PRELIMINARY INVESTIGATION
of
COLIFORM DENSITIES IN JAMAICA BAY

New York City Departments are presently engaged in a consideration of the feasibility of constructing combined sewer overflow treatment basins as a means of reducing the amount of pollution discharged into areas such as Jamaica Bay. It is hoped that these combined sewer overflow treatment basins will adequately remove suspended solids and provide the means for adequate disinfection of these overflows prior to their entrance into the receiving waterways. It is anticipated that this will improve the bacterial quality of the waters such as Jamaica Bay, and provide additional bathing beach area.

New York City Departments were prepared to proceed with the design and construction of these overflow basins. The design for the first overflow basin is well advanced; however, it was decided by New York City Departments to review the bacteriological status of the waters in Jamaica Bay. The results of this review led to the following comment in a Report prepared by the New York City Department of Public Works.

> "It was surprising to learn that according to the Annual Harbor Records, the coliform density had been increasing steadily since engineers had finished their studies. The semi-logarithmic plots of coliform densities over the past decade indicate that the curves had taken straight line form in the upper direction. Moreover, this increase in coliform density was noted to have taken

> "place over the last decade at a constant percentage rate varying from 8 - 18% per year in all the branches of the inner harbor as well as Jamaica Bay."

In view of this apparent increasing trend in coliform densities over the years, the Department of Public Works decided to hold the construction of these combined sewer overflow plants in abeyance.

A meeting was held of representatives from each of the various control agencies in the New York City Area. The purpose of this meeting was to discuss possible reasons for this apparent increase in the coliform densities as reflected by the graphs prepared by the New York City Department of Public Works and published in their Report entitled "Selected Data for Study on New York Harbor Coliform Densities in Reference to the Auxiliary (Marginal) Water Pollution Control Program for New York City". In preparation for this meeting, we requested and obtained copies of some of the New York City Department of Public Works data for the Canarsie sampling point in Jamaica Bay. The Commission Staff did a preliminary analysis of these limited data. The details on data, limitations and conclusions are presented in the subsequent sections.

PRESENTATION AND ANALYSIS OF DATA

The information and data utilized by the Commission Staff in its consideration of this problem consisted of certain coliform data, the Report from the New York City Department of Public Works (dated April, 1965) and the

U.S. Weather Bureau.

Plate No. 37 in the Public Works Report is a semi-logarithmic graph showing the variation in coliform densities with time (in years). A copy of this plate is included herewith for reference and demonstration of the trend under consideration.

Table I contains a listing of the New York City Department of Public Works coliform data made available to this Commission. It gives the date on which the samples were taken and the most probably number of coliform organisms per milliliter for top and bottom samples.

The nature of the test as run by the Department of Public Works precluded determination of actual MPN values when the densities were greater than 1100 coliforms/ml. Such MPN values were recorded as "$\triangleright$1100". However in such cases, the MPN of 1100 was used to compute their geometric mean values.

The Public Works data included, for each year, geometric mean MPN's for the top and bottom samples, respectively. The geometric means of only the top sample MPN values are used in the comparisons made in this study. The number of days on which samples were taken at Canarsie is given by year on the next page.

Year	Number of Sampling Days
1955	5
1956	9
1957	8
1958	12
1959	12
1960	12
1961	13
1962	13
TOTAL	84

Table II presents the precipitation data collected by the U. S. Weather Bureau and used in this analysis. Their data is that reported at the Battery unless otherwise noted. As a further consideration, in this table, the total precipitation on the day of sampling plus the previous day was considered as one condition; the total precipitation on the day of sampling and the two immediately preceding days was considered as a second condition; the total precipitation on the day of sampling and the three immediately preceding days was considered as another condition; the total precipitation on the day of sampling plus the four immediately preceding days was considered as another separate condition. The accumulated precipitation for each of these four periods of consideration are computed and tabulated in Table II, for each of the years. This accumulated precipitation for each period was then divided by the number of sampling days in each year to give an <u>average accumulation of precipitation per day of sampling</u> for the condition being considered.

