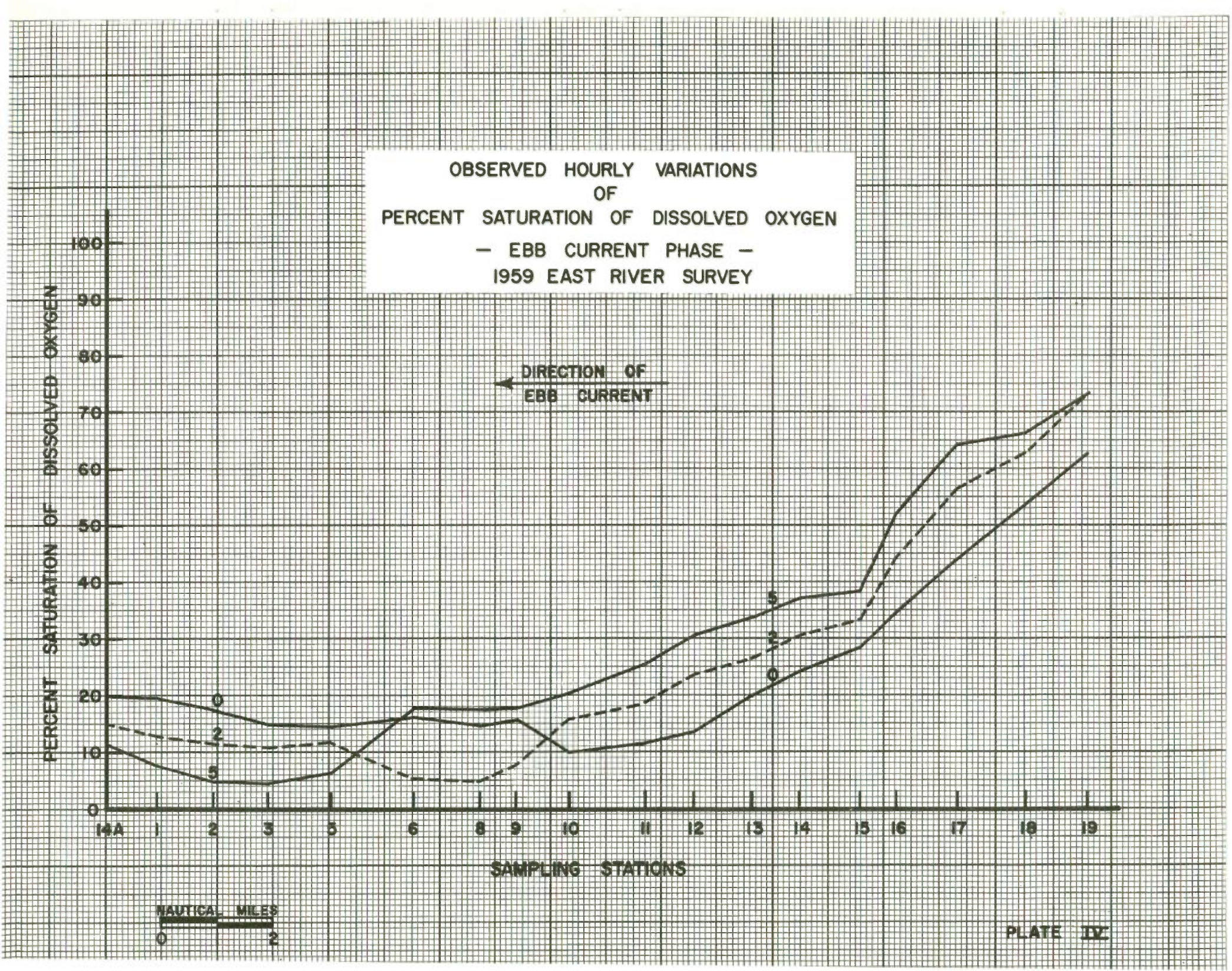
each hourly interval.

Plate IV is similar to that of Plate III except that it shows the observed hourly variations of percent saturation of dissolved oxygen occurring during the ebb current phase. Line "O", here, indicates the conditions existing throughout the profile just as the waters start ebbing towards the Upper Harbor and occur one hour after the conditions represented by Line "5" in Plate III. By comparing this plate with Plate III, it can readily be seen that the values indicated by Line "O" are very close to those of Line "5" in Plate III.

