THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

DEPARTMENT OF RESEARCH AND DEVELOPMENT

REPORT NO. 78-18-B

1976 ANNUAL SUMMARY REPORT

WATER QUALITY WITHIN THE WATERWAYS SYSTEM OF THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

VOLUME 2

BIOLOGICAL

December 1978

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VOLUME II

BIOLOGICAL

Charles Spielman
Sam Dennison
Parnell O'Brien
Irwin Polls
William Schmeelk

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SUMMARY

During 1976 the composition and distribution of plankton and bacteria at eighteen sampling bridges of bottom macroinvertebrates at twenty-one sampling stations, and of fish near twenty-six sampling locations along the Chicago River and Calumet River Systems were studied. Included with the bottom macroinvertebrate data were the sediment oxygen demands.

These data reveal that the areas of the man-made waterways closest to Lake Michigan have waters of better quality than the waters farther downstream (away from the Lake). The data show the greatest number of individual fish and species occur nearer to Lake Michigan, whereas, few or no fish were found in the waterways distant from Lake Michigan.

The phytoplankton species near Lake Michigan are a reflection of the lake's flora, while those farther downstream are representative of more polluted waters. In addition, the waters nearer Lake Michigan have much lower numbers of those bacteria considered to be of sanitary importance, including the indicators, TC, FC, and FS, and pathogens, than the waters farther downstream.

The greater variety of benthic macroinvertebrates were found near Lake Michigan, while only a few kinds were found downstream in the waterways. In general, Lake Michigan flora and fauna are present nearer to Lake Michigan and are replaced by other types farther downstream. The small number of clean water organisms nearer the lake make it doubtful if they reproduce in the waterways. Those present in the waterways apparently are replenished by individuals carried into the waterways from Lake Michigan.

CONCLUSION

This monitoring survey, covering 78 miles of the MSDGC major waterways system during 1976, shows that the quality of the water moving downstream from Lake Michigan becomes progressively lower. The present data were sufficient to show that waters leading from Lake Michigan are a reflection of the flora and fauna of Lake Michigan. However, sewage treatment plant effluents, combined sewer overflows, and other tributaries flowing into the system change these waters to those which are more representative of polluted waters. Pollution abatement resulting from construction of the Tunnel and Reservoir Plan (combined sewer overflow elimination), of the expanded and improved sewage treatment plants, and of the instream aeration project, should result in considerable improvement in water quality. Thereafter, the "clean" waters entering from the lake will not be altered as much as they are at the present time.

I. INTRODUCTION

The Metropolitan Sanitary District of Greater Chicago (MSDGC) is responsible for the quality of the water in the streams and canals within its jurisdiction. To monitor these waterways the MSDGC established a water quality study. The biological research activities under this monitoring program are provided by the Research and Development Department's Biology Research Section. For 1976, the field monitoring studies were handled by the following biology teams within the Biology Research Section: Analytical Microbiology, Aquatic Ecology, Aquatic Biology, and Fisheries. The 53 research stations in 1976 were selected to reflect general environmental conditions of the MSDGC main waterway systems.

The effects of pollutants on a waterway are reflected in the population density, species composition, and species diversity of natural aquatic communities. Therefore, information on all types of aquatic organisms present in a waterway is important in evaluating water quality. The long term water quality monitoring methods conducted by the MSDGC biology teams, as described in this report, are directed primarily toward sample collection and processing, organism identification and enumeration, and data reporting. This report summarizes the data obtained on the bacteria, phytoplankton, benthic macroinvertebrate and fish communities during 1976. The 1975 phytoplankton data, the 1974-1975 fish data, and the 1976 oxygen demands of the sediments have also been included.

II. WATER QUALITY MONITORING

Description of Waterways

Principal man-made and controlled waterways in the Metropolitan Sanitary District system are the North Shore Channel, channelized portions of the North Branch, South Branch, and main stem of the Chicago River, the Sanitary and Ship Canal, channelized portions of the Calumet and Little Calumet Rivers, and the Cal-Sag Channel (Figure 1). The canal system functions to provide navigation for boats and barges and to serve as receiving waters for conveying the flows from tributary streams, sewage treatment plant effluents, combined sewer overflows, and storm water run-off to the Des Plaines River through the canal terminus at the Lockport Powerhouse.

Eighteen (18) regular and nine (9) additional sampling stations covering approximately 78 miles of the waterways were selected for study (Figure 1, Tables 1 and 2). The biological data reported herein for 1976 are based, in part, on portions of the sampling conducted by the MSDGC under contract to the Northeastern Illinois Planning Commission as part of their 208 Areawide Waste Treatment Management Plan. Also, the fish collections were taken at 26 major locations throughout the MSD Waterways, located on the canal system and locations on other waterways (Table 3). The Des Plaines River and Salt Creek were included in the fish survey in 1976.

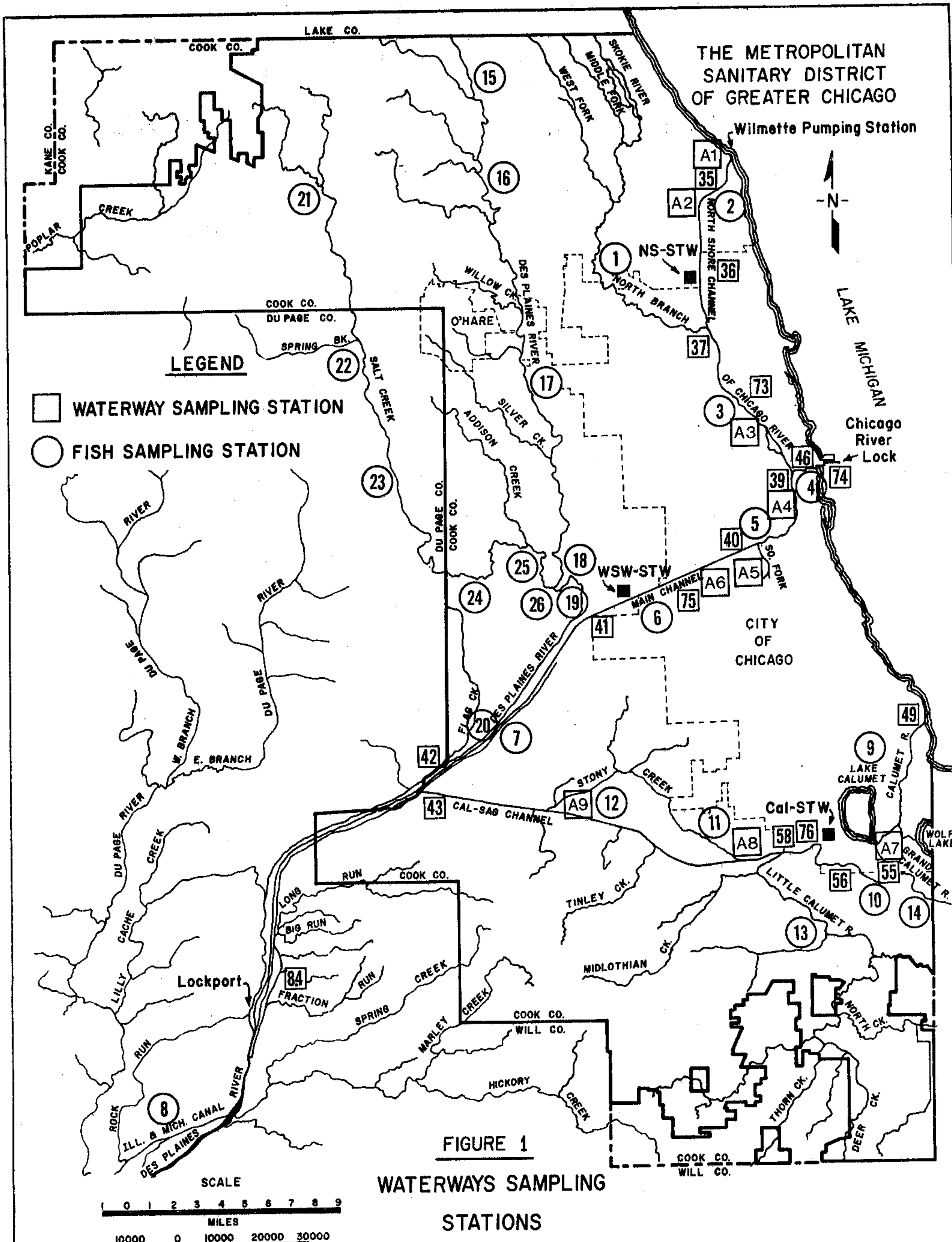

FIGURE 1

WATERWAYS SAMPLING STATIONS

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 1

List of Bacteria and Algae Sampling Bridges

Station Number	Location[1]	
Chicago River System		
35	Lincoln Street (NSC)[2]	
36	Touhy Avenue (NSC)	
37	Wilson Avenue (NBCR)	
73	Diversey Avenue (NBCR)	
46	Grand Avenue (NBCR)	
74	Outer Drive Bridge (Chicago River)	
39	Madison Avenue (SBCR)	
40	Damen Avenue (SBCR)	
75	Cicero Avenue (CS & SC)	
41	Harlem Avenue (CS & SC)	
42	Route 83 (CS & SC)	
8.4	16th Street (CS & SC)	
Calumet River System		
49	Ewing Avenue	(C-R)[2]
55	130th Street	(C-R)
56	Indiana Avenue	(LC-R)
76	Halsted Street	(LC-R)
58	Ashland Avenue	(CS-C)
43	Route 83	(CS-C)

1 - The water samples for analysis are taken from the upstream side of each bridge.

2 - NSC = North Shore Channel; NBCR = North Branch Chicago River; SBCR = South Branch Chicago River; CS & SC = Chicago Sanitary and Ship Canal; C-R = Calumet River; LC-R = Little Calumet River; CS-C = Cal-Sag Channel.

