# 316(b) DEMONSTRATION
# LA SALLE GENERATING STATION
# MAKEUP WATER INTAKE SYSTEM

Prepared by
COMMONWEALTH EDISON COMPANY
CHICAGO, ILLINOIS
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## 1.0 INTRODUCTION

The LaSalle County Generating Station is located near Seneca, Illinois on the Illinois River. The station will ultimately consist of two nuclear powered generating units, each having an 1100 megawatt net capacity. Both units are scheduled to be in service in 1979. The station has been designed with a cooling pond of 2058 acres.

National Pollutant Discharge Elimination System (NPDES) Permit No. IL 0048151 was issued for the LaSalle County Generating Station May 21, 1976. This permit requires Commonwealth Edison Company to submit to the U.S. Environmental Protection Agency Regional Administrator and the Illinois Environmental Protection Agency a demonstration predicting the ability of the intake system for the cooling pond to meet the requirements of Section 316(b) of the Act. This report is submitted in accordance with that requirement.

As required by the NPDES Permit, this report is based on presently available information regarding receiving water hydrology, intake siting and design, proposed intake operation and biological populations. This approach is utilized to allow the Agencies to assess the intake at an early stage.

## 2.0 PLANT INFORMATION

### 2.1 Station Background

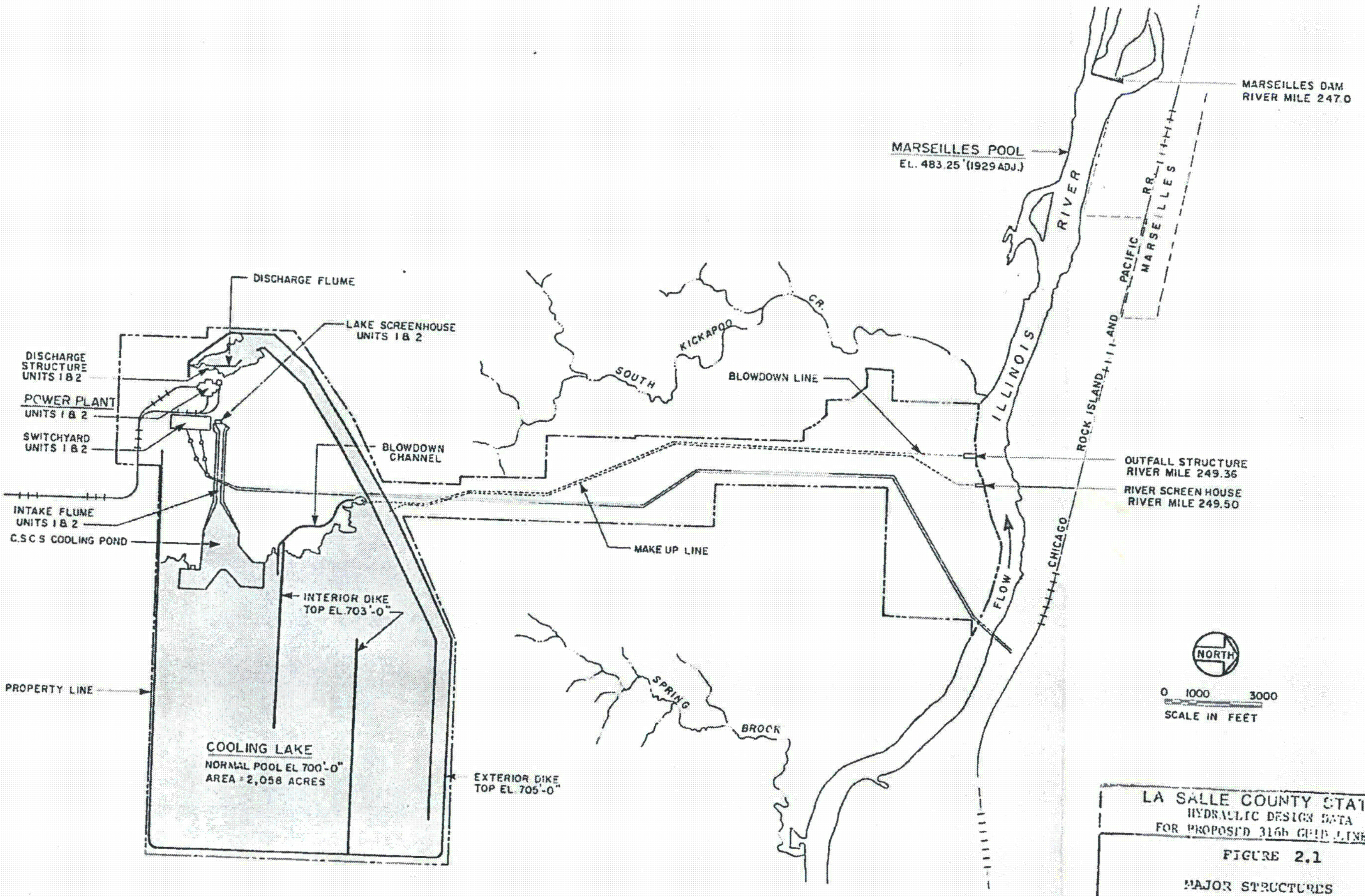
The LaSalle County Station is located in Brookfield Township, LaSalle County, Illinois. The site is centered at 41°14'44" north latitude and 88°40'06" west longitude and covers approximately 3060 acres.

A plan layout of the site is shown in Figure 2.1. The LaSalle County site consists of two adjoining parcels of land. The larger parcel, located about 5 miles south of the Illinois River, is where the station and a 2058 acre cooling pond are located. The second parcel consists of a corridor leading from the station site to the Illinois River. Routed through this area are the cooling pond make-up and blowdown lines.

The station consists of 2 boiling water reactors each with a rated power output of 1100 MWe. Construction of the station was begun in September, 1973. Commercial operation of the first unit is scheduled to begin May, 1979 with startup of the second unit in November 1979.

Two G.E. BWR/5 boiling water reactors, each with a rated core thermal power level of 3293 MWt, will supply steam at 985 psia. The turbine-generator unit, also manufactured by G.E., consists of a turbine, generator, exciter, controls and required subsystems. The steam turbines operate at 1800 rpm and are direct-drive coupled to the generators. The generators are rated three-phase, 25,000 volt - 60 Hz and are hydrogen cooled.

Waste heat will be dissipated by closed cycle circulation through an artificial cooling pond. Condenser cooling water is to be




LA SALLE COUNTY STATION
HYDRAULIC DESIGN DATA
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FIGURE 2.1

MAJOR STRUCTURES
AND SITE LAYOUT

circulated from the cooling pond at a rate of approximately 1.2 million gallons per minute. Cooling water in the lake will be diverted by a series of internal dikes that provide an extended flow path and assure adequate cooling. Make-up water for the pond will be withdrawn from the Illinois River through an intake flume. A cooling pond blowdown structure located approximately 200 yards downriver of the intake structure will be used to assure cooling pond water quality.

