REPORT ON THE WATER QUALITY OF LOWER LAKE MICHIGAN, CALUMET RIVER, GRAND CALUMET RIVER, LITTLE CALUMET RIVER AND WOLF LAKE

By

DEPARTMENT OF THE INTERIOR
FOR THE PERIOD
JANUARY 1966 THRU JUNE 1966

ILLINOIS - INDIANA

U.S. DEPARTMENT OF THE INTERIOR
Federal Water Pollution Control Administration
Great Lakes Region, Chicago, Illinois

October, 1966

STATUS REPORT ON THE

CALUMET AREA POST ACTION SURVEILLANCE PROJECT

DEPARTMENT OF THE INTERIOR

FOR THE PERIOD

JANUARY THROUGH JUNE 1966

ILLINOIS-INDIANA

U. S. Department of the Interior
Federal Water Pollution Control Administration
Great Lakes Region, Chicago, Illinois
October 1966

TABLE OF CONTENTS

LIST OF FIGURES

PERSONNEL

Raymond E. Johnson
Project Director until Sept. 23, 1966

Robert J. Bowden
Sanitary Engineer
Acting Director after Sept. 23, 1966

David E. Vaughn
Sanitary Engineer until Aug. 23, 1966

Harold A. Bond
Microbiologist until Sept. 2, 1966

Diane P. Gavel
Chemist

Anne Byrne
Microbiologist after Sept. 19, 1966

Joseph V. Slovick
Aquatic Sampler - Hydraulics Technician

William J. Degutis
Aquatic Sampler - Monitor Technician

Daniel Chorowicki
Aquatic Sampler

Lillian Ehlert
Secretary

INTRODUCTION

Part I of this report presents an evaluation of the progress made toward improved water quality in the Calumet Area as of June 30, 1966. This evaluation is based on the results of the sampling program of the Federal Water Pollution Control Administration's Calumet Area Post Action Surveillance Project. The waters reported on include the Grand Calumet River, the Indiana Harbor Canal, Indiana Harbor, the Little Calumet River, Wolf Lake and its outlet and Calumet Harbor.

Part II is an evaluation of the bacteriological quality of eight beaches on Lake Michigan and one on Wolf Lake which are located within the study area. This evaluation covers the entire 1966 bathing season and is based on the surveillance project's own sampling program, data provided by the Chicago Park District and data provided by the Indiana Board of Health.

Part III is a report on the status of the surveillance project and its future prospectus.

The cooperation provided by the Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board, the Metropolitan Sanitary District of Greater Chicago, the United States Coast Guard and others in supplying valuable information and facilities is gratefully acknowledged.

Background

Authority and Organization

A conference on pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and their tributaries, called by the Secretary of Health, Education and Welfare under the provisions of Section 8 of the Federal Water Pollution Control Act (33 USC 466 et. seq.) was held in Chicago, Illinois March 2-9, 1965.

Paragraph No. 14 of the Conclusions and Recommendations of the Conferees for this conference provided that "Surveillance will be the primary responsibility of the Indiana Stream Pollution Control Board, the Illinois Sanitary Water Board and the Metropolitan Sanitary District of Greater Chicago. The Department of Health,Education and Welfare will make available a resident technical group and visiting groups of experts which will assist the State agencies and the Metropolitan Sanitary District of Greater Chicago at such time as requested by them."

The State of Indiana, on April 6, 1965, and the State of Illinois, on April 16, 1965, requested an extensive sampling program by the Federal government to monitor the water quality in the Calumet Area. The Metropolitan Sanitary District has not formally requested a sampling program, but has requested laboratory assistance in the analysis of samples they have collected and in special studies they have conducted on chlorination of the effluent from their sewage treatment plant. The Calumet Area Surveillance Project was organized in the latter part of June 1965 to fulfill the requirements of paragraph No. 14 and the requests of the states.

On January 1, 1966 the Federal Water Pollution Control Administration was created within the Department of Health, Education and Welfare and incorporated the surveillance project.

On May 10, 1966 the Federal Water Pollution Control Administration was transferred from the Department of Health, Education and Welfare to the U. S. Department of the Interior.

Purpose and Scope

The purpose of the Calumet Area Surveillance Project is to assess the progress in the abatement of pollution in the conference area in cooperation with appropriate state and local agencies. This is being accomplished through a sampling program to monitor the water quality at various locations within the conference area and a series of electronic water quality monitors to continuously monitor the water quality at selected key points in the basin. Stream flow measurements are being made so that laboratory analyses in milligrams per liter can be converted to pounds per day. The information obtained through federal, state and local sampling programs and the information furnished by the industries to the state or other responsible agencies on the quality and quantity of their waste flows are evaluated.

Reports are prepared and presented to the Conferees and reconvened conferences on the current water quality and the progress toward abatement of the pollution.

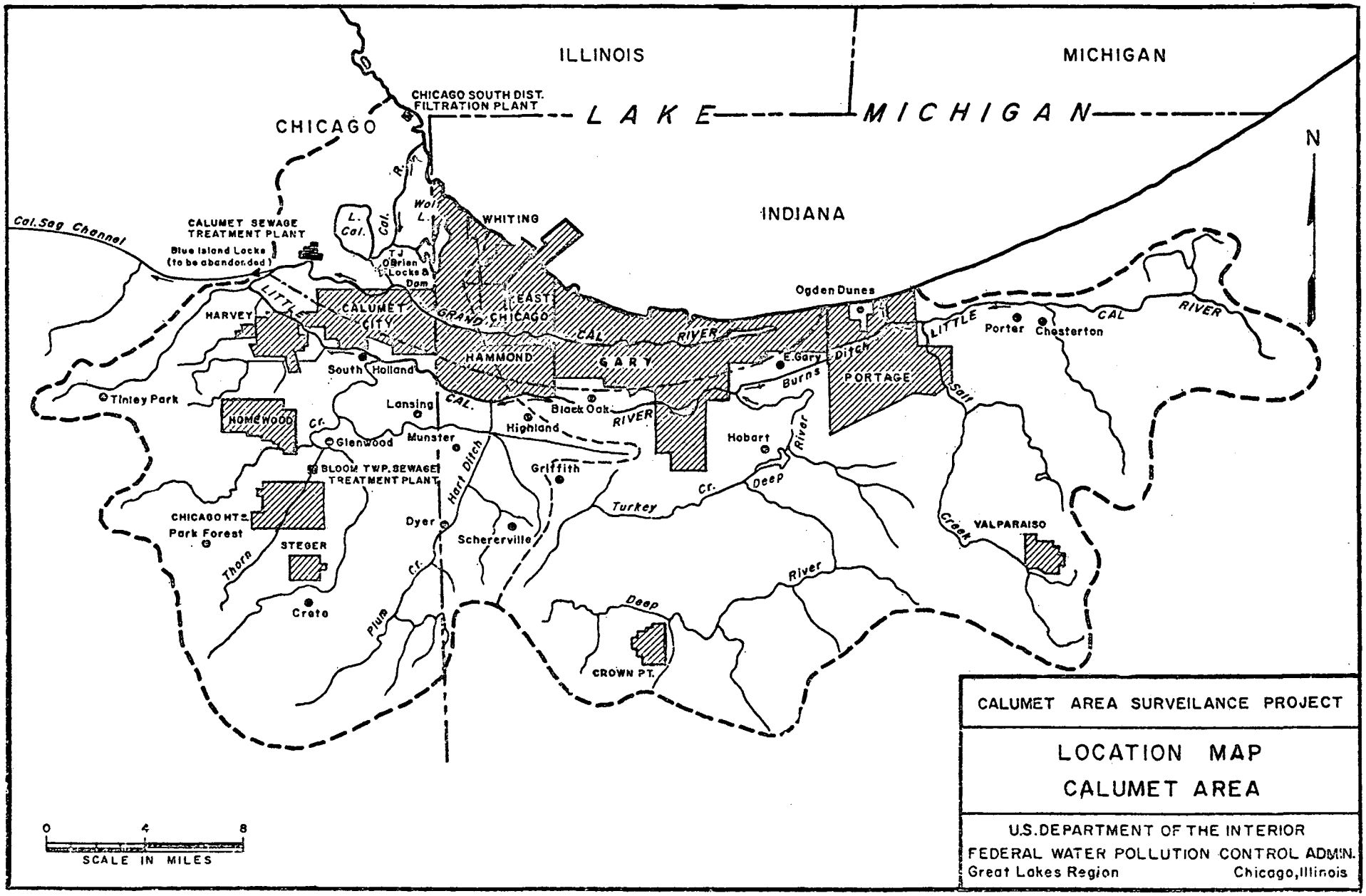
Description of Area

The Calumet area is a flat plain located at the southern end of Lake Michigan and includes the Calumet-Little Calumet River system, the Grand Calumet-Indiana Harbor Canal system, Wolf Lake and its outlet. It includes approximately 742 sq. miles and forms a part of the continental divide between the Mississippi River Basin and the Great Lakes-St. Lawrence River Basin. Approximately 60% of the area drains to Lake Michigan and the remaining 40% drains to the Mississippi River by way of the Illinois River. Despite this fact the area is not well drained. There are large, marshy, low-lying areas which are subject to flooding during and after heavy rainfalls. The streams are sluggish and meandering except where they have been artificially maintained and/or supplemented by industrial or municipal waste flows.

The Grand Calumet and the Little Calumet Rivers both traverse the divide. On the Grand Calumet the divide is normally located at the Hammond, Indiana Sewage Treatment plant outfall. Approximately two thirds of the effluent flows west into the Calumet River in Illinois and one third flows east to the Indiana Harbor Canal and Lake Michigan. Rainfall and lake level conditions can cause the divide to shift to either the east or the west.

The location of the divide on the Little Calumet River is not definite and varies over a distance of several miles in the vicinity of Highland, Indiana. The western portion flows to the Cal-Sag Channel in Illinois which connects the system to the Illinois River. The eastern portion flows to Lake Michigan by way of Burns Ditch which discharges to the lake near Ogden Dunes, Indiana.

Flow in the Calumet River is controlled by the O'Brien Lock and is directed from Lake Michigan to the Cal-Sag Channel except during periods of



CALUMET AREA SURVEILANCE PROJECT

LOCATION MAP
CALUMET AREA

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

heavy flooding or unusually low lake levels.

The Indiana Harbor Canal,which was completed in 1903,connects the Grand Calumet River to Lake Michigan. The Grand Calumet River east of the Hammond Sewage Treatment Plant outfall is tributary to Lake Michigan through the canal.

Wolf Lake is located on the Illinois-Indiana state line between Chicago, Illinois and Hammond, Indiana. The original outlet from Wolf Lake to Lake Michigan has been blocked and an outlet to the Calumet River in Chicago has been constructed. The City of Hammond maintains a park which occupies most of the Indiana shoreline of the lake. This park and the lake are extensively used for recreation. The Illinois portion of the lake is a part of the Wolf Lake Conservation Area.

Cities and Industries

The major population centers in the area are East Chicago, Gary, Hammond and Whiting, in Indiana; and Calumet City, Chicago Heights and a part of the south side of Chicago in Illinois. The area is highly industrialized. There are ten major steel mills including the united States Steel Corporation's Gary Works, Gary Sheet and Tin Mill, Youngstown Sheet and Tube Company, and Inland Steel Company in Indiana and United States Steel's South Works, the Wisconsin Steel Company, the Interlake Iron Corporation, the Republic Steel Corporation and the Acme Steel Company in Illinois. There are five petroleum refineries including the American Oil Company, the Cities Service Petroleum Company, the Mobil Oil Company, and the Sinclair Refining Company, in Indiana and the Clark Oil and Refining Co. in Illinois. Other industries include Lever Brothers, Union Carbide Chemical, I.E. Du Pont,

M. & T. Chemicals, American Maize and a large number of smaller concerns.

These industries are located in three major groups. One group is concentrated along the Calumet River in Illinois. Another is along the Indiana Harbor Canal and the third is in Gary, Indiana and discharges to the headwaters of the Grand Calumet River. These three groups make the Calumet Area one of the most important industrial centers in the nation.

DESCRIPTION OF PROGRAMS

Stream and Harbor Sampling Program

During the period January to June 1966 thirteen stream and harbor stations were sampled on a weekly basis for chemical and microbiological quality determinations. Nine of these were sampled during the entire period. The remaining four are lake stations that require a boat for sampling. These were not sampled until March 31, 1966 due to ice and inclement weather on the lake. The results of this program are presented in Part I of this report.

Beach Sampling Program

Sampling on seven beaches in the area was initiated on May 31, 1966 and continued on a twice weekly basis until September 15, 1966. Six of these beaches are located on Lake Michigan and one on Wolf Lake. Five of the beaches were sampled at their mid-points in water approximately four feet deep. Two beaches, Rainbow Beach and Calumet Inner Beach, were sampled at two points each at the one third points. Samples were collected on Tuesday and Thursday of each week and analyzed for total coliforms, fecal coliforms and fecal streptococci. This program was coordinated with the beach sampling programs of the Chicago Park District and the Indiana State Board of Health and data was distributed freely among the agencies. The results of the beach sampling program for the 1966 season are presented in Part II of this report.

Hydraulic Measurements Program

No gaging stations are maintained by the U. S. Geological Survey in the Grand Calumet-Indiana Harbor Canal drainage system. Therefore, six continuous water level recorders have been installed on these streams. The streams are being gaged at these stations so that rating curves can be developed for each station. The stage vs discharge relationship in the lower

reaches of the Indiana Harbor Canal is seriously distorted by fluctuations in the Lake level. For this reason no stage recorders have been installed in this area. Special flow area and velocity studies are planned in order to determine the effect of the numerous industrial outlets in the area.

Information provided by the U. S. Geological Survey and the Metropolitan Sanitary District will be used as the basis for flow calculations on the Little Calumet River, the Calumet River and Wolf Lake Outlet.

The purpose of this program is to develop flow data for all of the sampling stations in the surveillance area except for those located in Lake Michigan.

Automatic Monitoring Program

Many operations of the industries in the basin require discharge of wastes on a batch basis, and wastes from these tanks may be dumped at any time of the day, week, or month depending on the needs of the industry. These discharges and accidental spills of oil or other pollutants could pass into Lake Michigan or down the Illinois River unobserved by a once-a-week sampling program.

During November 1965 an automatic water quality monitoring station was installed in Indiana Harbor at the East Breakwall Inner Light. This installation continuously records the dissolved oxygen, pH, conductivity and temperature of the water flowing past this point into Lake Michigan. A complete report on this installation was given in the report covering the period June through November 1965.

A second monitor was installed during August 1966 to measure the same parameters at the mouth of the Calumet River. This monitor replaces the semi-portable, temporary monitor that had been located there during 1965. A complete

report on this new installation will be presented in the report for the June-December 1966 period. It is planned to mount the semi-portable monitor in a boat and use it for profile studies of the various streams in the area. This procedure should be of value in pinpointing specific sources of wastes in the area.

An automatic sampling device will be installed on each monitor as soon as it becomes available. This device will automatically collect a sample when one or more of the parameters being monitored exceed certain limits.

Next year it is planned to install two additional monitors and a central control station to which all the data will be continuously telemetered. One monitor will be located at Wentworth Avenue on the Little Calumet River and will monitor the quality of the water flowing across the State Line at this point. The other will be located on the Grand Calumet River below the industrial complex at Gary, Indiana. This will monitor pollutants discharged to the headwaters of the stream and may enable warnings to be given to downstream uses of the approaching pollution. Eventually a network of six monitors is planned for the area. This network will be coordinated with the monitoring systems of the states of Indiana and Illinois and of the Metropolitan Sanitary District.

Biological Surveying Program

The kinds and numbers of aquatic plants and animals inhabiting a particular body of water and the stream or lake bottom beneath it, reflect the quality of the water that prevails in the area. Some organisms are capable of withstanding polluted conditions and will multiply rapidly when

competition from other less tolerant organisms is eliminated. These pollution tolerant organisms include sludgeworms, bloodworms, leaches, blue grean algae and pulmonate snails. In an unpolluted environment the number of these organisms is restricted by competition from other species but when the other species are killed off by pollution they multiply rapidly. Therefore, the continuous or sudden introduction of toxic wastes, settleable solids or oxygen consuming materials alters the composition of the benthic population. A balanced population is not restored immediately upon the return of optimum water quality because of the lengths of the life cycles of those organisms which vary from weeks to years. This fact makes it possible to detect slugs of pollution that have passed through a sampling station.

Fifteen substrate samples of the Dendy type were made and used in the waters of the Calumet Area during October through November 1965 on an experimental basis. The results obtained from these samples have been compared with the more standard dredge samples that were taken at the same time. The results of this experiment are presented as an appendix to this report. Further experimentation with this sampling method is planned next spring.

Conclusions

1. The water quality in the Little Calumet River at the state line has been improved considerably since 1963 but still does not meet the proposed criteria. There has been no significant change in water quality since 1965.

2. The microbiological quality of the Grand Calumet River-Indiana Harbor Canal system has been improved considerably since 1965 due to separation of industrial and sanitary wastes. It is still not at an acceptable level, however.

3. The industrial pollution problem of this system has not improved since 1965 and has, if anything, become slightly worse. This is due to the fact that the industrial waste treatment facilities of most of the industries have not been completed and production in the area has increased.

4. Wolf Lake is a relatively clean body of water. The only pollution problem of any significance is occasional spills of MBAS from Lever Brothers Company and possibly batches of cyanide from an unknown source. Most of the water quality criteria for this lake are being met.

5. The beaches in 1966 met the criteria for bathing beaches a greater percentage of the time in 1966 than in 1965, but when they were polluted the pollution was just as bad in 1966 as it was in 1965.

PART I - WATER QUALITY

Stream and Harbor Sampling

Thirteen stream and harbor stations were sampled for bacteriological and chemical quality during the first six months of 1966. Samples were collected once each week except that stations requiring a boat could not be sampled during severe weather. All stream stations were sampled at mid-stream except for stations 6 and 11, which were sampled at the water quality monitor intake. The samples for bacteriological analysis were taken at a depth of 6 inches to 1 foot. The samples for chemical analysis were taken at mid-depth or 10 feet in the case of navigable channels.

All of the samples were immediately preserved and/or iced where required in accordance with procedures established in "Standard Methods for Examination of Water and Wastewater, 12th Edition, 1965." Laboratory analysis on samples subject to deterioration was initiated on the same day they were collected.

Bacteriological analyses were performed in accordance with "Standard Methods." Total coliform, fecal coliform and fecal streptococci counts were made on each sample. The results of these analyses are presented in Figures I-1 through I-6 . All values in Figures I-1 through I-6 and in the following discussion are the number of organisms per 100 ml.

Chemical analyses were performed in accordance with methods agreed upon at the Calumet Area Enforcement Laboratory Director's Meeting held on April 29, 1965. The six laboratory conferees discussed the methods to be used by all laboratories concerned with the Calumet Area Surveillance activities.

Grand Calumet River at Pennsylvania R.R. Bridge (Station 1)

This station is located upstream of the Gary Sewage Treatment Plant where the bulk of the flow is industrial waste from the United States Steel Company's complex at Gary, Indiana, which has waste discharges located approximately two miles upstream.

The nearest station for flow data is located four-tenths of a mile downstream at Industrial Avenue. This station is below the outfall of the Gary Sewage Treatment Plant, therefore another station, approximately one mile upstream at Bridge Street, has been gaged. The Pennsylvania R.R. bridge is not suitable for a gaging station. Flows at the Pennsylvania R. R. bridge should be somewhat higher than at Bridge Street because there is one tributary which drains an area north of the river between them. The average of seven gagings at Bridge Street between October 1965 and June 1966 is 652 cfs.

As shown in Figures I-2, I-4 and I-6 the bacterial counts for January-June 1966 have dropped considerably from the levels of June-November 1965. Total Coliforms varied from 130,000 to 100 with an average of 22,500 and a median of 6,000. All of these values, while still high, are less than 10% of their 1965 levels. Fecal Coliforms varied from 40,000 to less than 10 with an average of 5700 and a median of 1900. These values are also about 10% of their 1965 levels. Fecal streptococci showed a similar but less dramatic decrease varying from 4,000 to 10 with an average of 740 and a median of 410 which are all less than 50% of their 1965 levels.

The fact that the 1966 data includes such cold months as January, February and March while the 1965 data covers June through November, is responsible for a part of this drop.

The fact that a large amount of cooling water is discharged to the stream tends to minimize this effect, however. The minimum temperature during 1966 was 10°C.

The major part of this decrease is due to the separation and diversion of sanitary wastes from the U. S. Steel complex at Gary to the Gary sewage treatment plant. Although there has been a considerable improvement in the bacteriological quality of the stream it still does not meet the recommended criteria for the Grand Calumet River which calls for a maximum total coliform count of 5,000 except during periods of high runoff.

Further evidence of the reduction in domestic pollution is the increase in dissolved oxygen which is shown in Table I-1. The maximum DO increased from 6.0 mg/l in 1965 to 9.0 mg/l in 1966 and the median increased from 3.7 mg/l to 5.8 mg/l. Although a part of this difference is due to the colder season covered by the 1966 data some of it must be attributed to the reduction in sewage pollution. The effect of the cooling water and the fact that there was no corresponding rise in BOD support this view.

There is still a serious industrial waste problem at this site. The median pH of 6.9 remained the same in both 1965 and 1966. On June 3, 1966, however, the pH was 3.60 and the sulphates concentration was 200 mg/l compared with a normal range of 50 mg/l to 70 mg/l. This data indicates that spent pickling liquor was discharged from one or more of the upstream steel mills. A deep well injection disposal system for this waste was due to go into operation during July 1966. It is hoped that this will eliminate discharges of this nature.