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TABLE 2

List of Benthos Sampling Stations

Station Number	Location[1]	
Chicago River System		
A-1	Maple Street (NSC)[2]	
A-2	Main Street (NSC)	
36	Touhy Avenue (NSC)	
37	Wilson Avenue (NBCR)	
73	Diversey Avenue (NBCR)	
A-3	Division Street (NBCR)	
46	Grand Avenue (NBCR)	
A-4	Jackson Avenue (SBCR)	
A-5	Archer Avenue (SBCR)	
A-6	Western Avenue (SBCR)	
75	Cicero Avenue (CS & SC)	
41	Harlem Avenue (CS & SC)	
42	Rt. 83 (CS & SC)	
8.4	16th St. (CS & SC)	
Calumet River System		
49	Ewing	(C-R)[2]
A-7	Norfolk & Western	(C-R)
56	Indiana	(LC-R)
76	Halsted	(LC-R)
A-8	Western	(CS-C)
A-9	S.W. Hwy.	(CS-C)
43	Rt. 83	(CS-C)

1 - Sampling stations are the same as the 208 research stations; all were taken 100 ft. upstream of each bridge,

2 - NSC = North Shore Channel; NBCR = North Branch Chicago River; SBCR = South Branch Chicago River; CS & SC = Chicago Sanitary and Ship Canal; C-R = Calumet River; LC-R = Little Calumet River; CS-C = Cal- Sag Channel.

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TABLE 3

List of Fish Sampling Locations

Station Number	Location
1	North Branch Chicago River (NBCR) and including its junction with the North Shore Channel (NSC).
2	NSC above Northside Treatment Plant outfall.
3	NSC and NBCR below Northside Treatment Plant outfall.
4	Chicago River, including the junction of the North and South branches.
5	South Branch Chicago River and Chicago Sanitary and Ship Canal (CS & SC) above West-Southwest Treatment Plant outfall.
6	CS & SC below West-Southwest Treatment Plant outfall.
7	Shell Drainage Ditch including mouth to CS & SC
8	Des Plaines River, Brandon and Dresden Pools, including the Kankakee River near Wilmington, Illinois.
9	Calumet River above O'Brien Lock & Dam, including Calumet Harbor.
10	Little Calumet River (LCR) above Calumet Treatment Plant outfall.
11	Calumet Sag Channel (CSC) and LCR below Calumet Treatment Plant outfall.
12	CSC tributaries and mouths to Channel.
13	LCR above junction with CSC, including tributaries.
14	Grand Calumet River.
15	Des Plaines River: T42N/R11E/S12SE, Cook Co., 1500 meters above Dam #1, Wheeling.

TABLE 3 (Cont'd)

List of Fish Sampling Locations

Station Number	Location
16	Des Plaines River: T41N/R12E/S8SE, Cook Co., 400 meters upstream of Golf Road, Wheeling.
17	Des Plaines River: T40N/R12E/S27NE, Cook Co., from Grand Ave., 400 meters upstream, River Grove.
18	Des Plaines River: T38-39N/R12E/S2NE-35SE, Cook Co., 400 meters above mouth with Salt Creek, Lyons.
19	Des Plaines River: T38N/R12E/S2NW, Cook Co., 50 meters downstream of mouth of Salt Creek, Lyons.
20	Des Plaines River: T37N/R12E/S5NW, Cook Co., 515 meters south of Willow Springs Rd., Willow Springs.
21	Salt Creek: T41N/R11E/S21NW, Cook Co., upstream of pool above Rt. 62, Rolling Meadows.
22	Salt Creek: T40N/R11E/S9SW, DuPage Co., 200 meters downstream of mouth of Spring Brook, Wood Dale.
23	Salt Creek: T39N/R11E/S11NW, DuPage Co., 40 meters upstream of Rt. 83, Elmhurst.
24	Salt Creek: T39N/R12E/S31SE, Cook Co., upstream of Wolf Road, Bemis Woods, Western Springs.
25	Salt Creek: T39N/R12E/S27NE, Cook Co., 200 meters downstream of mouth of Addison Creek, Broadview.
26	Salt Creek: T38N/R12E/S2NW, Cook Co., mouth of Salt Creek with Des Plaines River, Lyons.

Types of Biological Samples

Four kinds of biological samples were collected in these waterways during the 1976 water quality monitoring program: (A) Bacteria, (B) Algae, (C) Benthos, and (D) Fish.

A. Bacteria

Bacterial analyses, which give an indication of the bacteriological or sanitary quality of the water, have been performed routinely on waterways samples for several years. Coliform, and the more specific fecal coliform and fecal streptococcus tests are used extensively by MSDGC to determine the bacteriological quality of the water. In addition to these routine parameters several other analyses were included in this 1976 study:

1. Total Plate Count - This is a highly empirical procedure which gives an estimate of the total microbial populations.
2. Salmonella - The genus Salmonella contains a variety of species which are pathogenic for man or animals, and usually for both.
3. Pseudomonas aeruginosa - This organism is a causative agent of otitis media, otitis externa, chronic ulcerations of the skin and many wound and burn infections.
4. Staphylococcus aureus - The most common infections caused by Staph. aureus include pimples, boils, carbuncles, and food poisoning.

B. <u>Algae</u>

The objective of this part of the study was the identification and enumeration of that group of the biota collectively called the plankton, specifically the phytoplankton (the zooplankton represented mainly by Protozoa and Rotataria, are present in much lower numbers) in the major waterways of the District. The plankton may be defined as those microscopic organisms suspended in the water with little or no powers of locomotion subject to distribution primarily through the action of waves or currents. The phytoplankton, as the principal primary producers in the waterways can serve as indicators of water quality. The phytoplankton studied belong to the following three groups:

1. The blue-green algae (Cyanophyta) - These are primitive forms (single celled, with nuclear material scattered throughout the center of the cell while green chlorophyll is diffused throughout the peripheral portion of cell; has blue pigment and sometimes a red pigment) some of which produce "water blooms"; "pea soup" appearance; septic "pig-pen" odors; impart a fish taste"; and cover rocks with slimy gelatinous masses.
2. Green algae (Chlorophyta) have pigments that are principally chlorophyll confined to chloro-

plasts or definite bodies. There is an organized nucleus, and the motile cells have flagelli.

3. Diatoms (Bacillariophyceae) have a greater proportion of yellow or brown pigment than chlorophyll and the cell wall is composed of silica.

4. Euglenoids (Euglenophyta) have flagella.

C. Benthos

In the waterways for 1976, the bottom macroinvertebrate communities were sampled to determine the composition and abundance of organisms. These organisms, having limited mobility and relatively long life spans, are sensitive to even subtle changes in water quality and therefore can serve as excellent indicators of pollution in the waterways of MSDGC. A diverse bottom fauna with no overabundance of any one group in a waterway indicates water of good quality. Experience shows that organic pollution may restrict the variety of organisms while favoring the development of large numbers of organisms that tolerate these pollution conditions. Pollution by toxic substances, however, may eliminate almost all benthic macroinbertebrates.

In addition to the benthos there was a need to quantify the oxygen demand characteristics of the bottom sediments. The importance of sediment oxygen damand in the oxygen regime of lakes and rivers has been described by a number of investigators (Baity, 1938; Fair, et al, 1941; Velz, 1958; and Owens and Edwards, 1963[1-4]).

D. Fish

Fish collections and analyses, which give the most meaningful index of water quality to the public, have been performed on the MSDGC waterways since 1974. Because fish occupy the upper levels of the aquatic food web, any water quality conditions that significantly affect the other kinds of organisms within the aquatic community will also affect the species composition, and abundance of the fish population.

Diversity indices are useful to measure the water quality of the environment for a community of fish species. Their use is based on the generally observed phenomenon that relatively undisturbed environments support communities having large numbers of species with no individual species present in overwhelming abundance. If the species in such a community are ranked on the basis of their numerical abundance, there will be relatively few species, with large numbers of individuals and large numbers of species represented by only a few individuals. Many forms of stress tend to reduce diversity by making the environment unsuitable for some species or by giving other species a competitive advantage.

Part of the water quality survey will lead to a qualitative description of which fish species inhabit which areas of each waterway including canals and streams, as well as quantitative enumeration of the relative abundance of each major species within selected habitat-typical areas of each waterway.

Methods of Biological Analysis of Waterways Samples

For 1975 during each month in each quarter, samples were collected from one of the three waterway segments (see Tables 1-3): 1st month: North Shore Channel (NSC)/North Branch Chicago River (NBCR), including the main river stem (CR) for this and next months; 2nd month: South Branch Chicago River (SBCR) and the Chicago Sanitary and Ship Canal (CS&SC); 3rd month: Calumet River System including the Little Calumet River (LC-R) and the Cal-Sag Channel (CS-C). This sampling system was changed in 1976 to one where the Chicago River System, including the NSC, NBCR, CR, SBCR, and the CS&SC, was sampled in alternate months with the Calumet River System.

A. Bacteria

Water samples for total coliform (TC), fecal coliform (FC), fecal streptococcus (FS), and total plate counts are collected in sterile 4-ounce Reagent bottles containing enough sodium thiosulfate to neutralize 15 mg/l chlorine. *Salmonella sp.*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* samples are collected in sterile one-gallon containers with enough sodium thiosulfate to neutralize 15 mg/l chlorine. All samples are taken one meter below the surface, in the center of the waterway, with a Kemmerer bottle, and are transported on ice to the R&D Laboratory.

Analyses are begun approximately twenty-four hours after collection. Total coliforms (TC) are estimated and verified according to membrane filter (MF) procedures outlined in _Standard Methods for the Examination of Water and Wastewater_[5], fecal coliform (FC) determinations and verifications are carried out according to the MF technique described by Geldreich _et al_[6]. Fecal streptococci (FS) are determined and verified by a MF technique described by Kenner _et al_[7].