Three 3-stage vertical turbine pumps each with a capacity of approximately 30,000 gpm are used to provide pond make-up. The pumps will pump up to 90,000 gpm of river water to the pond through 18,000 feet of 60 inch diameter pipe. Normal operation of the station calls for one or two pumps to be used to maintain proper pond levels. During the 9-month filling period, three pumps will be used.

The river screenhouse and blowdown structures are located approximately at river miles 249.5 and 249.36, respectively. Both structures are located on the Marseilles pool of the Illinois River. Normal elevation of the Marseilles pool is 482.8 feet. The average discharge of the Illinois River over the 55-year period of record is about 10,750 cfs. The maximum and minimum flows recorded at Marseilles, Illinois, are 93,900 cfs and 1460 cfs, respectively. The 7-day 10-year low flow is 3228 cfs.

## 2.2 Cooling Pond Make-up Intake System

### 2.2.1 General

Due to evaporation, blowdown, and possibly some seepage, it is expected that continuous pumping of cooling pond make-up water will be necessary to maintain the cooling pond water level at elevation 700'-0". It is estimated that approximately 49,000 gpm[1] of make-up water will continuously be required to replace 19,000 gpm[1] of water lost due to evaporation and another 30,000 gpm[1] of water lost due to pond blowdown.

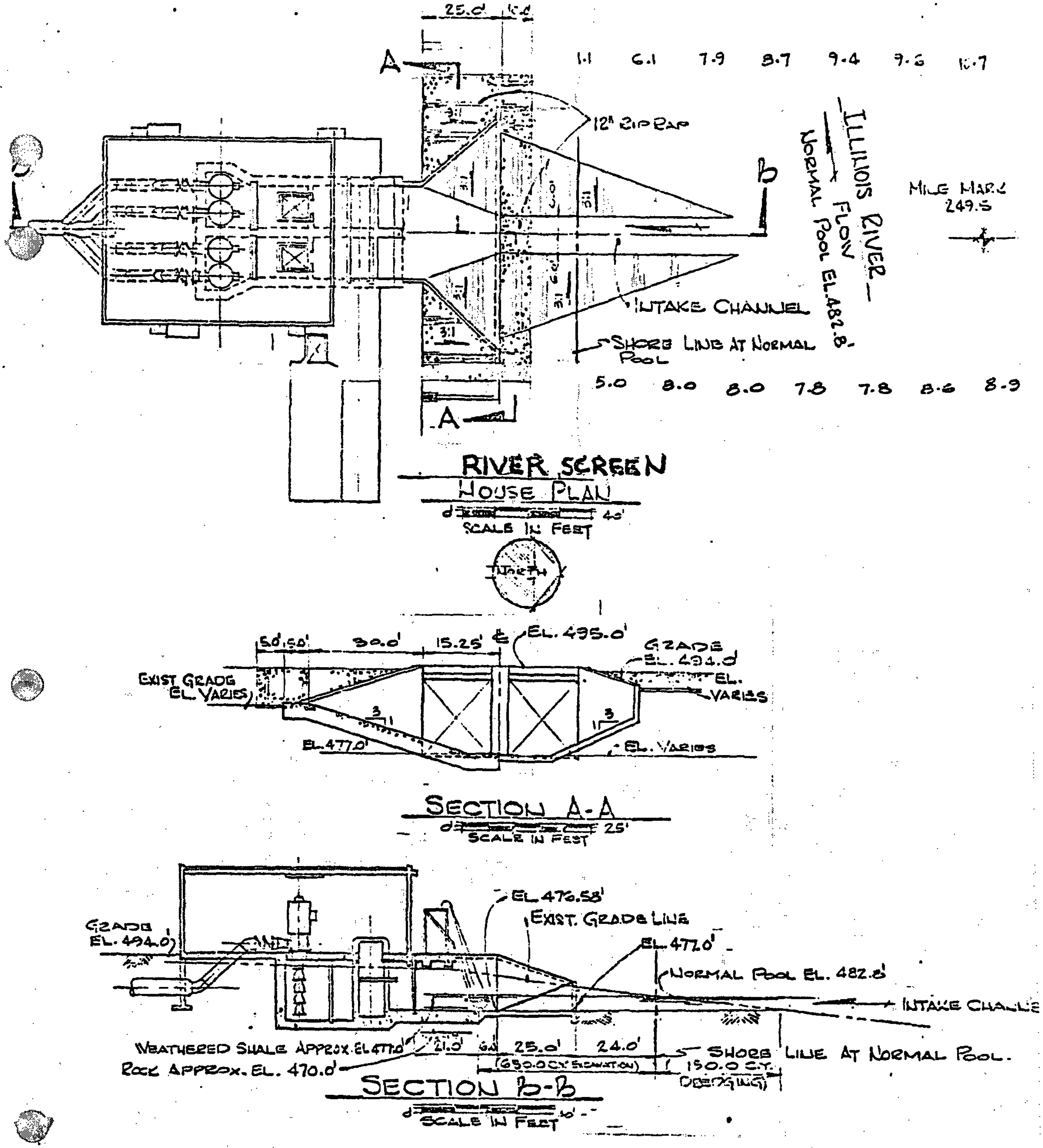
The cooling pond make-up intake system is shown in Figure 2.2. The intake system consists of an intake flume channeled into the bottom of the Illinois River and extending approximately 50 feet out from the shoreline. Recessed 24 feet from the shoreline is a 72 foot wide funneled inlet. At the mouth of the inlet, a floating boom made of partially submerged barrels has been installed to divert floating debris. The funneled inlet leads to two adjacent bar racks which precede two traveling screens located in the river screen house. River water then flows to compartments in the lower bay area of the screenhouse where the enclosed impellers of three vertical turbine pumps are located.

The river intake system was constructed with no provisions for river intake deicing. Additionally, there will be no use of biocides at the river intake system.

### 2.2.2. River Screenhouse Inlet

The river screenhouse inlet is located on the Marseilles Pool of the Illinois River at river mile 249.50. During station operation,

1 Calculated annual average rate.




**NOTES:**

1. ELEVATIONS & SOUNDINGS ARE IN FEET & TENTHS & REFER TO MEAN SEA LEVEL DATUM 1929 ADJ.
2. ILLINOIS RIVER POOL EL. 482.8' M.S.L. 1929 ADJ., CORRESPONDS TO ILL RIVER POOL EL. 483.25' M.S.L. 1912 ADJ.

LA SALLE COUNTY STATION

HYDRAULIC DESIGN DATA

FOR PROPOSED 316b GUIDELINES

FIGURE 2.2

RIVER SCREEN HOUSE PLAN AND SECTIONS

normal river elevation is expected at 482.8'. A low water elevation of 482.1' and a high water elevation of 483.6' have been determined as the minimum and maximum river levels to be encountered at the river screenhouse.