The major part of this precipitation information was collected at the Weather Station at Battery Park, New York. However, a brief comparison of this data was made with similar data collected at the Weather Bureau Station at Central Park and Kennedy International Airport. The values of precipitation recorded are believed to be comparable. Considering the accuracy necessary for this preliminary analysis, the precipitation data at either of these two stations was deemed representative of that at Jamaica Bay.

Conforming with the dimensions used by the United States Weather Bureau, precipitation is recorded in inches. The USWB qualitative measurement "T" meaning "trace" of precipitation was considered zero in all of the comparisons made.

Graph I is a comparison of the geometric means and the individual top samples of coliform concentrations per year at the Canarsis Station, with the average rainfall during specified periods from 1955 to 1962 inclusive.

Graph II is a condensation of Graph I. This is a comparison of some of the geometric mean MPN's with the average rainfall during specified periods. Other comments for Graph I also apply here.

DISCUSSION

A review of the New York City Department of Public Works Report concerning New York Harbor coliform densities, indicated that the coliform densities, in general, appeared to be rising, with time, in a similar manner at all of the sampling stations. Due to the limited time and data available, no detailed analysis could be made by the Commission staff. Therefore, it was decided to select one particular point for a preliminary analysis. It was decided to investigate the available Department of Public Works data for the Canarsie sampling point in Jamaica Bay. Although a check on all sampling points was not made, it is felt that this Canarsie data demonstrates the general trends for most of the sampling locations presented in the Public Works Report and that the conclusions drawn from the Canarsie data might possibly be valid for the other sampling stations.

The New York City Department of Public Works Plate No.37 is a graph showing a plot of the coliform density versus time in years. The curves on this graph are an arithmetic average of the geometric mean of the top samples and a geometric mean of the bottom samples taken at the indicated sampling station. The Canarsie curve shows the same general trend as the curves for each of the other sampling stations located on this Plate No.37. It can be noted that for all sampling stations (except one) on this Plate, there is a sharp

increase in the coliform densities for the year 1964 when compared with 1963. It is possible that this may be attributed to the Department of Public Works reporting a maximum MPN of 2400 per milliliter in 1964 instead of the previously utilized maximum of 1100 coliforms per milliliter in all previous years. This more than doubles the maximum reported density utilized in computation of the means plotted on this graph, and may be the cause of this sharp apparent increase. We do not have the individual data to verify this possibility.

The Commission requested and received coliform information from the Department of Public Works for the years 1955 through and including 1962 for the one sampling station at Canarsie.

Graph No.1 shows a variation of coliform density and inches of rainfall per sampling day versus time. The Graph is divided into two parts, with the coliform density per milliliter being shown on the bottom half of the graph. The time interval considered on this graph starts in 1955 and terminates in 1962. The geometric means of the top samples for the Canarsie sampling station are plotted for these years. Superimposed on these lines are the variations of individual coliform density determinations utilized to compute the geometric mean curve. The top half of Graph No.1 shows the variations of inches of rainfall per sampling day versus the same time scale in years. It is of

interest to note how the inches of rainfall per sampling day varies with the four conditions shown. All four of the curves demonstrate a general increase starting in 1955 through and including 1962. Curve No.1 presents the condition when considering the precipitation occurring on the day of sampling and the preceding day. It is interesting to note that this curve varies up and down as the geometric coliform density curve varies on the lower part of the graph. There is one exception to this which occurred in 1959. In 1959, the coliform density dropped when compared with the 1958 level, while the inches of rain per sampling day actually increased in 1959 versus that of 1958. On all other occasions, however, the up and down trend of the coliform density follows,,in general, that of the inches of rainfall per sampling day. Curves 2, 3 and 4 demonstrate similar trends but do not follow the geometric mean coliform density curve as closely as Curve No.1.