Total plate counts are performed utilizing a MF procedure and plate count agar. Plates are incubated for 48 ± 3 hours at 35°C. _Salmonellae_ are determined utilizing a MPN technique described by Kenner[8]. Three 500 ml, three 50 ml and three 5 ml portions of sample are filtered and the filters placed in dulcitol selenite enrichment broth (DSE). The containers of DSE are incubated at 40° ± 5°C for 48 hours and checked for selenite reduction. Positive tubes are streaked on xylose lysine desoxycholate agar (XLD) and incubated at 40°C for a day. The selective agar plates are examined for possible _Salmonella_, indicated by black colonies. Suspect colonies are transferred to triple sugar iron agar (TSI). Those showing positive results on TSI (black butt, red slant) are transferred to phenylalanine deaminase (PD) agar, lysine decarboxylase broth, and malonate utilization broth. Isolates able to decarboxylate lysine and unable to deaminate phenylalanine or utilize malonate are considered presumptive Salmonella and are identified biochemically utilizing the API or R/B enteric systems. Confirmation of isolates is performed with polyvalent Salmonella "O" antisera. Agglutination of a suspension of the isolate in contact with antisera would be considered evidence of Salmonellae. Verification and further serotyping of approximately 20% of the isolates are performed by the Illinois Department of Public Health.

Pseudomonas aeruginosa analyses are performed according to a MPN procedure in Standard Methods[5]. Five 10 ml, five 1 ml and five 0.1 ml portions of sample are inoculated into tubes of asparagine enrichment broth. Tubes are incubated for 48 hours at 35°C. Upon subculture to acetamide broth, tubes showing acetamide utilization are considered positive for Pseudomonas aeruginosa and a MPN is calculated.

Staphylococcus aureus is quantified using a MF procedure in Standard Methods[5]. Samples are filtered and placed on mannitol salt agar. Colonies which ferment mannitol are verified by gram staining and coagulase testing.

B. Algae

Surface grab samples are collected from bridges (on the upstream side) by the Industrial Waste Division samplers, placed into one-half gallon bottles containing 80 ml of formalin (37-40% formaldehyde), and delivered iced to the laboratory. At the laboratory these samples are split into two aliquots, one for the analysis of diatoms and the other for the remaining organisms or non-diatoms. Diatoms are easily separated from the other organisms and debris by nitric acid digestion of the sample. After digestion, the acid is diluted and the organisms concentrated by filtration onto a cellulose acetate membrane. After drying, a portion of the filter is cleared with immersion oil on a slide, and examined under the highest possible magnification for identification and counting.

The other aliquot, for non-diatom analysis, is allowed to settle in graduated cylinders after the addition of Ivory Liquid or similar detergent. Stepwise settlings into continuously smaller cylinders is accomplished until a concentrate of 200x the original sample is achieved. A tenth milliliter of this concentration is then examined at the highest magnification permissable and the organisms identified and counted.

The Shannon-Weiner Diversity Index used in analyzing the algae population data (derived from Margalef's[9] adaptation of information theory from quantum mechanics) takes into account the total plankton population and number of species and can be applied to the Chicago Waterways data. The working formula is:

$$\bar{d} = \frac{c}{N} (N \log_{10} N - \Sigma n_i \log_{10} n_i)$$

where c - 3.321928 (converts $\log_{10}$ to $\log_2$), N = total number of individuals, and n_i = number of individuals in the i^{th} species.

C. Benthos

Bottom samples were taken with a standard 529 sq. cm. Ponar grab sampler from the center and both sides of the waterway at each of the twenty-one benthic sampling stations (Figure 1). In the field, these samples were screened immediately with a large U.S. #30 mesh bucket sieve. The debris, including the macroinvertebrates, were placed in gallon containers and transported to the laboratory. There the organisms were removed from the debris for sorting and analysis. In situations where large numbers of organisms were collected, estimates of their abundance were made by analyzing aliquots of those samples.

To measure the sediment oxygen demands *in situ* at 21 SOD Stations on the waterways, a bottom sampler, similar to the steel chamber (24" long, 14" wide, and 10" deep) designed by the Illinois State Water Survey (Butts, 1974)[10] is used. This chamber has a volume of 30.27 liters and covers a bottom area of 0.22 square meters. With 100 feet of 3/4" rubber garden hose and five feet of clear flexible plastic tubing attached, the total volume of water contained within the system is 41.4 liters. The oxygen demand of the sediments is computed using the procedures of the Illinois State Water Survey in Peoria, and reported as grams oxygen per square meter per day ($g\ m^{-2}\ d^{-1}$) (Butts, 1974)[10].

If the initial dissolved oxygen measured in the field was less than 2 mg/l, a bottom sediment and water sample were collected from the sampling site in order to determine the oxygen demand of the sediment in the laboratory. Bottom samples were collected with a Standard Ponar Grab Sampler. No attempt was made to obtain relatively undisturbed sediment samples or to refrigerate the sample. A water sample was collected approximately one foot from the bottom at the same location as the sediment sample.

The sediment oxygen demand of the sediment was determined in the laboratory using an electrolytic respirometer (E/BOD Respirometer System, Oceanographic International Corporation). Basically, the system continuously replaces oxygen used in the sample by a manometrically triggered electrolysis reaction. The time during which the electrolysis cell is generating oxygen to the sample is converted electronically and displayed as milligrams of oxygen. A pump with an adjustable flow rate was used to recirculate the air, and to provide a fluid flow over the sediment without scouring.

Two-hundred milliliters of the sediment were poured through a funnel into the one liter reaction vessel. The water sample was siphoned slowly into the vessel, being careful not to disturb the sediment. Thirty minutes were allowed for the sediment to resettle. The sediment samples were monitored hourly for a total of 24 hours. The tests were initiated within six hours of the sampling time. The daily oxygen demand was computed using an equation derived from Butts (1974)[10].

D. Fish

Depending on the physical conditions of the sampling site (eg., water depth, bottom type, current velocity) the following gear were used to collect fish specimens:

1. A 230 volt alternating current, boat mounted, boom electrofisher followed by a backup boat; fish being stunned and collected with dip nets.
2. A direct current backpack electrofisher operating off a 12 volt battery; fish being stunned and collected with dip nets. (Whenever possible the backpacker and dipnetters were followed by two men dragging a 15 foot 3/16 inch mesh minnow seine).

3. A 30 foot 3/16 inch mesh minnow seine 4 foot high with a 4x4x4 foot bag was used occasionally when access by the boat shocker was not available and it was deemed necessary to supplement the backpack/seine collection; or when neither the boat shocker nor backpack shocker could be used.
4. The backpack shocker and dip nets alone were used where the bottom of the stream contained too much debris or otherwise rendered a followup seine useless.

The following methods were used with the above gear:

The boat shocker: was used on large streams of sufficient depth and access. Generally a 400 meter section of stream was marked-off by use of an optical range finder and fish were shocked on both sides of the stream for a total of 800 meters of shoreline. In some cases a shorter amount of shoreline was shocked due to physical problems (usually depth); this usually occurred at tributary mouths or in sections of small streams.

The backpack shocker/seine: was used on smaller or shallower streams where a boat shocker was not appropriate. Generally a 40 meter section of stream was marked off by use of an optical range finder and fish were shocked either (a) on both sides of the stream for a total of 80 meters of shoreline, or if the stream was narrow and the backpack seine covered all or most of its width then (b) two 40 meter sections of stream were measured in line and a total of 80 meters of the stream length was shocked. Whenever possible, the 40 meter section (or first section of an 80 meter section) was begun 100 meters upstream of the tributary mouth (if on a tributary) or 150 - 200 meters downstream of a dam tailrace if on a major channel. The backpack shocker/dip nets alone were used similarly.

The 30 foot 3/16 inch mesh minnow seine, 4 foot high with a 4x4x4 foot bag: would be pulled for distances of 40 meters of shoreline in some areas to supplement some collections. In one case it was dragged behind a 14 foot boat equipped with the backpack shocker on the bow.

Shocking time was noted for all boat shocking and backpack/seine sampling, as well as the backpack alone.

All large fish collected were identified to species, weighed to the nearest gram, and measured for total length to the nearest millimeter. They were then returned to the stream of capture. Most small fish (less than 80 millimeters total length) were preserved in 10-15% formalin and identified, weighed and measured in the laboratory.

The species diversity index used was that developed by Shannon[11]. It shall be labeled $\bar{d}$ in this report. We used natural logarithms in our computation. Species diversity indices were compared statistically by use of a "t" test for diversity indices mentioned in Zar[12]. Numbers of fish species, as well as numbers of individuals were compared by chi-square evaluation.

III. RESULTS AND DISCUSSION OF WATERWAYS QUALITY CONDITIONS

Bacteria

Waterways bacterial analyses for May through December, 1976 are presented in Tables 4, 5, and 6. These data suggest that the concentrations of the various indicators, TC, FC, and FS were generally lower near Lake Michigan and increase at stations farther downstream from the lake. Total plate count and *Pseudomonas aeruginosa*, were recovered from all 46 samples taken during the year. Their concentrations were also generally lower near the lake and increased downstream. *Staphylococcus aureus*, however, recovered in 22 of 46 samples, demonstrated no trend in concentration. *Salmonella* was isolated in only 10 of 46 samples, demonstrated no trend in concentration. *Salmonella* was isolated in only 10 of 46 samples, at station 43 on 9/21/76. The isolate was sent to the Illinois Public Health Department for serotyping and was identified as *Salmonella enteritidis* ser. Bredeny, a common serotype.

The confirmation rates for TC, FC, and FS were 74.7%, 93.9% and 99.2% respectively (Table 7). These rates indicate that a high level of confidence can be placed in the FC and FS results and less confidence in the TC results.

In general, bacterial levels were typical of a waterway system receiving large amounts of treated domestic effluent and some combined sewer overflows.