Phenol rose from a mean of 28 ug/l. to a mean of 126 ug/l. Some of this increase probably is due to the effect of the colder weather which tends

to reduce their rate of degradation, but in view of the large amount of cooling water which tends to maintain the temperature, it must be assumed that much of this increase is due to an increased amount of phenol being discharged to the stream. One sample in June 1965 contained 11.8 ug/l phenols and five June 1966 samples averaged 45.4 ug/l. Suspended solids also increased appreciably from an average of 44 mg/l in 1965 to an average of 247 mg/l in 1966. Cyanides appear to have increased from an average of 0.03 mg/l to 0.32 mg/l but the 1965 data for cyanides is undoubtedly too low. During December 1965 the analysis for cyanide was changed in order to eliminate interference which was caused by other pollutants.

Oil has been reported on the surface each time the station has been sampled since the beginning of the surveillance, in spite of the fact that an oil skimmer is located a few feet upstream from the sampling point.

The reasons for these increases in industrial waste are not clear but it is noted that a new basic oxygen steel shop was opened during December 1965.

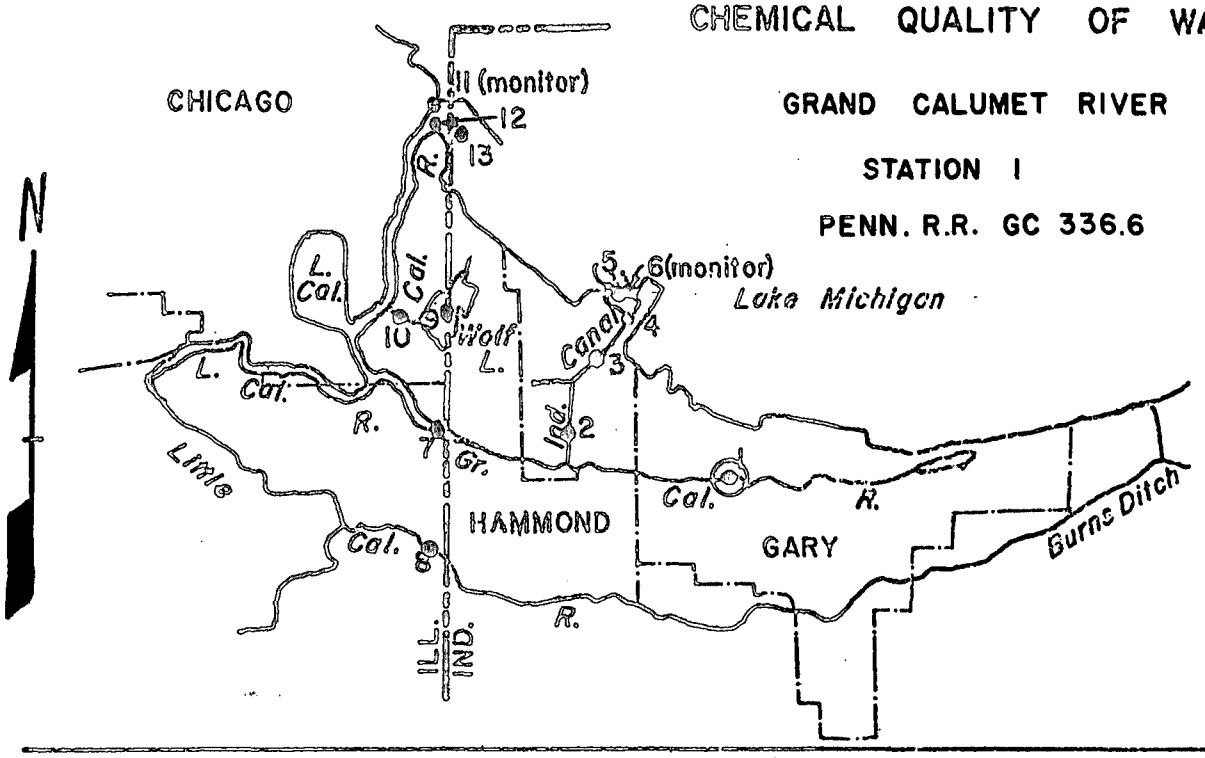
TABLE I - 1

CHEMICAL QUALITY OF WATER

GRAND CALUMET RIVER

STATION 1

PENN. R.R. GC 336.6



Parameter		June 1965-Nov.1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.2	4.1	6.7	6.9	8.0	3.6	6.8	6.9
DO	mg/l	6.0	1.1	3.6	3.7	9.00	2.50	5.83	5.80
BOD	"	17	5.7	9.8	8.5	16	2.4	8.6	8.6
COD	"	59	7.9	32	39	43	21	28	27
Sulphates	"	186	29	56	49	200	37	66	56
NH_3-N	"	3.7	0.87	1.5	1.6	4.4	1.5	2.4	2.4
NO_2-NO_3 N	"	7.5	0.32	1.4	0.69	11.3	0.18	0.89	0.55
Org-N	"	7.3	0.06	1.3	1.6	1.2	0.0	0.40	0.40
Total PO_4	"	0.93	0.10	0.28	0.24	0.58	0.11	0.26	0.23
Total Sol. PO_4	"	0.32	0.00	0.08	0.06	0.41	0.02	0.19	0.17
Total Iron	"	23	2.7	7.9	6.6	48	3.2	9.7	5.8
Phenol	ug/l	100	0	28	22	320	18	126	129
Cyanide	mg/l	0.19	0.00	0.03	0.01	0.63	0.00	0.32	0.39
Sus. Solids	"	70	26	44	59	125	30	67	68
Dis. Solids	"	365	170	245	235	380	205	247	235
Chlorides	"	-	-	-	-	40	14	20	18
MBAS	"	-	-	-	-	0.28	0.07	0.14	0.12
Conductivity	umho/cm	-	-	-	-	765	308	399	380
Temperature	°C	31	15	24.6	26	28	10	16	16

1965 data based on 19 samples except for: cyanide(17); susp.solids(10); dis. solids(9).
1966 data based on 26 samples except for: chlorides(19); ABS(19);conductivity(19).

Indiana Harbor Canal at 151st St. (Station 2)

This station was established in order to determine the quality of the water in the canal where it is formed by the two portions of the Grand Calumet River. This station is affected by effluent from the Gary, Hammond and East Chicago sewage treatment plants as well as the effluent from a number of industries on the Grand Calumet River. The Gary and East Chicago sewage treatment plants are chlorinating their effluent at present.

The total coliform count varied from 6000 to 270,000 with an average of 55,000 and a median of 46,000. These values are considerably below the June-November 1965 values which averaged 1,500,000 with a maximum of 4,300,000 and a minimum of 33,000 but are still very high and indicate considerable sewage pollution.

The Fecal Coliform count varied from 500 to 150,000 with an average of 16,500 and a median of 6800. The Fecal Streptococci count varied from 50 to 16,000 with an average of 2810 and a median of 1200. Each of these parameters are lower than they were in 1965 but they still indicate that a serious pollution problem still exists.

The counts at this station are considerably higher than the counts at the Pennsylvania RR Bridge(Station 1).This could be due to flow from the Hammond sewage treatment plant or flow from the industries on the Grand Calumet River.

The reduction in the counts between the 1965 data and the 1966 data is probably due to a combination of colder weather in 1966 and a reduction in domestic pollution by the industries. This station is also affected by cooling water discharges which reduce the effect of the colder weather. The minimum water temperature during 1966 was 10°C.

The continuation of the sewer separation programs by the industries and the completion of chlorinating facilities by the sewage treatment plants should bring a considerable improvement in the microbiological quality of the stream at this station.

The level of industrial pollution appears to be rising. The average sulphates concentration rose from 56 mg/l in 1965 to 88 mg/l in 1966, the average iron concentration rose from 2.4 mg/l to 5.5 mg/l, the average cyanide concentration rose from 0.03 mg/l to 0.19 mg/l, the average suspended solids content rose from 30 mg/l to 61 mg/l and the average phenol concentration rose from 19 ug/l to 107 ug/l.

The maximum sulphate concentration of 138 mg/l occurred on June 3,1966 and can be traced to discharge of spent pickling liquor from the steel complex at Gary, Indiana. The pH at this station had risen to 6.5 from the 3.6, found at Station 1, but is still the minimum pH found at Station 2. Much of the acid was probably neutralized by effluent from the Gary Sewage Treatment plant, which is located just below Station 1. Evidence of this slug of pickling liquor was also found at the next downstream station at Dickey Road where the sulphate concentration was 122 mg/l which is the maximum, and the pH was 6.6 which is below the average of 6.9.

This increase in the level of industrial pollution is due to the increased production in the area. Many of the industries are due to submit plans for additional waste treatment facilities to the Indiana Stream Pollution Control Board by December 1, 1966.

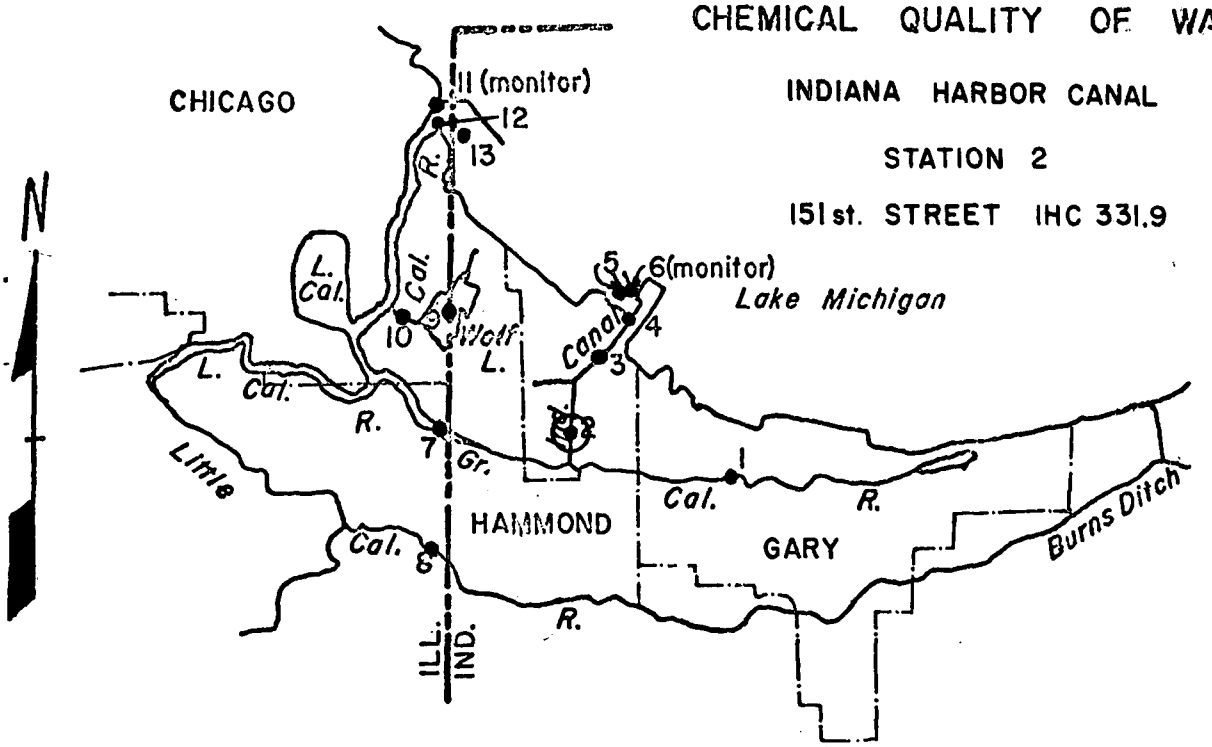
TABLE I - 2

CHEMICAL QUALITY OF WATER

INDIANA HARBOR CANAL

STATION 2

151st. STREET IHC 331.9



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.7	7.0	7.1	7.9	6.5	7.0	7.0
Conductivity	umho/cm	--	--	--	--	530	430	473	480
DO	mg/l	5.0	2.1	3.6	3.8	8.1	0.20	5.07	5.60
BOD	"	12	4.4	7.9	7.3	22	4.9	8.9	7.6
COD	"	65	7.7	29	14	60	18	29	28
Sulphates	"	71	50	56	56	138	74	88	87
Chlorides	"	--	--	--	--	70	29	36	32
MBAS	"	--	--	--	--	0.61	0.16	0.29	0.29
NH_3-N	"	4.0	0.77	1.8	2.3	4.7	2.4	3.4	3.3
NO_2-NO_3 N	"	2.2	0.23	1.2	1.1	1.5	0.21	0.80	0.80
Org-N	"	4.3	0.30	1.5	1.3	1.3	0.00	0.6	0.7
Total PO_4	"	4.6	0.52	1.3	0.81	2.0	0.32	0.82	0.75
Sol. PO_4	"	0.64	0.19	0.49	0.48	1.32	0.19	0.58	0.50
Iron	"	5.7	0.78	2.4	1.6	17	1.8	5.5	4.4
Phenol	ug/l	41	9	19	15	228	23	107	111
Cyanide	mg/l	0.17	0.00	0.03	0.00	0.44	0.00	0.19	0.16
Susp.Solids	"	59	16	30	27	110	23	61	59
Dis.Solids	"	640	240	315	280	375	250	295	295
Temperature	°C	27	13	20.6	20	26	5	15	15

1965 data based on 9 samples.
1966 data based on 26 samples except for: NH_3, NO4 and Org-N(25); conductivity (19); ABS(19) and chlorides(19).

Indiana Harbor Canal at Dickey Road (Station 3)

This station is located two and a half miles downstream from 151st St. (Station 2) and is the last highway bridge across the canal before it discharges into Indiana Harbor.

The trends evident at the two upstream stations are repeated at this station. The bacteriological counts are lows in 1966, the dissolved oxygen highs and the industrial pollution greater.

The total coliform counts varied from 13,000 to 440,000 with an average of 116,000 and a median of 96,000. As indicated on Figure I-2 these values are considerably lower than the June-Nov. 1965 counts but they are still high and indicate severe pollution.

The Fecal Coliform count varied from 2600 to 370,000 with an average of 71,000 and a median of 39,000. The Fecal Streptococci varied from 340 to 52,000 with an average of 16,740 and a median of 5300. Both of these parameters are high but are considerably lower than in 1965 as shown in Figures I-4 and I-6

This improvement is due to the separation programs started by several industries to separate sanitary wastes and send them to municipal sewage treatment plants. The counts at Dickey Road are only slightly higher than those at 151st St. This indicates that, although the sewage pollution contributed by the industries between the two stations has been reduced, it is still enough to make up for the normal die-off between the two stations. The average dissolved oxygen rose from 0.5 mg/l to 3.10 mg/l, although two zero readings were found during June 1966 and all the readings during June 1966 were extremely low. It is evident that there has been some decrease in sewage pollution.

The average sulphates concentration increased from 65 mg/l in 1965 to 80 mg/l in 1966, the average iron concentration increased from 2.40 mg/l to 3.16 mg/l, the average phenol concentration increased from 20 ug/l to 102 ug/l and the average suspended solids content increased from 14 mg/l to 25 mg/l. It is noted that, as at the other stations, the rise in phenols is magnified by the cold weather, but this effect is minimized by the cooling water discharged to the stream. The minimum water temperature at this station during 1966 was 9°C. The average cyanide appears to have increased from 0.00 mg/l to 0.13 mg/l, but the 1965 data is too low due to interference with the chemical analysis.

The concentration of sulphates, iron, phenols, cyanide and suspended solids decrease toward downstream. It must be pointed out, however, that the total flow increases considerably as you go down stream. The estimated average flow at Station 1 is 650 cfs; at Station 2 it is 955 cfs and at Dickey Road it is approximately 1000 cfs. This additional dilution water, the natural deterioration of phenols and cyanides and the settling to the bottom of suspended solids and iron are responsible for this apparent improvement in quality of downstream waters.

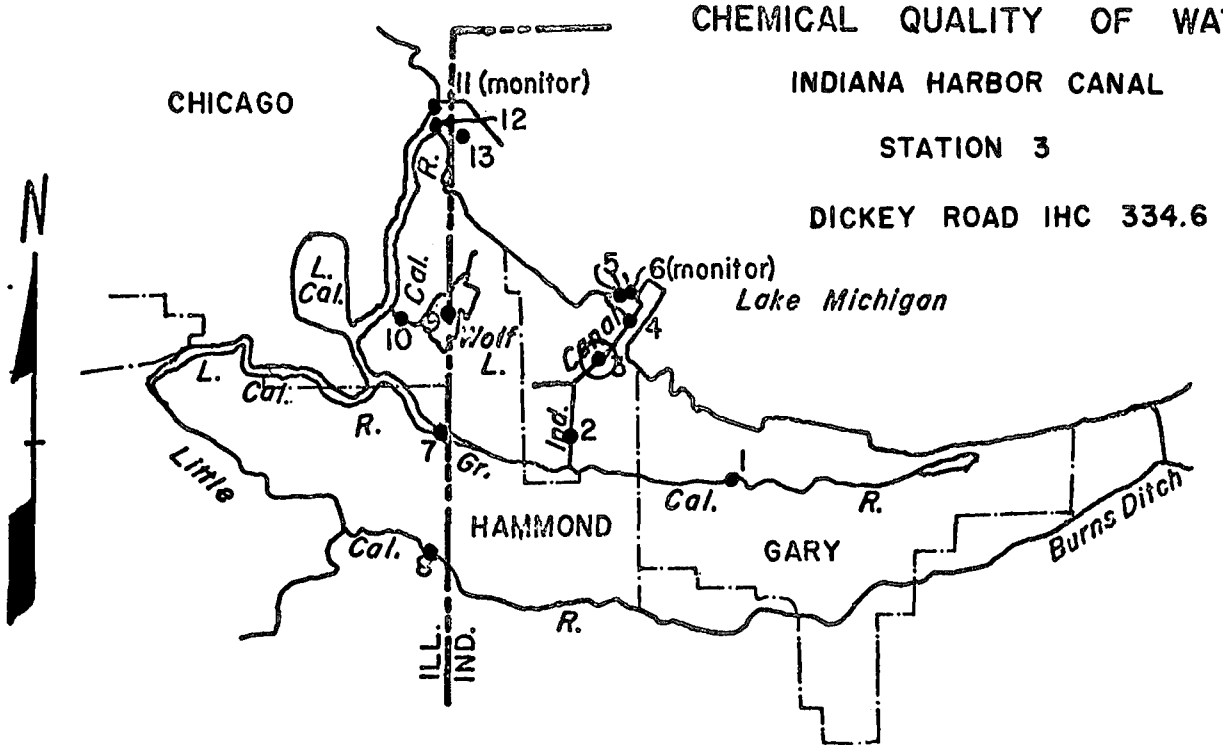
TABLE I-3

CHEMICAL QUALITY OF WATER

INDIANA HARBOR CANAL

STATION 3

DICKEY ROAD IHC 334.6



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.3	7.0	7.0	8.0	6.4	6.9	7.0
Conductivity	umho/cm	--	--	--	--	615	400	501	505
DO	mg/l	2.9	0.0	0.3	0.0	6.70	0.00	3.10	4.10
BOD	"	11	3.5	6.3	5.5	9.0	2.2	5.1	5.3
COD	"	48	0.0	23	20	33	12	22	22
Sulphates	"	77	46	65	66	122	59	80	78
Chlorides	"	--	--	--	--	44	22	29	29
MBAS	"	--	--	--	--	0.35	0.17	0.24	0.24
NH_3-N	"	3.1	1.1	2.3	2.4	6.7	2.6	3.7	3.6
NO_2-NO_3 N	"	3.5	0.31	1.1	1.1	2.8	0.15	0.84	0.75
Org-N	"	3.8	0.08	1.9	2.1	2.4	0.3	0.7	0.6
Total PO_4	"	0.91	0.24	0.57	0.53	0.73	0.26	0.47	0.46
Sol. PO_4	"	0.57	0.01	0.26	0.29	0.54	0.11	0.32	0.29
Iron	"	3.8	0.88	2.4	2.2	9.0	0.99	3.16	2.3
Phenol	ug/l	42	1	20	20	483	16	102	61
Cyanide	mg/l	0.00	0.00	0.00	0.00	0.56	0.00	0.13	0.13
Susp. Solids	"	23	6	14	12	84	6	25	19
Dis. Solids	"	340	240	260	300	385	220	314	310
Temperature	°C	29	13	23.0	25	27	9	15	14

1965 data based on 19 samples except for: cyanide (18) and susp. solids(10).
1966 data based on 26 samples except for chlorides(19); ABS(19) and conductivity(19).

Indiana Harbor (Stations 4, 5 and 6)

Indiana Harbor was sampled at three points during January-June 1966. Station 4 is located at the mouth of the Indiana Harbor Canal, upstream of the Inland Steel and Youngstown Sheet and Tube turning basins. Station 5 is located immediately downstream of the turning basins and downstream from all industrial outfalls to the harbor. The average dry weather flow to Lake Michigan past this station is 2700 cfs, but under certain wind and lake level conditions lake water is backed up into the harbor for short periods of time. Station 6 is located at the east breakwall inner light which is about 150 feet from Station 5 and contains a water quality monitoring Station. Station 6 was established during January 1966 to correlate the monitoring program with the sampling program.

Stations 4 and 5 are boat stations and cannot be sampled in rough weather. During 1966 they were not sampled until March 31, 1966, therefore the data at these stations is affected less by the colder months.

The trends established at the upstream stations are evident at these stations. At Station 4 the total Coliform count varied from 5100 to 77,000 with an average of 28,000 and a median at 15,000. These values are approximately one tenth of their level in June-November 1965. This indicates that progress has been made by the industries in separating the industrial and domestic wastes. The remaining high levels of these counts indicate that a problem still exists. Figures I-4 and I-6 show that the Fecal Coliform and Fecal Streptococci are at the same level as in 1965. The fact that total Coliforms decreased while Fecal Coliforms and Fecal Streptococci remained the same indicates that the remaining pollution is fresh and may be caused by passing or moored vessels.