Graph No.II is the same as Graph No.I with the exception that the individual samples are not included in the coliform section. Considering Curve No.1 on Graph I, the inches of rainfall per sampling day in 1955 were .01 and increased to 0.26 inches in 1962. This represents a very large percent increase in inches of rainfall per sampling day. (actually 2,500 percent) Considering the same two terminal conditions, the coliform density increased from approximately 110 in 1955 to

350 per milliliter in 1962. This corresponds to a 220 percent increase in coliform in the same time interval. It is felt that the trend demonstrated by the geometric mean curve over these years is very closely related to the inches of rainfall per sampling day over the same time period and especially as represented by Curve No.1. This seems to imply that the closest correlation with the coliform density curve is accomplished when considering the precipitation on the day of sampling and the immediately preceding day.

After a meeting with representatives of the New York City Department of Public Works and Department of Health, the Commission constructed the same graph as Graph No.I with the exception that all precipitation less than .04 inches during any day or occurring after 4 P.M. on the day of sampling were eliminated from the computation of inches of rainfall per sampling day. It is of interest to state that this did not change the trend of the curves shown in Graphs I and II.

Plate No.37 shows that in 1953 a sharp drop in the observed coliform densities occurred at all of the sampling stations. This marked decrease in coliform density occurred at practically all of the sampling stations utilized by the Department of Public Works in other areas of the New York Harbor. The annual rainfall for 1953 was not lower than the other years considered on this Plate; however, the rainfall for the

summer sampling months of 1953 was the lowest in approximately twenty years.

SUMMARY AND CONCLUSIONS

A brief preliminary investigation of the data gathered by the New York City Department of Public Works and presented in their report under date of April 1965 has revealed some interesting considerations. It is to be understood that this investigation is very brief and considered only a part of the total data gathered by the New York City Department of Public Works; however, we believe that the following statements and conclusions can be made:

(1) According to the Department of Public Works report, the variation of coliform densities, with time, follows the same general trend toward increasingdensities at most of the sampling stations.

(2) Although 1964 was one of the driest years, the adoption of a higher maximum coliform density of 2400 per ml. may be responsible for the apparent increase in 1964 versus 1963 data on Plate No.37 of the Department of Public Works. Dredging of sludge during 1964 may have also contributed to the higher count.

(3) There appears to be a good correlation between the variation of coliform density with inches of rainfall per sampling day, especially when considering the rainfall on the day of sampling and the immediately preceding day.

(4) Considering the years 1955 versus 1962, there was a 220 percent increase in coliform densities at the Canarsie sampling point.

(5) Considering the average inches of rainfall per sampling day, for the day of sampling, and the one prior day, for the years 1955 and 1962, there was a 2,500 percent increase.

(6) The number of samples involved during dry weather is not considered intensive enough at any one time to adequately establish a reference level of coliform density for dry weather conditions.

(7) For the years considered, the wet weather coliform density could not be properly evaluated. With the dilutions used, there was a limiting maximum value of 1100 per milliliter.

(8) This preliminary study provides a strong indication that the discharge from combined sewers during the time of rainfall is the major factor controlling the level of coliform concentrations in the New York Metropolitan waters. The marked increase of the coliforms seems to be due to the fact that during the sampling months, the amount of rainfall has increased for years included in this study.

T A B L E I

NEW YORK CITY DEPARTMENT OF PUBLIC WORKS
COLIFORM CONCENTRATIONS / ML
AT CANARSIE (JAMAICA BAY) STATION J 3
MPN/ML/48 Hr.

DATE	TOP	BOTTOM
6-23-55	39	43
6-30-55	93	23
7-7-55	460	93
7-28-55	150	23
9-15-55	150	93
Geometric Mean	110	32
6-14-56	9.1	93
6-28-56	460	240
7-12-56	> 1100	93
7-16-56	43	43
8-2-56	150	240
8-9-56	> 1100	240
8-16-56	460	93
9-6-56	240	460
9-13-56	> 1100	9.1
Geometric Mean	248	108
6-13-57	43	93
7-3-57	43	93
7-22-57	93	9.1
8-1-57	240	460
8-8-57	150	93
8-22-57	93	43
9-16-57	> 1100	460
9-19-57	460	43
Geometric Mean	150	85

TABLE I-2

MPN/ML/48 HR.