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TABLE 4

BACTERIAL COUNTS PER 100ML GEOMETRIC AVERAGE OF 5/25/76, 8/24/76 and 11/23/76
SAMPLING RUNS - NORTH SHORE CHANNEL; NORTH BRANCH AND MAIN STEM OF CHICAGO RIVER

Station[1]	TC[2]	FC[2]	FS[2]	S.[3] aureus	P.[4] aeruginosa	Salmonella	TPC[5]
35	2.2×10^4	6.9×10^2	2.6×10^2	$<2.6 \times 10^1$	2.4×10^2	$<4.0 \times 10^{-2}$	1.8×10^6
36	3.9×10^2	1.5×10^2	9.9×10^1	$<1.0 \times 10^2$	6.6×10^2	$<4.0 \times 10^{-2}$	3.2×10^6
37	9.7×10^2	1.9×10^2	1.0×10^4	$<1.4 \times 10^3$	1.0×10^3	$<4.0 \times 10^{-2}$	1.9×10^6
73	4.6×10^3	2.8×10^2	4.0×10^3	$<1.4 \times 10^2$	3.6×10^3	$<4.0 \times 10^{-2}$	1.8×10^6
46	2.1×10^4	1.9×10^2	1.9×10^2	3.1×10^2	2.6×10^2	$<3.0 \times 10^{-2}$	1.6×10^7

1. See Figure 1.
2. TC = total coliform; FC = fecal coliform; FS = fecal streptococcus
3. S = Staphylococcus
4. P = Pseudomonas
5. TPC = Total Plate Count

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TABLE 5

BACTERIAL COUNTS PER 100ML GEOMETRIC AVERAGE OF 7/14/76 and 10/26/76 SAMPLING RUNS - SOUTH BRANCH CHICAGO RIVER AND SANITARY AND SHIP CANAL

Station[1]	TC[2]	FC[2]	FS[2]	*S.*[3] *aureus*	*P.*[4] *aeruginosa*	*Salmonella*	TPC[5]
74	$>6.8 \times 10^3$	$>8.1 \times 10^2$	$>1.8 \times 10^3$	4.4×10^3	9.5×10^1	$<2.0 \times 10^{-2}$	$>3.9 \times 10^7$
39	$>4.0 \times 10^3$	6.6×10^2	6.9×10^3	$<2.8 \times 10^2$	1.8×10^3	$<3.0 \times 10^{-2}$	9.8×10^6
40	6.2×10^4	1.2×10^3	4.4×10^3	8.0×10^3	$>5.1 \times 10^3$	$<3.0 \times 10^{-2}$	5.0×10^6
75	8.9×10^4	5.5×10^3	2.2×10^4	$<3.1 \times 10^2$	5.0×10^3	$<2.0 \times 10^{-2}$	1.8×10^7
41	2.6×10^4	3.2×10^2	1.9×10^4	$<1.9 \times 10^2$	1.4×10^3	$<3.0 \times 10^{-2}$	1.2×10^8
42	$>6.4 \times 10^5$	9.9×10^3	2.9×10^3	$<5.7 \times 10^2$	$\geq 7.6 \times 10^4$	$<3.0 \times 10^{-2}$	2.9×10^8
8.4	9.1×10^4	1.5×10^3	2.9×10^3	$<3.0 \times 10^1$	1.0×10^4	$<3.0 \times 10^{-2}$	3.4×10^8

1. See Figure 1.
2. TC = total coliform; FC = fecal coliform; FS = fecal streptococcus
3. S = *Staphylococcus*
4. P = *Pseudomonas*
5. TPC = Total Plate Count

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 6

BACTERIAL COUNTS PER 100ML GEOMETRIC AVERAGE OF 7/27/76, 9/22/76 and 12/9/76 SAMPLING RUNS - CALUMET RIVER, LITTLE CALUMET RIVER, AND CAL SAG CHANNEL

Station[1]	TC[2]	FC[2]	FS[2]	S.[3] aureus	P.[4] aeruginosa	Salmonella	TPC[5]
49	5.0×10^{2}	7.8×10^{1}	3.3×10^{3}	6.9×10^{4}	3.9×10^{1}	$<5.0 \times 10^{-2}$	7.7×10^{5}
55	3.1×10^{2}	6.0×10^{1}	4.0×10^{3}	$<8.2 \times 10^{2}$	7.6×10^{1}	$<5.0 \times 10^{-2}$	3.4×10^{6}
56	7.6×10^{4}	1.4×10^{3}	3.9×10^{3}	$<1.3 \times 10^{3}$	7.4×10^{2}	$<5.0 \times 10^{-2}$	2.5×10^{7}
76	5.0×10^{4}	1.1×10^{3}	8.2×10^{3}	$<3.7 \times 10^{1}$	3.5×10^{2}	$<4.0 \times 10^{-2}$	1.9×10^{6}
58	1.3×10^{5}	6.0×10^{3}	5.6×10^{4}	$<1.2 \times 10^{3}$	2.8×10^{3}	$<5.0 \times 10^{-2}$	1.5×10^{7}
43	3.3×10^{4}	4.3×10^{2}	9.1×10^{2}	5.3×10^{2}	8.6×10^{2}	$<5.0 \times 10^{-2}$	4.4×10^{6}

1. See Figure 1.
2. TC = total coliform; FC = fecal coliform; FS = fecal streptococcus
3. S = *Staphylococcus*
4. P = *Pseudomonas*
5. TPC = Total Plate Count

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 7

Total Coliform, Fecal Coliform and Fecal Streptococcus Colony Confirmations on Ecosystematic Stations During 1976

	TC*	FC*	FS*
Number Confirmed	133	123	135
Confirmations Attempted	178	131	136
Percent Confirmed	74.7	93.9	99.2

* TC = total coliform; FC = fecal coliform; FS = fecal streptococcus

Algae

Total plankton population densities for 1975 and 1976 are plotted against station location on each waterway system (Figures 2 and 3 respectively). In the Chicago River system, from Lincoln St. (Station 35) to 16 St. (Station 8.4), no significant change occurs except for the July 1976 sampling run which produced higher population counts. For the Calumet River system no significant changes in terms of population numbers occur between 1975 and 1976.

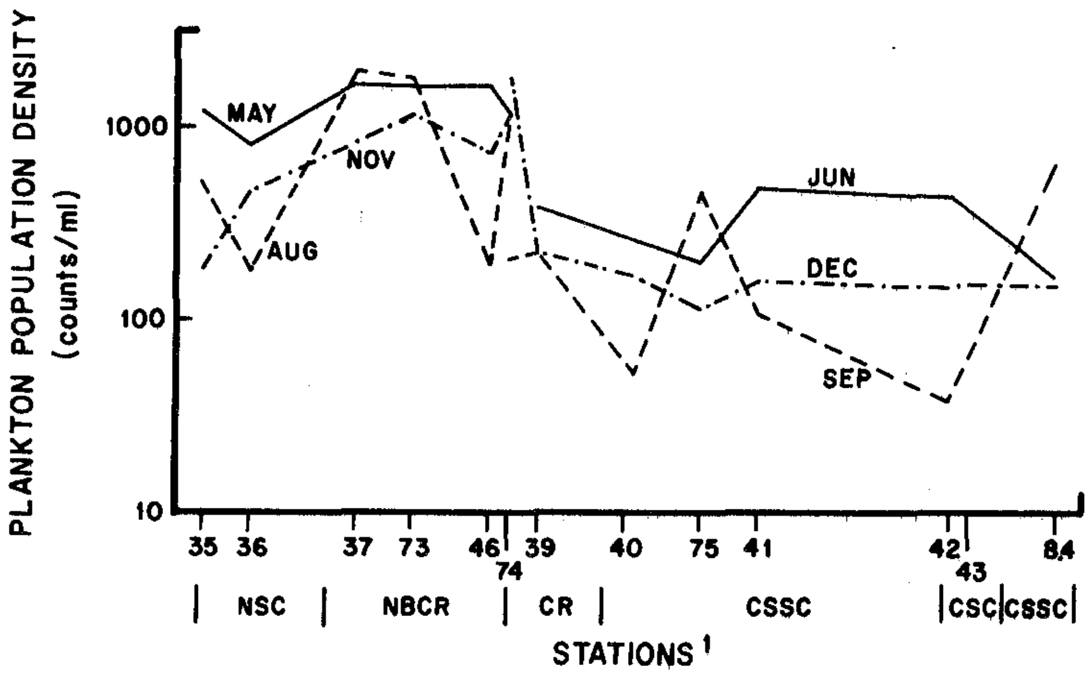
In general, the better the water quality the higher the species diversity index (Shannon-Weaver) or the lower the population density of plankton the higher the species diversity. Examination of Figures 4 and 5 demonstrates that species diversities were generally higher during 1975 than in 1976. Since the population densities were essentially the same this difference between years may reflect the differences in climatic conditions between 1975 and 1976. It should be recalled that 1976 was the driest year on record. Thus, there was little enrichment due to runoff, thereby changing plankton succession patterns and affecting species diversities.

At present 398 plankton species have been identified from the Chicago and Calumet River systems. Of these species 380 belong to the phytoplankton which, by class, contributed the following numbers of species: Diamtoms-161 species, green algae-124 species, blue-green algae-46 species, and euglenoids-28 species. The

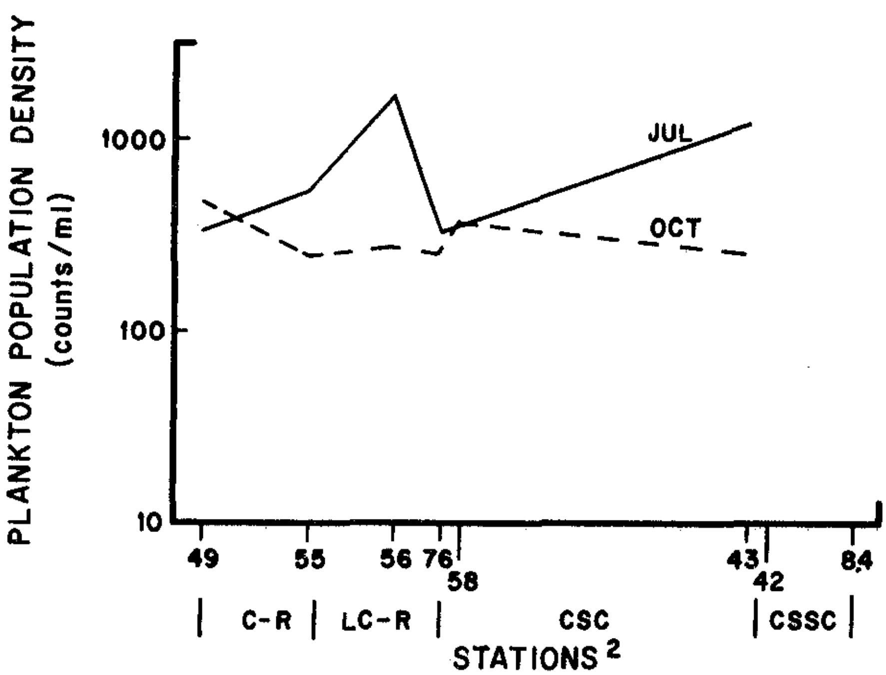
THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

NUMBER OF PLANKTON AT EACH STATION SAMPLED ON THE WATERWAYS DURING 1975

Figure 2



1. NSC = North Shore Channel; NBCR = North Branch Chicago River; CR = Chicago River; CSSC = Chicago Sanitary and Ship Canal; CSC = Cal-Sag Channel.