Line "2", Plate IV, indicates the change brought about along the profile, by two hours of ebbing of the waters towards the Upper Harbor. The better quality waters from Long Island Sound flowing into the Upper East River have produced higher percent saturation values at all of the Stations from 19 down through 10. The suppression of dissolved oxygen noted between Stations 10 and 5 is brought about by the movement of the "slug of pollution" over these stations. The values at Stations 5 through 14A have also been dropped.

Line "5" shows the variation of percent saturation values near the end of the ebb current phase. It also shows that the maximum percent saturation values are reached in the section from Stations 19 through 6 and are brought about by the entrance of better waters from Long Island Sound. The "slug of pollution" is now situated over the section extending from Station 6 down to Station 14A. Thus, the ebb current phase has tended to raise the percent saturation values in the Upper East River and move the "slug of pollution" to its southerly position near Newtown Creek. The flooding and ebbing caused an oscillation of a concentrated "slug of pollution" from the Lower to the Upper East River and back. The concentrated "slug of pollution" is longer in length in the Lower than it is in the Upper East River. This is what one would expect when considering the fact that the Upper East River has a much greater cross-sectional area.

Plate V shows the observed hourly variations of


OBSERVED HOURLY VARIATIONS
OF
PERCENT SATURATION OF DISSOLVED OXYGEN
— EBB CURRENT PHASE —
1959 EAST RIVER SURVEY
PERCENT SATURATION OF DISSOLVED OXYGEN
100
90
80
70
60
50
40
30
20
10
0
DIRECTION OF
EBB CURRENT
0
2
5
14A
1
2
3
5
6
8
9
10
11
12
13
14
15
16
17
18
19
SAMPLING STATIONS
NAUTICAL MILES
0
2
PLATE IV.