Water entering the intake inlet first flows from the shoreline into a 24 ft. long channel, which leads to a 57 ft. wide floating boom. The boom, constructed from styrofoam filled 55 gallon drums, is free to float with river wave action. The boom deflects large floating debris which would otherwise be trapped on bar racks located approximately 25 feet behind the boom. As installed, the boom extends only approximately 10 inches below the river.

The submerged intake channel is riprapped and extends approximately 75 feet from the boom out into the river. Approximately 50 feet of the channel extends past the shoreline into the river. The river bottom has been excavated to elevation 477'0" to provide a 12 foot wide bottom for the channel. Along both sides of the channel, the river bottom is sloped at a rate of 3:1 down to the 477'0" elevation.

The intake bay width at the shoreline spans approximately 72 feet. From the shoreline to the floating boom the channel is 72 feet wide where it then tapers to approximately 30 feet at the bar racks. The inlet area floor elevation at the bar racks is 476'7".

Calculations by the architect-engineer indicate that during normal make-up periods (approximately 93% average annual station

operating time), the cooling pond make-up rate will be 30,000 gpm with one pump operating. River intake velocities at the approach inlet of the canal near the shoreline, have been calculated to range from 0.4 fps to 0.6 fps, depending on river pool elevation. The 0.4 fps velocity corresponds to the high river elevation of 483.6' and the 0.6 fps velocity to the low river elevation of 482.1'. At the normal river pool elevation of 482.8', river intake velocities of approximately 0.5 fps will occur.

Periods of make-up requiring two pumps have been calculated at approximately 7% of the station operating time. With two pumps operating make-up rates approaching 60,000 gpm will result. River intake velocities in the vicinity of the shoreline under these conditions will range from 0.6 fps to 1.0 fps at the high and low river levels, respectively. At normal river levels, an approach velocity of 0.8 fps is expected.

### 2.2.3 Bar Racks

The river inlet to the screenhouse is screened for large debris by vertical trash bar racks. The racks consist of 5" x 1/2" steel bars spaced to give 2½" openings. Two sets of bar racks, each approximately 12'6" W x 22'9" H span across the 30 ft. wide inlet area leading to the screenhouse. Details of the bar racks and cleaning mechanism are presented in Figure 2.3.