At Station 5 the total Coliform count varied from 13,000 to 140,000 with an average of 66,000 and a median of 66,000. As indicated in Figure I-2 these values are at the same level as they were in June-November 1965. The Fecal Coliform counts varied from 19,000 to 1600 with an average of 8900 and a median of 8700. Figure I-6 indicates that these values are considerably higher than in 1965. The Fecal Streptococci counts varied from 1100 to 32 with an average of 279 and a median of 220. Figure I-4 indicates that these values are in the same range as in 1965 but that the average is somewhat lower.

At Station 6, near the monitor, the total Coliform count varied from 330,000 to 1000 with an average of 34,000 and a median of 15,000. The Fecal Coliform varied from 5800 to less than 10 with an average of 1929 and a mean of 1700. The Fecal Streptococci varied from 1600 to 15 with an average of 355 and a median of 190. As shown in Figures I-2 and I-6 the average median and minimum counts for total and fecal coliform are significantly lower than the counts at Station 5 which is only 150 feet away. Station 6 was sampled during the entire period from January to June whereas Station 5 was only sampled from April to June because it is a boat station. Thus a comparison of the data from these two stations gives some indication of the effect of the colder months on the bacteriological data. It is interesting to note that the Fecal Streptococci counts were not affected nearly as much by the colder weather. This phenomenon has been noted throughout all of the data collected by the Project.

The counts in the harbor are all lower than those at Dickey Road (Station 3). This is partially due to the fact that there is a much greater dilution factor in the harbor. The estimated flow at Station 5 is 2700 cfs versus 1000 cfs at Dickey Rd. There is still a considerable amount of bacteriological

pollution being discharged to Lake Michigan in close proximity to several water supply intakes and bathing beaches. The improvement in the sanitary condition of the canal is not as dramatic at Stations 4 and 5 as it is at the upstream stations. At Station 4 the average dissolved oxygen increased slightly from 3.4 mg/l in 1965 to 3.74 mg/l in 1966 and total Coliform is the only bacterial count that showed a significant decrease. At Station 5 the dissolved oxygen rose slightly but the bacterial counts were higher in 1966 than in 1965. The sanitary conditions at these stations are undoubtedly affected by vessel pollution.

At Station 4 the average sulphate concentration rose from 51 mg/l in 1965 to 65 mg/l in 1966, and the phenols rose from an average of 12 ug/l in 1965 to 18 ug/l in 1966. Cyanide appears to have risen from an average of 0.00 mg/l to 0.07 mg/l but interference with the analysis affected the 1965 data. The average concentration of iron at Station 4 remained the same but is considerably higher at Station 4 than at Station 3 which indicates that a considerable amount of iron is being discharged to the canal between these two stations.

Station 6, which was not sampled in 1965, is located about 300 feet from Station 5. A comparison of tables I-5 and I-6 indicates that there is no significant difference in the data between these two stations except that the dissolved oxygen is higher at Station 6. This is probably due to the turbulence around the structure and the large growths of algae on the structure. Station 6 was sampled during January, February and March, while Station 5 was not. This, of course, increased the average DO, but the average DO at Station 6 from March 31, 1966 thru June 29, 1966 was 5.89 mg/l which is still higher than the 4.63 mg/l found at Station 5.

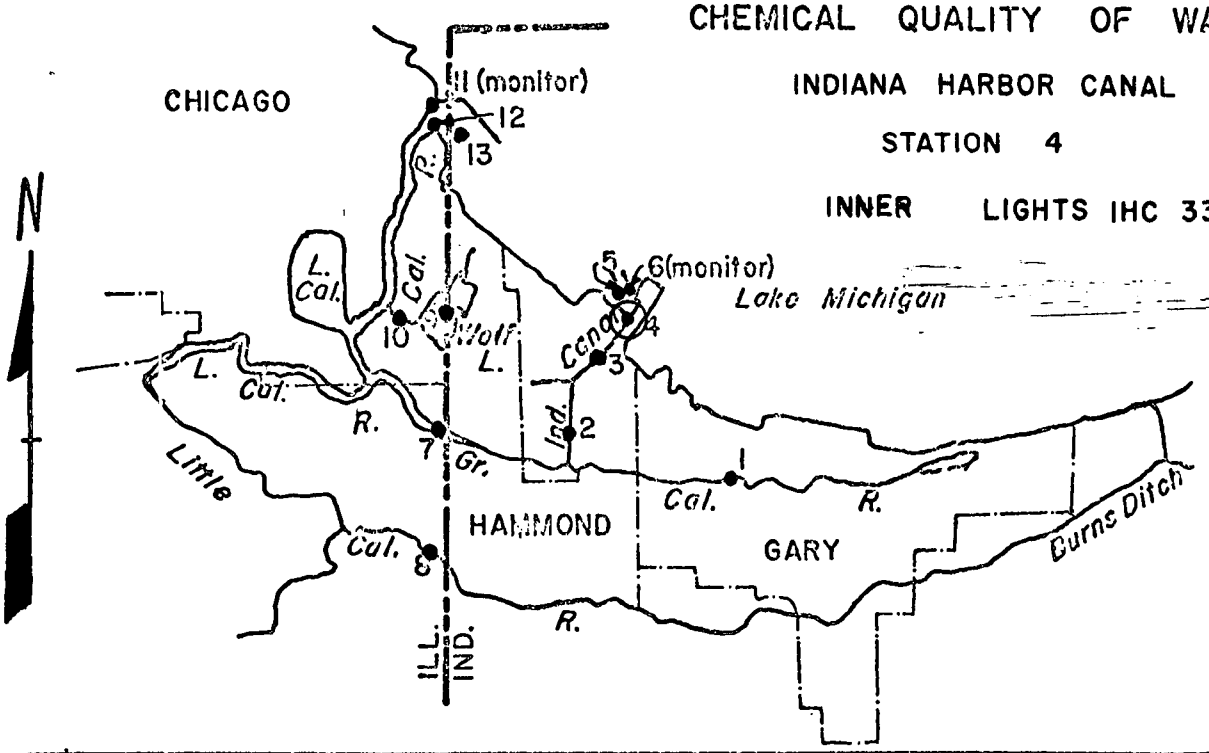
TABLE I - 4

CHEMICAL QUALITY OF WATER

INDIANA HARBOR CANAL

STATION 4

INNER LIGHTS IHC 335.7



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.9	7.1	7.1	8.0	6.8	7.1	7.0
Conductivity	umho/cm	--	--	--	--	460	385	419	420
DO	mg/l	5.9	2.4	3.4	2.4	5.2	2.05	3.74	3.60
BOD	"	9.1	2.8	4.8	3.7	5.0	2.4	3.8	4.1
COD	"	67	0.0	20	9.3	18	11	13	15
Sulphates	"	62	34	51	54	84	23	65	70
Chlorides	"	--	--	--	--	30	21	25	25
MBAS	"	--	--	--	--	0.25	0.07	0.17	0.17
NH_3-N	"	1.4	0.75	1.1	1.1	5.6	2.2	3.2	3.0
NO_2-NO_3 N	"	0.74	0.29	0.42	--	0.55	0.11	0.31	0.30
Org-N	"	1.7	0.30	1.1	1.3	0.9	0.0	0.4	0.4
Total PO_4	"	0.23	0.08	0.16	0.15	0.27	0.09	0.18	0.20
Sol. PO_4	"	0.10	0.03	0.06	0.06	0.19	0.06	0.14	0.15
Iron	"	5.0	2.1	3.1	2.6	4.9	1.5	3.0	3.0
Phenol	ug/l	21	6	12	9	26	11	18	18
Cyanide	mg/l	0.01	0.00	0.00	0.00	0.25	0.00	0.07	0.07
Susp. Solids	"	105	10	36	13	81	11	21	16
Dis. Solids	"	255	215	240	250	305	230	263	265
Temperature	°C	25	17	21.8	22	24	12	18	19

1965 data based on 6 samples except for: susp. solids(4) and dis.solids(3).
1966 data based on 12 samples except for NH_3, NO_3, and Org-N (11).

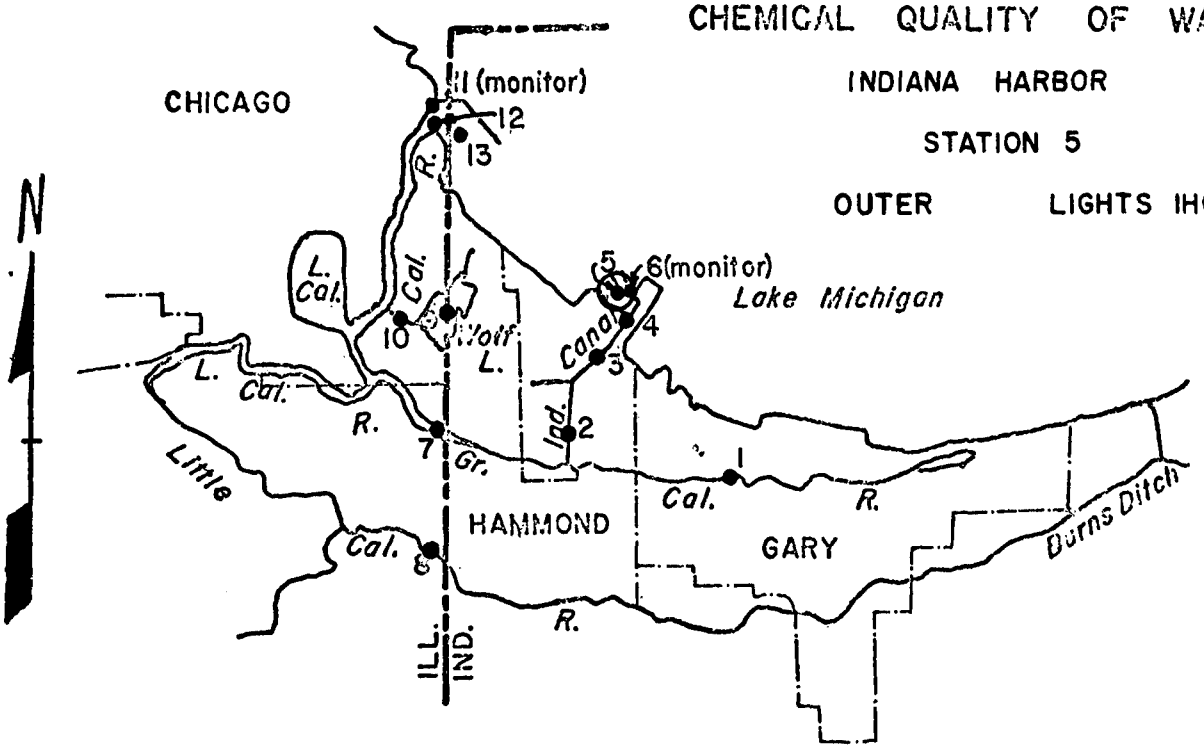
TABLE I-5

CHEMICAL QUALITY OF WATER

INDIANA HARBOR

STATION 5

OUTER LIGHTS IHC 336.2



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.3	6.9	7.1	7.1	7.9	6.8	7.0	7.0
Conductivity	umho/cm	--	--	--	--	420	350	384	385
DO	mg/l	6.1	1.9	4.2	4.2	6.65	3.05	4.63	4.80
BOD	"	13	2.3	4.5	3.0	5.5	2.0	3.3	3.5
COD	"	67	8.4	20	8.6	27	8	13.3	13
Sulphates	"	54	32	45	50	81	45	62	62
Chlorides	"	--	--	--	--	26	16	22	23
MBAS	"	--	--	--	--	0.21	0.10	0.14	0.14
NH_3-N	"	1.4	0.26	0.89	0.73	4.4	1.5	2.4	2.4
NO_2+NO_3 N	"	0.59	0.10	0.42	0.44	0.45	0.12	0.29	0.32
Org.-N	"	1.4	0.10	0.73	0.71	0.8	0.00	0.2	0.2
Total PO_4	"	0.21	0.06	0.14	0.15	0.19	0.08	0.12	0.14
Sol. PO_4	"	0.12	0.03	0.07	0.07	0.11	0.00	0.07	0.08
Iron	"	3.0	1.3	1.9	1.7	5.6	1.3	3.0	3.1
Phenol	ug/l	7	0	4	3	19	5.4	10.4	10.0
Cyanide	mg/l	0.01	0.00	0.00	0.00	0.19	0.01	0.05	0.02
Susp. Solids	"	13	3.0	5.0	5.0	3.7	9.0	14.8	13
Dis. Solids	"	255	230	175	235	280	205	240	235
Turbidity	units	--	--	--	--	11.2	1.8	6.3	6.2
Temperature	°C	26	17	22.2	21	23	12	17	17

1965 data based on 6 samples except for: susp. solids(4) and dis. solids (3).
1966 data based on 12 samples.

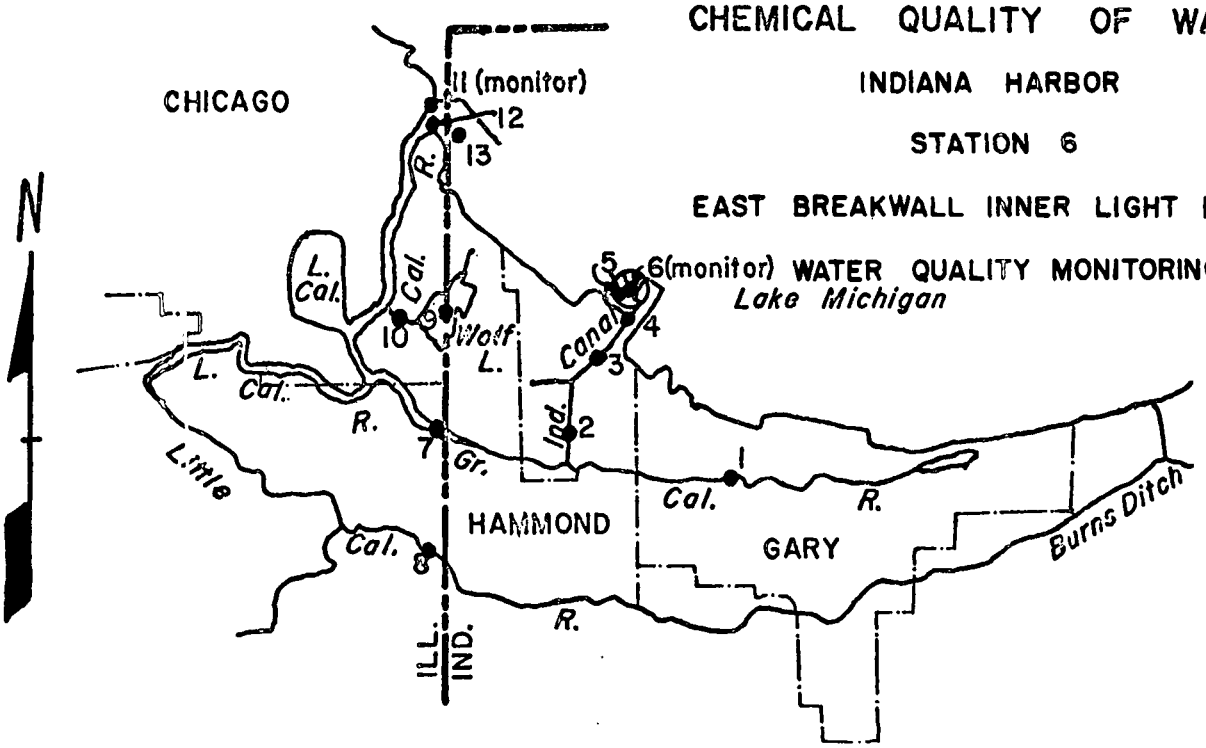
TABLE I - 6

CHEMICAL QUALITY OF WATER

INDIANA HARBOR

STATION 6

EAST BREAKWALL INNER LIGHT IHC 336.25



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH						8.0	6.6	7.07	7.0
Conductivity	umho/cm					460	320	372	385
DO	mg/l					8.0	2.80	6.50	7.1
BOD	"					5.6	1.7	3.4	3.6
COD	"					37	4.0	12.0	11.0
Sulphates	"					77	34	59	66
Chlorides	"					32	10	21	22
MBAS	"					.35	.08	.15	.15
NH_3-N	"					2.8	0.19	1.9	1.9
NO_2-NO_3 N	"					0.70	0.12	0.42	0.40
Org.-N	"					2.1	0.2	0.6	0.5
Total PO_4	"					0.34	0.08	0.14	0.13
Sol. PO_4	"					0.30	0.03	0.09	0.08
Iron	"					8.1	1.3	3.1	3.0
Phenol	ug/l					45	1.4	15.6	14
Cyanide	mg/l					0.20	0.00	0.08	0.07
Susp. Solids	"					46	8	17	15
Dis. Solids	"					265	200	239	240
Temperature	°C					19	6	12	12

Station not sampled during 1965.
1966 data based on 26 samples except for: chlorides(19); ABS(19).

Grand Calumet River at Indiana Harbor Belt R.R. Bridge (Station 7)

This station is located in Illinois just across the Illinois-Indiana state line and is designed to measure the amount of pollution crossing the state line. This station is one of the control points established by the Calumet Area Technical Committee.

The bulk of the dry weather flow in this stream is made up of effluent from the Hammond Sewage Treatment Plant and industrial effluent from one steel company and several smaller companies.

The stream at this point is grossly polluted. The twenty-six samples collected by the Surveillance Project during the period of this report had a maximum total coliform count of 5,300,000, a minimum of 28,000, a mean of 970,000 and a median of 590,000. As can be seen in Figure I-1 these values compare closely to the values for June-November 1965. Figures I-3 and I-5 indicate that Fecal Coliform and Fecal Streptococci are considerably higher in 1966. The maximum Fecal Streptococci rose to 530,000 with a minimum of 500, a mean of 35,000 and a median of 12,000. The Fecal Coliform ranged from 1000 to 620,000 with a mean of 106,000 and a median of 63,000. The mean and median for both Fecal Streptococci and Fecal Coliform rose considerably from their June-Nov. 1965 levels. This increase is significant because the colder months of January, February and March would normally cause a decrease.

The chemical data presented in Table No. I-7 indicates an average chloride content of 87 mg/l, an average sulphate content of 187 mg/l, an average ammonia content of 14.7 mg/l, an average total phosphate content of 7.67 mg/l and an average dissolved solids content of 688 mg/l. All of these parameters are considerably above the recommended criteria and are normally found in raw or

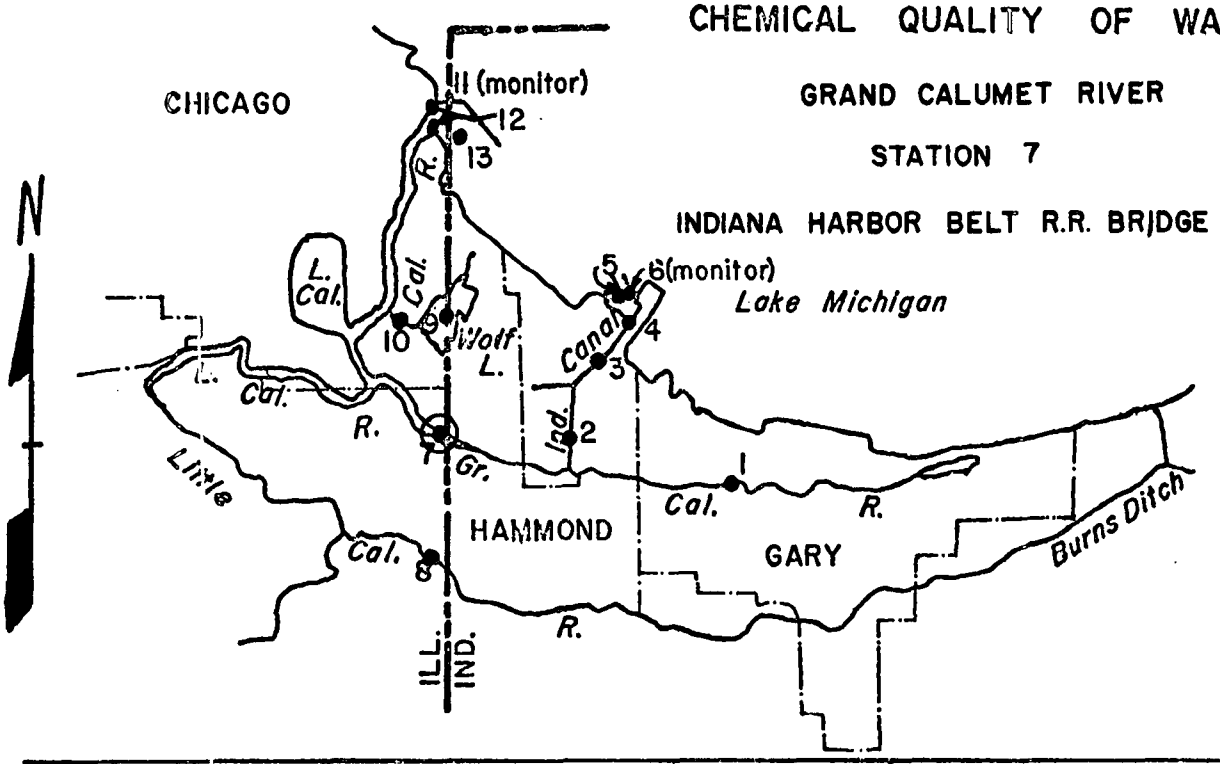
TABLE I - 7

CHEMICAL QUALITY OF WATER

GRAND CALUMET RIVER

STATION 7

INDIANA HARBOR BELT R.R. BRIDGE GC 328.5



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		7.2	6.5	7.0	7.0	8.2	6.8	7.24	7.2
Conductivity	umho/cm	--	--	--	--	1150	410	922	1020
DO	mg/l	5.4	0.0	2.7	2.7	6.4	0.00	4.00	4.2
BOD	"	20	4.6	11	7.3	104	3.2	26.4	21
COD	"	108	16	47	26	224	25	67	56
Sulphates	"	282	52	179	179	280	76	187	192
Chlorides	"	--	--	--	--	180	22	87	85
MBAS	"	--	--	--	--	1.8	.15	.70	.63
NH_3-N	"	7.8	1.2	2.9	2.4	12	0.55	4.72	3.9
NO_2NO_3 N	"	13	1.2	5.3	4.6	15	1.1	6.3	6.4
Org-N	"	3.7	0.05	0.90	1.8	6.6	0.6	2.4	1.9
Total PO_4	"	12	5.4	7.7	6.9	16.0	0.90	7.67	7.0
Sol. PO_4	"	9.2	1.3	5.2	5.5	10.1	0.3	2.9	2.0
Iron	"	17	0.27	2.8	0.82	7.9	0.6	2.13	1.3
Phenol	ug/l	46	4	18	16	90	3.1	24.4	19
Cyanide	mg/l	0.12	0.00	0.02	0.00	0.05	0.00	.0096	.01
Susp. Solids	"	155	7	38	20	110	5	38	28
Dis. Solids	"	705	58	480	540	770	270	668	700
Turbidity	units	--	--	--	--	19.5	1.8	6.2	5.1
Temperature	°C	21	6	15.9	17	23	3	11	9

1965 data based on 9 samples.
1966 data based on 26 samples except for: turbidity(19); chlorides(19); ABS(19).

partially treated sewage.

