ASSESSMENT

OF

AMBIENT WATER QUALITY

AND

SEWAGE TREATMENT PLANT EFFLUENTS

IN

THE INTERSTATE SANITATION DISTRICT

PREPARED BY
INTERSTATE SANITATION COMMISSION
311 West 43rd Street, Rm 201
New York, New York 10036
March 1989

INTRODUCTION

The Interstate Sanitation Commission was created in 1936 by a compact between the States of New York and New Jersey for the abatement of existing water pollution and the control of future water pollution in tidal waters of the New York Metropolitan Area. The State of Connecticut joined the Commission in 1941.

The Interstate Sanitation District encompasses hundreds of miles of coastline in one of the most populated and heavily industrialized areas in the world. From the time of the earliest settlements, the District has been undergoing constant change. What is of upmost concern is to ensure that as changes occur, they are planned for and carried out in an environmentally sound manner.

The report was prepared to determine the current status of the District's water quality by identifying any trends over a five-year period -- 1981 and 1986 -- for dissolved oxygen (D.O.) and heavy metals. An assessment was also compiled based on sewage treatment plant data for 1985 to 1987 for total suspended solids (TSS), biochemical oxygen demand (BOD), fecal coliforms, visible oil and grease, and floating solids. The data used in this report were retrieved from information collected by the Commission during the ambient water quality surveys performed in 1981 and 1986 and sewage treatment plant (STP) investigations conducted from 1985 to 1987. There were in total of 732 observations of ambient water quality data and 607 of STP inspection reports.

METHOD OF DATA ANALYSIS

The Interstate Sanitation District (ISD) was divided into nine different areas based on the characteristics of the shoreline and geographical settings in the region. If the sampling station was within the boundaries of a specific area, its data was used to interpret the water quality information for that area. For those sampling stations located close to an area's boundary line, their water quality data (dissolved oxygen & salinity) were run through a "Discriminant Analysis" with data from neighboring areas to determine the area designation. Figure 1 and Table 1 describe the nine areas.

The ambient water quality data were retrieved from STORET and the statistical analyses available in STORET were utilized. Given two sets of water quality data for different time periods, analyses were performed to determine the changes in water quality, if any, over a 5-year period. In most of the cases, the water quality data exhibited a non-normal type of distribution which precluded the use of parametric analysis procedures. This phenomena was observed by running both datasets through a normality test. Therefore, the frequency distribution analysis and Wilcoxon Rank Sum Test, nonparametric statistical methods, were used for analysis.

The data were divided into nine waterways for frequency distribution analysis. The divisions for the concentration ranges in the tables for each pollutant were developed by reviewing frequency distributions generated from the data.

The Wilcoxon Rank Sum Test is a commonly used nonparametric technique for trend analysis. It will test the null hypothesis

that the "before" and "after" concentrations are equally high or low (i.e., there is no change) against the two-sided alternative that the "before" concentrations are higher than the "after" concentrations (i.e., there is an improvement in the water quality).

It is also of interest to estimate the magnitude of such a change, if there is one determined by the Wilcoxon analysis. It is a two-step approach involving the calculation of a matrix from the two sets of data. First, the differences between two datasets are calculated by subtracting each observation in the "after" (1986 data) group from each observation in the "before" (1981 data) group. The second step is to rearrange the matrix in ascending order and use the median value as the point of estimate of the difference in the two groups.

RESULTS AND CONCLUSIONS

Dissolved Oxygen

Long-term dissolved oxygen concentrations were improved within the District waterways in 1986 compared to 1981. The lowest and average D.O. values in 1986 were higher than those reported in 1981. A frequency distribution of surface D.O. concentrations for 1981 and 1986 is shown in Table 2 and a graph of the high, average and low values is shown in Figure 2. Although the number of samples collected in 1986 is less than those collected in 1981, lower surface D.O. readings were recorded in the East River and Arthur Kill/Kill Van Kull/Newark Bay (A/K/N) areas in the summer of 1986. Table 3 and Figure 3 show D.O. concentrations generally lower in the bottom waters compared to the surface values.

Heavy Metals

Cadmium concentrations primarily ranged from < 0.5 ug/l to 5.0 ug/l and showed a similar frequency distribution pattern for areas throughout the District as shown in Table 4. The highest cadmium value was measured Western Long Island Sound with a value of 18.3 ug/l in 1986. The data did not exhibit a significant temporal trend.

Copper concentrations were high, ranging predominantly from 3.3 ug/l to 60 ug/l. High values of copper concentrations were found in the Arthur Kill/Kill Van Kull/Newark Bay area both in 1981 and in 1986. In general, no spatial trend was observed (see Table 5). However, there was a noticeable temporal trend existing in the Upper NY Bay and Lower NY Bay. The magnitude of

decrease in concentrations was estimated to be 8.5 ug/l (52% decrease) in the Upper Bay and 25 ug/l (68% decrease) in the Lower NY Bay.

Lead concentrations ranged primarily from less than 5 ug/l to 40 ug/l and were found to be highest in the Western Long Island Sound in 1986 with the value of 52 ug/l (see Table 6). It was observed to have a step trend of decreasing concentrations in the East River, Arthur Kill/Kill Van Kull/Newark Bay, Lower NY Bay, Jamaica Bay/Rockaway Inlet, and Raritan Bay/Sandy Hook Bay areas. The decreases were statistically significant and the magnitude of the trends were estimated to be 11 ug/l (50% decrease) in the East River, 14 ug/l (70% decrease) in the A/K/N, 8 ug/l (77% decrease) in the Lower NY Bay, 10 ug/l (53% decrease) in Jamaica Bay/Rockaway Inlet, and 8 ug/l (61% decrease) in Raritan Bay/Sandy Hook Bay. A spatial trend was not evident.

Mercury concentrations ranged from < 0.1 ug/l to 1.0 ug/l as indicated in Table 7. The Upper NY Bay, A/K/N, and Lower NY Bay areas showed statistically significant improvements by 50% reduction of mercury concentrations. However, the Western Long Island Sound showed signs of higher mercury concentrations in 1986 than in 1981. No spatial trend was detected.