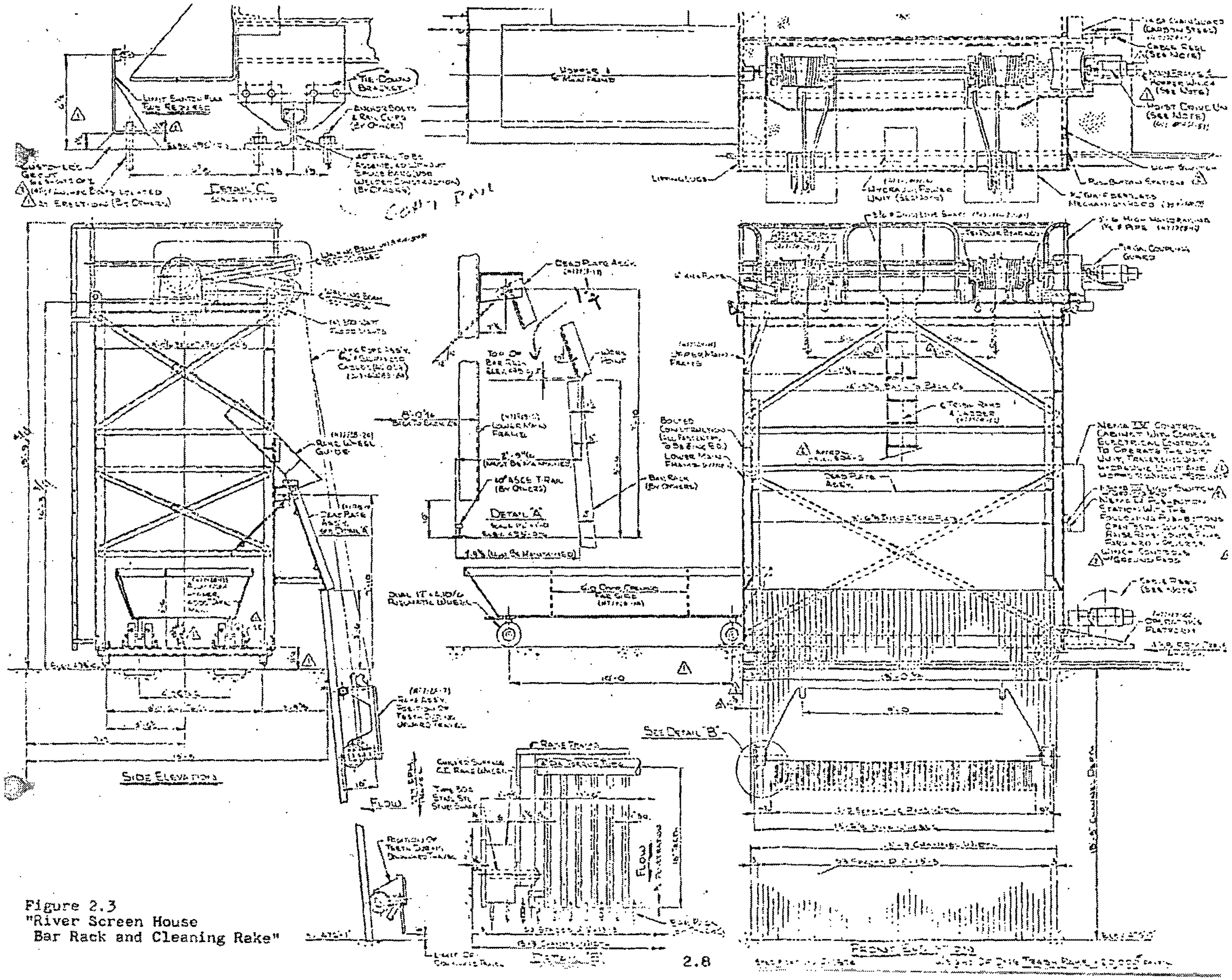


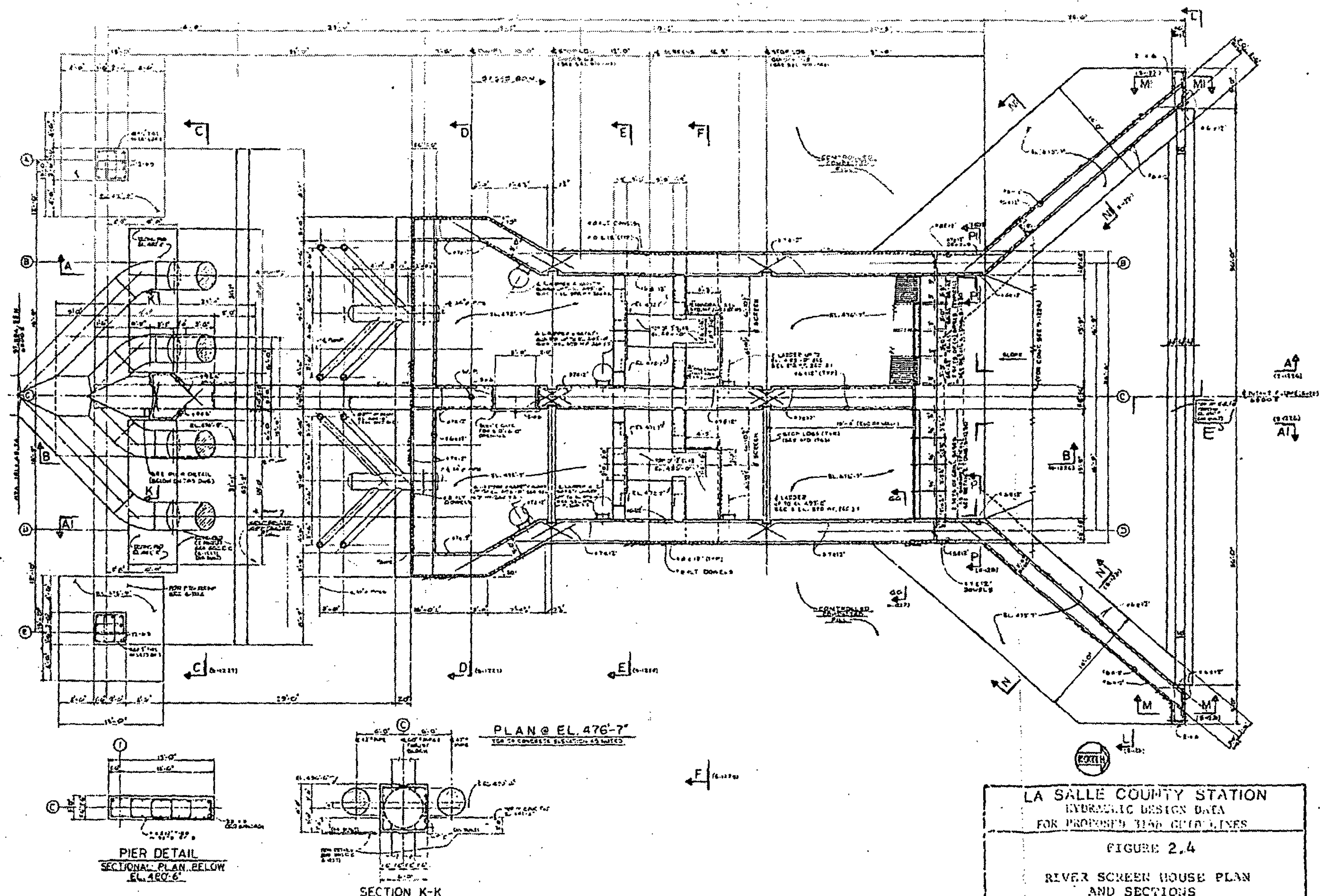

Figure 2.3
"River Screen House
Bar Rack and Cleaning Rake"

To clean accumulated debris from the surface of the trash rack, a traveling trash rake is positioned at the top of the rack. The rake contains steel teeth which are raised and lowered by a drum hoist mechanism. The entire unit, called a traveling hoist car, moves on tracks located adjacent to and behind the bar racks. By moving along the track all areas of the bar rack are accessible to the trash rake for cleaning.

Cleaning of the bar racks is provided by an apron on the hoist car which allows the rake to travel vertically from the rack to the dumping position without premature dumping of trash. A trash chute then directs the collected debris to a trash cart. The trash cart is a four wheeled, bottom dumping cart which fits within the framework of the hoist car. All waste dumped into the cart is eventually disposed of by a local waste disposal service.

### 2.2.4 Cooling Pond Make-up Screenhouse

The cooling pond make-up screenhouse shelters two traveling screens, three cooling pond make-up pumps and support equipment including motor control switch gear, transformers and valve equipment. Illustrated in Figures 2.4 and 2.5 are the plan and section views of the screenhouse and the inlet canal. The screenhouse has been constructed with provisions allowing for the addition of a fourth make-up pump.




LA SALLE COUNTY STATION
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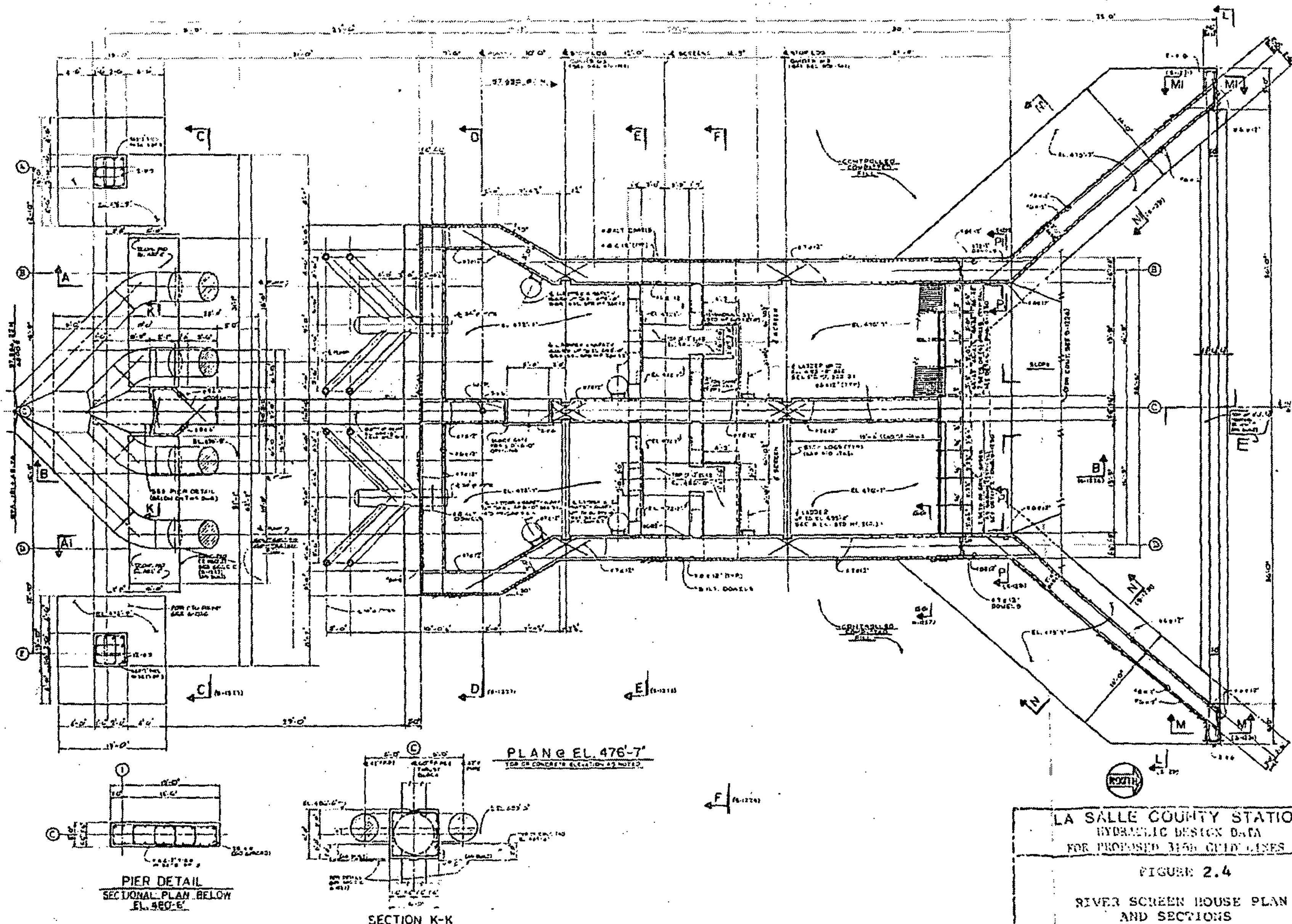
FIGURE 2.4