OBSERVED HOURLY VARIATIONS OF CHLORIDE CONCENTRATION
— FLOOD CURRENT PHASE —
1959 EAST RIVER SURVEY

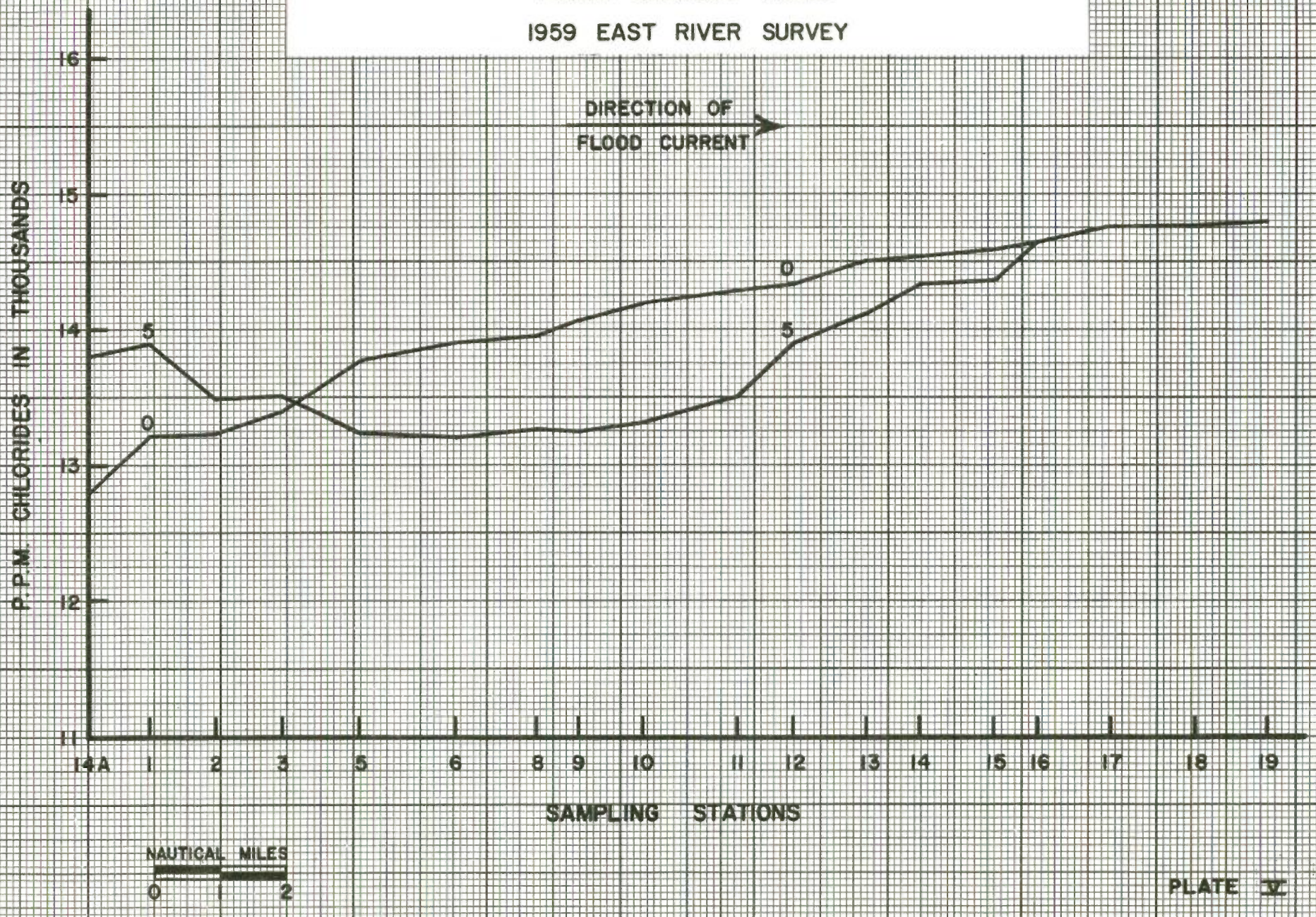


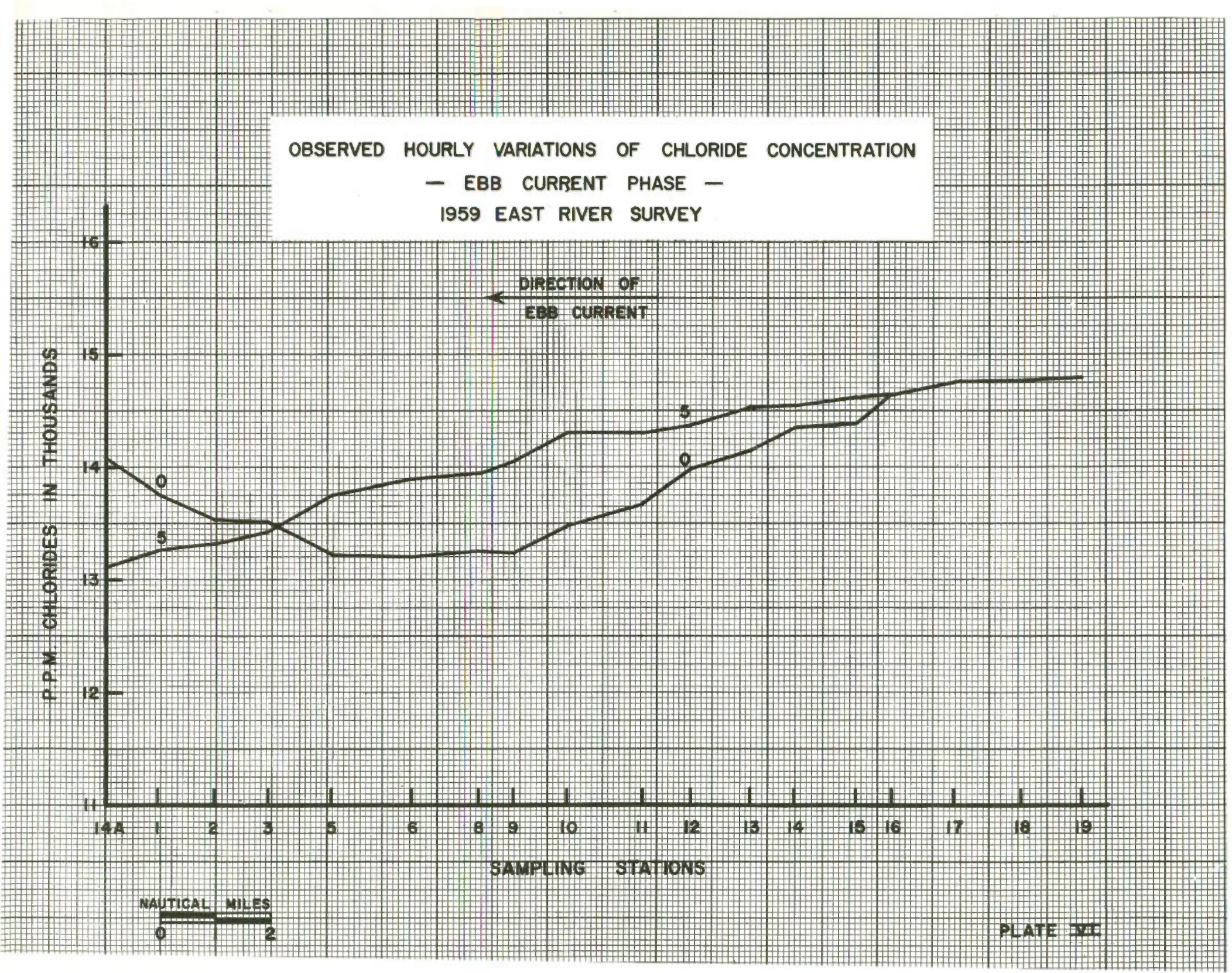
PLATE IV

chloride concentration produced by the flood current phase. Here again, Line "O" shows the variation of chloride concentration throughout the profile at the beginning of the flood current. The chloride concentration varies from 12,800 ppm at Station 14A, to a maximum of 14,900 ppm at Station 19. Line "5" shows the variation of chloride concentration after five hours of flooding, or five hours after the conditions indicated by Line "O". Thus, the flooding has increased the chloride concentration in the lower section of the East River from Stations 14A through Station 3.This is due to the waters entering the Lower East River from the Upper Bay during the flood phase. The section of this profile extending from Station 3 through Station 12 has a lower concentration of chlorides and indicates the presence of a larger amount of fresh water than at either end of the profile. Also, it should be noted that the variations of chloride concentrations at Stations 14 and 15 are very small. These stations show an average variation of approximately 100 parts per million chlorides above or below the station means. Station 14 is approximately one mile inside the East River, while Station 15 is at Throggs Neck. The small variation of chloride concentrations at the two stations indicates a very small influence from fresh water flow. Also, there was little variability of chloride concentration produced by the flooding or ebbing currents at Stations 16, 17, 18 and 19.

Plate VI shows the observed hourly variations in chloride concentrations produced by the ebb current phase of the tidal cycle. The conditions described by Line "O", Plate VI, occurred one hour after the conditions represented by Line "5" on Plate V.

Coliform Density