The industries above this station probably contribute a considerable quantity of the sulphates found at the station but the other parameters such as iron, phenol and cyanide which are normally associated with the steel industry are not high. The primary source of the pollution at this point appears to be the sewage treatment plant at Hammond.

Little Calumet River at Wentworth Avenue (Station 8)

The Wentworth Avenue station was established to monitor the wastes in the Little Calumet River flowing from Indiana to Illinois. The station is located approximately one half mile downstream from the state line and is one of the control points established by the Calumet Area Technical Committee. The closest gaging station for flow data is a United States Geological Survey station located about one mile upstream at Hohman Avenue. There are no significant sources of flow between the two stations.

As reported in the report covering the period June-November 1965 considerable progress has been made on this stream since the Great Lakes Illinois River Basin Project sampled it in 1963. The twenty samples taken by the GLIRB Project during August and September of 1963 indicated severe pollution from domestic sewage with an average total coliform count of 1,600,000 and a minimum of 130,000. The average value for fecal streptococci during this period was 80,000 with a minimum of 19,000. In 1965 the average total Coliform count was 800,000 with a maximum of 3,500,000 and a minimum of 20,000. The average Fecal Streptococci had been reduced to 6300 with a maximum of 150,000 and a minimum of 13,000.

The data for the first six months of 1966 is somewhat lower. As indicated in Figure I-1 the total Coliform ranged from 13,000 to 2,200,000 with

an average of 330,000 and a median of 110,000. This reduction is probably due to the lower counts during the colder months of January, February and March, and it does not appear that the quality of the water has changed substantially since 1965.

Table I-8 indicates the average dissolved oxygen in January-June 1966 was 6.4 mg/l compared with 1.8 mg/l for June-November 1965. The DO for June 1966, however, was below 2.0 mg/l and is comparable to the DO for June 1965. Therefore, this apparent improvement in DO is probably the result of the cold weather samples. Table I-8 further shows that BOD and COD decreased somewhat but sulphates increased. Ammonia and organic nitrogen both decreased while nitrates increased. Total phosphates and soluble phosphates decreased slightly while phenols increased. The increase in phenols is also due to the colder months since it is not degraded as rapidly at lower temperatures. The suspended solids decreased while the dissolved solids increased.

The stream at this point is not as grossly polluted as it was in 1963 but it still does not meet the criteria recommended by the technical committee. The improvement is due to the diversion of sewage from Griffith and Highland to the Hammond Sewage Treatment Plant. The remaining problems are due to some industrial pollution, combined sewer overflows and storm sewer outfalls. The combined sewer overflows are probably the cause of the high bacteria counts still found at this station on several occasions.

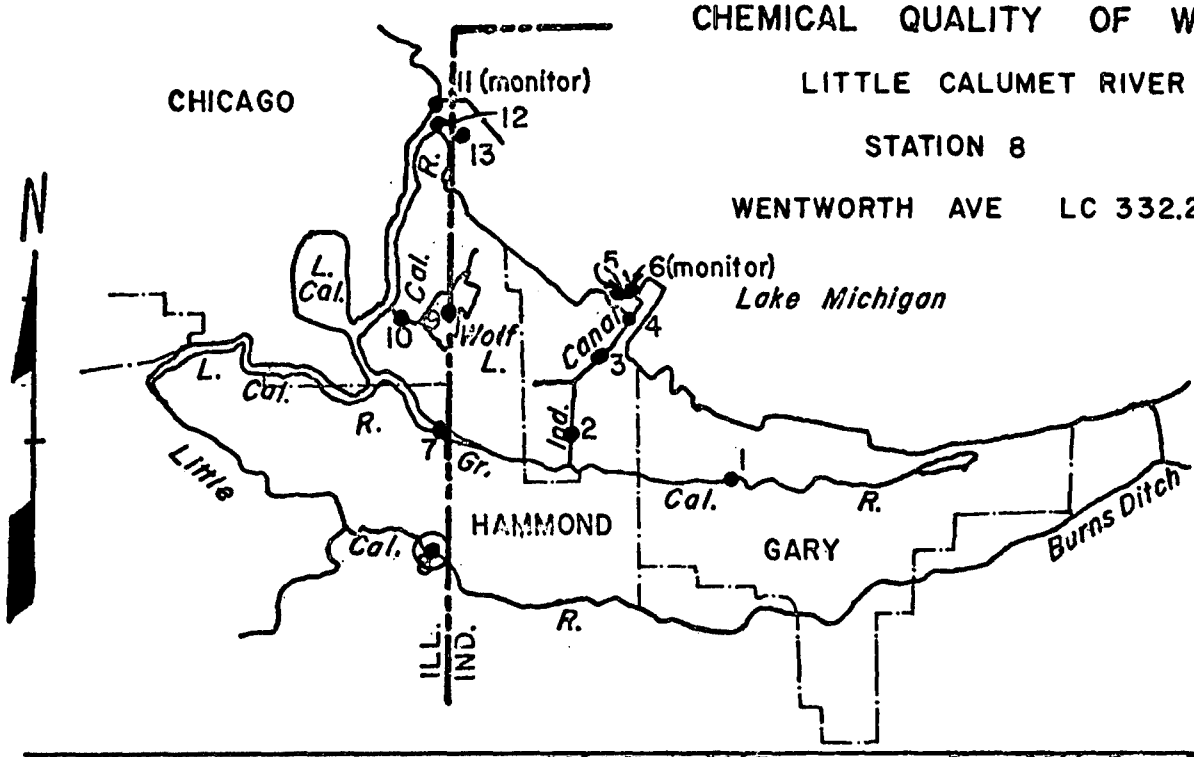
TABLE I - 8

CHEMICAL QUALITY OF WATER

LITTLE CALUMET RIVER

STATION 8

WENTWORTH AVE LC 332.2



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.8	7.1	7.4	7.3	8.0	7.0	7.5	7.5
Conductivity	umho/cm	--	--	--	--	1220	425	808	765
DO	mg/l	5.0	0.0	1.8	1.5	11.0	0.2	6.4	7.3
BOD	"	35	3.9	13	10	16	3.9	8.2	7.8
COD	"	79	5.9	45	51	89	20	45	39
Sulphates	"	310	57	172	170	300	101	187	180
Chlorides	"	--	--	--	--	55	17	41	44
MBAS	"	--	--	--	--	.76	.15	.28	.25
NH_3-N	"	3.7	0.42	2.1	2.1	3.1	.35	1.4	1.4
NO_2-NO_3 N	"	4.4	0.04	1.3	0.72	4.3	.12	1.7	1.8
Org-N	"	8.6	0.13	3.2	2.8	2.95	0.8	1.7	1.4
Total PO_4	"	14	1.5	5.3	4.5	6.9	.22	3.5	3.0
Sol. PO_4	"	9.7	0.51	3.4	3.6	3.1	0.0	1.4	1.1
Iron	"	3.8	0.45	1.5	1.2	3.1	.44	1.0	.91
Phenol	ug/l	38	0	8	6	39	.24	12.4	9.3
Cyanide	mg/l	.12	0.00	0.01	0.00	.02	.00	.005	.00
Susp. Solids	"	705	17	175	41	980	13	89	32
Dis. Solids	"	640	110	470	505	860	255	595	570
Turbidity	units	--	--	--	--	103	1.2	15.6	9.0
Temperature	°C	24	4	16.2	18	23	0	8	7

1965 data based on 19 samples except for cyanide(17); susp.solids(10); dissolved solids(10).
1966 data based on 25 samples except for turbidity(19); conductivity(18) chlorides(19), ABS(19).

Wolf Lake and Outlet (Stations 9 and 10)

Wolf Lake, which is located on the Indiana-Illinois state line, has been sampled at two points. Station 9 is directly on the state line which runs along a causeway that bisects the lake. This station monitors the quality of the water crossing the state line and has been established as a control point by the Calumet Area Technical Committee. Station 10 is located on the Wolf Lake outlet at Carondolet Avenue about 3000 feet downstream from Wolf Lake and monitors the quality of the water leaving the lake.

The quality of the water at Station 9 is good and meets the recommended criteria in most respects. During the first six months of 1966 the total Coliform count ranged from 4 to 1300 with an average of 116 and a median of 50. The Fecal Coliform counts ranged from less than 1 to 660 with an average of 38 and a median of 6. The Fecal Streptococci varied from less than 1 to 50 with an average of 12 and a median of less than 10. Figures I-2 and I-4 show that the total Coliform and Fecal Streptococci are lower than in June-November 1965 while the Fecal Coliform remained the same. The 1966 data is biased by the cold months, the temperature being zero degrees centigrade for over a month. The data indicates no significant change in quality since 1965.

The criteria for ammonia are not met but the maximum value was 0.56 mg/l which does not indicate a serious problem. The ammonia content appears to have increased slightly since 1965 but the 1965 data is based on only two samples and is not effected by the colder temperatures which inhibit the microbiological action that breaks down ammonia. The nitrates and organic nitrogen which are products of that microbiological action decreased slightly in the 1966 data.

The only pollution problem which is evident at this station is MBAS. MBAS concentrations vary from a maximum of 0.19 mg/l to 0.10 mg/l with an average of 0.12 mg/l and a median of 0.11 mg/l. These values are considerably above the recommended criteria and foam has been noted on the lake on several occasions. On two occasions during August of 1966 our beach sampler reported that the lake was covered with foam and all recreational uses were suspended.

The detergents originate at the Lever Brothers Company. In general, these wastes do not inhibit the use of the lake which is widely used for swimming, boating, fishing and water skiing, but on occasion an acute problem is caused by spills or accidental discharges which prevent all use of the lake and could possibly effect the fish population of the lake if the foam persisted for an extended period.

On January 26, 1966, 0.35 mg/l of cyanide was found at Station 9. The source of this cyanide is not known. It is possible that this is an erroneous finding since no cyanide was detected in the other 25 samples taken at this point and none was found in the outlet at Station 10 on that date. Cyanides were detected at Station 10 on four occasions but never more than 0.02 mg/l. It is possible that occasional discharges are coming from one of the industries on the lake.

The water quality at Station 10 is generally the same as at Station 9. The sulphates and phenols are somewhat higher and the solids content is slightly increased but all of the other parameters are almost equal. The solids content would normally be higher in a small stream running through an area of dense vegetation than in an open lake, but the reasons for the increased phenols and sulphates are not clear.

TABLE I-9

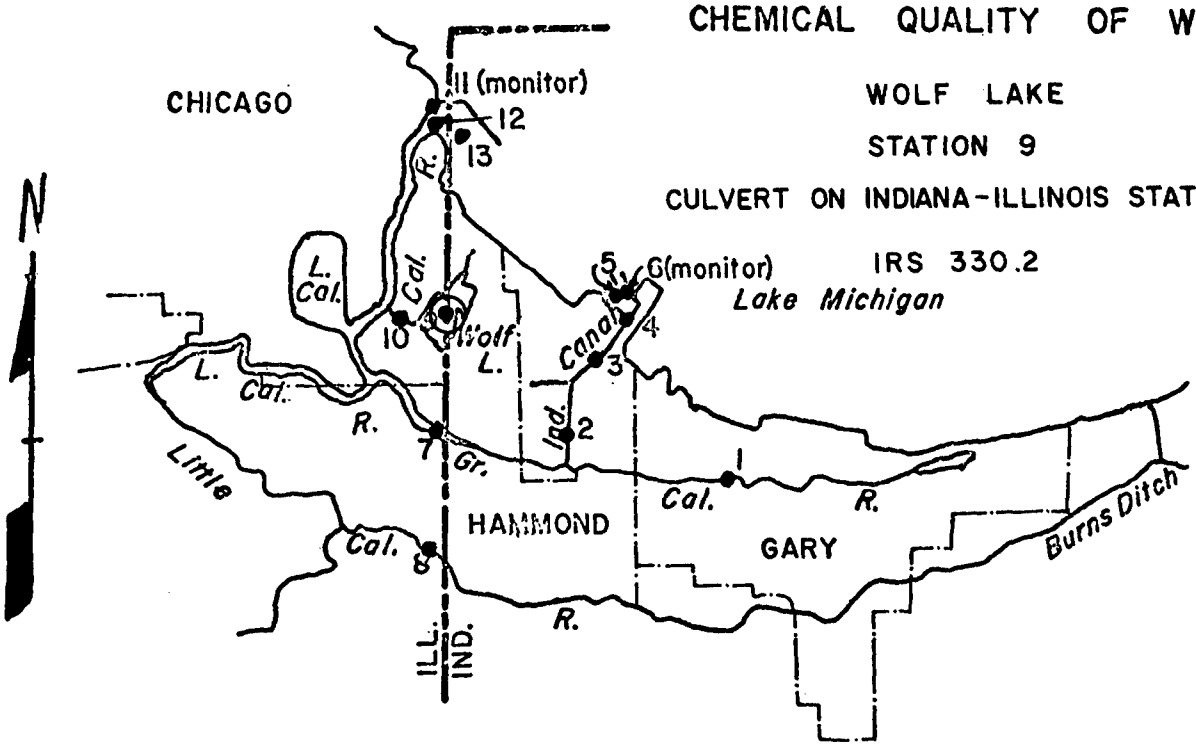
CHEMICAL QUALITY OF WATER

WOLF LAKE

STATION 9

CULVERT ON INDIANA-ILLINOIS STATE LINE

IRS 330.2



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.2	8.1			9.8	7.5	8.1	8.0
Conductivity-	umho/cm	--	--			460	350	414	400
DO	mg/l	11.0	10.0			15	7.70	11.04	11.2
BOD	"	5.5	3.7			7.8	1.9	3.9	3.7
COD	"	23	22			26	10	18	18
Sulphates	"	60	46			69	45	55	55
Chlorides	"	--	--			38	27	31	30
MBAS	"	--	--			.19	.10	.12	.11
NH_3-N	"	0.26	0.07			.56	.02	.28	.30
NO_2-NO_3 N	"	0.40	0.38			1.2	.03	.38	.30
Org-N	"	0.94	0.82			1.19	.51	.76	.71
Total PO_4	"	0.15	0.11			.34	.04	.11	.08
Sol. PO_4	"	0.00	0.00			.07	.00	.02	.02
Iron	"	0.38	0.28			.56	.04	.24	.22
Phenol	ug/l	20	1			19	.14	3.05	2
Cyanide	mg/l	0.00	0.00			.35	.00	.01	.00
Susp. Solids	"	51	2.4			48	4	13	9
Dis. Solids	"	265	255			320	180	268	265
Turbidity	units	--	--			4.2	0.5	2.3	2.1
Temperature	°C	--	--			24	0	8	5

1965 data based on 2 samples.
1966 data based on 26 samples except for sol.phosphate(25); conductivity(19) turbidity(19); ABS(19); chlorides(19).

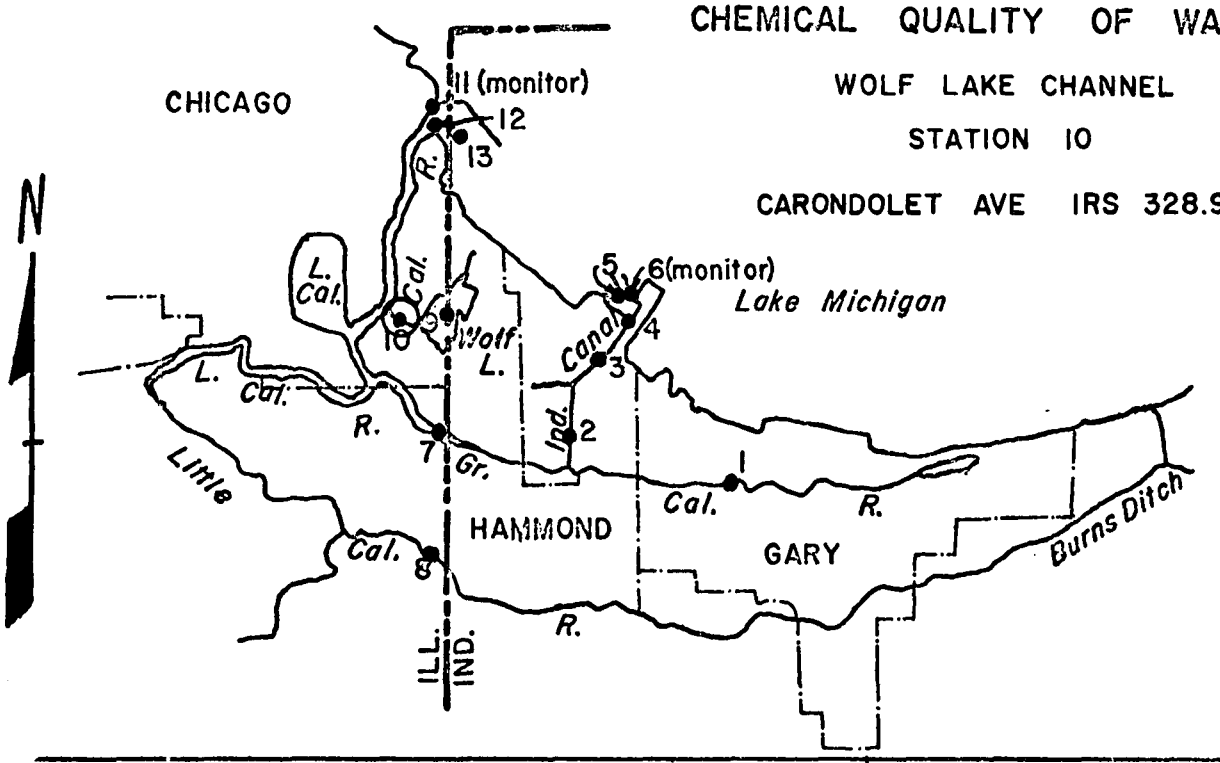
TABLE I - 10

CHEMICAL QUALITY OF WATER

WOLF LAKE CHANNEL

STATION 10

CARONDOLET AVE IRS 328.9



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.4	8.2			8.8	7.9	8.47	8.5
Conductivity	umho/cm	--	--			545	370	463	460
DO	mg/l	9.9	8.0			14.0	5.9	10.6	11.4
BOD	"	2.4	1.9			5.0	1.9	3.1	3.3
COD	"	20	12			26	12	18	18
Sulphates	"	55	45			92	69	77	77
Chlorides	"	--	--			37	30	34	35
MBAS	"	--	--			.24	.09	.13	.12
NH_3-N	"	0.21	0.12			0.67	0.10	0.27	0.28
NO_2-NO_3 N	"	0.25	0.23			0.67	0.10	0.37	0.34
Org-N	"	0.83	0.61			1.11	0.35	0.70	0.62
Total PO_4	"	0.11	0.09			0.27	0.03	0.07	0.06
Sol. PO_4	"	0.06	0.01			0.24	0.00	0.03	0.02
Iron	"	0.37	0.22			0.77	0.05	0.23	0.23
Phenol	ug/l	7	0			15	1.4	6.8	8.0
Cyanide	mg/l	0.00	0.00			0.02	0.00	0.002	0.00
Susp. Solids	"	20	17			65	2	25	24
Dis. Solids	"	280	270			315	220	289	295
Temperature	°C	--	--			25	0	8	5

1965 data based on 2 samples.
1966 data based on 26 samples except for: conductivity(19); chlorides(19); ABS(19).

GPO 801-482-7

Calumet Harbor (Stations 11, 12 and 13)

There are three sampling stations located at Calumet Harbor. Station 11 is located at the mouth of the Grand Calumet River immediately adjacent to the north pierhead light. This station was established during January 1966 in order to correlate the sampling program with a water quality monitor which is located in the pierhead light structure.

Station 12 is located at the mouth of the Grand Calumet River at mid-stream. The purpose of this station is to monitor the quality of the water entering the river from the harbor.

Station 13 is located in mid harbor approximately 3500 feet from the mouth of the river. This station monitors the quality of the water flowing in from Lake Michigan to the river. Stations 12 and 13 require a boat for sampling and therefore can be sampled only when the weather permits.

The operation of the O'Brien Lock tends to isolate the area by reversing the predominate flow of the river so that water flows from the lake to the river most of the time. For this reason the bulk of the pollution in the harbor and at the river mouth originates in the immediate area.

As shown in Figure I-1 the average and median total Coliform counts for both the river mouth and the harbor were somewhat lower during the first six months of 1966 than during June-November 1965. The 1966 data is biased by the low values found during the cold months. The values for April, May and June of 1966 compare with the values of August and September of 1965 to indicate that there has been no significant change in the amount of microbiological pollution in the area.