DATE	TOP	BOTTOM
6-12-58	460	240
6-19-58	> 1100	150
7-3-58	93	93
7-10-58	240	93
7-17-58	460	150
7-31-58	1100	93
8-7-58	43	3.6
8-14-58	240	43
8-21-58	75	75
8-28-58	1100	240
9-4-58	23	3.6
9-8-58	460	43
Geometric Mean	247	56
6-4-59	240	240
6-11-59	93	23
6-30-59	240	43
7-6-59	150	9.1
7-9-59	23	9.1
7-23-59	93	93
8-3-59	1100	460
8-10-59	> 1100	290
8-27-59	240	3.6
9-17-59	43	93
9-22-59	43	43
9-24-59	460	150
Geometric Mean	175	58

TABLE I-3

MPN/ML/48 HR.

DATE	TOP	BOTTOM
6-16-60	> 1100	460
6-23-60	460	150
6-30-60	240	43
7-7-60	> 1100	460
7-21-60	210	93
7-28-60	> 1100	> 1100
8-4-60	> 1100	460
8-11-60	2.3	460
8-18-60	> 1100	1100
8-25-60	240	23
9-1-60	> 1100	1100
9-8-60	9.1	23
Geometric Mean	276	227
6-8-61	460	150
6-15-61	> 1100	240
6-22-61	1100	460
6-29-61	> 1100	460
7-13-61	1100	> 1100
7-20-61	93	> 1100
7-27-61	1100	460
8-3-61	1100	240
8-10-61	240	1100
8-17-61	240	75
8-24-61	1100	> 1100
8-31-61	43	240
9-7-61	1100	> 1100
Geometric Mean	440	442

TABLE I-4

MPN/ML/48 HR.

DATE	TOP	BOTTOM
6-7-62	43	9.1
6-14-62	>1100	>1100
6-21-62	43	>1100
7-5-62	23	3.6
7-12-62	1100	460
7-19-62	1100	240
7-26-62	>1100	460
8-2-62	150	150
8-9-62	>1100	1100
8-16-62	1100	240
8-23-62	210	240
8-30-62	>1100	1100
9-5-62	460	240
Geometric Mean	350	230

TABLE II

PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU

Date of Sampling	PRECIPITATION					ACCUMULATED PRECIPITATION SAMPLING DAY IN			
	Sampling Day	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	First + Prior Day	Second + Prior Day	Third + Prior Day	Fourth + Prior Day
1955									
6-23	0	0	0.25	0.35	0.03	0	0.25	0.60	0.63
6-30	0	0	0	0	0.01	0	0	0	0.01
7-7	0	0.03	0	0	0	0.03	0.03	0.03	0.03
7-28	0	0	0	0	0.03	0	0	0	0.03
9-15	0.02	0	0	0	0.01	0.02	0.02	0.02	0.03
TOTAL						0.05	0.30	0.65	0.73
AVERAGE	per sampling day					0.01	0.06	0.13	0.15
1956									
6-14	0	0	0	0	0.07	0	0	0	0.07
6-28	0	0.49	0	0	0.09	0.49	0.49	0.49	0.58
7-12	0.02	0	0	0.35	0.05	0.02	0.02	0.37	0.42
7-16	0.16	0	0.05	0.33	0.02	0.16	0.21	0.54	0.56
8-2	0	0	0	0	0	0	0	0	0
8-9	0	0	0	0.70	0.13	0	0	0.70	0.83
8-16	0	0	0	0.07	0	0	0	0.07	0.07
9-6	0.46	0	0	0	0.06	0.46	0.46	0.46	0.52
9-13	0	0	0	0	0	0	0	0	0
TOTAL						1.13	1.18	2.63	3.05
AVERAGE						0.13	0.13	0.29	0.34