The Most Probable Number of coliform organisms was determined at Stations 7 through 20. Determinations were made at these stations to evaluate the variation of coliform density through the Upper East River and west end of Long Island Sound. This data will not only show the existing conditions but will serve as a basis of comparison in determining the effect of chlorination facilities, which will be added to the Tallmans Island Sewage Treatment Plant.


OBSERVED HOURLY VARIATIONS OF CHLORIDE CONCENTRATION
— EBB CURRENT PHASE —
1959 EAST RIVER SURVEY
DIRECTION OF
EBB CURRENT
P.P.M. CHLORIDES IN THOUSANDS
16
15
14
13
12
11
0
5
5
0
14A
1
2
3
5
6
8
9
10
11
12
13
14
15
16
17
18
19
SAMPLING STATIONS
NAUTICAL MILES
0
2
PLATE VI

The geometric mean of all observed MPN values was computed for each station and the results tabulated in Table II.

There were two rains during the survey, which affected the observations. The MPN values observed during the day of the rain and the following day were used to compute a geometric mean for the wet weather conditions. The latter values and the ratios of wet to dry weather values are also tabulated in Table II.

The geometric mean of the MPN values observed during dry weather conditions are plotted on Plate VII and show how the values decrease from a geometric mean of 58,770 coliform organisms per 100 ml. to a minimum of 254 at Station 19 near Gangway Rock. The higher count at Station 8 may be attributed to the influence of the large amount of raw and unchlorinated domestic waste entering and cumulating in that section of the East River. Plate III, showing the observed hourly variation of percent saturation of dissolved oxygen during the flood current phase, demonstrates how dissolved oxygen may be used to indicate how far the pollution moves in one flood phase; also, how far the waters, which are high in coliform organisms, may be moved in a few hours. Thus, the tidal currents cause the grossly polluted waters to exert direct influence over Upper East River Stations during part of the current cycle.