One of the twenty-five samples taken at Station 11 showed considerably

higher counts total and fecal coliforms than the remaining samples. These values (30,000 total coliforms and 18,000 fecal coliforms on April 29, 1966) were not included in the six month average values and are shown separately on Figures I-1 and I-5 . The high fecal coliform count indicates that the pollution was animal or human in origin. The field notes indicate that a boat passed while the sample was being taken. A sample taken 10 minutes earlier at Station 12, which is approximately 150 feet from Station 11, gave normal counts. These facts indicate that the pollution probably was a result of the passing vessel. This, along with a similar incident discussed in the previous report, emphasizes the need for control of vessel pollution.

Since the primary flow at Calumet Harbor is from Lake Michigan to the river, the level of microbiological pollution is much lower than at Indiana Harbor. The pollution that does exist is local in origin and is probably due primarily to vessels using the harbor and the river. Tables I-11 and I-12 show that the chemical quality of the water at Station 11 and Station 12 is very similar. The dissolved oxygen and the suspended solids are somewhat higher near the monitor. This phenomena, which also occurred at the Indiana Harbor Monitor, is explained by the turbulence caused by the structure. In addition, the phenol content is considerably higher near the monitor. This may be due to outfalls from the U. S. Steel Corporation which are located near by and often cause the water to be discolored along the bank of the stream.

Since the primary flow is from the lake the general quality of the water at each of these stations is good. Tables I-12 and I-13 show that there has been no significant change in the quality of the water since June-November 1965. Station 13 is in mid-harbor and represents the quality of the water coming from the lake. The increases in iron, phenol and suspended solids content between stations 11 and 12 and Station 13 indicate the effect of the U.S. Steel outfalls on the harbor.

TABLE I - II

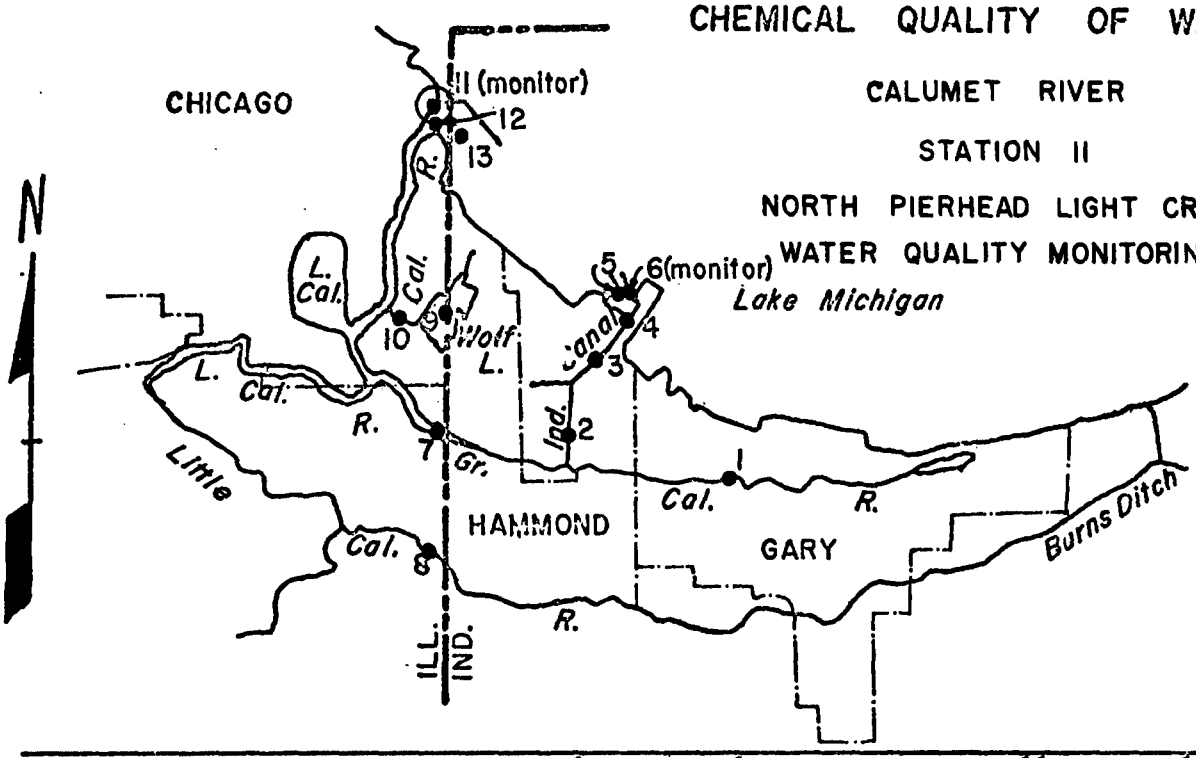
CHEMICAL QUALITY OF WATER

CALUMET RIVER

STATION II

NORTH PIERHEAD LIGHT CR 333.45

WATER QUALITY MONITORING STA.



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH						8.3	7.4	7.8	7.8
Conductivity	umho/cm					330	203	298	300
DO	mg/l					14.1	4.2	10.1	10.4
BOD	"					4.9	0.9	2.5	2.2
COD	"					36	0.7	9.5	8.8
Sulphates	"					35	21	27	27
Chlorides	"					16	10	12	12
MBAS	"					.22	.03	.07	.05
NH_3-N	"					0.72	0.21	0.49	0.46
NO_2-NO_3-N	"					0.32	0.09	0.20	0.22
Org-N	"					0.70	0.05	0.34	0.31
Total PO_4	"					0.90	0.04	0.17	0.09
Sol. PO_4	"					0.78	0.00	0.11	0.04
Iron	"					8.6	0.09	2.1	1.1
Phenol	ug/l					15	0.6	2.9	2.7
Cyanide	mg/l					0.13	0.00	0.02	0.01
Susp. Solids	"					85	8	29	23
Dis. Solids	"					210	160	182	185
Temperature	°C					19	0	7	6

Station not sampled during 1965.

1966 data based on 25 samples except for: NH_3, NO_2, NO_3 and Org-N(24) Chlorides(19), ABS(19).

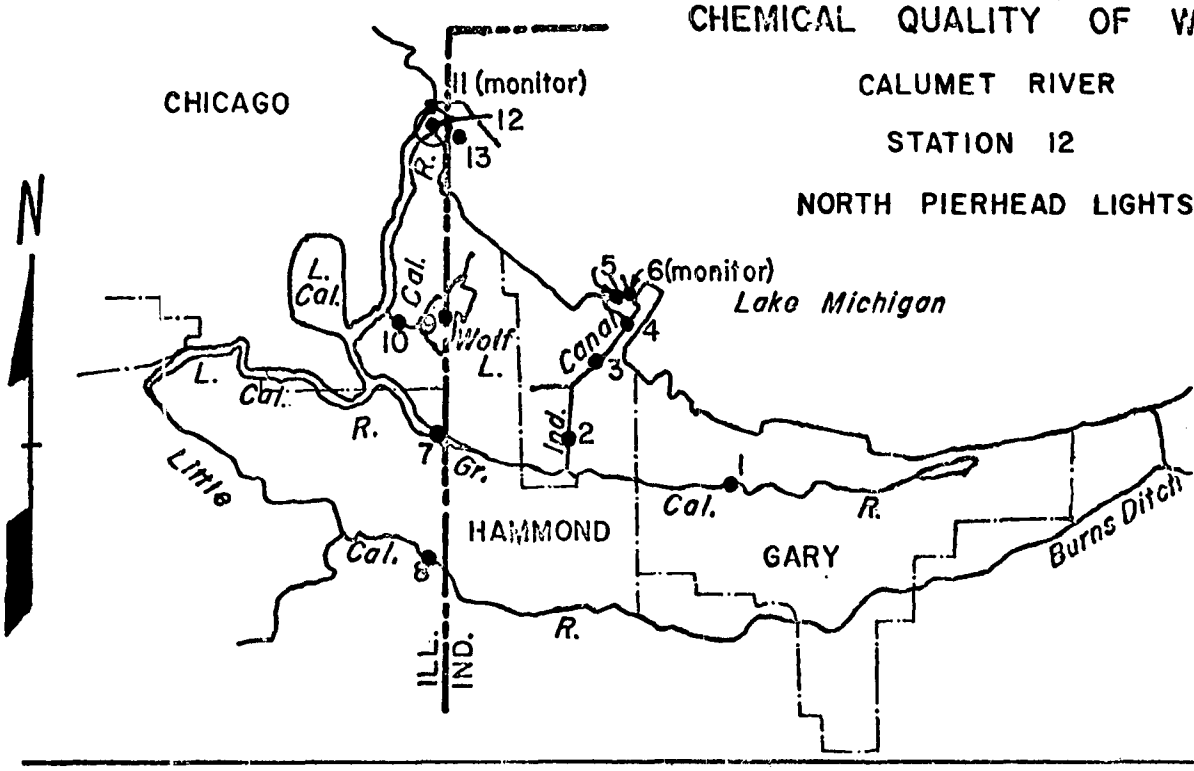
TABLE I - 12

CHEMICAL QUALITY OF WATER

CALUMET RIVER

STATION 12

NORTH PIERHEAD LIGHTS CR333.4



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
pH		8.0	7.8	7.9	7.9	8.1	7.5	7.86	7.9
Conductivity	umho/cm	--	--	--	--	330	285	300	295
DO	mg/l	9.4	7.1	8.1	8.1	11.1	5.40	8.46	7.85
BOD	"	3.7	1.0	1.8	1.5	5.5	1.0	2.8	2.2
COD	"	74	0.9	17	8.9	18	1.6	10.4	10
Sulphates	"	26	19	24	24	30	18	25	25
Chlorides	"	--	--	--	--	16	9	12	12
MBAS	"	--	--	--	--	.10	.03	.06	.05
NH_3-N	"	0.39	0.16	0.24	0.22	0.68	0.35	0.50	0.50
NO_2-NO_3 N	"	0.41	0.17	0.28	0.28	0.35	0.09	0.20	0.21
Org N	"	0.60	0.04	0.27	0.29	3.23	0.07	0.56	0.33
Total PO_4	"	0.25	0.02	0.12	0.80	0.13	0.05	0.08	0.08
Sol. PO_4	"	0.23	0.02	0.08	0.05	0.09	0.01	0.04	0.04
Iron	"	2.3	0.23	0.98	0.72	1.8	0.55	1.10	1.10
Phenol	ug/l	8	0	2	1	12	0.0	1.9	0.6
Cyanide	mg/l	0.01	0.00	0.00	0.00	0.12	0.00	0.01	0.01
Susp. Solids	"	76	2	22	18	53	4	20	17
Dis. Solids	"	280	160	195	185	235	175	192	185
Alkalinity	mg/l $CaCO_3$	--	--	--	--	117	110	113	113
Temperature	°C	22	11	16.6	18	19	4	11	11

1965 data based on 11 samples except for: susp. solids(8) and dis. solids(7).
1966 data based on 13 samples except for: chlorides(12) and ABS(12).

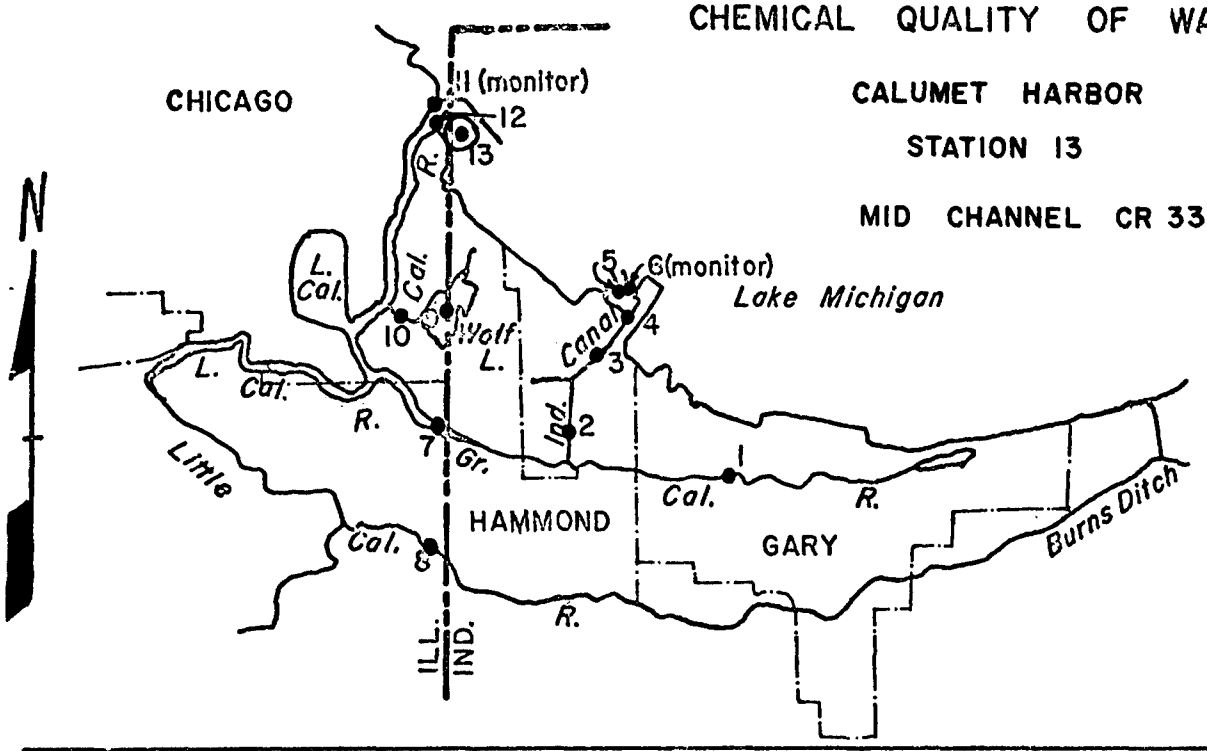
TABLE I - 13

CHEMICAL QUALITY OF WATER

CALUMET HARBOR

STATION 13

MID CHANNEL CR 334.0



Parameter		June 1965-Nov. 1965 Max	Min	Mean	Median	Jan. 1966-June 1966 Max	Min	Mean	Median
Alkalinity		--	--	--	--	121	107	113	111
pH		8.0	7.7	7.9	7.9	8.1	7.4	7.8	7.8
Conductivity	umho/cm	--	--	--	--	310	270	293	300
DO	mg/l	10	7.0	8.5	8.3	12.2	7.3	9.2	9.3
BOD	"	2.1	1.0	1.5	1.6	4.8	1.3	2.6	2.3
COD	"	26	0.0	9.0	5.9	16	3.0	9.2	10
Sulphates	"	37	19	25	24	26	18	24	25
Chlorides	"	--	--	--	--	14	8	11	11
MBAS	"	--	--	--	--	.09	.03	.05	.04
NH_3-N	"	0.27	0.10	0.19	0.20	0.48	0.24	0.33	0.33
NO_2-NO_3 N	"	0.53	0.17	0.27	0.23	0.35	0.08	0.18	0.16
Org N	"	0.51	0.03	0.26	0.26	0.56	0.10	0.37	0.39
Total PO_4	"	0.78	0.02	0.15	0.06	0.10	0.04	0.06	0.06
Sol. PO_4	"	0.29	0.02	0.08	0.04	0.05	0.00	0.02	0.02
Iron	"	1.8	0.09	0.52	0.18	2.1	0.29	0.66	0.48
Phenol	ug/l	3	0	1	0	5.3	0.0	1.3	0.0
Cyanide	mg/l	0.01	0.00	0.00	0.00	0.01	0.00	.002	0.00
Susp. Solids	"	17	1	8	6	46	3	12	9
Dis. Solids	"	195	155	175	170	210	170	190	185
Turbidity	units	--	--	--	--	8.8	1.3	2.6	3.4
Temperature	°C	22	10	16.2	18	18	5	12	14

1965 data based on 10 samples except for: susp. solids(7) and dis. solids(6).
1966 data based on 12 samples except for: turbidity(10).

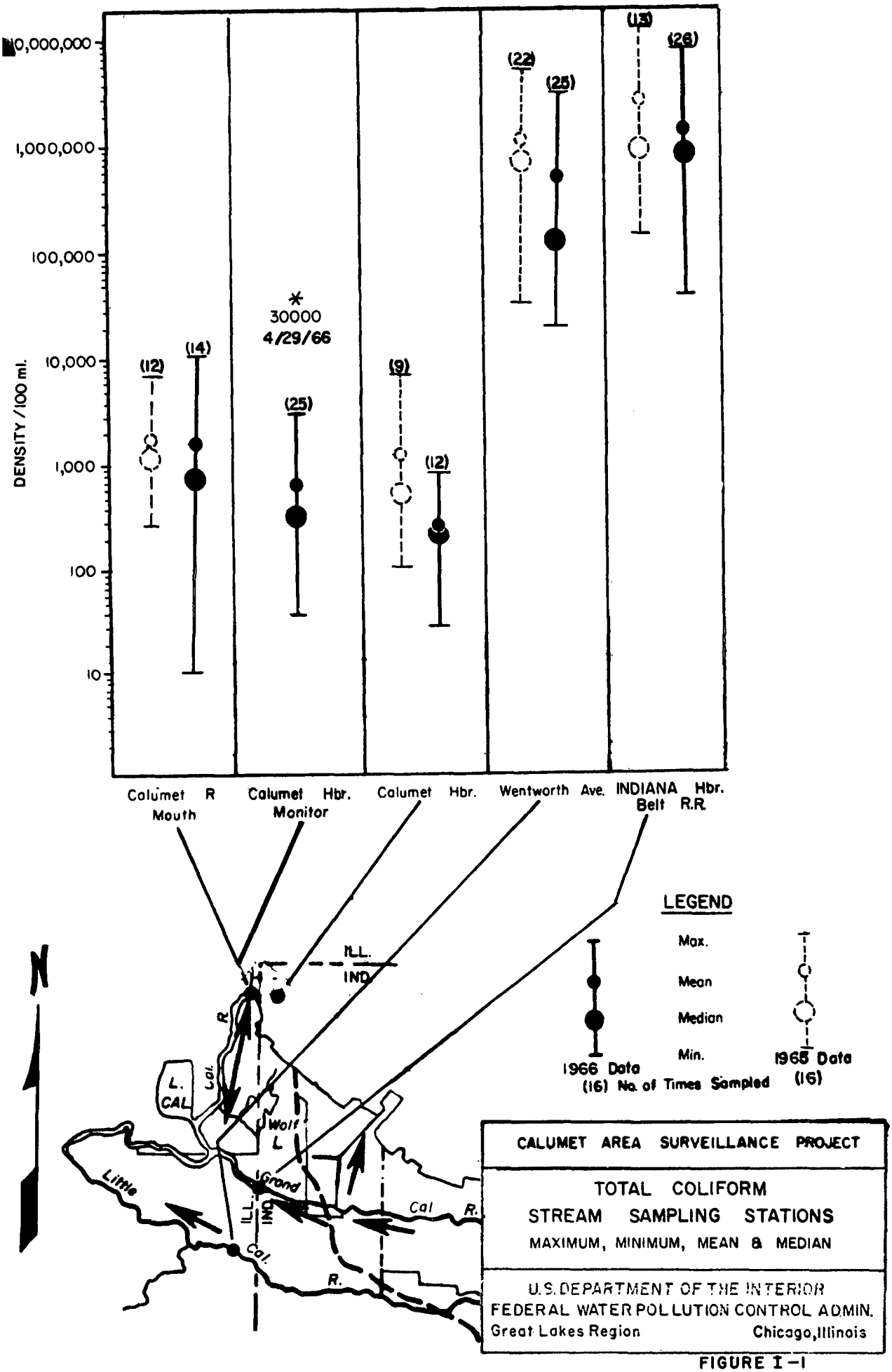
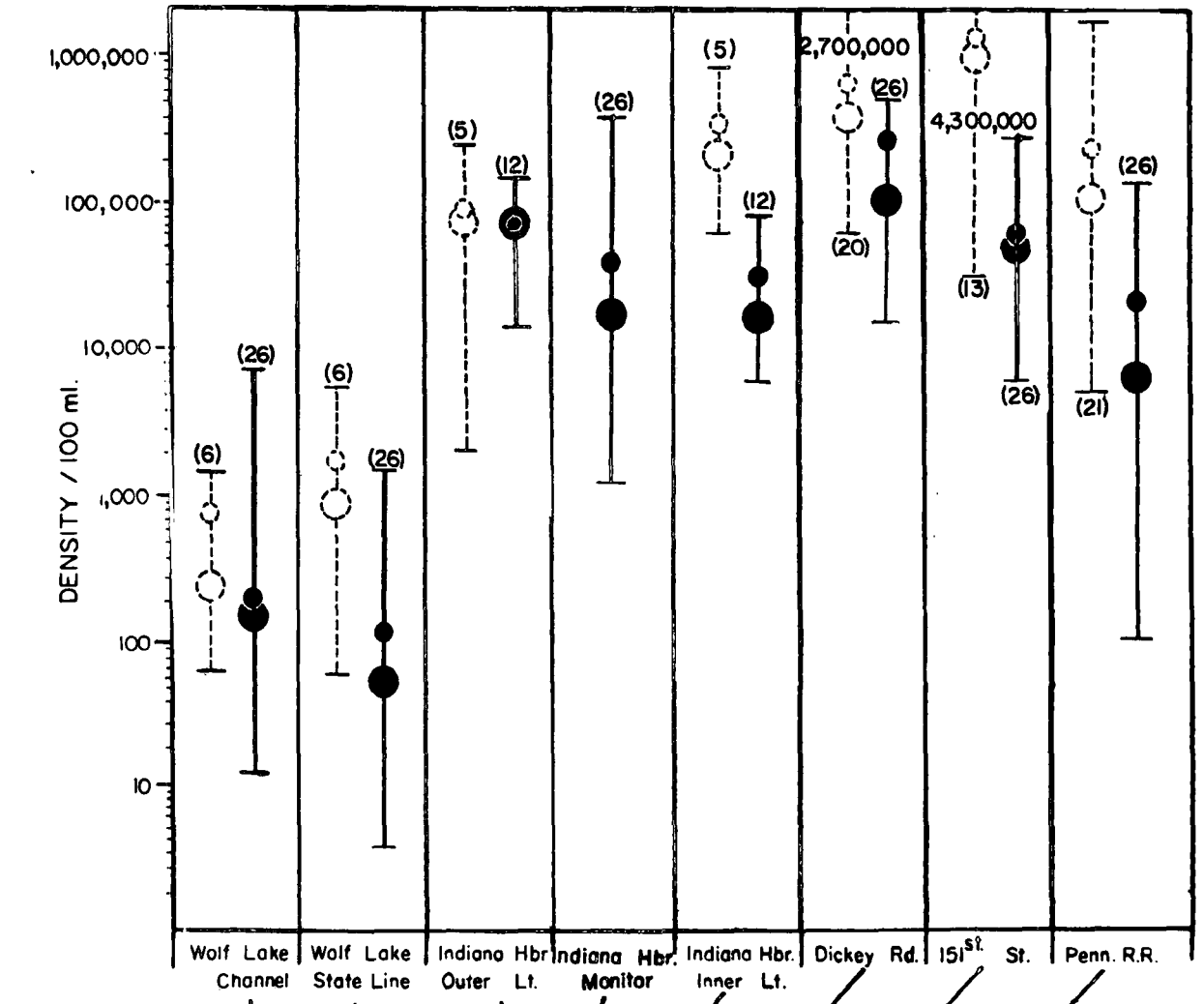
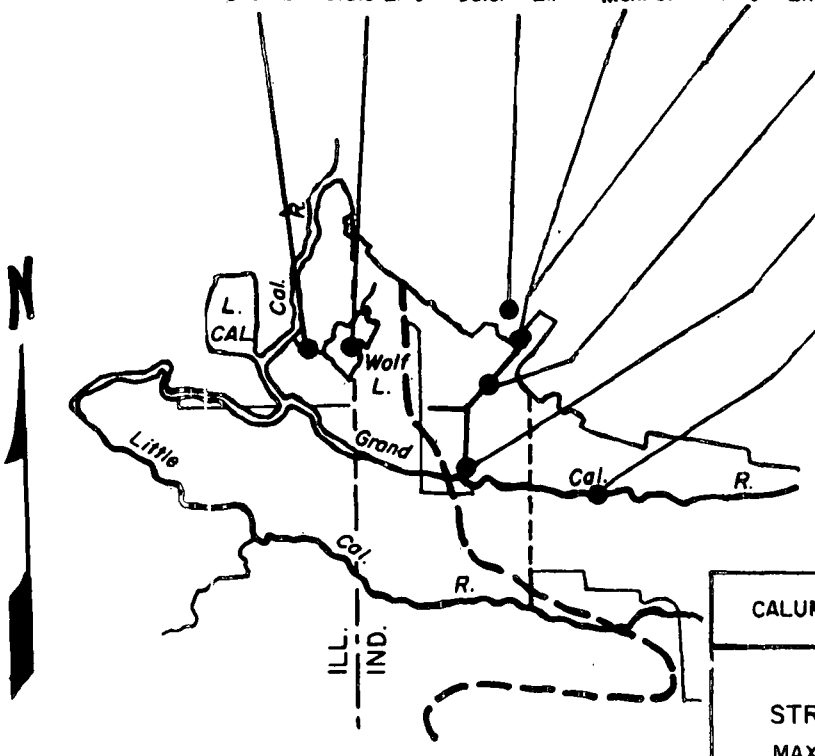