RIVER SCREEN HOUSE PLAN AND SECTIONS




LA SALLE COUNTY STATION
HYDRAULIC DESIGN DATA
FOR PROPOSED 3156 GRID LINES

FIGURE 2.4

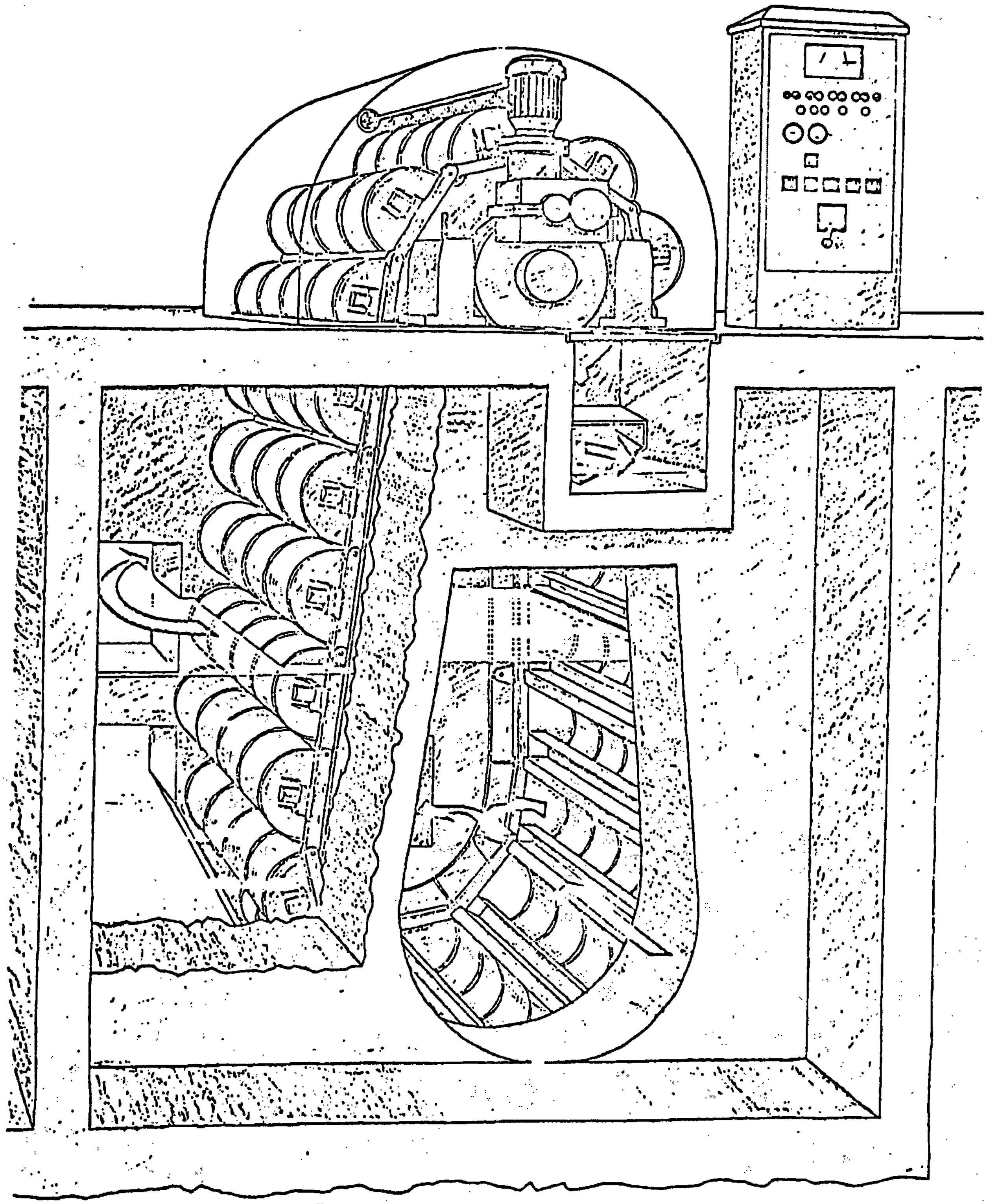
RIVER SCREEN HOUSE PLAN
AND SECTIONS

2.2.5 Traveling Screens

The river screenhouse contains two Beloit-Passavant center flow traveling screens with 3/8 inch screen openings. The screens are shown in Figures 2.6 and 2.7. As installed, one screen serves two of the pond make-up pumps. A second screen serves the third pump.

The Beloit-Passavant dual flow traveling band screen operates according to the internal flow system, whereby water passes through the screen from the inside to the outside. With this principle, the entire submerged screening area is utilized during the screening process. This results in one side of the screening medium always exposed to the dirty water side of the unit and the other side to the screened water side. In this manner, the possibility of debris or entrapped organisms not discharged during a pass through the cleaning shower is eliminated from carryover into the screened water area.