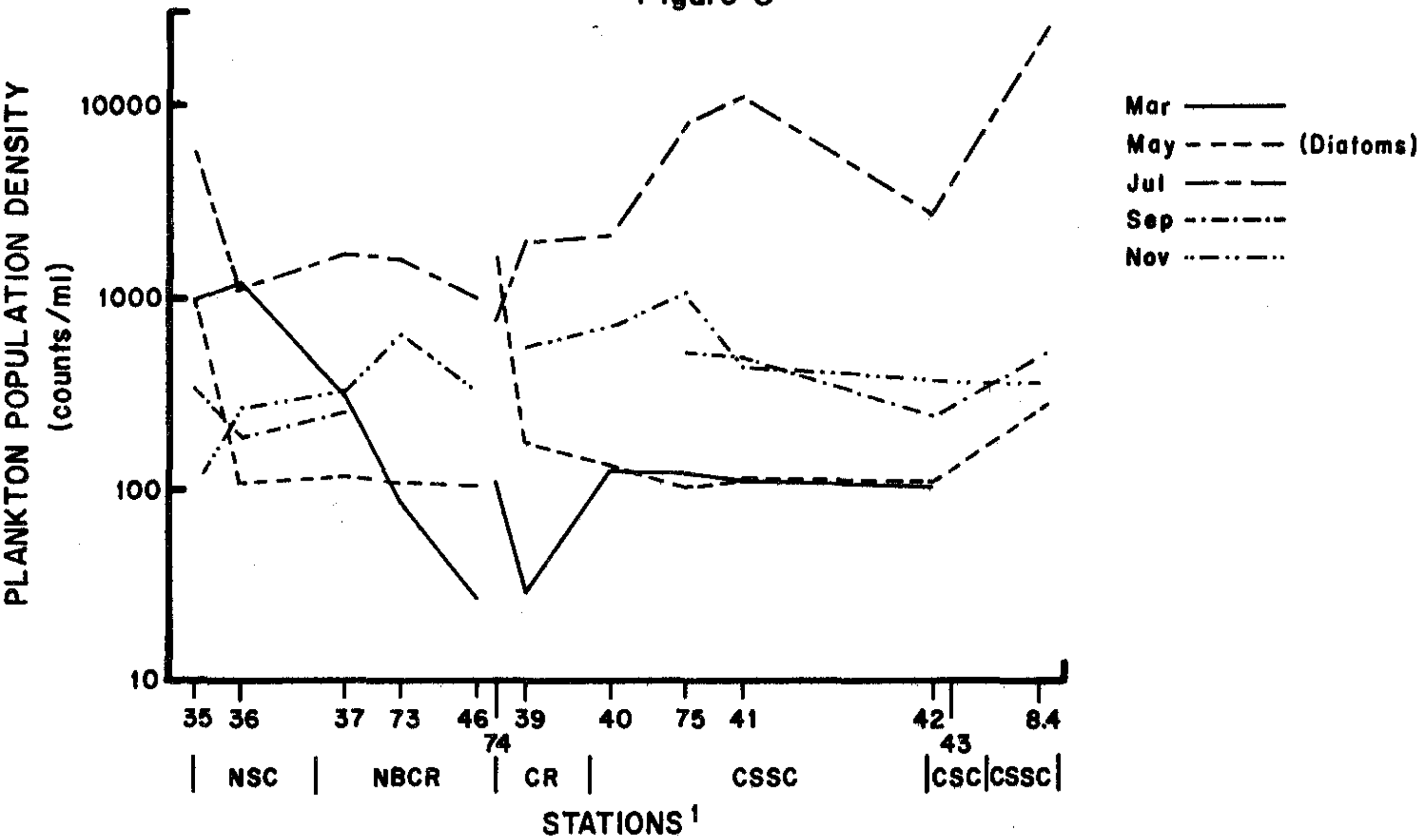


2. C-R = Calumet River; LC-R = Little Calumet River; CSC = Cal-Sag Channel; CSSC = Chicago Sanitary and Ship Canal.

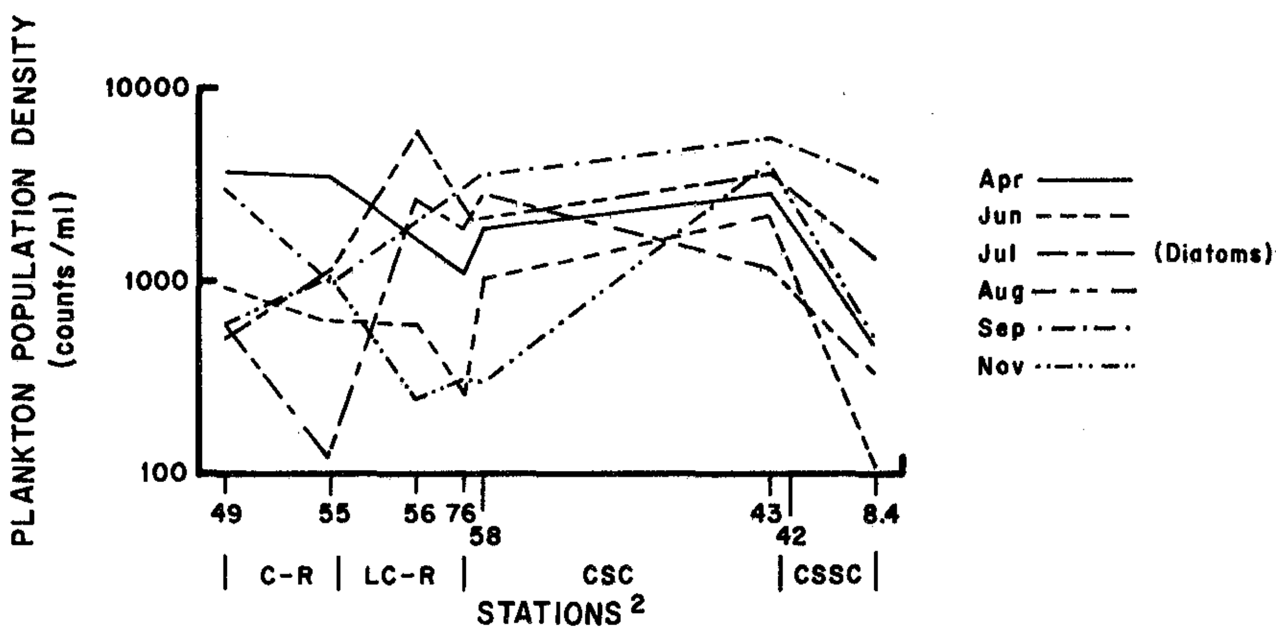
THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

NUMBER OF PLANKTON AT EACH STATION SAMPLED ON THE WATERWAYS DURING 1976

Figure 3



1. NSC = North Shore Channel; NBCR = North Branch Chicago River; CR = Chicago River; CSSC = Chicago Sanitary and Ship Canal; CSC = Cal-Sag Channel.