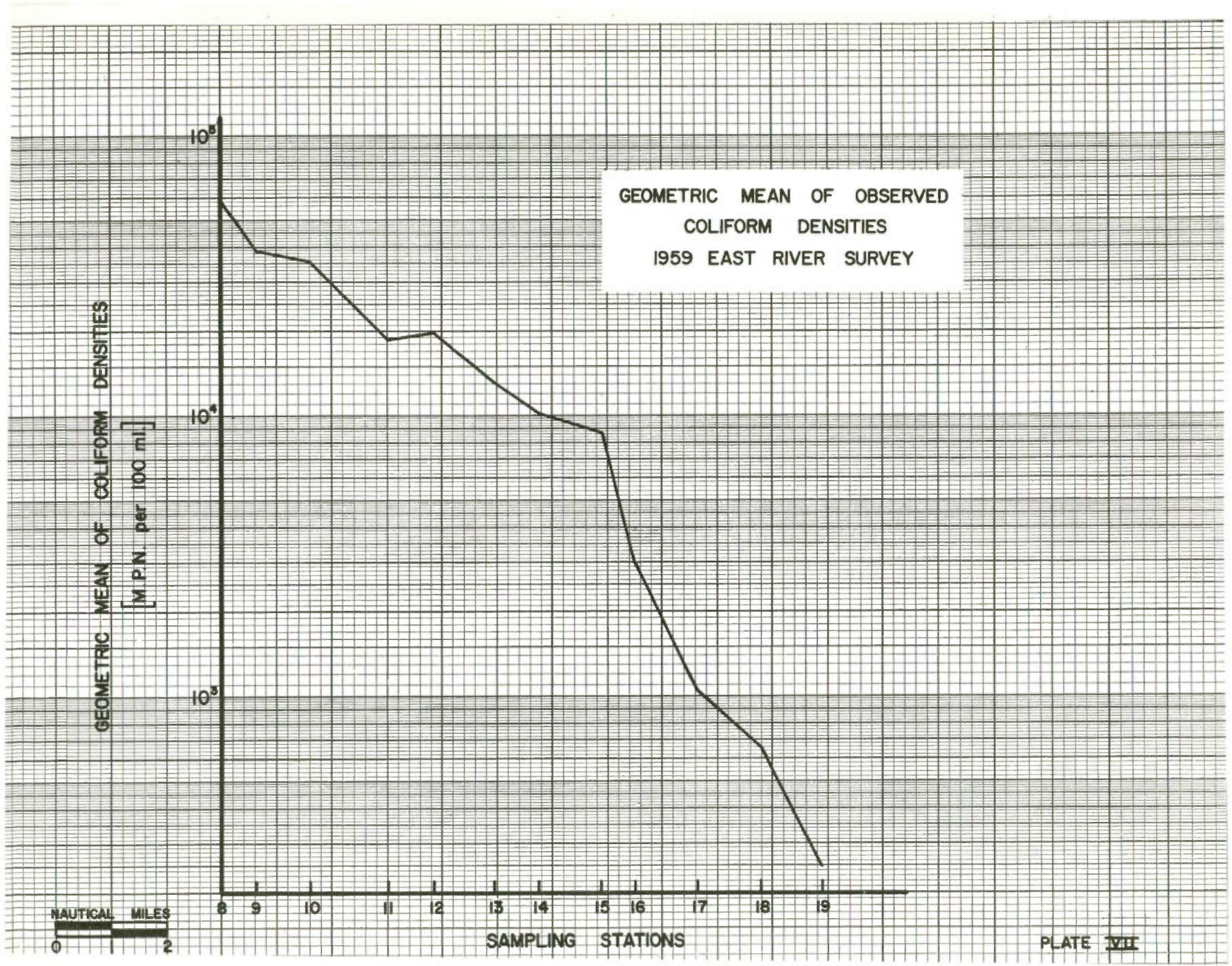
Proceeding from Station 8 towards Station 15 at Throggs Neck, it can be seen that the geometric mean coliform density diminishes from a high of 58,770 MPN per 100 ml. to 8,655 MPN per 100 ml., at Station 15. The observed mean concentration diminishes at a greater rate in passing from Stations 15 to 19. This greater rate of decrease in numbers of organisms may be attributed to the increased dilution afforded by Long Island Sound waters.