10,000,000
1,000,000
100,000
10,000
1,000
100
10
DENSITY / 100 ml.
(12)
(14)
(25)
30000
4/29/66
(9)
(12)
(22)
(25)
(13)
(26)
Calumet R Mouth
Calumet Hbr. Monitor
Calumet Hbr.
Wentworth Ave.
INDIANA Belt R.R.
Hbr.
LEGEND
Max.
Mean
Median
Min.
1966 Data
1965 Data
(16) No. of Times Sampled
(16)
N
ILL.
IND.
L. CAL
Wolf L
Grand
Little
Cal. R.
CALUMET AREA SURVEILLANCE PROJECT
TOTAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois

FIGURE I-1





LEGEND

Max.
Mean
Median
Min.

1966 Data (16) NO. of Times Sampled

1965 Data (16)

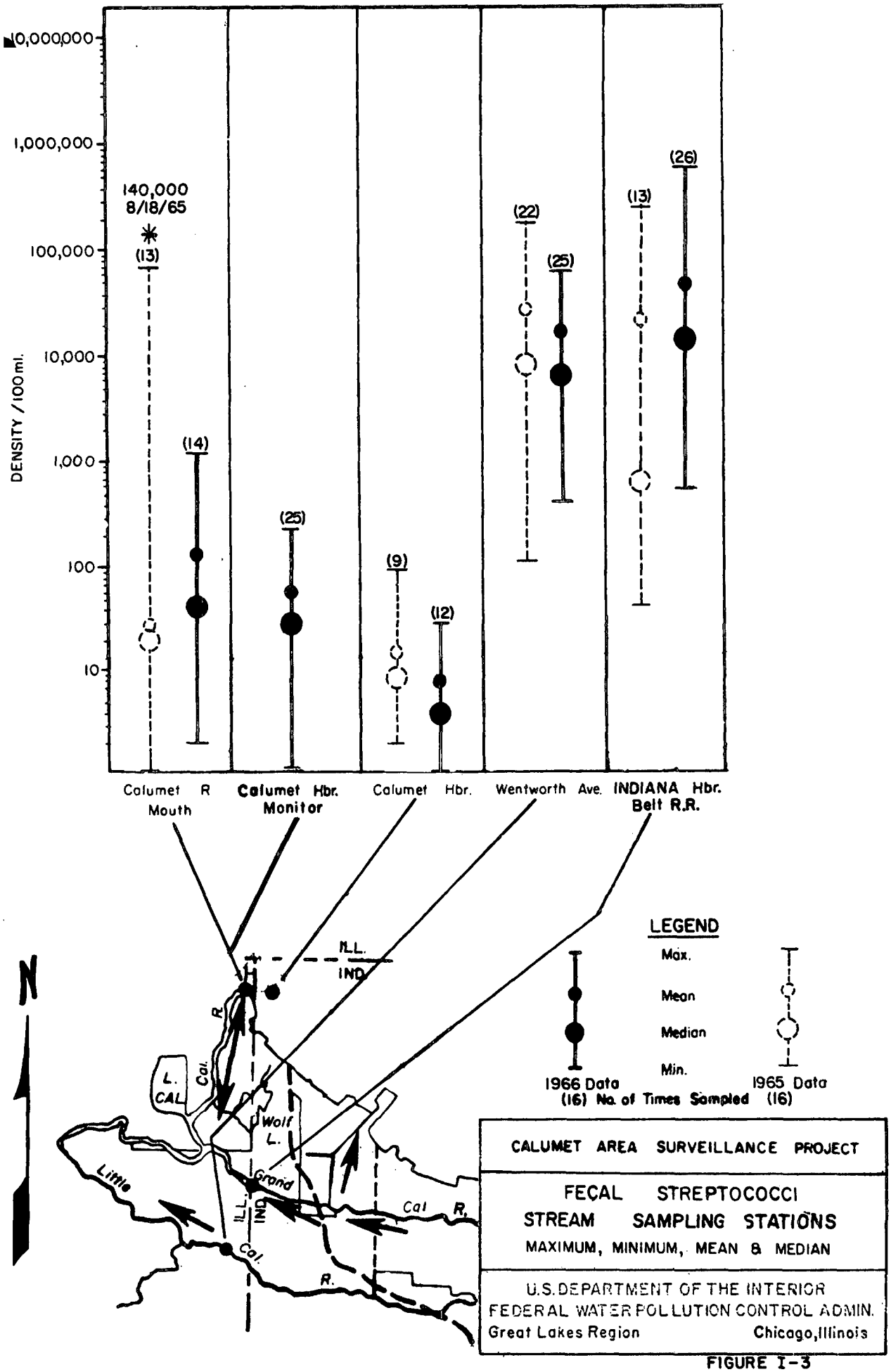
CALUMET AREA SURVEILLANCE PROJECT

TOTAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

GPO 801-482-6

FIGURE 1-2



CALUMET AREA SURVEILLANCE PROJECT

FECAL STREPTOCOCCI
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I-3

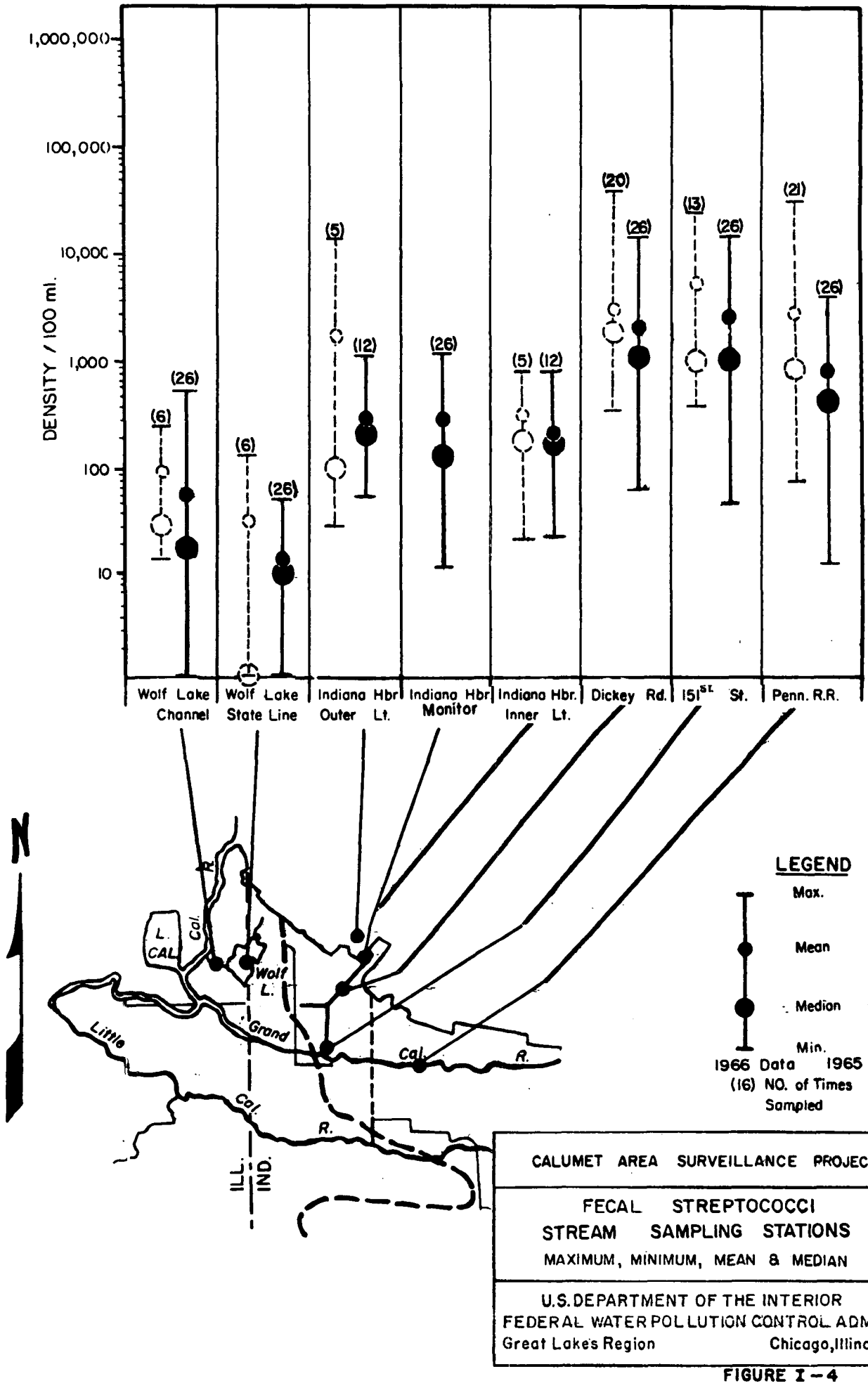

1,000,000
100,000
10,000
1,000
100
10
DENSITY / 100 ml.
(6)
(26)
(6)
(26)
(5)
(12)
(26)
(5)
(12)
(20)
(26)
(13)
(26)
(21)
(26)
Wolf Lake Channel
Wolf Lake State Line
Indiana Hbr Outer Lt.
Indiana Hbr Monitor
Indiana Hbr. Inner Lt.
Dickey Rd.
151ST St.
Penn. R.R.
N
L. CAL
Cal. R.
Wolf L.
Grand
Little
Cal. R.
Cal. R.
ILL.
IND.
LEGEND
Max.
Mean
Medion
Min.
1966 Data
1965 Data
(16) NO. of Times (16)
Sampled
CALUMET AREA SURVEILLANCE PROJECT
FECAL STREPTOCOCCI
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois

FIGURE I – 4

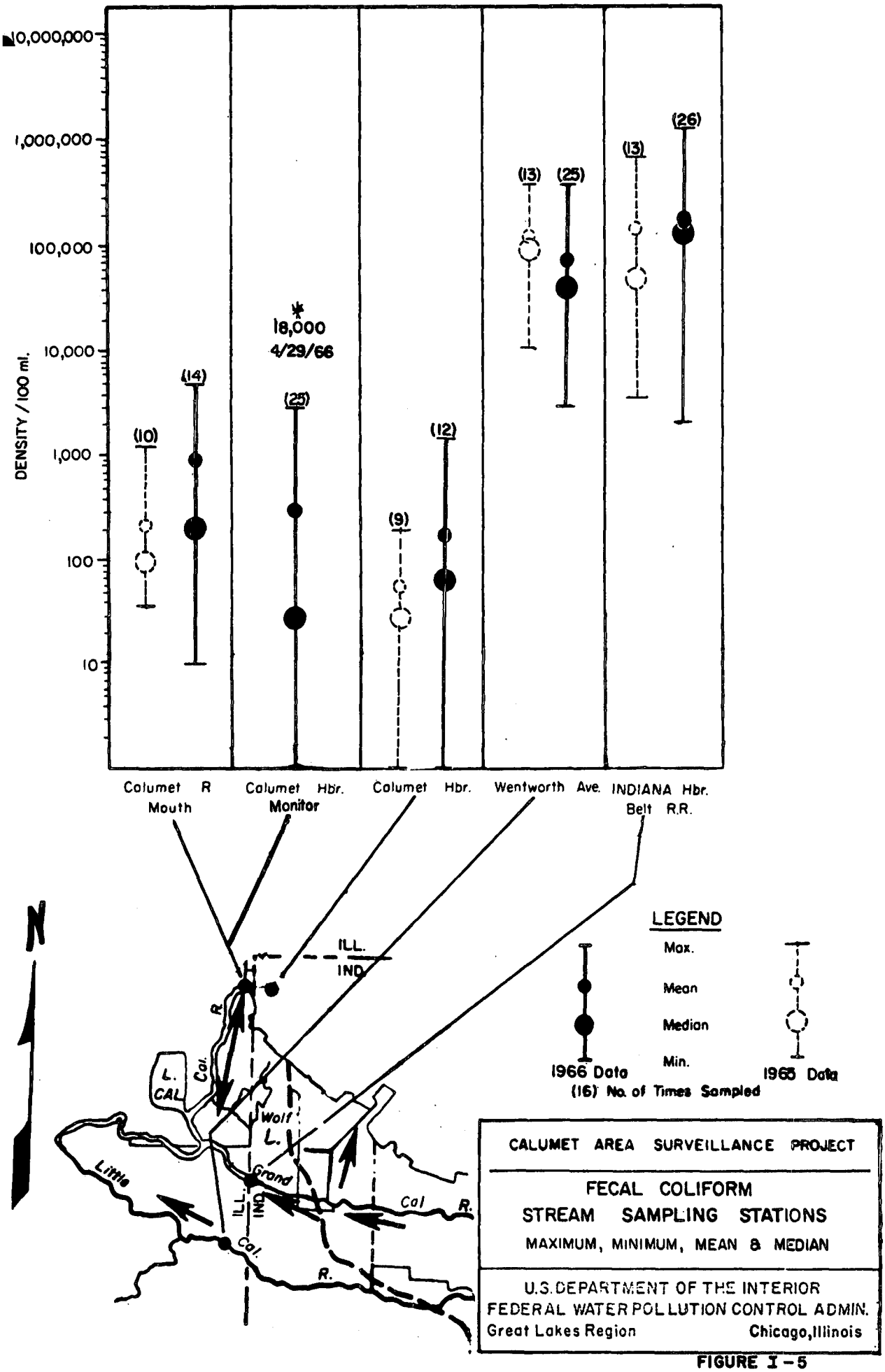
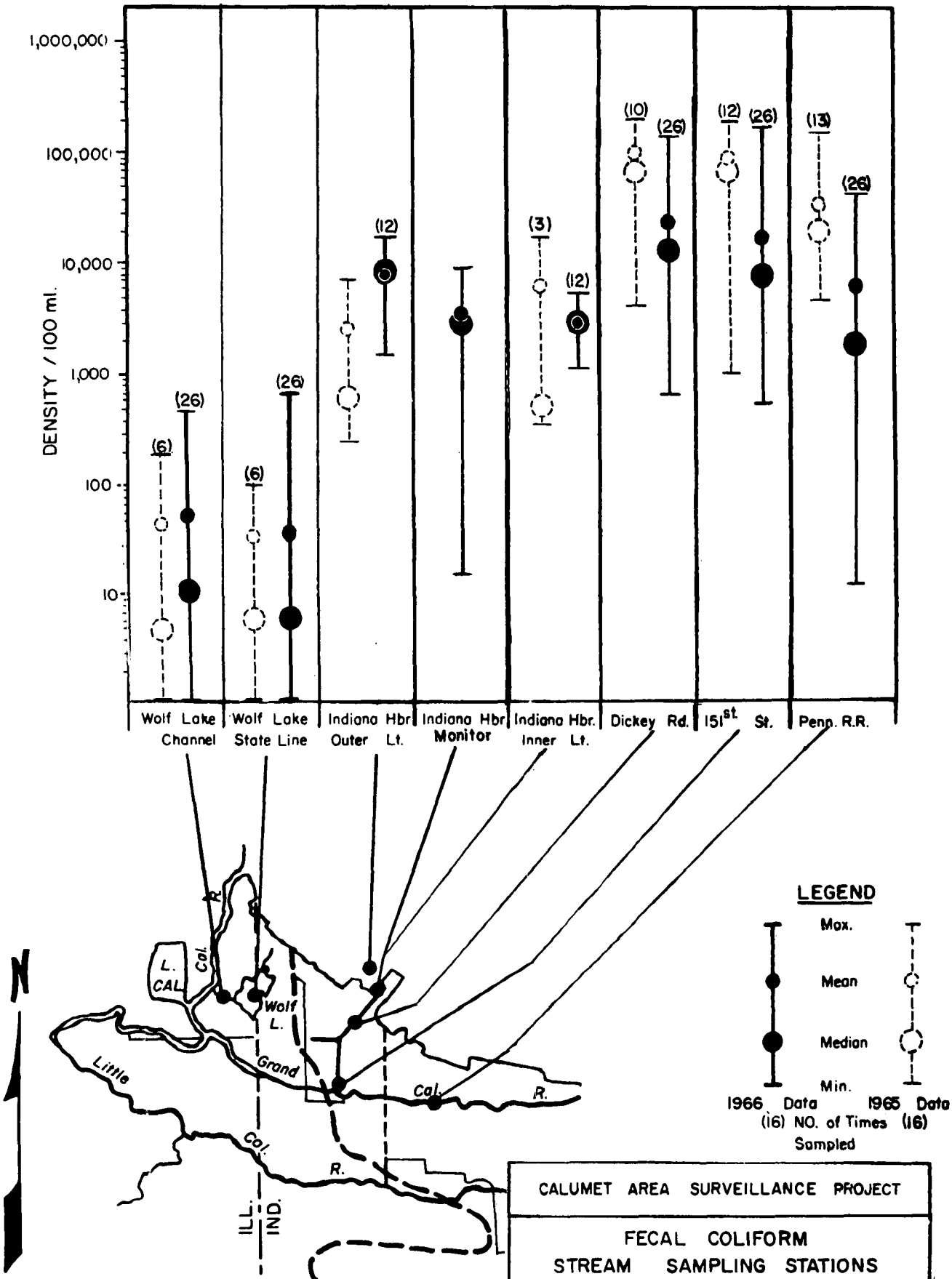

10,000,000
1,000,000
100,000
10,000
1,000
100
10
DENSITY / 100 ml.
(10)
(14)
(25)
18,000
4/29/66
(9)
(12)
(13)
(25)
(13)
(26)
Columet R Mouth
Calumet Hbr. Monitor
Calumet Hbr.
Wentworth Ave.
INDIANA Hbr. Belt R.R.
N
ILL.
IND.
R.
L. CAL
Cal.
Wolf L.
Grand
Little
Cal R.
LEGEND
Max.
Mean
Median
Min.
1966 Data
1965 Data
(16) No. of Times Sampled
CALUMET AREA SURVEILLANCE PROJECT
FECAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois

FIGURE I-5



CALUMET AREA SURVEILLANCE PROJECT

FECAL COLIFORM
STREAM SAMPLING STATIONS
MAXIMUM, MINIMUM, MEAN & MEDIAN

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE I-6

PART II - BEACH SAMPLING PROGRAM

Microbiological information is based on sampling of Lake Michigan beaches in the Calumet Area between May 31 and September 15, 1966. Samples collected by the Surveillance Project were processed in the GLIRBP Laboratories by means of the membrane filter (MF) method to determine total coliform, fecal coliform and fecal streptococci,

Seven Lake Michigan beaches in the Calumet Area were sampled during the 1966 bathing season. The beaches sampled were Rainbow, Calumet Park Inner and Calumet Park Outer, in Illinois. Rainbow beach was sampled at 75th Place and 77th Place and Calumet Park Inner beach at 99th and 100th Streets. Hammond, Whiting, E. Chicago and Wolf Lake at 121st Street were the Indiana beaches sampled. Wolf Lake was not included in the beach sampling program during the 1965 season.