Nickel concentrations ranged from less than 5 ug/l to 41 ug/l (see Table 8). The highest value, 41 ug/l, was recorded in the East River in 1981. A spatial trend was not observed among the areas. Nevertheless, the Western Long Island Sound, East River, Upper NY Bay, and Lower NY Bay had shown trends of decreasing nickel concentrations. The decreases were estimated to be 1.0 ug/l (12%) in Western Long Island Sound, 3.0 ug/l (30%) in the East River, 2.0 ug/l (28%) in Upper NY Bay, and 2.5 ug/l (33%) in Lower NY Bay. The trends were statistically

significant.

Zinc concentrations ranged predominantly from 7 ug/l to 100 ug/l (see Table 9). The highest value was observed in the Western Long Island Sound with a value of 174 ug/l in 1981. Although no spatial trend was evident within the District, there was a significant trend of reduced zinc concentrations in areas of the Western Long Island Sound, the East River, and Upper NY Bay. The magnitude of the decreases were estimated to be 41 ug/l (58%) in the Western Long Island Sound, 14 ug/l (38%) in the East River, and 21 ug/l (57%) in the Upper NY Bay. They were statistically significant at the 95% confidence level.

Chromium concentrations were low, ranging from < 0.3 ug/l to 10 ug/l as shown in Table 10. A spatial trend was not distinguishable within the District. A temporal trend of decreasing chromium concentrations was detected in Western Long Island Sound, the East River, A/K/N, and Raritan Bay/Sandy Hook Bay areas. The decreases in chromium concentrations were estimated to be 1.5 ug/l (60%) in Western Long Island Sound, 3.0 ug/l (75%) in East River, 2.2 ug/l (55%) in A/K/N, and 2.2 ug/l (55%) in Raritan Bay/Sandy Hook Bay areas. These trends were statistically significant.

Silver concentrations ranged primarily from < 1 ug/l to 5 ug/l (see Table 11). The highest silver concentration was observed in Jamaica Bay/Rockaway Inlet with a value of 69 ug/l in 1986. No spatial trend was detected in the District.

Arsenic concentrations ranged from < 1 ug/l to 20 ug/l; approximately 90% of the measurements were below 3 ug/l. A spatial trend was not observed in the District. Table 12 shows the frequency distributions of arsenic concentrations in the nine

different areas.

Sewage Treatment Plant Effluents

An analysis of ISC sewage treatment plant investigations was performed on data collected for the periods of October 1985 through September 1986 and October 1986 through September 1987. There were 378 investigation reports (81 for primary and 297 for secondary) in 1986 and 229 reports (44 for primary and 185 for secondary) in 1987. The Commission's "6-hour average" and "visual" effluent discharge limitations were used to analyze the data. ISC's 6-hour requirements for BOD and TSS are 50 ug/l. For fecal coliforms the 6-hour geometric mean cannot exceed 800/100 ml and no individual sample can exceed 2400/100 ml. Also, the effluent must not contain floating solids or visible oil and grease. The analysis results are presented in Table 13. Generally speaking, there was a better compliance record in 1987 than in 1986 for all the aforementional parameters; especially fecal colforms. The Commission's year-round disinfection requirement went into effect in July, 1986 and the bacteriological testing showed a significant improvement in compliance for both primary and secondary treatment plants. The Commission's year-round disinfection requirement has had a positive impact on the effluent quality regarding fecal coliforms. This could be due to the fact by operating the disinfection equipment year-round rather than seasonally, there is a greater familiarity with the process and better operations and maintenance procedures.