Station 17 is located in the main channel of Long Island Sound and is opposite Stepping Stones Beach. The geometric mean density of coliform organisms observed at Station 17 was 1,050 MPN per 100 ml. The sponges released in the East River travelled

Table II

GEOMETRIC MEAN
of the
MOST PROBABLE NUMBER OF COLIFORM ORGANISMS
Per 100 ml.

SAMPLING STATION	OBSERVED GEOMETRIC MEAN MPN/100 ml.		RATIO OF MEAN VALUES
	WET WEATHER	DRY WEATHER	WET WEATHER / DRY WEATHER
7	18,100	21,900	0.83 - 1
8	75,570	58,770	1.29 - 1
9	73,290	38,570	1.90 - 1
10	82,180	35,150	2.34 - 1
11	80,260	18,560	4.32 - 1
12	60,620	19,710	3.08 - 1
13	55,700	13,200	4.22 - 1
14	35,290	10,170	3.47 - 1
15	16,610	8,655	1.92 - 1
16	6,628	2,959	2.24 - 1
17	1,348	1,050	1.28 - 1
18	1,205	650	1.85 - 1
19	254	250	1.02 - 1
20	36,100	25,100	1.44 - 1


GEOMETRIC MEAN OF OBSERVED
COLIFORM DENSITIES
1959 EAST RIVER SURVEY
GEOMETRIC MEAN OF COLIFORM DENSITIES
[M.P.N. per 100 ml]
10^5
10^4
10^3
8 9 10 11 12 13 14 15 16 17 18 19
SAMPLING STATIONS
NAUTICAL MILES
0 2
PLATE VII

out across Little Neck Bay into Long Island Sound and were recovered near Stepping Stones Beach. Some of the sponges went ashore just east of and others were sighted just west of the Stepping Stones Beach.

A study of the observed hourly variations of percent saturation of dissolved oxygen, shown in Plate III, demonstrates how poorer quality waters from Station 12 are moved from the Upper East River through Throggs Neck and out into Long Island Sound. The geometric mean coliform density profile, Plate VII, shows how the predominant source of pollution for the waters opposite Stepping Stones Beach is the East River. Thus, the course of the sponges, the mean coliform density profile and the dissolved oxygen variations all confirm the passage of pollution from the East River to Long Island Sound and Stepping Stones Beach area.

SUMMARY AND CONCLUSIONS

(1) The waters classified as Class "B" in the East River did not meet the minimum Compact requirement of 30 percent saturation of dissolved oxygen for the entire distance of approximately 9.5 miles.

(2) The waters classified as Class "A" in the Upper East River and west end of Long Island Sound did not meet the minimum Compact requirement of 50 percent saturation of dissolved oxygen for a distance of approximately 5.5 miles.

(3) No significant increase in dissolved oxygen in the East River is expected until the completion of the Newtown Creek Pollution Control Project in 1965.

(4) There is a section of badly polluted water which oscillates up and down the East River with the flooding and ebbing currents and varies in length due to changes in cross sectional area.

(5) There is a section of water which is comparatively lower in chloride concentration and which oscillates up and down the East River with the tidal currents. This section, as outlined by the hourly variations of chloride concentration coincides closely with the grossly polluted "slug" outlined by the hourly variations in percent saturation of dissolved

oxygen.

(6) The variations in chloride concentration at Throggs Neck were observed to be very small and indicate that any flow of fresh water, out through Throggs Neck, was comparatively small in volume.

(7) Pollution which is introduced at Station 12 can be carried by tidal currents through Throggs Neck to Stepping Stones Beach.

(8) Chlorination facilities for the Tallmans Island Sewage Treatment Plant, near Station 12, are under construction, and are expected to reduce the coliform density in the Upper East River and westerly end of Long Island Sound.

APPENDIX A

DESCRIPTION OF SAMPLING STATIONS

Used in the

1959 WATER AREA SURVEY

DESCRIPTION of SAMPLING STATIONS
Used in the
1959 WATER AREA SURVEY

I. EAST RIVER AND LONG ISLAND SOUND AREA

STATION 1 — Mid-channel of East River

East-West Range -
Pier #39 Manhattan with Finger Pier #2 Brooklyn (Foot of Bridge Street).