TABLE II (Continued) PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU

Date of Sampling	PRECIPITATION					ACCUMULATED PRECIPITATION SAMPLING DAY INCL.			
	Sampling Data	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	First PrioR Day	+ Second Prior Day	+ Third Prior Day	+ Fourth Prior Day
1957									
6-13	0	0	0	0	0	0	0	0	0
7-13	0	0	0	0.01	0.13	0	0	0.01	0.14
7-22	0	0	0	0	0	0	0	0	0
8-1	0	0	0.40	0	0.06	0	0.40	0.40	0.46
8-8	0	0	0	0	0.22	0	0	0	0.22
8-22	0	0	0	0	0	0	0	0	0
9-16	0.85	0.11	0.06	0	0	0.96	1.02	1.02	1.02
9-19	0	0	0.23	0.85	0.11	0	0.23	1.08	1.19
TOTAL						0.96	1.65	2.51	3.03
AVERAGE						0.12	0.21	0.31	0.38

TABLE II
(Continued)

PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU

Date of Sampling 1958	PRECIPITATION					ACCUMULATED PRECIPITATION SAMPLING DAY INCLUDING			
	Sampling Day	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	First Prior Day	+ Second Prior Day	+ Third Prior Day	+ Fourth Prior Day
6-12	0	0.08	0.10	0.45	0	0.08	0.18	0.63	0.63
6-19	0	0.42	0	0	0	0.42	0.42	0.42	0.42
7-3	0	0	0	0	0	0	0	0	0
7-10	0	0.02	0.62	0	1.06	0.02	0.64	0.64	1.70
7-17	0	0.22	0.03	0.13	0.34	0.22	0.25	0.38	0.72
7-31	0.69	0	0.22	0.09	0.13	0.69	0.91	1.00	1.13
8-7	0	0	0	0	0	0	0	0	0
8-14	0	0.13	0.12	0.01	0	0.13	0.25	1.26	0.26
8-21	0.01	0	0	0	0	0.01	0.01	0.01	0.01
8-28	0	0	0	2.10	0.03	0	0	2.10	2.13
9-4	0	0	0	0	0	0	0	0	0
9-8	0	0	0	0	0	0	0	0	0
TOTAL						1.57	2.66	5.44	7.00
AVERAGE						0.13	0.22	0.45	0.58

PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU

TABLE II
(Continued)

Date of Sampling	PRECIPITATION (Inches)					ACCUMULATED PRECIPITATION SAMPLING DAY INCLUDING			
	Sampling Day	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	First Prior Day	+ Second Prior Day	+ Third Prior Day	+ Fourth Prior Day
1959									
6-4	0	0.01	1.30	0	0	0.01	1.31	1.31	1.31
6-11	0	0	0	0	0	0	0	0	0
6-30	0	0	0	0	0.03	0	0	0	0.03
7-6	0	0	0	0	0	0	0	0	0
7-9	0	0	0	0	0	0	0	0	0
7-23	0.19	0.04	0	1.08	0.26	0.23	0.23	1.31	1.57
8-3	0	0	0	0	0	0	0	0	0
8-10	0	1.52	0.67	0	0	1.52	2.19	2.19	2.19
8-27	0	0	0	0.08	0	0	0	0.08	0.08
9-17	0	0	0	0	0	0	0	0	0
9-22	0	0	0	0	0	0	0	0	0
9-24	0	0	0	0	0	0	0	0	0
TOTAL						1.76	3.73	4.89	5.18
AVERAGE						0.15	0.31	0.41	0.43

TABLE II
(Continued)

PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU

Date of Sampling 1960	PRECIPITATION Sampling Day	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	ACCUMULATED PRECIPITATION SAMPLING DAY INCLUDING First Prior Day	+ Second Prior Day	+ Third Prior Day	+ Fourth Prior Day
6-16	0	0.09	0.06	0	0.58	0.15	0.15	0.15	0.73
6-23	0	0	0	0	0	0	0	0	0
6-30	0	0.05	0	0	0	0.05	0.05	0.05	0.05
7-7	0	0	0	0	0.83	0	0	0	0.83
7-21	0	0.05	0.02	0	0	0.07	0.07	0.07	0.07
7-28	0	2.35	0	0	0	2.35	2.35	2.35	2.35
8-4	0	0.06	0	0	0	0.06	0.06	0.06	0.06
8-11	0	0.22	0	0.19	0	0.22	0.41	0.41	0.41
8-18	0	0	0	0.12	0	0	0.12	0.12	0.12
8-25	0	0	0	0.53	0.58	0	0.53	0.53	1.11
9-1	0	0.75	0.03	0	0	0.78	0.78	0.78	0.78
9-8	0	0	0	0	0.04	0	0	0	0.04
TOTAL						3.57	3.68	4.52	6.55
AVERAGE						0.30	0.31	0.38	0.55

TABLE II
(Continued)

PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU *

Date of Sampling	PRECIPITATION					ACCUMULATED PRECIPITATION SAMPLING DAY INCLUDING			
	Sampling Day	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	First Prior Day	+ Second Prior Day	+ Third Prior Day	+ Fourth Prior Day
1961									
6-8	0	0	0	0	0	0	0	0	0
6-15	0	0.52	0	0	0	0.52	0.52	0.52	0.52
6-22	0.96	0.65	0	0	0	1.61	1.61	1.61	1.61
6-29	0	0	0.15	0.02	0.15	0	0.15	0.17	0.32
7-13	0.14	0	0	0	0	0.14	0.14	0.14	0.14
7-20	1.17	0	0	0	0.01	1.17	1.17	1.17	1.18
7-27	0	0	0	0.58	0	0	0	0.58	0.58
8-3	0.64	0.01	0	1.11	0	0.65	0.65	1.76	1.76
8-10	0	0	0	0.05	0	0	0	0.05	0.05
8-17	0	0	0	0	0	0	0	0	0
8-24	0.03	0.30	0	0.57	0.50	0.33	0.33	0.90	1.40
8-31	0	0	0	0	0.20	0	0	0	0.20
9-7	0	0	0	0	0	0	0	0	0
TOTAL						4.42	4.57	6.90	7.76
AVERAGE						0.34	0.35	0.53	0.60

* Central Park Data

TABLE II (Continued)