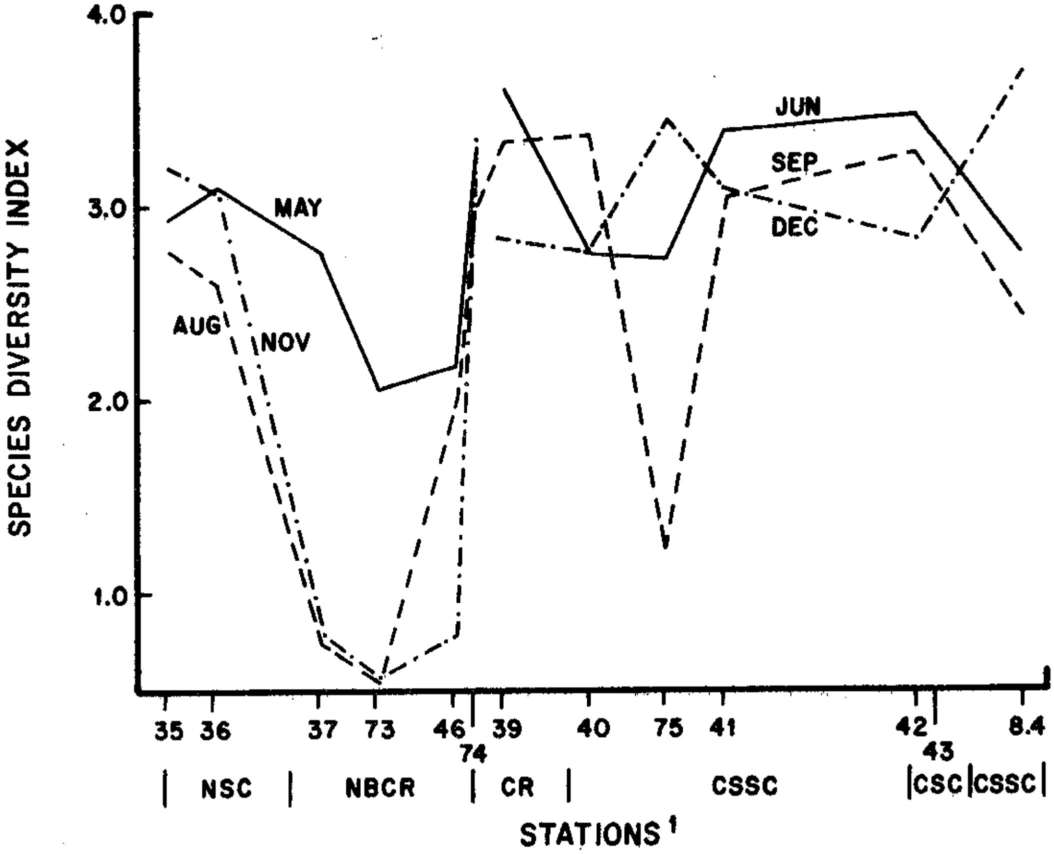


2. C-R = Calumet River; LC-R = Little Calumet River; CSSC = Chicago Sanitary and Ship Canal; CSC = Cal-Sag Channel.

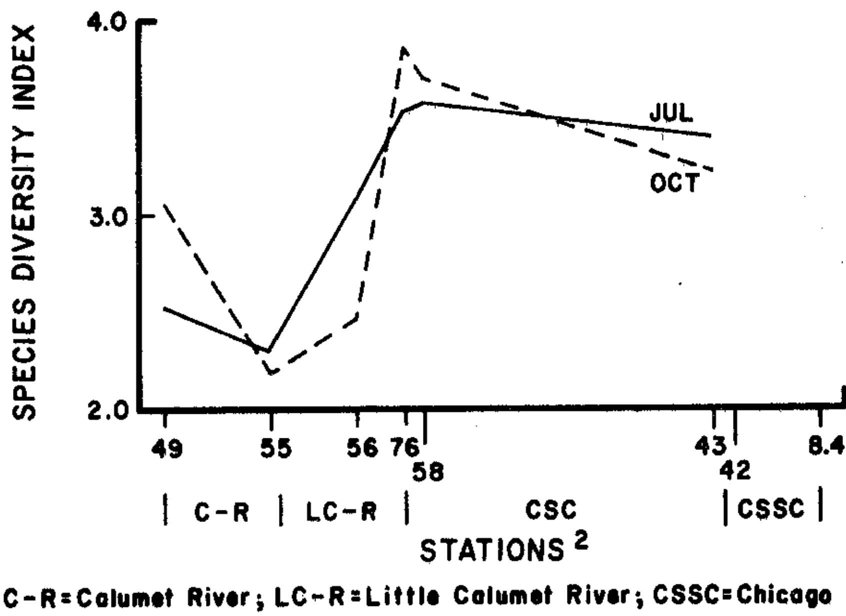
THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

SPECIES DIVERSITY INDEX - 1975

Figure 4



1. NSC = North Shore Channel; NBCR = North Branch Chicago River; CR = Chicago River; CSSC = Chicago Sanitary and Ship Canal; CSC = Cal-Sag Channel.

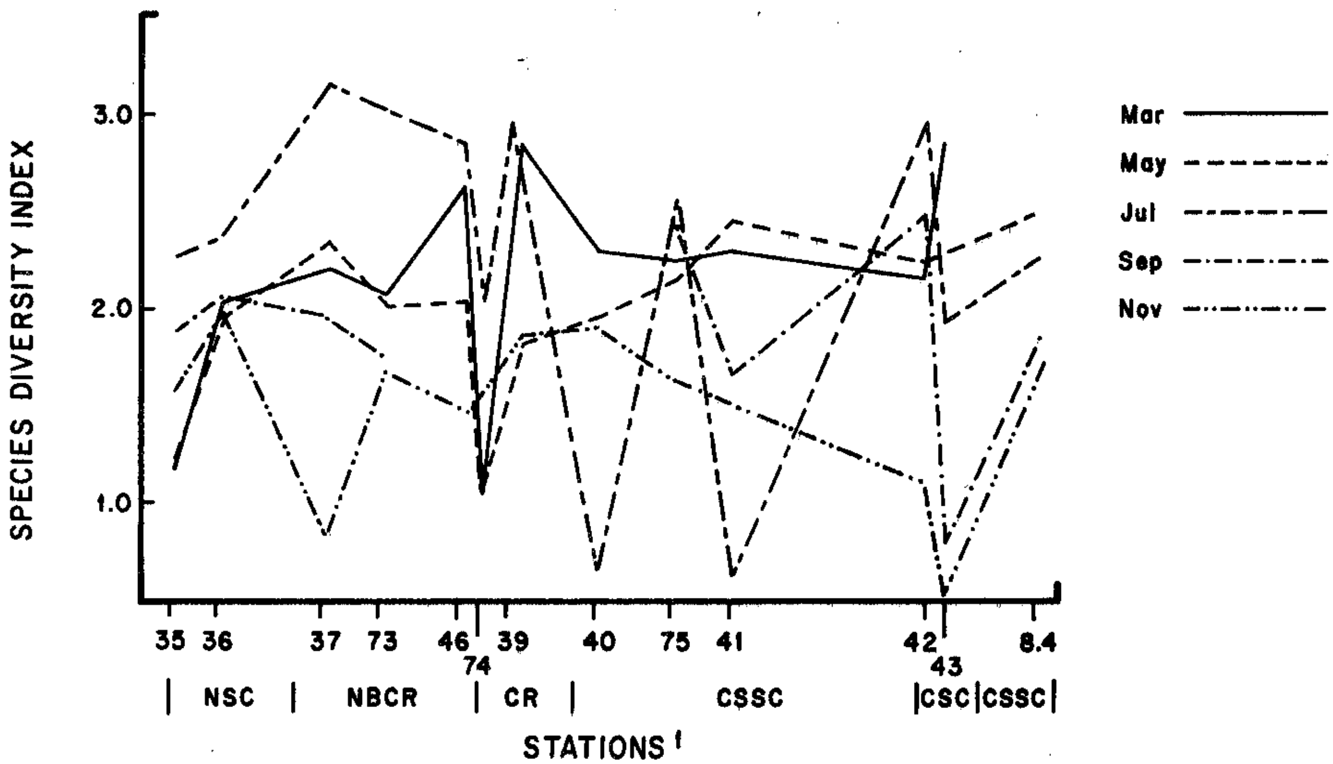


2. C-R = Calumet River; LC-R = Little Calumet River; CSSC = Chicago Sanitary and Ship Canal; CSC = Cal-Sag Channel.

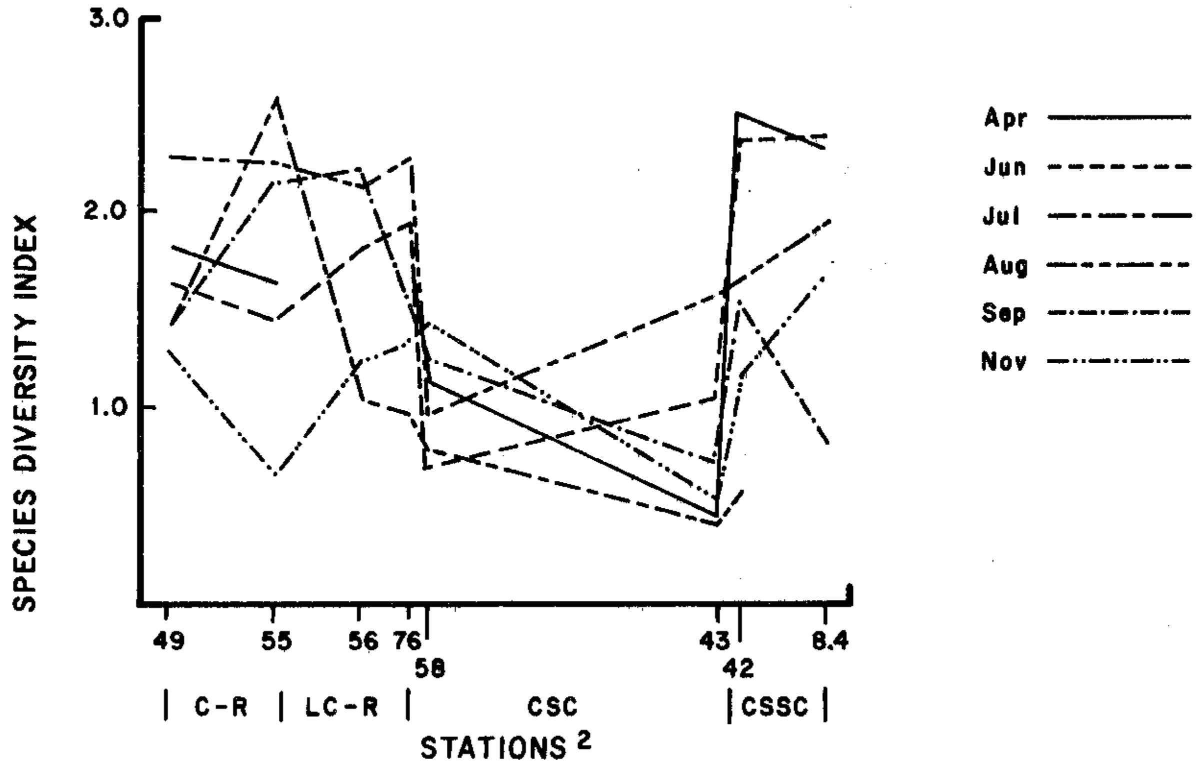
THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

SPECIES DIVERSITY INDEX – 1976

Figure 5



1. NSC = North Shore Channel; NBCR = North Branch Chicago River; CR = Chicago River; CSC = Cal-Sag Channel; CSSC = Chicago Sanitary and Ship Canal.



2. C-R = Calumet River; LC-R = Little Calumet River; CSSC = Chicago Sanitary and Ship Canal; CSC = Cal-Sag Channel.

remaining species belong to the chysophytes, dinoflagellates, xanthophytes, and cryptophytes.