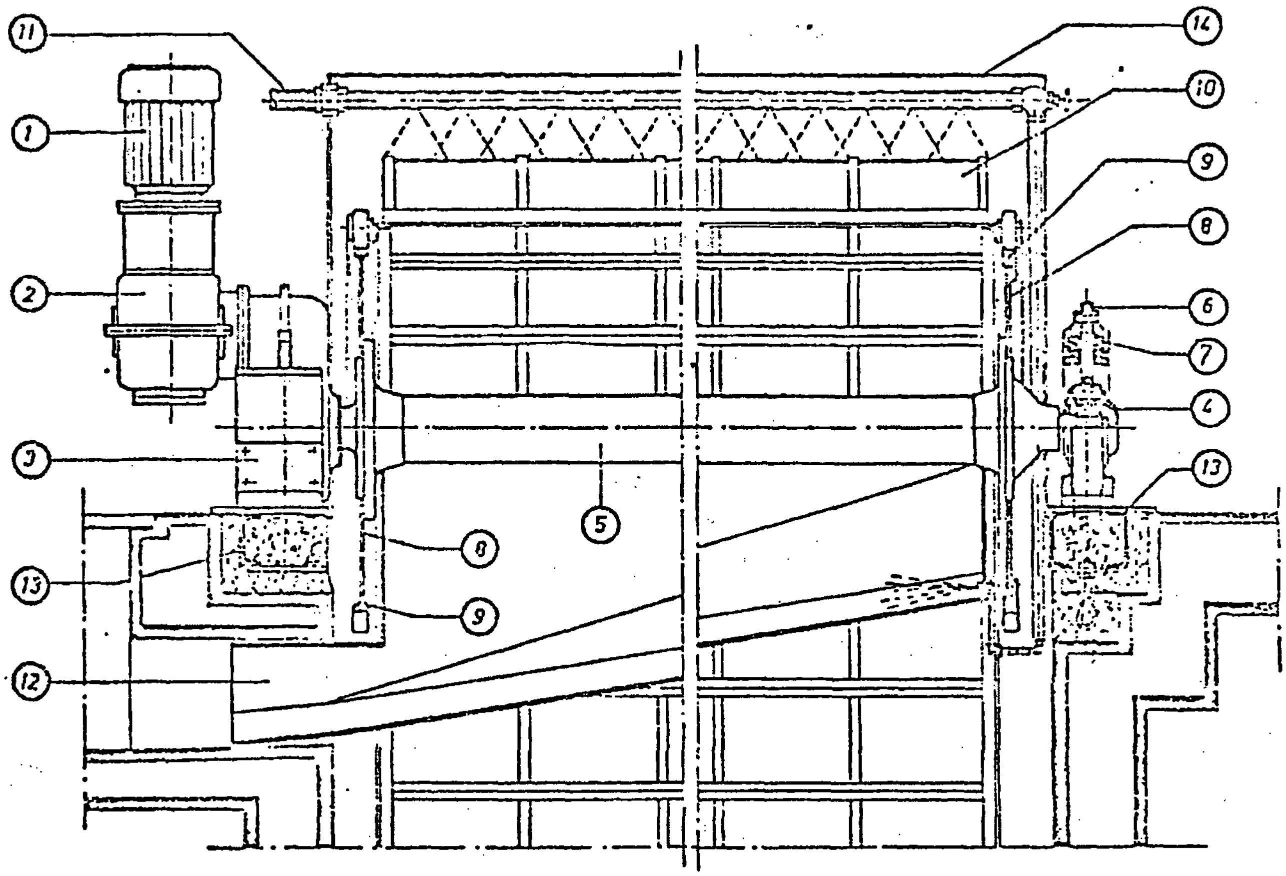
A design feature of this traveling band screen is the application of the semi-circular type screening basket. These baskets increase the screening area by approximately 60% compared to the base area of the basket frames. Retaining plates installed as part of the basket prevents debris accumulated on the internal screen surface from dropping back into the screening unit. The retaining plate also assists in dewatering collected trash.



SINGLE ENTRY, DOUBLE EXIT
VERTICAL TRAVELING SCREEN

**FIGURE 2.6**

TRAVELING BAND SCREEN (DUAL FLOW)
Drive Unit




1 Motor
2 Gear Drive
3 Gear Drive Support
4 Roller Bearing
5 Torque Tube
6 Chain Take-Up
7 Disc Spring Suspension
8 Sprocket
9 Sprocket Tooth
10 Screening Basket
11 Shower Header
12 Waste Trough
13 Support Frame
14 Housing

**Figure 2.7**
**Details of Beloit-Passavant Traveling Screen.**

All screened particles are removed by a spray from the upper interior of the screen and are collected in a waste trough located inside the traveling band screen. Debris removal is performed by a special screen shower header with 19 flat spray nozzles discharging water at a total rate of 38 gpm and pressure of 60 psi. Debris collected is eventually disposed of by a local waste disposal service.

Cleaning of the traveling screens is actuated by pressure differential controls which are used to regulate the speed of the screen drive unit. In addition, an adjustable timer is provided to automatically operate the screen at preset intervals, if for any reason it has not been previously actuated by level differential.

Significant performance and design data for the traveling screens are tabulated in Table 2.1.

Table 2.1 - Performance Data for Beloit-Passavant

| | | |
|---|---|---|
| Basket width | - | 6'0" |
| Screen Opening Size | - | 3/8 inch square |
| Capacity | - | 90,000 gpm |
| Intake Velocity at Low Water Depth | - | 2 pumps operating - 0.7 fps<br>1 pump operating 0.4 fps |
| Chain Pitch | - | 20" |
| Drive Sprocket Centers | - | 18'-0" |
| Drive Motor & Horsepower | - | 1 @ 2.5/5.0 H.P. |
| Speed of Travel of Basket | - | 14.0-28.0 ft./min. |
| Basket Cleaning | - | Upper spray system - automatic pressure differential actuated. |

Calculations by the architect-engineer indicate that at the normal cooling pond make-up rate of 30,000 gpm (one pump running) river intake flows at the traveling screens will range from 0.3 fps to 0.4 fps depending on river pool elevation. The 0.3 fps velocity corresponds to the high river elevation of 483.6' and the 0.4 fps velocity to the pool low water elevation of 482.1'. At the normal pool elevation of 482.8', river intake velocities averaging 0.35 fps are expected at the traveling screens.

It is anticipated that on an average annual basis, make-up to the cooling pond will be provided approximately 7% of the time, by two make-up pumps. River intake flows at the traveling screens with two pumps running have be calculated to range from 0.5 fps (at high river elevation 483.6') to 0.7 fps (at low river elevation 482.1'). At the normal pool elevation of 482.8', river intake flows will average 0.6 fps with two pumps operating.