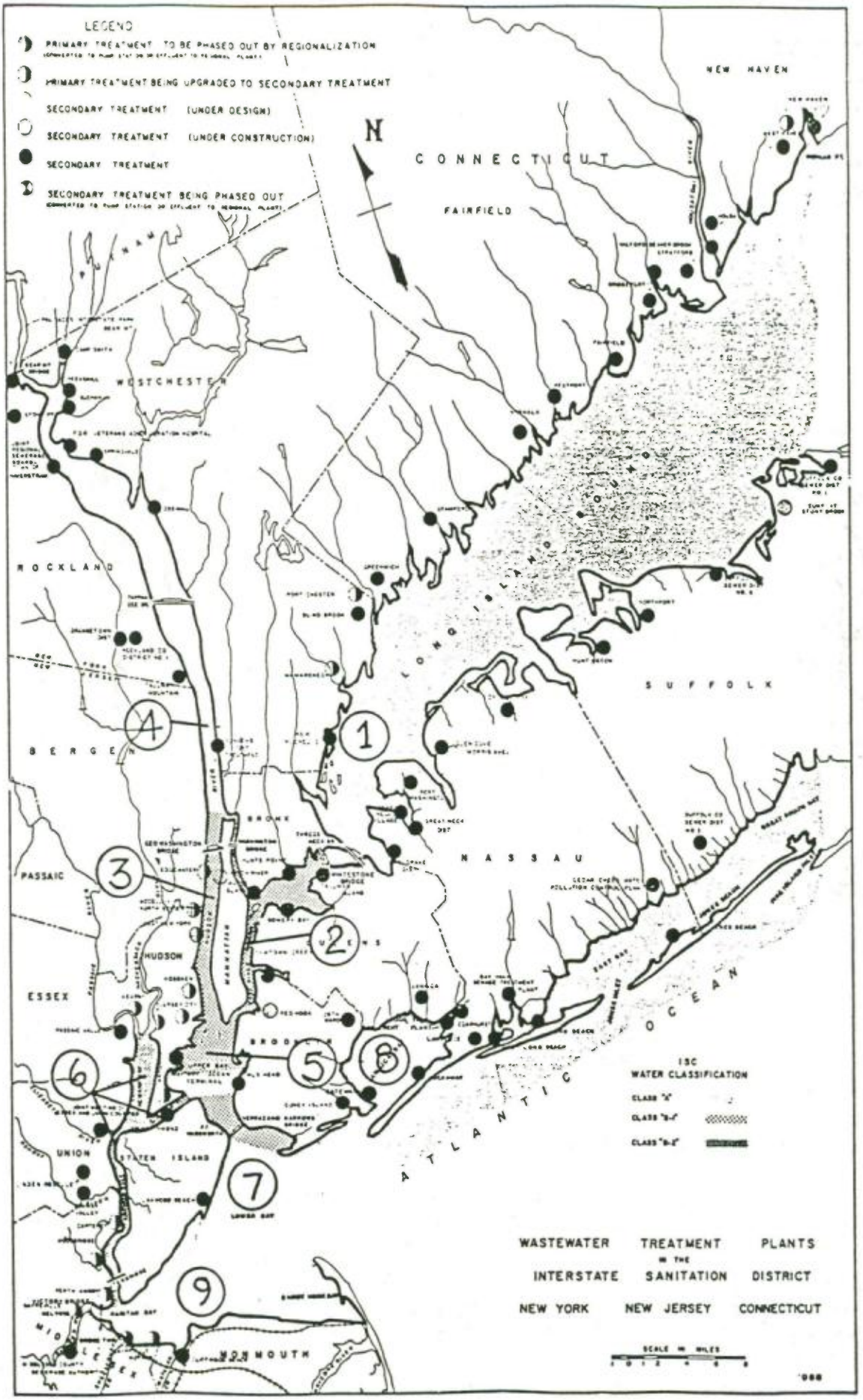
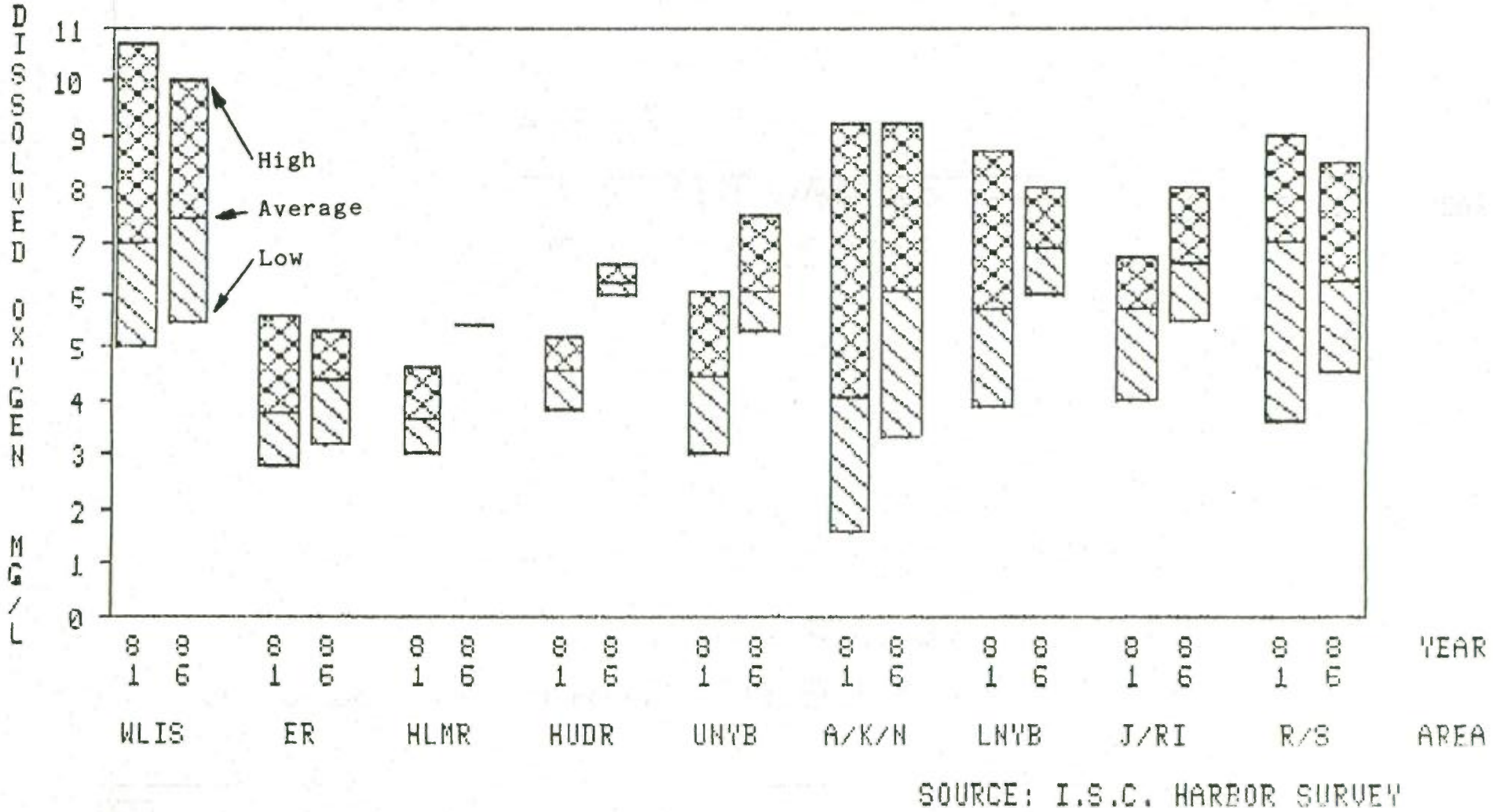

LEGEND
PRIMARY TREATMENT TO BE PHASED OUT BY REGIONALIZATION
PRIMARY TREATMENT BEING UPGRADED TO SECONDARY TREATMENT
SECONDARY TREATMENT (UNDER DESIGN)
SECONDARY TREATMENT (UNDER CONSTRUCTION)
SECONDARY TREATMENT
SECONDARY TREATMENT BEING PHASED OUT
N
CONNECTICUT
NEW HAVEN
FAIRFIELD
WESTCHESTER
ROCKLAND
BERGEN
PASSAIC
HUDSON
ESSEX
UNION
STATEN ISLAND
BRONX
NASSAU
SUFFOLK
LONG ISLAND SOUND
ATLANTIC OCEAN
1
2
3
4
5
6
7
8
9
ISC
WATER CLASSIFICATION
CLASS "A"
CLASS "B"
CLASS "B-I"
WASTEWATER TREATMENT PLANTS
IN THE
INTERSTATE SANITATION DISTRICT
NEW YORK NEW JERSEY CONNECTICUT
SCALE IN MILES