Benthos

Waterways benthological analyses for July through December, 1976 are presented in this report (Table 8). The bottom macroinvertebrates (benthos) were, with a few exceptions, pollution-tolerant forms. Their abundance and dispersal showed essentially no changes since 1975. The dominant benthic macroinvertebrates in the sediments were pollution-tolerant oligochaetes ("sludge worms").

The sediment oxygen demand (SOD) values range from 1.23-27.39 grams/m^2/day (Table 9). The highest rates generally occured in the North Shore Channel and North Branch of the Chicago River, as well as in areas below sewage treatment plants.

Fish

Fish were sampled from the Chicago Channel System (North Shore Channel, Sanitary and Ship Canal, Calumet Sag Channel and their tributaries), from the Des Plaines River, and from Salt Creek (Figure 1 Table 3).

Collections were made from the North Shore Channel and Sanitary and Ship Canal during September-November, 1974-1975 and June, 1976; from the Calumet Sag Canal during September-November, 1974-1976; from the Des Plaines River during November, 1974 and during August-November, 1976, and from Salt Creek during August-September, 1974 and May-June and August, 1976.

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 8

Benthic Macroinvertebrate Abundance During 1976 (July - December)*

Station Name	Station Number	River System	Benthic Macroinvertebrates (Number/m^2): Oligochaeta (aquatic worms)	Hirudinea (leeches)	Chronomidae (midges)	Pelecypoda (clams)	% Oligochaeta*
Maple	A-1	North Shore Channel	47,000	6	590	--	99
Main	A-2	North Shore Channel	276	--	--	--	100
---NSTP Outfall---							
Touhy	36	North Shore Channel	110,000	--	17,000	--	87
Wilson	37	Chicago - North Branch	430,000	13	3,900	--	99
Diversey	73	Chicago - North Branch	8,800	7	1,300	6	98
Division	A-3	Chicago - North Branch	11,000	--	--	--	100
Grand	46	Chicago - North Branch	69,000	--	6	--	99+

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 8 (Cont'd)

Benthic Macroinvertebrate Abundance During 1976 (July - December)*

Station Name	Station Number	River System	Benthic Macroinvertebrates (Number/m^2) Oligochaeta (aquatic worms)	Hirudinea (leeches)	Chronomidae (midges)	Pelecypoda (clams)	% Oligochaeta*
Jackson	A-4	Chicago - South Branch	190,000	--	48	2,000	99
Archer	A-5	Chicago - South Fork S.B.	28	--	--	--	100
Western	A-6	Chicago - CS & SC	65,000	6	7	--	99+
Cicero	75	Chicago - CS & SC	29,000	--	--	--	100
---SWTP Outfall---							
Harlem	41	Chicago - CS & SC	170,000	--	--	--	100
Rt. 83	42	Chicago - CS & SC	130,000	--	--	--	100
16th St.	8.4	Chicago - CS & SC	28,000	--	--	--	100
Ewing	49	Calumet - Cal.	2,500	140	--	--	95

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 8 (Cont'd)

Benthic Macroinvertebrate Abundance During 1976 (July - December)*

Station		River System	Benthic Macroinvertebrates (Number/m^2)				
Name	Number		Oligochaeta (aquatic worms)	Hirudinea (leeches)	Chronomidae (midges)	Pelecypoda (clams)	% Oligochaeta*
Norfolk & Western	49	Calumet - Cal.	500	--	32	13	92
Indiana	56	Calumet - L. Cal.	2,800	76	1,700	1,400	47
CTP Outfall							
Halsted	76	Calumet - L. Cal.	200,000	7	16	--	99+
Western	A-8	Calumet - Cal-Sag Ch.	77,000	--	--	--	100
SW Hwy.	A-9	Calumet - Cal-Sag Ch.	26,000	--	--	--	100
Rt. 83	43	Calumet - Cal-Sag Ch.	54,000	--	6	--	99+

* The abundance of oligochaeta is also expressed as a percentage of the total macroinvertebrate bottom fauna.

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 9

Sediment Oxygen Demand Values in Deep Draft Waterways in Cook County for 1976

Station			Date of Sampling	Water Temperature (°C)	SOD_T $g/m^2/Day$	SOD_{20} $g/m^2/Day$
No.	Name	Waterway				
A-1	Maple	N. Sh. Ch.	7/6/76	22.0	10.15	9.26
A-2	Main	N. Sh. Ch.	9/20/76	20.0	16.32*	16.32*
---Northside STP Outfall---						
36	Touhy	N. Sh. Ch.	7/9/76	23.0	10.37	9.04
37	Wilson	Chgo. N. Br.	7/28/76	24.0	16.14	13.43
73	Diversey	Chgo. N. Br.	9/7/76	23.5	27.39	23.32
			11/10/76	9.6	11.39	6.76
A-3	Division	Chgo. N. Br.	9/20/76	20.0	1.23*	1.23*
46	Grand	Chgo. N. Br.	10/18/76	20.0	2.38*	2.38*

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 9 (CONT'D)

Sediment Oxygen Demand Values in Deep Draft Waterways in Cook County for 1976

Station No.	Station Name	Station Waterway	Date of Sampling	Water Temperature (°C)	SOD_T $g/m^2/Day$	SOD_{20} $g/m^2/Day$
A-4	Jackson	Chgo.-S.Br.	7/20/76	24.0	7.55	6.28
			11/9/76	10.5	5.98	9.25
A-5	Archer	Chgo.-S.Frk. S.Br.	9/27/76	10.0	2.79*	4.42*
			12/6/76	10.0	2.79*	4.42*
A-6	Western	Chgo.-CS&SC	9/27/76	20.0	5.62*	5.62*
			12/7/76	4.0	1.45	3.02
75	Cicero	Chgo.-CS&SC	10/22/76	20.0	3.43*	3.43*
----------	----------	----------	-West-Southwest STP Outfall-	----------	----------	----------
41	Harlem	Chgo.-CS&SC	8/30/76	28.0	20.42	14.14
42	Rt. 83	Chgo.-CS&SC	10/4/76	27.5	5.22*	3.70*
8.4	16th St.	Chgo.-CS&SC	10/4/76	20.0	3.46*	3.46*

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 9 (CONT'D)

Sediment Oxygen Demand Values in Deep Draft Waterways in Cook County for 1976

Station No.	Station Name	Station Waterway	Date of Sampling	Water Temperature (°C)	SOD_T g/m^2/Day	SOD_{20} g/m^2/Day
49	Ewing	Calumet-Cal.	8/11/76	22.5	2.69	2.40
			11/23/76	11.5	2.85	4.21
A-7	Norfolk & Western	Calumet-Cal.	8/10/76	24.5	9.36	7.61
			11/19/76	8.5	3.21	5.44
56	Indiana	Calumet-L. Cal.	8/12/76	25.0	8.81	7.00
			11/17/76	8.5	2.20	3.73
---	---	---	Calumet STP Outfall	---	---	---
76	Halsted	Calumet-L. Cal.	8/16/76	24.0	9.23	7.68
			11/18/76	12.5	8.51	12.01
A-8	Western	Calumet-Cal Sag Ch.	10/12/76	22.0	3.77*	3.44*
			11/16/76	9.0	5.49	9.10
A-9	Southwest Hwy.	Calumet-Cal Sag Ch.	8/31/76	25.0	No Data Available	
43	Rt. 83	Calumet-Cal Sag Ch.	10/12/76	22.0	2.48*	2.26*

* Determination by respirometer; all others In-Situ

Results of these fish collections in terms of the number of individuals of each species collected within each waterway of the Chicago Channel System, including that portion of the Des Plaines River which connects the Sanitary and Ship Canal with the Illinois River, are listed in Table 10.

In general, the pattern of species distribution throughout the Channel System was such that a large number of species (30) occurred at those localities nearest Lake Michigan and above sewage treatment plant outfalls (localities 2, 4, 9, and 10) and at the locality furthest from the lake in the Des Plaines and Kankakee Rivers (26 species at locality 8), with a lower number of species being found throughout the main body of the System (13 species at localities 3, 5, 6, and 11). Eighteen species were collected from the tributaries (localities 1, 7, 12, and 13) of the System.

Results of fish collections in terms of the number of individuals of each species collected within the Des Plaines River (Cook Co.) and Salt Creek (Cook and DuPage Counties) are listed in Table 11.

Seventeen species were collected from the Des Plaines River in northwestern Cook Co. and 12 species were collected from the River in southwestern Cook Co. Sixteen species were collected from Salt Creek in northwestern Cook Co., 5 species in northeastern DuPage Co., and 7 species in southwestern Cook Co.

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 10

NUMBER OF FISH TAKEN IN THE CHICAGO CHANNEL SYSTEM DURING 1974 - 1976
PRIMARILY WITH SEINES AND ELECTROFISHING GEAR

SPECIES	LOCALITY[a]														
	1	2	3	4	5	6	7[b]	8	9[b]	10	11	12[b]	13[b]	14[b]	Total
alewife	0	413	0	56	0	0	0	0	4	2	0	0	0	0	475
gizzard shad	1	2	0	15	0	0	0	628	16	475	59	5	2	0	1203
rainbow trout	0	1	0	0	0	0	0	0	5	0	0	0	0	0	6
coho salmon	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
chinook salmon	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
American smelt	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
central mudminnow	0	0	0	0	0	0	0	0	0	0	2	5	5	0	12
stoneroller	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
goldfish	39	470	9	31	7	39	11	142	15	90	31	56	37	0	977
carp	38	192	2	22	3	18	1	300	38	114	15	39	26	0	808
carp x goldfish hybrid	9	57	1	4	4	6	0	5	1	12	3	6	1	0	109
hornyhead chub	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
golden shiner	0	2	0	8	0	0	0	0	2	6	1	8	0	0	27
emerald shiner	0	0	0	0	0	0	0	141	53	384	1	0	0	0	579
striped shiner	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
common shiner	0	0	0	0	0	0	0	8	0	1	0	0	0	0	9
bigmouth shiner	0	0	2	0	0	0	0	26	0	0	0	0	0	0	28
spottail shiner	0	29	0	0	0	0	0	0	0	0	0	0	0	0	29
spotfin shiner	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5
sand shiner	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
suckermouth minnow	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
bluntnose minnow	0	510	0	229	0	0	0	198	801	206	0	36	3	0	1983
fathead minnow	39	23	0	1	0	0	1	0	2	1	0	0	1	0	68
bullhead minnow	0	0	0	0	0	0	0	4	0	0	0	0	0	0	4
creek chub	0	0	0	0	0	0	0	0	0	0	2	95	189	0	286
quillback	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
white sucker	0	1	0	0	0	0	0	11	0	0	0	3	4	0	19
black bullhead	16	0	1	1	0	4	1	3	0	0	4	14	0	0	44
channel catfish	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 10 (Cont'd)