### 2.2.6 Make-up Pumps

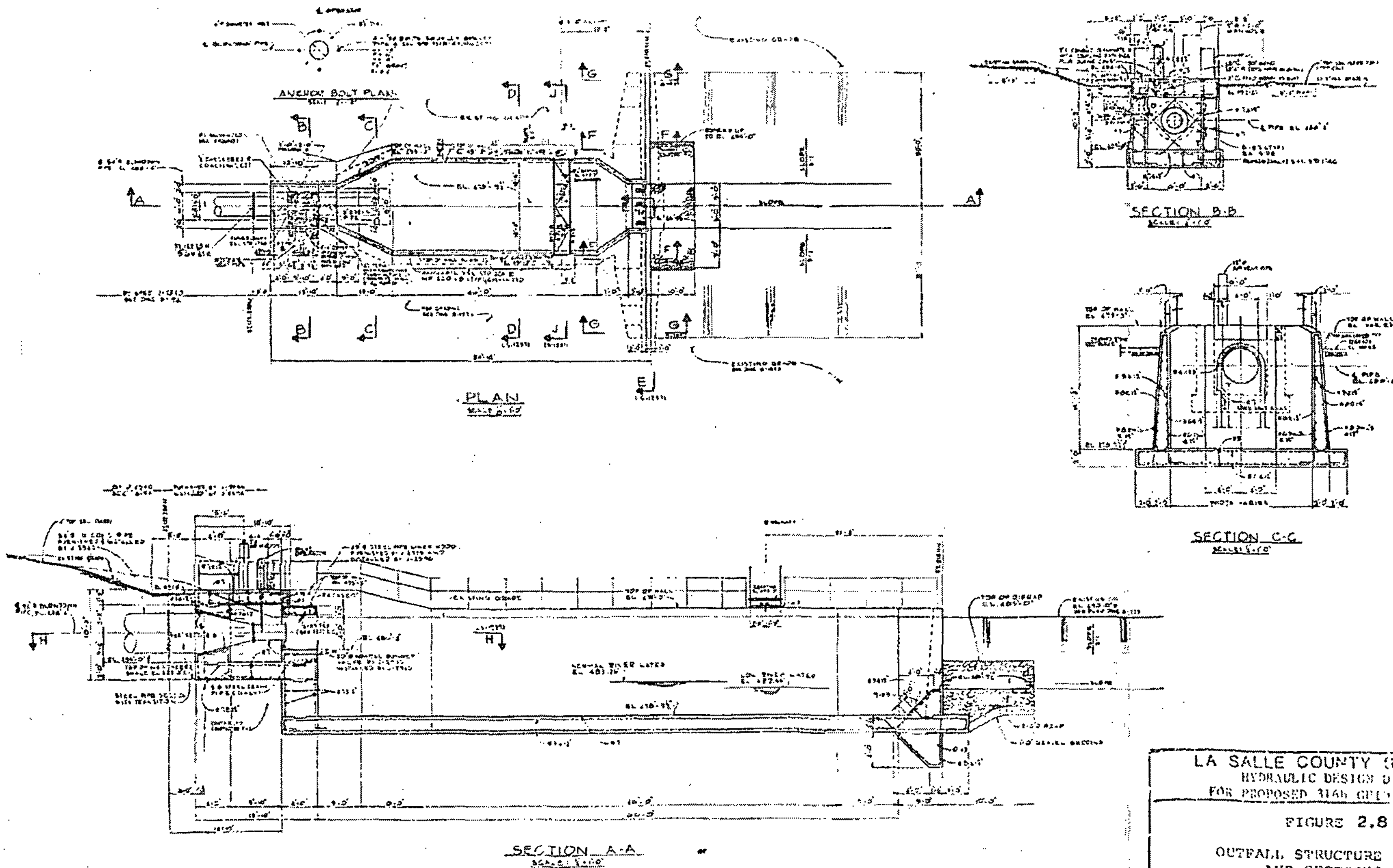
Three cooling pond make-up pumps, located inside the river screenhouse, supply make-up water to the cooling pond from the Illinois River. The locations of the pump are shown in Figure 2.4 and 2.5. Manufactured by the Layne & Bowler Division Singer Co., the pumps, driven by 3000 H.P. Westinghouse Corp. motors, have a pumping capacity of 30,000 gpm each. The pumps are

3-stage vertical turbine pumps with an enclosed impeller rotating at 710 revolutions per minute. Suction and discharge pressures are approximately 5 psi and 150 psi, respectively. The pumps are capable of pumping against an elevation head of 189 feet (between the screen-house and cooling pond discharge). Discharge from the pumps flow into 3 - 42 inch diameter pipes which eventually merge into 1 - 60 inch diameter pipe. During operation of these pumps, hydraulic turbulence is expected behind the traveling screens near the suction zone of the pump.

## 2.3 Other River Structures

The cooling pond discharge system consists of one blowdown structure situated on the Illinois River at river mile 249.36. The cooling pond blowdown line has a discharge capacity of 200 cfs. The line, as shown in Figure 1, originates in the cooler region of the cooling pond near the intake flume for condenser cooling water. From this point, the 66-inch diameter blowdown pipe is routed under an interior dike, under the condenser cooling water discharge flume and exterior dike, and to the river outfall structure. The blowdown pipe is designed for gravity flow. The centerline elevations of the pipe are 694.75 feet MSL at the cooling pond inlet and 488.25 MSL at the river discharge point. A motor-operated shutoff valve at both the river and lake ends of the line permits maintenance and flexibility in cooling pond operation.

Blowdown from the cooling pond is discharged to the Illinois River at an annual average rate of 51.1 cfs at 100% capacity for the two units. Figure 2.8 shows the outfall structure in detail. The blowdown is discharged through a 20-inch diameter Howell Bunger Valve into a 660-ft. long stilling basin. From the stilling basin, the blowdown enters the Illinois River through an open flume having a bottom width of 10 feet and side slopes of 3:1. The bed elevation of the flume is 481.79 feet. Because the normal pool elevation of the Illinois River is 482.8', the blowdown is discharged very near the water surface.




LA SALLE COUNTY STATION
HYDRAULIC DESIGN DATA
FOR PROPOSED 316b GUIDELINES

FIGURE 2.8

OUTFALL STRUCTURE PLAN AND SECTIONS

## 3.0 GENERAL ECOLOGICAL SETTING

### 3.1 General Hydrology

Stream flows on the Illinois Waterway have been found to fluctuate significantly due not only to seasonal effects but to man's regulatory activities through Lake Michigan diversion and the lock-and-dam system. For example, on September 20, 1971, flows in the Dresden Pool dropped from about 17,000 on the preceding day to 2400 cfs.

The discharge record nearest the LaSalle site on the Illinois River is at Marseilles, at river mile 246.6, about 3 river miles below the site (Table 3.1). The gaging station at Marseilles is in the Starved Rock pool, which extends from river mile 231.0 to 247.0. The flow and river stage data at this location, during a period from October 1919 through September 1971 are as follows:

| | (cubic feet per sec.) | Surface elevation (feet, MSL) |
|---|---|---|
| Normal | 8,000 | 459.00 |
| Average (52 years) | 10,630 | -- |
| Maximum (July 14, 1957) | 93,900 | 478.11 |
| Minimum (October 16, 1943) | 1,460 | -- |

At a given point in time, the flow recorded at this gaging station very closely represents the flow that passed the proposed LaSalle Station site the day before. There is no gage on the Illinois River above the La Salle site. However, most of the rivers which flow into the Illinois River are gaged.