North-South Range -
Center of Manhattan Bridge

STATION 2 — Mid-channel of East River

East-West Range -
E. Houston St. (Overpass) Manhattan with Pfizer Storage Tank, Brooklyn.

North-South Range -
South end of Pier J (Brooklyn Navy Yard) with center of Williamsburg Bridge.

STATION 3 — Mid-channel of East River

East-West Range -
Pier #73 (School Ship) Manhattan with open Pier, ft. of Greene St., Brooklyn.

North-South Range -
Poorhouse Flats Range.

STATION 4 — Mid-channel of (East Channel, Welfare Island)

East-West Range -
Group of buildings, south end of Island (Center Bldg.) with open pier (North side) Hoffman Beverage Co.

STATION 5 — Mid-channel of (West Channel, Welfare Island)

East-West Range -
Pedestrian overpass on East River Drive with group of buildings, south end of Welfare Island. (Same buildings as in Station 4)

STATION 6 — Mid-channel of East River

East-West Range -
Group of buildings, north end of Welfare Island with south end of Carl Schurz Park.

North-South Range -
Stack on Welfare Island with flag pole at Gracie Mansion.

STATION 7 — Mid-channel of Harlem River

Under center of pedestrian bridge to Wards Island.

STATION 8 — Mid-channel at Hell Gate (East River)

Under center of N.Y., N.H. and H.R.R. Bridge.

STATION 9 — Mid-channel of East River

East-West Range -
Fl.R.Bell Beacon on Wards Island with tall stack on Con Edison's Astor Plant.

STATION 10 — Mid-channel of East River

East-West Range-
Fl.G.Beacon on North Brother Island with twin stack on Power House, Bronx.

STATION 11 — Mid-channel of East River

East-West Range -
Fl.G. Beacon (College Point) with stack on Rikers Island.

North-South Range -
Line from center of Sanitation Pier (Hunts Pt.) with Fl.R.#4 Buoy (Station approx. 250 yds. S.E. of #4 Buoy).

STATION 12 — Mid-channel of East River

East-West Range -
Sludge storage tank (Tallmans Island) with large gas storage tank (Hunts Pt.).

North-South Range -
Line of #1 Bell Buoy with Fl.G.Beacon, College Point. (Station approx. 200 yds. north of #1 Bell Buoy).

STATION 13 Mid-channel of East River

Under center of Whitestone Bridge.

STATION 14 Mid-channel of East River

East-West Range -
Bridge Tower (Old Ferry Pt.) with Tower on New Throggs Neck Bridge (Fort Schuyler)

Northeast-Southeast Range -
Fl.G. Bell Beacon (Whitestone) with water tank (Fort Schuyler).

STATION 14A Mid-channel of East River
East-West Range -
Pier #11 Manhattan with Pier #2 (Meyer Line - Brooklyn)

STATION 15 Mid-channel of East River

East-West Range -
R-Nun #2 (Willets Pt.) with tower on Whitestone Bridge (Bronx)

North-South Range -
Fl.R.#48 Bell Buoy with R-Nun #2 (Little Bay)

STATION 16 Mid-channel of Long Island Sound

East-West Range -
Mast at Kings Pt. with water tower (Fort Schuyler)

North-South Range -
Stepping Stone Light with Fl.R. #48 Bell Buoy (Fort Schuyler)

STATION 17 Off Stepping Stone Light (Approx. 300 yds to N.)

North-South Range -
Stack on Hart Island with Bridge Tower (Fort Schuyler)

East-West Range -
Stepping Stone Light with Mast
at Kings Pt.

STATION 18 — Off Fl.R. Bell - Hart Island

North-South Range -
Gangway Rock Light with Stepping
Stone Light.

East-West Range -
Fl. R. Bell (Hart Island) with
tip of Hewlett Pt.

STATION 19 — Off Gangway Rock Light

North-South Range -
Tower on Sands Point with
stack on Hart Island

East-West Range -
#1 Gong with Fl. Bell Buoy #27
(Gangway Rock)

STATION 20 — Mid-channel of Rikers Island Channel
off Fl. R. #4 Buoy.