Procedure

Samples were obtained in four feet of water at elbow depth, approximately 18" below the surface. The samples were immediately stored in an ice chest until processed at the laboratory. The sampler recorded the following information at the time of collecting the sample; number of bathers within a one-hundred foot radius; air temperature, water temperature, wind speed and direction; cloud cover and weather conditions; and surf conditions. All samples were processed on the same day that they were taken.

The laboratory methods followed are in accordance with the procedure established in "Standard Methods for the Examination of Water and Wastewater" (12th ed). Fecal coliform determinations were made by the MF method, using M-FC broth base (Difco) with Rosolic acid as an indicator. This method was developed by Geldreich et al at the Robert A. Taft Sanitary Engineering Center (Geldreich et al. '65, J.A.W.W.A., 57: 2: 208-214, Feb).

Data Analyses

Comparisons of the 1965 and 1966 data for total coliform, fecal streptococci and fecal coliform densities are shown graphically for each beach in Figures II-1, II-2 and II-3. It should be noted that a greater number of samples were collected and analyzed in 1966 than in 1965.

The maximum, minimum, arithmetic mean and median densities for total coliform at Rainbow and E. Chicago beaches are approximately the same as in 1965 (Figure II-1). Calumet Park Inner and Outer beaches show slightly lower counts for total coliform in 1966 while Hammond and Whiting beaches are markedly higher. The maximum values as shown in Figure 1 indicate that Hammond and Whiting beaches are subject to periods of extremely heavy pollution.

Fecal streptococci are an indication of possible contamination of the water from domestic sewage. Fecal streptococci densities for 1965 and 1966 are compared graphically in Figure II-2. The maximum and mean counts for the beaches at Calumet Park Outer, Hammond, Whiting and E. Chicago are considerably higher than in 1965 indicating that the beaches are subject to contamination from domestic wastes.

The beaches were sampled 27-29 times during the 1966 season for fecal coliform counts. Figure II-3 shows a graphic comparison of the 1965 and 1966 findings. It should be noted that there were only four samples in 1965 and that these were at the end of the season when temperatures were lower and beach usage less. The maximum and mean fecal coliform counts are higher in 1966 at every sampling point. Thirty-three percent of the samples collected at Hammond and 22% of the Whiting beach samples had counts of more than 10,000 fecal coliform per 100 ml.

Wolf Lake at 121st was not sampled in the 1965 season but was sampled 32 times in 1966. The total coliform counts ranged from a maximum of 4,400 to a minimum of 6 with the median 230 and the mean 525. Fecal streptococci counts ranged from less than 1 to 380 with the mean 32 and the median 10. Twenty-seven samples for fecal coliform determinations ranged from 2 to 1,100 with the mean 79 and the median 10. These values indicate that the lake is relatively free of pollution and most of the bacteria probably originate with the bathers using the beach.

The criteria for determining satisfactory water quality for bathing at the beaches in the Calumet Area are:

a. The water quality is satisfactory if MF coliforms are less than 1,000 and MF fecal streptococci are less than 100.

b. The water quality is satisfactory if MF coliforms are between 1,000 and 5,000 and MF fecal streptococci are less than 20.

These standards have been applied to the data collected at the beaches in the Calumet Area for the 1966 swimming season. Table II-1 gives the number and percent of times water quality at beaches did not meet the criteria.

Table II-1

	1965		1966	
Beach	No. of times criteria not met	% of time criteria not met	No. of times criteria not met	% of time criteria not met
Rainbow 75th	10	74	10	32%
77th			13	42%
Calumet Outer	9	57	16	51%
Calumet Inner 99th	15	91	14	43%
100th			12	37%
Hammond	16	100	24	75%
Whiting	10	60	24	77%
E. Chicago	11	61	16	50%
Wolf Lake	-	-	3	9%

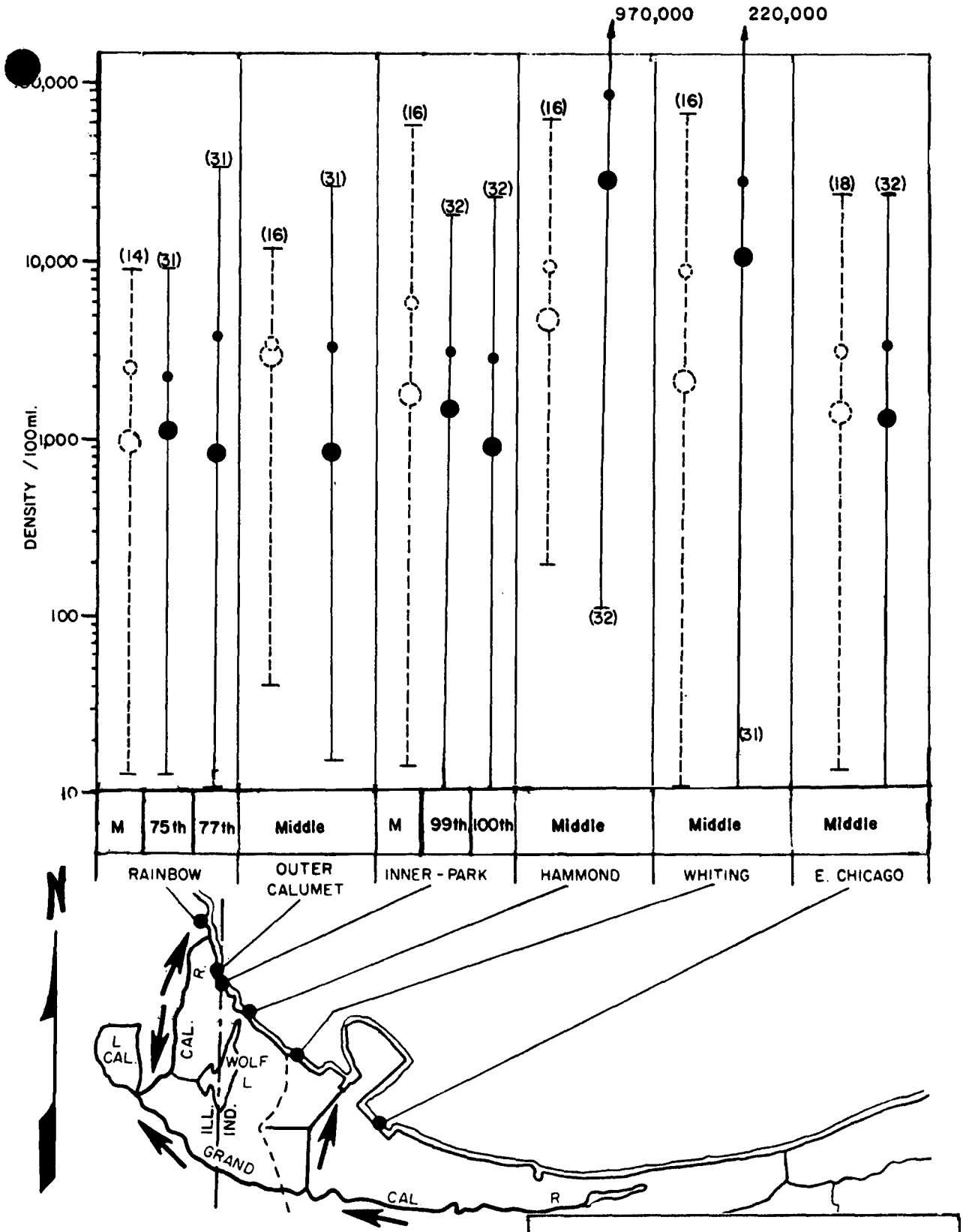
From this table it is clear that the beaches were somewhat cleaner in 1966 than they were in 1965 but that significant pollution still exists especially at the Hammond and Whiting beaches which met the criteria less than one quarter of the time.

Figures II-1, II-2 and II-3 indicate that fecal coliform and fecal streptococci did not decline as much as the total coliform counts and that on certain days there were extremely high counts at several beaches. This indicates that much of the pollution is animal in origin and fairly fresh. It may have originated from bathers using the beaches or from boats and offshore shipping.

No correllation was found between the coliform counts and rainfall which would cause local drainage and possible outflows from combined sewers. It must be noted however, that the 1966 bathing season was unusually dry and therefore, this study is not conclusive.

It was noted that 75% of the high counts occurred when the wind had an easterly component. This is probably due to the higher wave action which is associated with easterly winds. The waves tend to stir up the bottom.

GPO 801-482-5



LEGEND

(16) No. Times Sampled

Max.
Mean
Median
Min.

1965 Data

(16)

Max.
Mean
Median
Min.

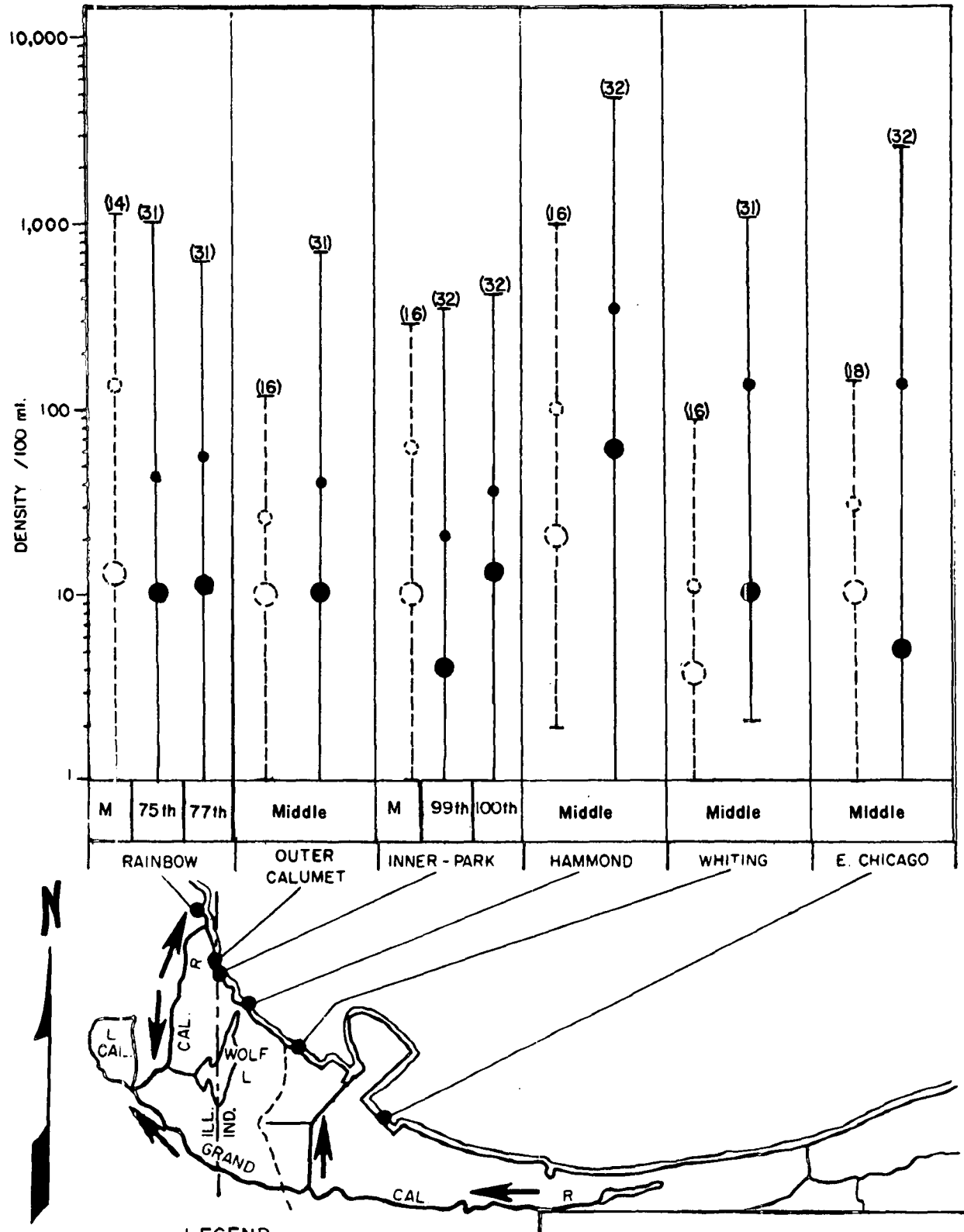
1966 Data

CALUMET AREA SURVEILLANCE PROJECT

BEACH SAMPLING – TOTAL COLIFORM
MAXIMUM, MINIMUM, MEAN & MEDIAN
JUNE – SEPT. 1966

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE II-1

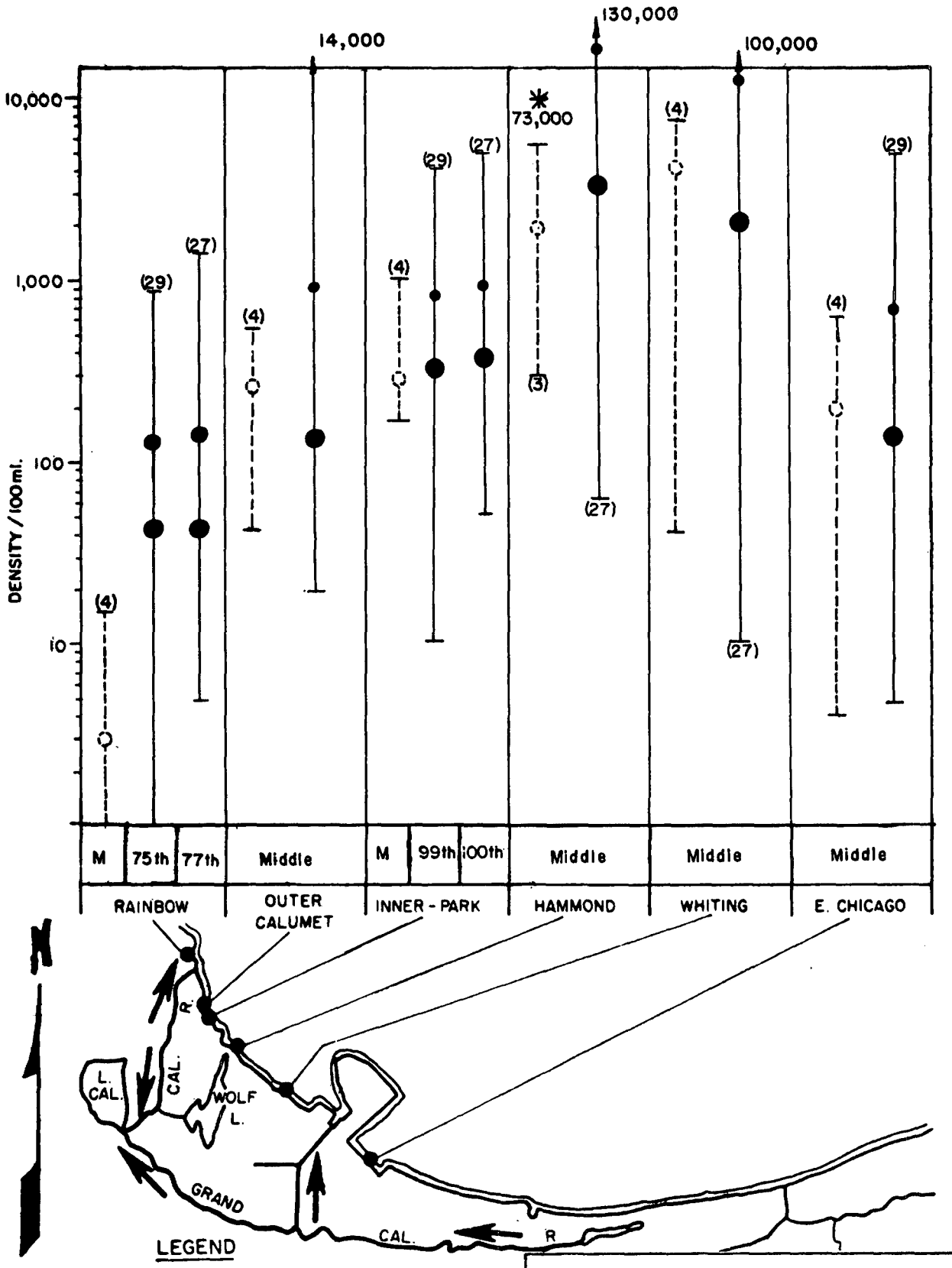


CALUMET AREA SURVEILLANCE PROJECT

BEACH SAMPLING - FECAL STREPTOCOCCI
MAXIMUM, MINIMUM, MEAN & MEDIAN
JUNE - SEPT. 1966

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE II-2



CALUMET AREA SURVEILLANCE PROJECT

BEACH SAMPLING - FECAL COLIFORM
MAXIMUM, MINIMUM, MEAN & MEDIAN
JUNE- SEPT. 1966

U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region Chicago, Illinois

FIGURE II-3

PART III - AUTOMATIC MONITORING

Description of Facilities

At present there are two automatic water quality monitoring stations in operation, one at Calumet Harbor and one at Indiana Harbor. These instruments, manufactured by the Schneider Instrument Company of Cincinnati, Ohio, consist of three main elements; the flow cells, the electronic circuitry and the data recorder.

A flow cell consists of a tapered cylindrical chamber through which water from the river is continuously pumped. Electrochemical probes which are capable of detecting changes in the chemical properties of the water can be inserted into the cell. These probes send an electric signal to the electronic circuitry portion of the monitor where it is amplified, modified, displayed on a galvanometer and sent to the data recording section of the monitor.

Each monitor has eight flow cells so that it is capable of handling a minimum of eight parameters. Some parameters such as temperature can be put in the same flow cell with another parameter so that the flow cells can handle more than eight parameters.

The electronics section of the monitor consists of separate circuits for each parameter. Each of these circuits includes several potentiometers and a galvanometer which can be calibrated to show the value of the parameter at all times. Compensation circuits are included so that parameters that are dependent upon other parameters can be measured on a uniform basis. For example, the conductivity parameter has a temperature compensation circuit so that the conductivity is always recorded as 25°C conductivity. The electronics section has eight cubicles so that it is limited to eight parameters. An additional

section would be required to accommodate more than eight parameters.

The recorder section takes signals from the electronic circuits, converts them into mechanical energy and prints the data on a chart which is moving at the rate of one inch per hour. The value of each parameter is recorded once every 6 minutes. The recorder has twelve channels and therefore has the capacity to handle twelve parameters.

At present four parameters are being measured at each monitor. These include temperature, specific conductivity, pH and dissolved oxygen. These are being measured primarily because they are the ones for which reliable probes have been developed. Probes are being developed for sulphates and chlorides. These will be added to each monitor as soon as they become available.

Evaluation of Results

At its present stage of development the automatic monitoring program is not producing up to its full potential. There are two basic reasons for this, one is that the parameters being measured are not the critical pollution parameters in the area and the second is that,at present, the data is not presented in a form that permits immediate investigation of significant variations in the parameters being measured.

Except for some initial problems the monitors have demonstrated their ability to operate reliably and continuously over a considerable period of time with a minimum of maintenance. As indicated in Figures III-1 through III-4 the data has a reasonable range and is in reasonable agreement with the results of our weekly sampling program. Much of the variation from the weekly sampling results can be explained by the fact that the samples were not taken at exactly the same point or depth as the monitor intake. In the future,

weekly samples for full laboratory analysis will be taken directly from the flow cells in the monitor.

The purpose of continuous monitoring is not to establish water quality. A weekly sampling program is more suitable for this purpose because of the great number of analyses that can be run in the laboratory. The primary purpose of the monitor is to give immediate indication and warning of changes in the water quality so that action can be taken to determine the cause of the change and so that downstream users can be warned if necessary. Due to the fact that the data is stored on a chart and is not immediately available unless the monitor is attended at all times, this utilization has not been realized.