Figure 1

Figure 2

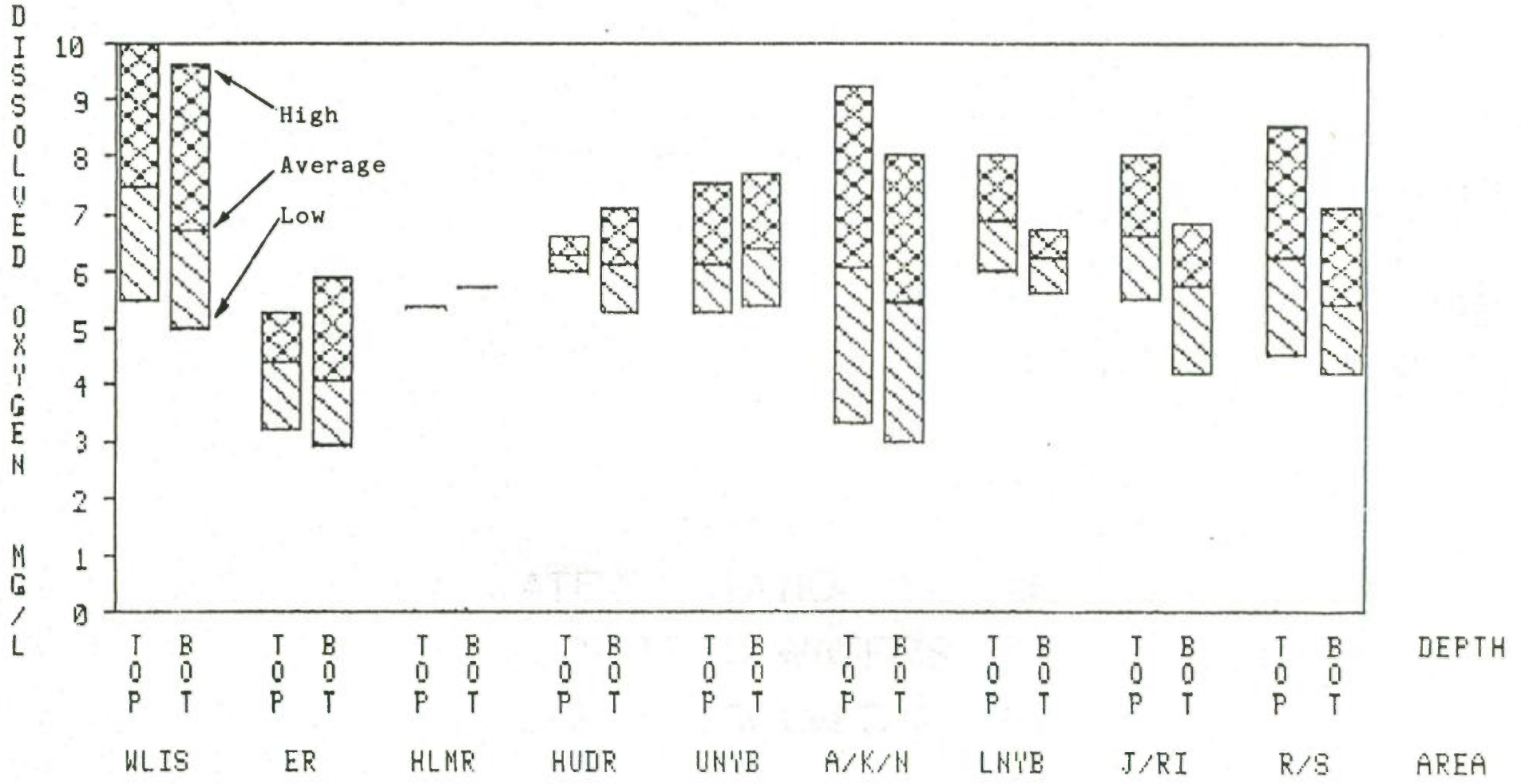
INTERSTATE SANITATION COMMISSION
DISTRICT WATERS
81 & 86 SUMMER TOP DISSOLVED OXYGEN DATA



SOURCE: I.S.C. HARBOR SURVEY

Figure 3

INTERSTATE SANITATION COMMISSION
DISTRICT WATERS
1986 SUMMER DISSOLVED OXYGEN DATA



SOURCE: I.S.C. HARBOR SURVEY

TABLE 1

SAMPLING STATIONS

IN THE

INTERSTATE SANITATION DISTRICT

Area Name	Area Number	Waterway	Number of Sampling Stations
WLIS	1	Upper East River & Western Long Island Sound	15
ER	2	East River	7
HLMR	3	Harlem River	3
HUDR	4	Hudson River	4
UB	5	Upper Bay	5
A/K/N	6	Arthur Kill Kill Van Kull & Newark Bay	8
LB	7	Lower NY Bay	5
J/RI	8	Jamaica Bay & Rockaway Inlet	9
R/S	9	Raritan Bay & Sandy Hook Bay	6

TABLE 2
INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF SUMMER SURFACE DISSOLVED OXYGEN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE DISSOLVED OXYGEN CONCENTRATION IN MG/L 1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	> 5.1	TOTALS
WLIS	81	0 0.0	0 0.0	0 0.0	1 1.4	69 98.6	70 100.0
	86	0 0.0	0 0.0	0 0.0	0 0.0	14 100.0	14 100.0
ER	81	0 0.0	2 10.0	14 70.0	2 10.0	2 10.0	20 100.0
	86	0 0.0	0 0.0	2 40.0	2 40.0	1 20.0	5 100.0
HLMR	81	0 0.0	1 12.5	4 50.0	3 37.5	0 0.0	8 100.0
	86	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 100.0
HUDR	81	0 0.0	0 0.0	3 33.3	5 55.6	1 11.1	9 100.0
	86	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 100.0
UB	81	0 0.0	1 4.8	8 38.1	4 19.0	8 38.1	21 100.0
	86	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0	5 100.0
A/K/N	81	2 6.1	10 30.3	9 27.3	4 12.1	8 24.2	33 100.0
	86	0 0.0	0 0.0	2 16.7	3 25.0	7 58.3	12 100.0
LB	81	0 0.0	0 0.0	1 5.3	3 15.8	15 78.9	19 100.0
	86	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 100.0
J/RI	81	0 0.0	0 0.0	1 2.9	3 8.8	30 88.3	34 100.0
	86	0 0.0	0 0.0	0 0.0	0 0.0	6 100.0	6 100.0
R/S	81	0 0.0	0 0.0	1 4.0	2 8.0	22 88.0	25 100.0
	86	0 0.0	0 0.0	0 0.0	2 33.3	4 66.7	6 100.0
Total: FREQ./ % of FREQ.	81	2 0.8	14 5.9	41 17.1	27 11.3	155 64.9	239 100.0
	86	0 0.0	0 0.0	4 7.3	7 12.7	44 80.0	55 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 3

INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF 1986 SUMMER DISSOLVED OXYGEN*

Area	DEPTH	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE DISSOLVED OXYGEN CONCENTRATIONS IN MG/L 1.1-2.0	2.1-3.0	3.1-4.0	4.1-5.0	> 5.1	TOTALS
WLIS	Top	0 0.0	0 0.0	0 0.0	0 0.0	14 100.0	14 100.0
	Bot.	0 0.0	0 0.0	0 0.0	2 14.3	12 85.7	14 100.0
ER	Top	0 0.0	0 0.0	2 40.0	2 40.0	1 20.0	5 100.0
	Bot.	0 0.0	2 40.0	1 20.0	1 20.0	1 20.0	5 100.0
HLMR	Top	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 100.0
	Bot.	0 0.0	0 0.0	0 0.0	0 0.0	1 100.0	1 100.0
HUDR	Top	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 100.0
	Bot.	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 100.0
UB	Top	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0	5 100.0
	Bot.	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0	5 100.0
A/K/N	Top	0 0.0	0 0.0	2 16.7	3 25.0	7 58.3	12 100.0
	Bot.	0 0.0	1 8.3	4 33.3	1 8.4	6 50.0	12 100.0
LB	Top	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 100.0
	Bot.	0 0.0	0 0.0	0 0.0	0 0.0	3 100.0	3 100.0
J/RI	Top	0 0.0	0 0.0	0 0.0	0 0.0	6 100.0	6 100.0
	Bot.	0 0.0	0 0.0	0 0.0	1 16.7	5 83.3	6 100.0
R/S	Top	0 0.0	0 0.0	0 0.0	2 33.3	4 66.7	6 100.0
	Bot.	0 0.0	0 0.0	0 0.0	2 66.7	1 33.3	3 100.0
Total: FREQ./ % of FREQ.	Top	0 0.0	0 0.0	4 7.3	7 12.7	44 80.0	55 100.0
	Bot.	0 0.0	3 5.8	5 9.6	7 13.5	37 71.1	52 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (Top is 5 feet below water surface; bottom is 5 feet above bottom)

TABLE 4

INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF CADMIUM CONCENTRATIONS IN WATER COLUMN*

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE CADMIUM CONCENTRATION IN UG/L ‹ 0.5	0.6-1.0	1.1-2.7	2.8-5.0	› 5.1	TOTALS
WLIS	81	2 7.1	5 17.9	16 57.1	4 14.3	1 3.6	28 100.0
	86	11 33.4	7 21.2	11 33.3	3 9.1	1 3.0	33 100.0
ER	81	3 27.3	2 18.2	4 36.3	2 18.2	0 0.0	11 100.0
	86	2 22.2	1 11.1	3 33.4	3 33.3	0 0.0	9 100.0
HLMR	81	2 40.0	0 0.0	2 40.0	1 20.0	0 0.0	5 100.0
	86	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	2 100.0
HUDR	81	1 25.0	0 0.0	3 75.0	0 0.0	0 0.0	4 100.0
	86	1 25.0	1 25.0	2 50.0	0 0.0	0 0.0	4 100.0
UB	81	5 50.0	2 20.0	3 30.0	0 0.0	0 0.0	10 100.0
	86	2 40.0	3 60.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	2 15.4	4 30.8	7 53.8	0 0.0	0 0.0	13 100.0
	86	3 23.1	3 23.1	4 30.7	2 15.4	1 7.7	13 100.0
LB	81	4 50.0	0 0.0	2 25.0	2 25.0	0 0.0	8 100.0
	86	1 16.7	2 33.3	2 33.3	1 16.7	0 0.0	6 100.0
J/RI	81	5 35.7	3 21.4	6 42.9	0 0.0	0 0.0	14 100.0
	86	4 33.3	3 25.0	4 33.3	1 8.4	0 0.0	12 100.0
R/S	81	5 50.0	3 30.0	1 10.0	1 10.0	0 0.0	10 100.0
	86	3 42.9	0 0.0	4 57.1	0 0.0	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	29 28.1	19 18.5	44 42.7	10 9.7	1 1.0	103 100.0
	86	27 29.6	21 23.1	31 34.1	10 11.0	2 2.2	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 5

INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF COPPER CONCENTRATIONS IN WATER COLUMN*

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE COPPER CONCENTRATIONS IN UG/L ‹ 2.0	2.1-3.2	3.3-10	10.1-20	20.1-60	› 60.1	TOTALS
WLIS	81	1 3.7	0 0.0	15 55.6	9 33.3	2 7.4	0 0.0	27 100.0
	86	1 3.0	2 6.1	20 60.6	6 18.2	0 0.0	4 12.1	33 100.0
ER	81	0 0.0	0 0.0	3 27.3	3 27.3	5 45.4	0 0.0	11 100.0
	86	0 0.0	0 0.0	6 66.7	2 22.2	1 11.1	0 0.0	9 100.0
HLMR	81	0 0.0	0 0.0	1 20.0	3 60.0	1 20.0	0 0.0	5 100.0
	86	0 0.0	0 0.0	1 50.0	1 50.0	0 0.0	0 0.0	2 100.0
HUDR	81	0 0.0	0 0.0	1 25.0	1 25.0	2 50.0	0 0.0	4 100.0
	86	0 0.0	0 0.0	1 25.0	2 50.0	1 25.0	0 0.0	4 100.0
UB	81	0 0.0	0 0.0	1 10.0	5 50.0	4 40.0	0 0.0	10 100.0
	86	0 0.0	0 0.0	5 100.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	0 0.0	0 0.0	0 0.0	4 30.8	5 38.4	4 30.8	13 100.0
	86	0 0.0	0 0.0	0 0.0	4 30.8	3 23.1	6 46.1	13 100.0
LB	81	0 0.0	0 0.0	0 0.0	2 25.0	4 50.0	2 25.0	8 100.0
	86	0 0.0	0 0.0	4 66.7	1 16.7	1 16.6	0 0.0	6 100.0
J/RI	81	0 0.0	0 0.0	2 14.3	3 21.5	8 57.1	1 7.1	14 100.0
	86	0 0.0	0 0.0	2 16.7	3 25.0	2 16.7	5 41.6	12 100.0
R/S	81	0 0.0	0 0.0	0 0.0	3 30.0	6 60.0	1 10.0	10 100.0
	86	0 0.0	0 0.0	1 14.3	2 28.6	0 0.0	4 57.1	7 100.0
Total: FREQ./ % of FREQ.	81	1 1.0	0 0.0	23 22.5	33 32.3	37 36.3	8 7.9	102 100.0
	86	1 1.1	2 2.2	40 43.9	21 23.1	8 8.8	19 20.9	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 6
INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF LEAD CONCENTRATION IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE LEAD CONCENTRATION IN UG/L < 8.6	8.7-15	15.1-25	25.1-40	> 40.1	TOTALS
WLIS	81	15 53.6	7 25.0	5 17.8	1 3.6	0 0.0	28 100.0
	86	24 72.8	4 12.1	0 0.0	4 12.1	1 3.0	33 100.0
ER	81	0 0.0	3 27.3	5 45.4	3 27.3	0 0.0	11 100.0
	86	8 88.9	0 0.0	1 11.1	0 0.0	0 0.0	9 100.0
HLMR	81	0 0.0	3 60.0	2 40.0	0 0.0	0 0.0	5 100.0
	86	1 50.0	1 50.0	0 0.0	0 0.0	0 0.0	2 100.0
HUDR	81	0 0.0	2 50.0	2 50.0	0 0.0	0 0.0	4 100.0
	86	1 25.0	2 50.0	1 25.0	0 0.0	0 0.0	4 100.0
UB	81	3 30.0	1 10.0	5 50.0	1 10.0	0 0.0	10 100.0
	86	5 100.0	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	0 0.0	4 30.8	4 30.8	4 30.7	1 7.7	13 100.0
	86	13 100.0	0 0.0	0 0.0	0 0.0	0 0.0	13 100.0
LB	81	2 25.0	3 37.5	2 25.0	1 12.5	0 0.0	8 100.0
	86	6 100.0	0 0.0	0 0.0	0 0.0	0 0.0	6 100.0
J/RI	81	5 35.7	1 7.1	4 28.6	4 28.6	0 0.0	14 100.0
	86	9 75.0	3 25.0	0 0.0	0 0.0	0 0.0	12 100.0
R/S	81	1 10.0	7 70.0	2 20.0	0 0.0	0 0.0	10 100.0
	86	7 100.0	0 0.0	0 0.0	0 0.0	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	26 25.2	31 30.1	31 30.1	14 13.6	1 1.0	103 100.0
	86	74 81.3	10 11.0	2 2.2	4 4.4	1 1.1	91 100.0

* Source of data: Interstate Sanitation Commission during 1981 and 1986 (5 feet below water surface)

TABLE 7
INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF MERCURY CONCENTRATION IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE MERCURY CONCENTRATION IN UG/L < 0.1	0.11-0.3	0.31-0.5	0.51-1.0	> 1.0	TOTALS
WLIS	81	16 57.1	12 42.9	0 0.0	0 0.0	0 0.0	28 100.0
	86	3 9.1	23 69.7	5 15.1	2 6.1	0 0.0	33 100.0
ER	81	3 27.3	5 45.4	3 27.3	0 0.0	0 0.0	11 100.0
	86	2 22.2	6 66.7	1 11.1	0 0.0	0 0.0	9 100.0
HLMR	81	2 40.0	2 40.0	1 20.0	0 0.0	0 0.0	5 100.0
	86	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0
HUDR	81	1 25.0	3 75.0	0 0.0	0 0.0	0 0.0	4 100.0
	86	3 75.0	1 25.0	0 0.0	0 0.0	0 0.0	4 100.0
UB	81	4 40.0	5 50.0	1 10.0	0 0.0	0 0.0	10 100.0
	86	5 100.0	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	2 15.4	3 23.1	4 30.7	3 23.1	1 7.7	13 100.0
	86	5 38.5	7 53.8	1 7.7	0 0.0	0 0.0	13 100.0
LB	81	2 25.0	1 12.5	5 62.5	0 0.0	0 0.0	8 100.0
	86	4 66.7	2 33.3	0 0.0	0 0.0	0 0.0	6 100.0
J/RI	81	3 21.4	3 21.4	6 42.9	2 14.3	0 0.0	14 100.0
	86	2 16.7	9 75.0	1 8.3	0 0.0	0 0.0	12 100.0
R/S	81	3 30.0	5 50.0	2 20.0	0 0.0	0 0.0	10 100.0
	86	1 14.3	6 85.7	0 0.0	0 0.0	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	36 34.9	39 37.9	22 21.3	5 4.9	1 1.0	103 100.0
	86	27 29.7	54 59.3	8 8.8	2 2.2	0 0.0	91 100.0

*. Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 8

INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF NICKEL CONCENTRATIONS IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE NICKEL CONCENTRATIONS IN UG/L < 5.0	5.1-7.1	7.2-10	10.1-14	14.1-41	TOTALS
WLIS	81	11 39.3	2 7.2	6 21.4	7 25.0	2 7.1	28 100.0
	86	22 66.7	4 12.1	5 15.2	1 3.0	1 3.0	33 100.0
ER	81	1 9.1	3 27.3	4 36.3	2 18.2	1 9.1	9 100.0
	86	5 55.6	2 22.2	1 11.1	0 0.0	1 11.1	9 100.0
HLMR	81	3 60.0	1 20.0	1 20.0	0 0.0	0 0.0	5 100.0
	86	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0
HUDR	81	2 50.0	0 0.0	2 50.0	0 0.0	0 0.0	4 100.0
	86	3 75.0	1 25.0	0 0.0	0 0.0	0 0.0	4 100.0
UB	81	3 30.0	2 20.0	5 50.0	0 0.0	0 0.0	10 100.0
	86	5 100.0	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	3 23.1	1 7.7	0 0.0	2 15.4	7 53.8	13 100.0
	86	6 46.1	2 15.4	2 15.4	1 7.7	2 15.4	13 100.0
LB	81	2 25.0	2 25.0	2 25.0	0 0.0	2 25.0	8 100.0
	86	6 100.0	0 0.0	0 0.0	0 0.0	0 0.0	6 100.0
J/RI	81	3 21.4	5 35.7	5 35.7	1 7.2	0 0.0	14 100.0
	86	7 58.3	2 16.7	2 16.7	1 8.3	0 0.0	12 100.0
R/S	81	5 50.0	0 0.0	0 0.0	3 30.0	2 20.0	10 100.0
	86	2 28.6	1 14.3	2 28.5	2 28.5	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	33 32.0	16 15.5	25 24.3	15 14.6	14 13.6	103 100.0
	86	58 63.7	12 13.2	12 13.2	5 5.5	4 4.4	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 9

INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF ZINC CONCENTRATIONS IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE ZINC CONCENTRATIONS IN UG/L ≤ 30	30.1-58	58.1-100	100.1-170	> 170	TOTALS
WLIS	81	6 21.4	7 25.0	7 25.0	6 21.4	2 7.2	28 100.0
	86	22 66.7	8 24.2	1 3.0	2 6.1	0 0.0	33 100.0
ER	81	3 27.3	6 54.5	2 18.2	0 0.0	0 0.0	11 100.0
	86	6 66.7	3 33.3	0 0.0	0 0.0	0 0.0	9 100.0
HLMR	81	3 60.0	2 40.0	0 0.0	0 0.0	0 0.0	5 100.0
	86	2 100.0	0 0.0	0 0.0	0 0.0	0 0.0	2 100.0
HUDR	81	1 25.0	3 75.0	0 0.0	0 0.0	0 0.0	4 100.0
	86	3 75.0	1 25.0	0 0.0	0 0.0	0 0.0	4 100.0
UB	81	4 40.0	4 40.0	2 20.0	0 0.0	0 0.0	10 100.0
	86	5 100.0	0 0.0	0 0.0	0 0.0	0 0.0	5 100.0
A/X/N	81	1 7.7	4 30.8	7 53.8	1 7.7	0 0.0	13 100.0
	86	5 38.5	2 15.4	5 38.4	1 7.7	0 0.0	13 100.0
LB	81	2 25.0	3 37.5	2 25.0	1 12.5	0 0.0	8 100.0
	86	4 66.7	1 16.7	1 16.6	0 0.0	0 0.0	6 100.0
J/RI	81	6 42.9	3 21.4	4 28.6	1 7.1	0 0.0	14 100.0
	86	4 33.3	2 16.7	6 50.0	0 0.0	0 0.0	12 100.0
R/S	81	2 20.0	6 60.0	2 20.0	0 0.0	0 0.0	10 100.0
	86	3 42.9	0 0.0	4 57.1	0 0.0	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	28 27.2	38 36.9	26 25.3	9 8.7	2 1.9	103 100.0
	86	54 59.3	17 18.7	17 18.7	3 3.3	0 0.0	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 10
INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF CHROMIUM CONCENTRATION IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE CHROMIUM CONCENTRATION IN UG/L ≤ 1.0	1.1-3.0	3.1-5.0	5.1-7.0	7.1-10	TOTALS
WLIS	81	4 14.3	13 46.4	4 14.3	3 10.7	4 14.3	28 100.0
	86	26 78.8	6 18.2	1 3.0	0 0.0	0 0.0	33 100.0
ER	81	1 9.1	1 9.1	5 45.4	2 18.2	2 18.2	11 100.0
	86	9 100.0	0 0.0	0 0.0	0 0.0	0 0.0	9 100.0
HLMR	81	0 0.0	1 20.0	2 40.0	2 40.0	0 0.0	5 100.0
	86	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	1 100.0
HUDR	81	0 0.0	2 50.0	1 25.0	1 25.0	0 0.0	4 100.0
	86	0 0.0	0 0.0	3 75.0	1 25.0	0 0.0	4 100.0
UB	81	3 30.0	2 20.0	1 10.0	1 10.0	3 30.0	10 100.0
	86	2 40.0	0 0.0	3 60.0	0 0.0	0 0.0	5 100.0
A/K/N	81	2 15.4	2 15.4	6 46.1	1 7.7	2 15.4	13 100.0
	86	6 46.2	6 46.1	1 7.7	0 0.0	0 0.0	13 100.0
LB	81	2 25.0	1 12.5	2 25.0	3 37.5	0 0.0	8 100.0
	86	5 83.3	1 16.7	0 0.0	0 0.0	0 0.0	6 100.0
J/RI	81	5 35.7	6 42.9	0 0.0	3 21.4	0 0.0	14 100.0
	86	7 58.4	4 33.3	1 8.3	0 0.0	0 0.0	12 100.0
R/S	81	3 30.0	1 10.0	4 40.0	2 20.0	0 0.0	10 100.0
	86	5 71.4	2 28.6	0 0.0	0 0.0	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	20 19.4	29 28.1	25 24.3	18 17.5	11 10.7	103 100.0
	86	60 65.9	21 23.1	9 9.9	1 1.1	0 0.0	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 11

INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF SILVER CONCENTRATIONS IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE SILVER CONCENTRATIONS IN UG/L ≤ 1.0	1.1-2.3	3.4-5.0	5.1-13	13.1-69	TOTALS
WLIS	81	12 42.9	5 17.8	11 39.3	0 0.0	0 0.0	28 100.0
	86	25 75.8	5 15.1	2 6.1	1 3.0	0 0.0	33 100.0
ER	81	7 63.4	0 0.0	4 36.4	0 0.0	0 0.0	11 100.0
	86	5 55.6	3 33.3	1 11.1	0 0.0	0 0.0	9 100.0
HLMR	81	4 80.0	0 0.0	1 20.0	0 0.0	0 0.0	5 100.0
	86	0 0.0	0 0.0	2 100.0	0 0.0	0 0.0	2 100.0
HUDR	81	3 75.0	1 25.0	0 0.0	0 0.0	0 0.0	4 100.0
	86	2 50.0	1 25.0	1 25.0	0 0.0	0 0.0	4 100.0
UB	81	9 90.0	0 0.0	1 10.0	0 0.0	0 0.0	10 100.0
	86	3 60.0	2 40.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	10 76.9	1 7.7	1 7.7	1 7.7	0 0.0	13 100.0
	86	13 100.0	0 0.0	0 0.0	0 0.0	0 0.0	13 100.0
LB	81	7 87.5	0 0.0	1 12.5	0 0.0	0 0.0	8 100.0
	86	6 100.0	0 0.0	0 0.0	0 0.0	0 0.0	6 100.0
J/RI	81	14 100.0	0 0.0	0 0.0	0 0.0	0 0.0	14 100.0
	86	6 50.0	2 16.7	3 25.0	0 0.0	1 8.3	12 100.0
R/S	81	7 70.0	0 0.0	3 30.0	0 0.0	0 0.0	7 100.0
	86	7 100.0	0 0.0	0 0.0	0 0.0	0 0.0	10 100.0
Total: FREQ./ % of FREQ.	81	73 70.9	7 6.8	22 21.4	1 0.9	0 0.0	103 100.0
	86	67 73.6	13 14.3	9 9.9	1 1.1	1 1.1	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

TABLE 12
INTERSTATE SANITATION DISTRICT
FREQUENCY DISTRIBUTIONS OF ARSENIC CONCENTRATION IN WATER COLUMN *

Area	YEAR	FREQUENCY & PERCENT FREQUENCY OF OCCURRENCE ARSENIC CONCENTRATION IN UG/L ≤ 1.0	1.1-2.0	2.1-3.0	3.1-5.0	5.1-20	TOTALS
WLIS	81	4 14.3	22 78.6	0 0.0	1 3.6	1 3.5	28 100.0
	86	5 15.1	21 63.6	4 12.1	3 9.1	0 0.0	33 100.0
ER	81	0 0.0	6 54.5	4 36.4	1 9.1	0 0.0	11 100.0
	86	2 22.2	3 33.4	3 33.3	1 11.1	0 0.0	9 100.0
HLMR	81	0 0.0	4 80.0	0 0.0	0 0.0	1 20.0	5 100.0
	86	0 0.0	2 100.0	0 0.0	0 0.0	0 0.0	2 100.0
HUDR	81	0 0.0	2 50.0	0 0.0	0 0.0	2 50.0	4 100.0
	86	1 25.0	2 50.0	1 25.0	0 0.0	0 0.0	4 100.0
UB	81	1 10.0	8 80.0	1 10.0	0 0.0	0 0.0	10 100.0
	86	2 40.0	3 60.0	0 0.0	0 0.0	0 0.0	5 100.0
A/K/N	81	1 7.7	6 46.1	4 30.8	1 7.7	1 7.7	13 100.0
	86	3 23.1	5 38.4	3 23.1	2 15.4	0 0.0	13 100.0
LB	81	0 0.0	6 75.0	1 12.5	1 12.5	0 0.0	8 100.0
	86	0 0.0	5 83.3	1 16.7	0 0.0	0 0.0	6 100.0
J/RI	81	2 14.3	9 64.3	1 7.1	1 7.1	1 7.1	14 100.0
	86	2 16.7	3 25.0	5 41.7	0 0.0	2 16.6	12 100.0
R/S	81	0 0.0	8 80.0	0 0.0	1 10.0	1 10.0	10 100.0
	86	1 14.3	3 42.8	1 14.3	2 28.6	0 0.0	7 100.0
Total: FREQ./ % of FREQ.	81	8 7.8	71 68.9	11 10.7	6 5.8	7 6.8	103 100.0
	86	16 17.6	47 51.6	18 19.8	8 8.8	2 2.2	91 100.0

* Source of data: Interstate Sanitation Commission surveys during 1981 and 1986 (5 feet below water surface)

Table 13

INTERSTATE SANITATION COMMISSION
ANALYSIS OF SEWAGE TREATMENT PLANT EFFLUENT DATA *
FOR THE PERIOD
10/01/1985 THROUGH 09/30/1987

	TYPE OF TREATMENT			
	PRIMARY		SECONDARY	
PARAMETER AND TIME PERIOD	% PASSED	% FAILED	% PASSED	% FAILED
Total Suspended Solids (6-hour average TSS)				
10/01/85 - 09/30/86	22.2	77.8	83.3	16.7
10/01/86 - 09/30/87	20.9	79.1	86.2	13.8
Biochemical Oxygen Demand (6-hour average BOD)				
10/01/85 - 09/30/86	4.9	95.1	84.0	16.0
10/01/86 - 09/30/87	11.4	88.6	87.6	12.4
Fecal Coliforms (Individual Samples) **				
10/01/85 - 09/30/86	61.9	38.1	85.2	14.8
10/01/86 - 09/30/87	71.4	28.6	90.2	9.8
Fecal Coliforms (6-hour Geometric Mean)				
10/01/85 - 09/30/86	66.7	33.3	87.6	12.4
10/01/86 - 09/30/87	76.2	23.8	94.0	6.0
Floating Solids				
10/01/85 - 09/30/86	92.5	7.5	95.6	4.4
10/01/86 - 09/30/87	95.2	4.8	96.2	3.8
Visible Oil and Grease				
10/01/85 - 09/30/86	97.5	2.5	99.3	0.7
10/01/86 - 09/30/87	100.0	0.0	99.5	0.5

* ISC sampling data

** Passed = Passed 2400/100 ml criteria for all individual grab samples taken during an investigation

Failed = Failed 2400/100 ml criteria for at least one individual grab sample taken during an investigation