PRECIPITATION DATA COLLECTED BY U.S. WEATHER BUREAU *

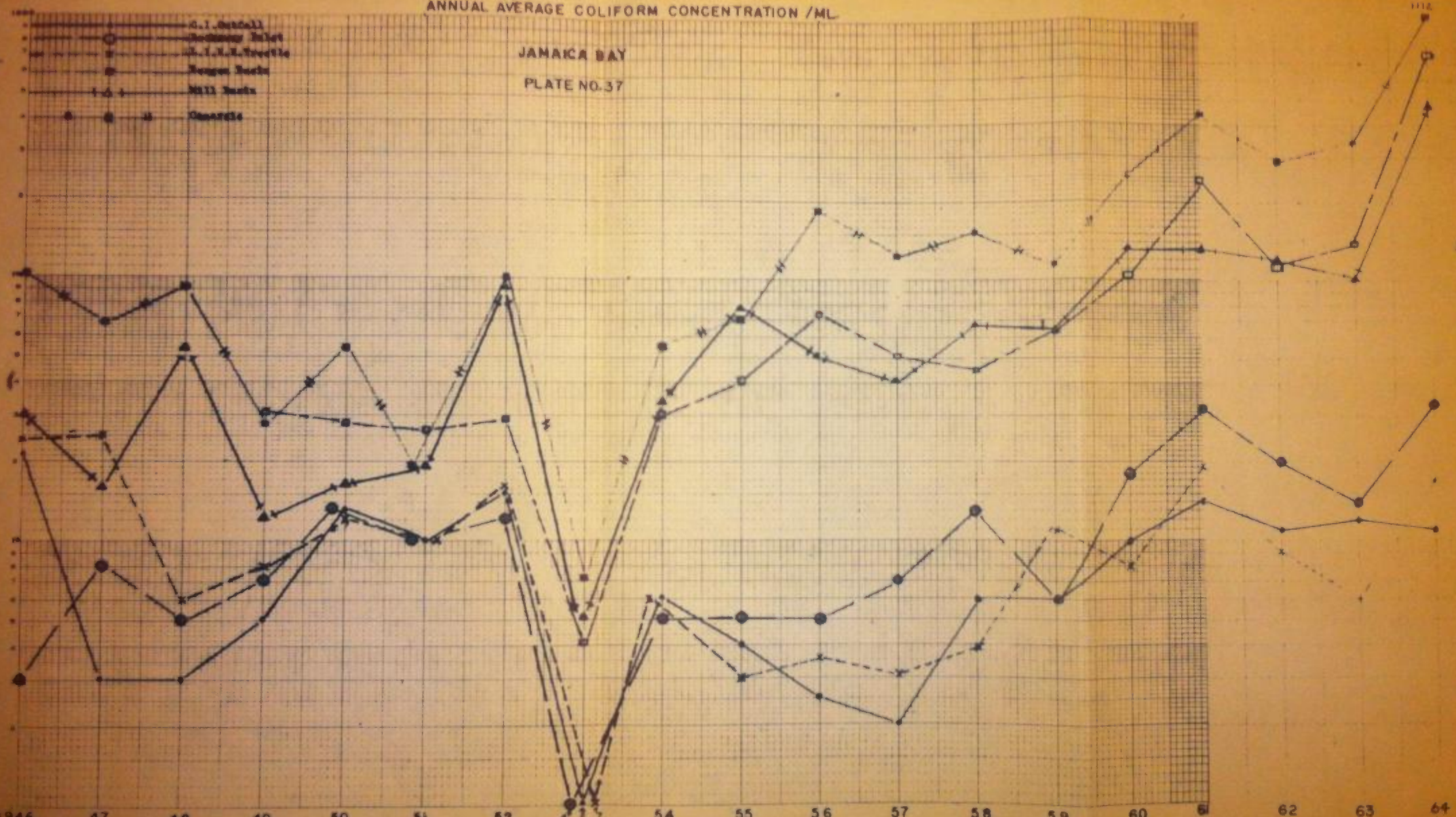
Date of Sampling	PRECIPITATION					ACCUMULATED PRECIPITATION SAMPLING DAY INCLUDING			
	Sampling Day	First Prior Day	Second Prior Day	Third Prior Day	Fourth Prior Day	First Prior Day	+ Second Prior Day	+ Third Prior Day	+ Fourth Prior Day
1962									
6-7	0	0.04	0.64	0	0	0.04	0.68	0.68	0.68
6-14	0	0.63	0.53	0	0	0.63	1.16	1.16	1.16
6-21	0	0.09	0.05	0	0	0.09	0.14	0.14	0.14
7-5	0	0	0	0	0	0	0	0	0
7-12	0	0	0	0	0	0	0	0	0
7-19	0	0.40	0	0	0	0.40	0.40	0.40	0.40
7-26	0	0	0	0.84	0.40	0	0	0.84	1.24
8-2	0	0	0	0	0	0	0	0	0
8-9	0.83	0	0.62	0	0	0.83	1.45	1.45	1.45
8-16	0.23	0	0	0	0	0.26	0.26	0.26	0.26
8-23	0	0	0.73	0.21	0	0	0.73	0.94	0.94
8-30	0	0.36	1.59	0	0	0.36	1.95	1.95	1.95
9-5	0.77	0.02	0	0.17	0	0.79	0.79	0.96	0.96
TOTAL						3.40	7.56	8.78	9.18
AVERAGE						0.26	0.58	0.68	0.71