NUMBER OF FISH TAKEN IN THE CHICAGO CHANNEL SYSTEM DURING 1974 - 1976
PRIMARILY WITH SEINES AND ELECTROFISHING GEAR

SPECIES	LOCALITY[a]														
	1	2	3	4	5	6	7[b]	8	9[b]	10	11	12[b]	13[b]	14[b]	Total
tadpole madtom	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
mosquitofish	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4
brook silverside	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
nine-spine stickleback	0	1	0	2	0	0	0	0	0	0	0	0	0	0	3
white bass	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
yellow bass	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
rock bass	0	3	0	63	0	0	0	2	2	0	0	0	0	0	70
green sunfish	100	25	6	3	0	0	20	285	14	4	80	43	19	0	599
pumpkinseed sunfish	7	3	0	4	0	0	0	7	8	2	0	2	0	0	33
orangespotted sunfish	2	41	0	0	0	0	0	6	0	0	0	0	0	0	49
bluegill	39	0	2	6	0	0	3	38	3	5	8	74	6	0	184
No. longear sunfish	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
redear sunfish	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
smallmouth bass	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
largemouth bass	6	2	0	10	0	0	0	3	93	29	0	8	2	0	153
white crappie	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
black crappie	2	0	1	1	1	1	0	0	1	0	1	2	0	0	10
green x pumpkinseed sunfish hybrid	0	1	0	0	0	0	0	3	0	0	1	1	0	0	6
green x bluegill sunfish hybrid	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
green x longear sunfish hybrid	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
yellow perch	0	118	1	0	0	0	0	0	20	55	0	0	0	0	194
freshwater drum	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
mottled sculpin	0	0	0	2	0	0	0	0	1	0	0	0	0	0	3
Totals	298	1897	25	460	15	68	37	1831	1082	1386	212	398	297	0	8006

a See Figure 1, Table 3
b 1974 data included

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

TABLE 11

NUMBER OF FISH TAKEN IN THE DES PLAINES RIVER AND SALT CREEK (COOK AND DUPAGE COUNTIES) DURING 1976 PRIMARILY WITH SEINES AND ELECTROFISHING GEAR

Species	Locality[a]												
	Des Plaines River						Salt Creek						
	15	16	17	18	19	20	21[b]	22	23	24	25	26	Tot.
gizzard shad	0	0	0	0	0	9	0	0	0	0	0	0	9
central mudminnow	0	0	0	0	0	0	11	0	0	0	0	0	11
northern pike	1	0	0	0	0	0	0	0	0	0	0	0	1
goldfish	0	1	145	63	12	45	4	0	0	91	44	0	405
carp	72	37	26	33	2	22	18	8	1	9	6	0	234
carp x goldfish hybrid	0	0	40	53	4	14	0	0	0	2	19	1	133
golden shiner	0	0	0	0	0	1	3	0	0	0	0	0	4
bigmouth shiner	0	0	0	0	0	0	278	0	0	0	0	0	278
spotfin shiner	0	6	1	0	0	0	0	0	0	0	0	0	7
sand shiner	0	1	0	0	0	0	0	0	0	0	0	0	1
bluntnose minnow	0	3	0	0	0	21	71	0	0	0	0	0	95
fathead minnow	0	0	2	0	0	0	70	0	4	1	0	0	77
creek chub	0	0	0	0	0	0	7	0	0	0	0	0	7
whitesucker	2	12	0	0	0	0	16	7	0	0	0	0	37
black bullhead	2	11	3	1	0	5	32	2	0	0	2	1	59
yellow bullhead	1	4	0	0	0	0	4	0	0	0	0	0	9
blackstripetop minnow	2	0	0	0	0	0	0	0	0	0	0	0	2
rock bass	1	0	0	0	0	0	0	0	0	0	0	0	1
green sunfish	21	121	9	15	0	16	39	2	0	1	1	1	226
pumpkinseed	0	1	0	0	0	1	7	0	0	0	0	0	9
bluegill	34	8	2	4	0	6	53	0	0	0	0	0	107
largemouth bass	1	0	0	2	0	2	8	0	0	0	1	0	14
white crappie	0	0	0	2	0	0	0	0	0	0	0	0	2
black crappie	3	2	0	2	0	2	9	0	0	0	0	1	19
Totals	140	207	228	175	18	144	630	19	5	104	73	4	1747

a See Figure 1, Table 3.
b 1974 data included.

Catch statistics for all waterways are listed in Table 12. Both number of fish collected per 30 minutes electrofishing as well as weight of fish collected per 30 minutes electrofishing were lower in those areas below sewage treatment plants within the Chicago Channel System.

Numbers of fish and weight of catch per 30 minutes electrofishing in the Des Plaines River averaged higher in northwestern Cook Co. than in southwestern Cook Co. Numbers of fish and weight of catch per 30 minutes electrofishing in Salt Creek averaged highest in northwestern Cook Co. and lowest in northwestern DuPage Co.

Values of species diversity, $\bar{d}$, for areas of the Chicago Channel System above and below major treatment plants are listed in Table 13. Species diversity was not different above and below these plants. The number of species was greater above the North Side Plant. The number of fish per 30 minutes, that is, the density of individuals, was higher above both the North Side and Calumet Treatment Plants then below these plants.

This suggests that the water quality below treatment plant outfalls is deleterious to all species of fish, not allowing any one species to overpopulate the area. Thus the proportion of species remains similar though their density is greatly decreased below these plants.

Since the area above the West-Southwest Plant is itself below the North Side Plant outfall as well as many industrial outfalls neither fish species diversity, number of species or

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TABLE 12

Catch Statistics for Fish Collected in the Chicago Channel System, Des Plaines River, and Salt Creek, 1974 - 1976

	Locality[a]													
	Chicago Channel System													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
# Species[b]	11	20	8	18	3	4	6	26	20	14	12	15	12	0
N/30'[c]	45	117	3	77	1	4	62	275	266	130	9	115	44	0
Wt/30'[d]	12.9	25.1	0.2	23.8	0.7	1.3	3.1	21.1	28.2	15.4	0.4	7.8	4.7	0

	Locality[a]											
	Des Plaines River - Cook Co.						Salt Creek - Cook & DuPage Co.					
	15	16	17	18	19	20	21	22	23	24	25	26
# Species[b]	11	12	7	8	2	11	16	4	2	4	6	4
N/30'[c]	123	122	195	131	15	90	143	32	0	36	35	17
Wt/30'[d]	70.6	40.6	35.5	38.7	1.5	15.4	1.4	7.8	0	1.2	6.1	0.8

a See Figure 1.
b Number of species.
c Number of fish collected per 30 minutes electrofishing.
d Weight in kilograms of fish collected per 30 minutes electrofishing.

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TABLE 13

RESULTS OF STATISTICAL COMPARISONS OF SPECIES DIVERSITY ($\bar{d}$), SPECIES NUMBER AND NUMBER OF FISH PER 30 MINUTES ABOVE AND BELOW MAJOR CHICAGO TREATMENT PLANTS

Locality Number	Locality Description	$\bar{d}$	Number of Species	Fish per 30 Minutes
North Side Treatment Plant				
2	Above Outfall	1.868	20	117
3	Below Outfall	1.832	8*	3*
Calumet Treatment Plant				
10	Above Outfall	1.729	14	130
11	Below Outfall	1.715	12	9*
West-Southwest Treatment Plant				
5	Above Outfall	1.211	3	1
6	Below Outfall	1.114	4	4

* significant difference ($P \leq 0.05$ that the parameters come from the same population) above and below the respective treatment plant outfall.

density of fish (all listed in Table 13 are different above and below this treatment plant).

Values of species diversity for areas of the Des Plaines River and Salt Creek are listed in Table 14. Significant decreases in diversity occur between Golf Rd. and Grand Ave. and between upstream and downstream areas near the mouth of Salt Creek. Many fish with ovarian tumors were collected from the Grand Ave. locality during 1976. The density of fish was significantly ($P \leqq 0.05$) lower below the mouth of Salt Creek than above. Salt Creek evidently is deleterious to the water quality of the Des Plaines River.

Fish species diversity was lowest at those localities at Rt. 83 (#23) and at Wolf Rd. (#24) on Salt Creek with both species numbers and density remaining low to the mouth with the Des Plaines River. Evidently the deterioration of Salt Creek water quality which occurs as it flows through DuPage County does not appreciably improve even as it flows into the Des Plaines River.

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TABLE 14

RESULTS OF STATISTICAL COMPARISONS OF SPECIES DIVERSITY INDICES ($\bar{d}$) AT LOCALITIES COMPARED WITHIN THE DES PLAINES RIVER AND SALT CREEK SYSTEMS, RESPECTIVELY

Des Plaines Locality				Salt Creek Locality		
Number	Description	$\bar{d}$	DOWNSTREAM ↓	Number	Description	$\bar{d}$
15	Above Dam #1	1.376		21	Rt. 62	1.954
16	Golf Rd.	1.431		22	Wooddale	1.206*
17	Grand Ave.	1.132*		23	Rt. 83	0.500*
18	Above Salt Cr.	1.524*		24	Wolf Rd.	0.494
19	Below Salt Cr.	0.849*		25	Broadview	1.077*
20	Willow Spgs. Rd.	2.012*		26	Mouth DPR	1.386*

* significant difference ($P \leq 0.05$ that the parameters come from the same population) between the diversity indices compared within each system in a downstream fashion.

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