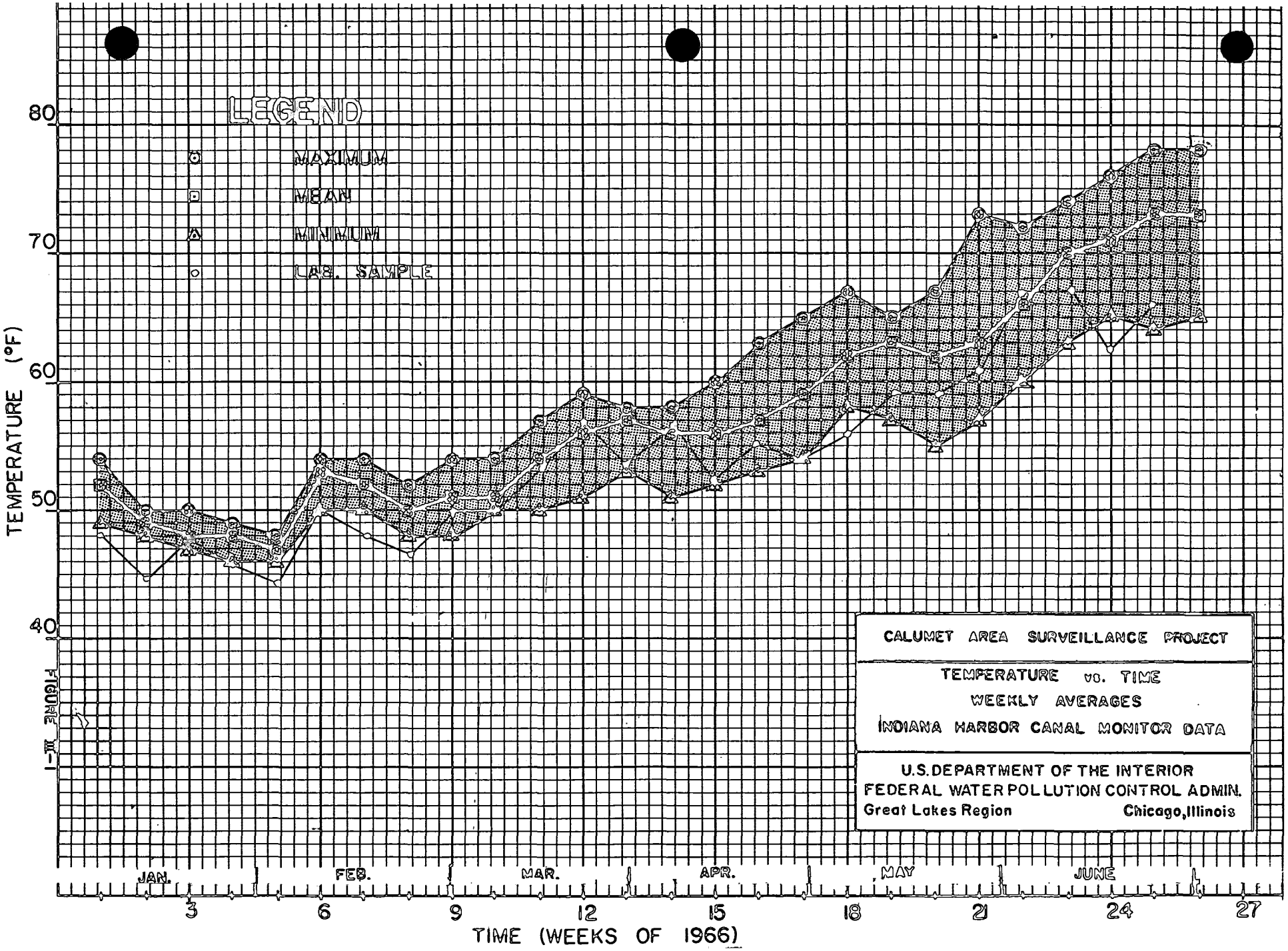
Proposed Improvements

The addition of the ferric iron and sulphates parameters should provide a more direct measurement of the industrial pollution that is predominant in the area.

A central station to which all monitors will telemeter their data is planned. The data will be continuously displayed so that any deviations in water quality could be instantly detected and investigated. In addition, each monitor will be equipped with an automatic sampler which will take a sample if any parameter exceeds certain limits and will flash a warning in the central station.

Eventually there will be a network of six monitors in the area. The central station will receive the data from each of these stations, display it and store it in a computor for analysis. This will give the project the ability to detect and immediately react to changes in water quality in the area.

GPO 801-482-4


LEGEND
MAXIMUM
MEAN
MINIMUM
LAB. SAMPLE
TEMPERATURE (°F)
80
70
60
50
40
JAN.
FEB.
MAR.
APR.
MAY
JUNE
3
6
9
12
15
18
21
24
27
TIME (WEEKS OF 1966)
CALUMET AREA SURVEILLANCE PROJECT
TEMPERATURE vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
FIGURE III-1

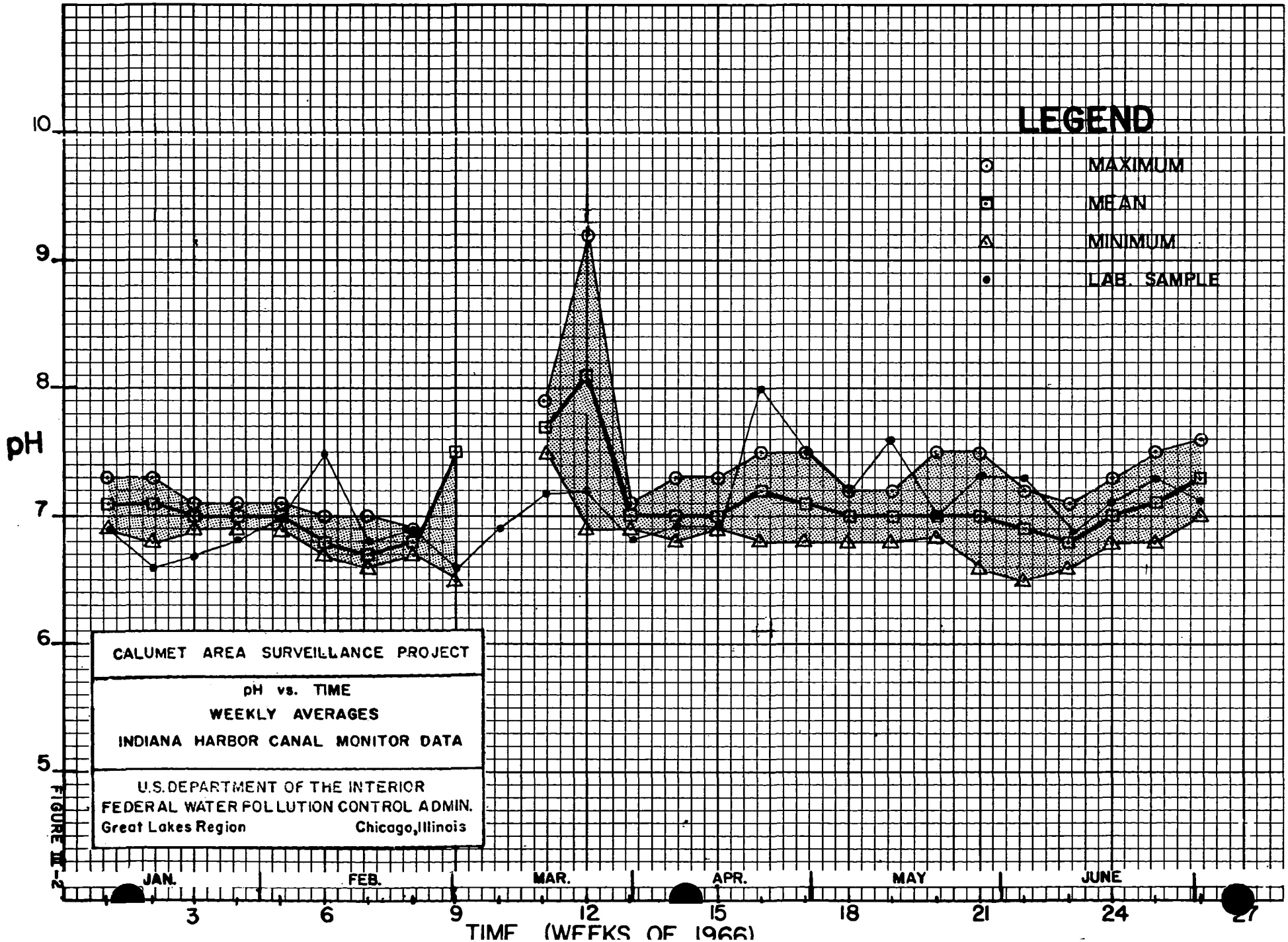

LEGEND
MAXIMUM
MEAN
MINIMUM
LAB. SAMPLE
pH
10
9
8
7
6
5
JAN.
FEB.
MAR.
APR.
MAY
JUNE
3
6
9
12
15
18
21
24
27
TIME (WEEKS OF 1966)
CALUMET AREA SURVEILLANCE PROJECT
pH vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois

FIGURE III-2

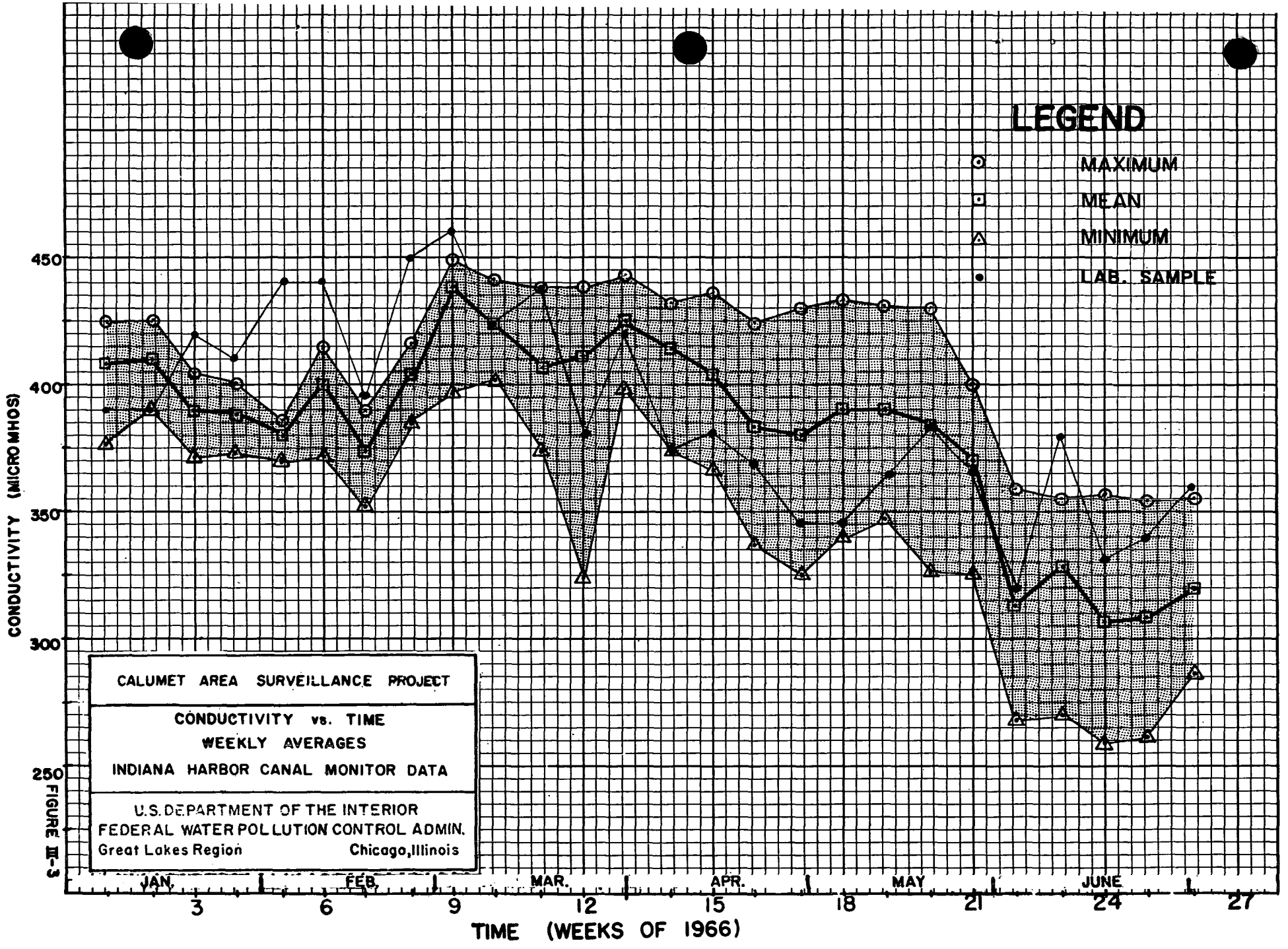

LEGEND
MAXIMUM
MEAN
MINIMUM
LAB. SAMPLE
CONDUCTIVITY (MICROMHOS)
450
400
350
300
250
CALUMET AREA SURVEILLANCE PROJECT
CONDUCTIVITY vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois
JAN.
FEB.
MAR.
APR.
MAY
JUNE
3
6
9
12
15
18
21
24
27
TIME (WEEKS OF 1966)

FIGURE III-3

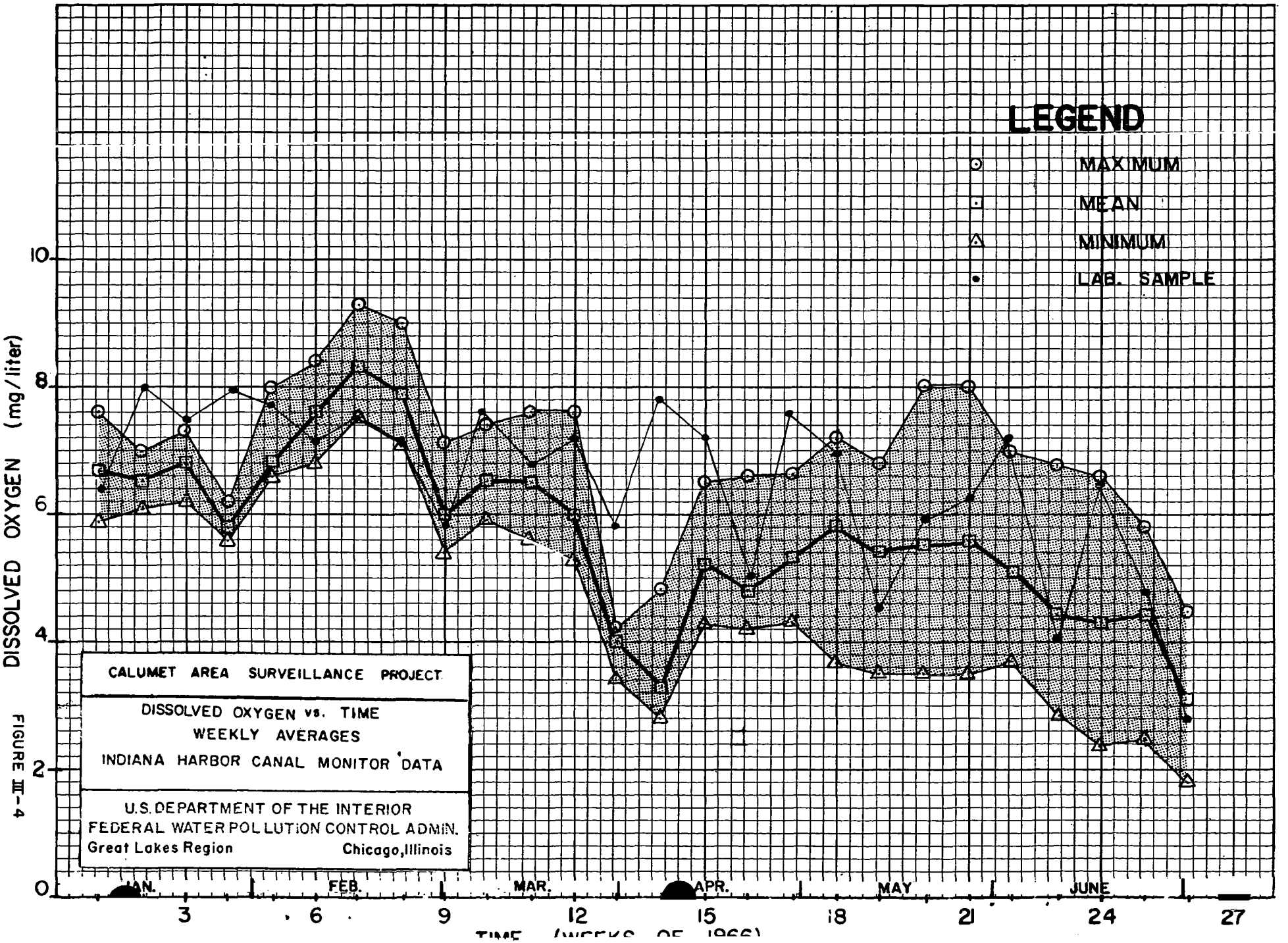

LEGEND
MAXIMUM
MEAN
MINIMUM
LAB. SAMPLE
DISSOLVED OXYGEN (mg/liter)
0
2
4
6
8
10
JAN.
FEB.
MAR.
APR.
MAY
JUNE
3
6
9
12
15
18
21
24
27
TIME (WEEKS OF 1966)
CALUMET AREA SURVEILLANCE PROJECT
DISSOLVED OXYGEN vs. TIME
WEEKLY AVERAGES
INDIANA HARBOR CANAL MONITOR DATA
U.S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMIN.
Great Lakes Region
Chicago, Illinois

FIGURE III-4

ADDENDUM

COMPARISON ON USE OF DENDY SAMPLERS AND OTHER BOTTOM SAMPLERS

by
H. J. Fisher
Chief Biologist

During November 1965, samples were collected at the same stations with the Dendy sampler and the Petersen dredge or the Eckman dredge by personnel of the Calumet Area Surveillance Project. The Dendy sampler used plates representing sand, sawdust, or shell substrate. All samples were presented to the biological laboratory of Great Lakes-Illinois River Basins Project for analysis.

Identification of organisms found in each sample was completed during the summer of 1965. Results are shown in the table at the end of this report.

Discussion

The purpose of this brief study was to determine the correlation, if any, between the effectiveness of sampling macroorganisms by the Dendy sampler with that of regular bottom samplers, that is, the Eckman dredge and the Petersen dredge.

Reference to the table indicates that there was little correlation between the number of individuals and species collected by the Dendy sampler, set at sites above the bottom, with those collected by the Eckman or Petersen dredge from the bottom. In most samples, the numbers of individuals and species collected by either of the latter two samplers exceeded those collected by the Dendy sampler.

Only those samples collected on the bottom by Dendy compare somewhat with bottom samples collected by the other bottom samplers at the same station.

RESULTS OF DENDY SAMPLES COMPARED TO BOTTOM SAMPLES

Location	Type of Dendy	Depth of Dendy Sampler	Type of Organisms	No. of Organisms	Organisms in Bottom Samples	No. of Organisms
Calumet River 106th St.	1. Sawdust 2. Sand	27' above bottom	No organisms found Zygaptera	- 1	Hirudinea Oligochaeta Tubificidae	2 3 364
Little Calumet River Ashland Avenue	Sawdust	1½' above bottom	No organisms found	-	Tubificidae	6976
Little Calumet Wentworth Avenue	1. Sawdust 2. Sand	1' above bottom	1. Tendipedidae 2. Tubificidae Tendipedidae	38 1 28	Tubificidae Nematoda Tendipedidae	275 1 35
Calumet River Torrence Avenue	1. Sand 2. Sawdust	17'above bottom	1. Tubificidae 2. No organisms found	48 -	Oligochaeta	602
Grand Calumet and Indianapolis Blvd.	1. Sand 2. Sawdust-shells 3. Sawdust	on bottom	1. Physa Tubificidae Tendipedidae 2. Lyanea Tubificidae Tendipedidae 3. Tubificidae	10 16 18 27 36 9 183	Physa Tubificidae Tendipedidae	4 323 2
Grand Calumet and Indiana Harbor Belt R.R.	Shell	8" above bottom	Tubificidae Tendipedidae	368 1	Tubificidae Tendipedidae Tendipedinae	1094 55 5
Grand Calumet and Industrial Hwy.	1. Sawdust-shell 2. Sand	on bottom	1. Physa Tubificidae Tendipedidae 2. Tubificidae	1 266 2 310	Tubificidae	968

The numbers of the tubificidae, pollution tolerant worms, collected by the Eckman or Petersen dredge far exceeded those collected by the Dendy sampler on the bottom at the following stations: Grand Calumet and Indianapolis Boulevard and Grand Calumet and Industrial Highway. Only at the Calumet River Bridge Street Station did the number of tubificidae collected by the Dendy sampler on the bottom exceed the numbers of these sludge worms taken by the regular bottom samplers.

It is the writer's opinion that the numbers of individuals and the numbers of species of aquatic organisms collected above the bottom by the Dendy sampler did not compare closely with those taken by either the Eckman or Petersen dredge hauls from the bottom in the present study. Although a closer correlation between the results of the methods was noted on samples taken from the bottom, more comparing tests should be made between the Dendy sampler on the bottom with the Eckman or Petersen dredge hauls in order to obtain more reliable comparable results.

It is the writer's opinion that accurate conclusions cannot be made from the one sampling conducted in this study.

Comment by Peggy Harris, Biologist

"Dendy samples leave organisms, such as blood worms, in their natural state of color; however, oligochaetes have the tendency to become clear and jelly-like in consistency and to cling to the plates."

RESULTS OF DENDY SAMPLES COMPARED TO BOTTOM SAMPLES

Location	Type of Dendy	Depth of Dendy Sampler	Type of Organisms	No. of Organisms	Organisms in Bottom Samples	No. of Organisms
Wolf Lake Channel and Corondolet Ave.	1. Sand 2. Sawdust	1' above bottom	1. Simulidae 2. No organisms	125		
					Pontaporeia	12
					Isopoda	1
					Physa	1
					Gyraulus	2
					Hirudinea	5
					Glossiphonia	2
					Tubificidae	42
					Tendipedidae	67
					Simulidae	101
					Emphemeroptera	2
					Trichoptera	1
Indiana Harbor Canal 151st Street	1. Sawdust 2. Sand	1' above bottom	1. Tubificidae 2. Tubificidae	31 6	Tubificidae Tendipedidae	232 2
Grand Calumet River Bridge Street	1. Sand 2. Sawdust	on bottom	1. Tubificidae 2. No organisms	179 -	Tubificidae	13
Little Calumet River New York Central Bridge	1. Sand 2. Sawdust	14' above bottom	1. Tendipedidae Odonata 2. Tubificidae	13 1 3	Tubificidae Tendipedidae	654 2
Calumet River at Indiana Avenue	1. Sand 2. Sawdust	14' above bottom	1. No organisms found 2. Tubificidae Tendipedidae	- 6 2	Hirudinea Tubificidae Tendipedidae	4 1161 17
Calumet River 130th Street	Sawdust	-	No organisms found		Tubificidae	24

GPO 801-482-3