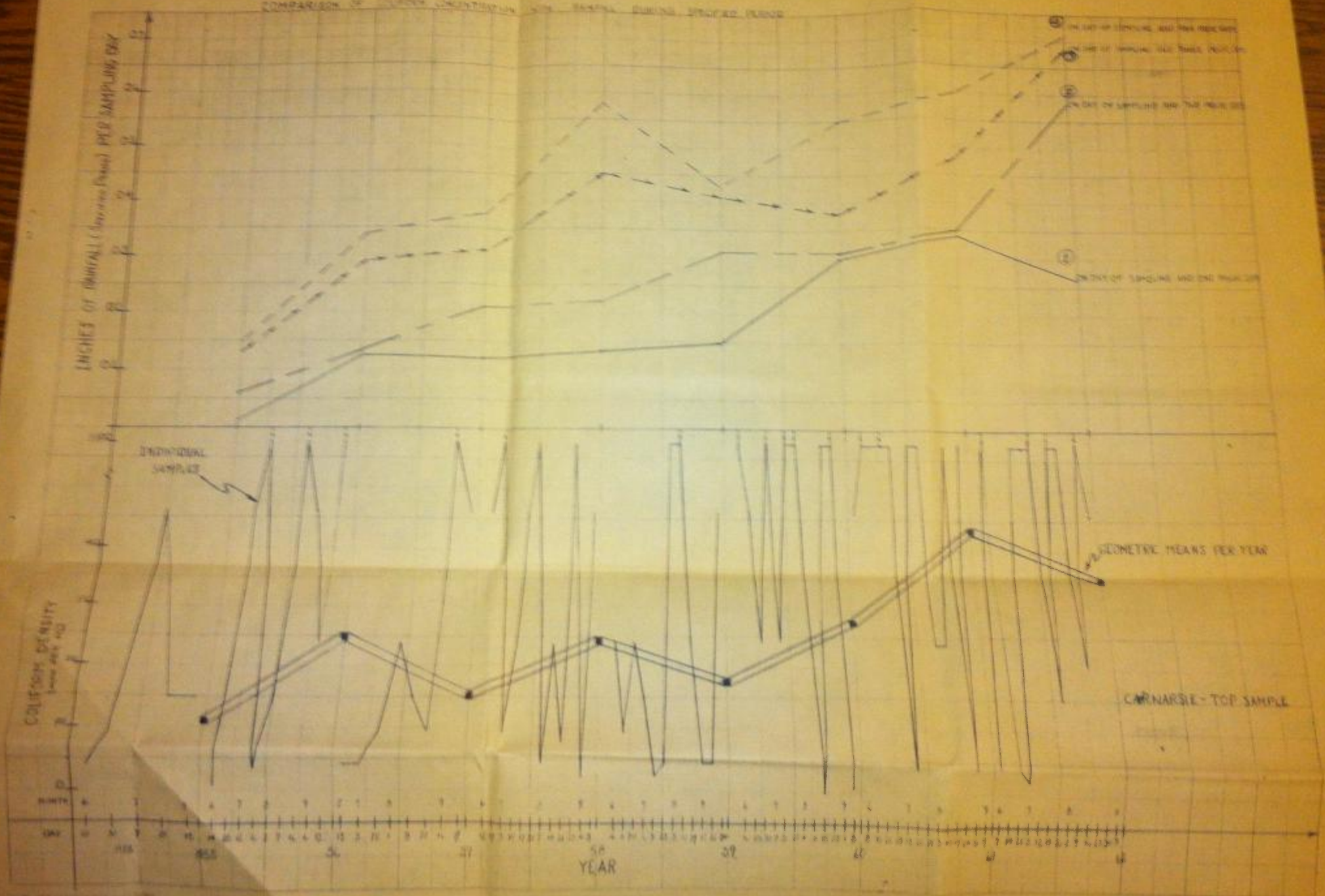
* Central Park Data

ANNUAL AVERAGE COLIFORM CONCENTRATION /ML

JAMAICA BAY

PLATE NO. 37





INTERSTATE SANITATION COMMISSION
10 Columbus Circle
New York 19, New York

COMPARISON OF COLIFORM CONCENTRATION WITH RAINFALL DURING SPECIFIED PERIODS