## Table 3.1

# Discharge Record, Illinois River at Marseilles for 1971 Water Year(a)

ILLINOIS RIVER BASIN

05543500 Illinois River at Marseilles, Ill.

LOCATION.--Lat 41°19'40", long 88°43'10", in SE¼SW¼ sec.13, T.33 N., R.4 E., La Salle County, on right bank 0.4 mile downstream from dam in Marseilles, 6.9 miles upstream from Fox River, and at mile 246.6.

DRAINAGE AREA.--7,640 sq mi, approximately.

PERIOD OF RECORD.--October 1919 to current year.

GAGE.--Water-stage recorder. Datum of gage is 462.91 ft above mean sea level. October 1919 to January 1935, nonrecording gage at site at Morris, 16.6 miles upstream, at datum 478.5 ft above mean sea level. January 1935 to September 1939, water-stage recorder at site 300 ft downstream from site used 1919-35 and at that datum.

AVERAGE DISCHARGE.--52 years, 10,630 cfs.

EXTREMES.--Current year: Maximum discharge, 27,100 cfs Mar. 16 (gage height, 6.14 ft); minimum daily, 3,050 cfs Jan. 31.
Period of record: Maximum discharge, 93,900 cfs July 14, 1957 (gage height, 15.20 ft); minimum daily, 1,460 cfs Oct. 16, 1943.
A stage of 26.2 ft at Morris occurred in 1831, and a stage of 25.4 ft (ice jam) occurred at present site on Jan. 21, 1916.

REMARKS.--Records good except those for winter periods, which are poor. Figures of daily discharge include flow through navigation locks. Flow regulated by powerplants and navigation dam above station. Since Jan. 17, 1900, flow has included diversion from Lake Michigan through Chicago Sanitary and Ship Canal (see Station No. 05537000).

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13,100 | 10,800 | 8,300 | 4,680 | 4,430 | 16,500 | 9,130 | 6,500 | 6,250 | 4,980 | 8,360 | 7,910 |
| 2 | 11,100 | 10,500 | 8,890 | 5,760 | 5,230 | 14,300 | 8,180 | 5,590 | 5,710 | 5,730 | 8,310 | 7,940 |
| 3 | 9,640 | 12,000 | 8,380 | 5,700 | 4,590 | 12,400 | 8,900 | 4,140 | 4,890 | 6,850 | 8,100 | 7,810 |
| 4 | 9,170 | 11,000 | 8,950 | 5,180 | 6,030 | 11,000 | 8,930 | 5,320 | 5,660 | 6,490 | 8,020 | 8,000 |
| 5 | 9,160 | 11,200 | 6,830 | 5,170 | 14,500 | 9,630 | 9,260 | 6,000 | 4,540 | 12,200 | 8,100 | 9,000 |
| 6 | 9,040 | 12,400 | 8,460 | 4,540 | 10,500 | 10,300 | 8,700 | 10,400 | 6,100 | 8,070 | 7,910 | 10,100 |
| 7 | 9,550 | 10,100 | 6,480 | 4,950 | 9,500 | 9,950 | 7,700 | 8,150 | 7,160 | 7,430 | 7,690 | 8,410 |
| 8 | 8,820 | 9,960 | 6,550 | 6,590 | 9,000 | 8,480 | 8,940 | 7,190 | 5,010 | 9,870 | 8,010 | 7,510 |
| 9 | 8,880 | 11,100 | 6,420 | 5,230 | 9,500 | 8,460 | 7,030 | 7,740 | 4,830 | 8,270 | 7,890 | 7,200 |
| 10 | 7,610 | 11,900 | 7,460 | 4,470 | 11,100 | 8,030 | 7,570 | 7,110 | 5,410 | 7,880 | 8,060 | 7,760 |
| 11 | 7,740 | 11,900 | 11,100 | 4,560 | 7,320 | 8,050 | 5,660 | 7,480 | 7,170 | 8,870 | 8,990 | 6,800 |
| 12 | 7,700 | 11,100 | 10,900 | 4,090 | 7,750 | 7,710 | 7,020 | 8,490 | 6,980 | 10,700 | 8,230 | 5,840 |
| 13 | 8,110 | 10,400 | 9,940 | 4,900 | 6,450 | 7,410 | 6,510 | 7,490 | 6,270 | 11,000 | 8,130 | 5,920 |
| 14 | 16,800 | 11,300 | 9,460 | 4,450 | 6,160 | 11,100 | 5,590 | 8,230 | 6,040 | 11,500 | 8,080 | 5,490 |
| 15 | 20,500 | 9,390 | 8,940 | 4,810 | 6,410 | 20,300 | 6,700 | 8,340 | 5,530 | 9,760 | 7,980 | 5,440 |
| 16 | 17,500 | 8,770 | 9,240 | 4,060 | 5,630 | 26,100 | 6,480 | 8,210 | 6,210 | 8,890 | 9,260 | 4,620 |
| 17 | 15,200 | 8,020 | 7,080 | 4,790 | 6,420 | 22,500 | 6,220 | 5,670 | 6,200 | 8,660 | 9,800 | 5,250 |
| 18 | 13,800 | 7,050 | 7,930 | 4,260 | 9,150 | 19,700 | 5,940 | 7,760 | 5,870 | 7,710 | 7,540 | 5,690 |
| 19 | 12,100 | 7,320 | 7,580 | 4,450 | 16,100 | 22,700 | 6,010 | 6,510 | 9,230 | 6,530 | 7,770 | 7,970 |
| 20 | 12,000 | 10,100 | 8,020 | 4,350 | 19,600 | 23,500 | 5,810 | 5,830 | 6,940 | 6,920 | 7,690 | 5,330 |
| 21 | 11,500 | 7,500 | 8,030 | 3,480 | 20,300 | 22,800 | 5,390 | 6,410 | 6,070 | 6,570 | 7,660 | 5,690 |
| 22 | 9,560 | 7,500 | 7,160 | 4,640 | 17,700 | 20,100 | 4,740 | 5,420 | 6,290 | 6,440 | 7,620 | 5,150 |
| 23 | 9,570 | 7,110 | 6,740 | 3,260 | 18,600 | 17,900 | 5,190 | 6,790 | 7,270 | 6,330 | 7,910 | 5,860 |
| 24 | 9,430 | 5,740 | 6,120 | 3,740 | 17,300 | 17,000 | 5,440 | 5,450 | 6,010 | 7,850 | 8,030 | 5,500 |
| 25 | 8,120 | 6,600 | 6,290 | 4,410 | 16,500 | 14,300 | 4,990 | 5,420 | 7,280 | 6,940 | 11,000 | 6,080 |
| 26 | 7,910 | 6,810 | 4,780 | 4,320 | 19,500 | 12,000 | 5,810 | 5,030 | 5,760 | 5,800 | 8,810 | 5,680 |
| 27 | 7,490 | 7,610 | 5,000 | 4,120 | 21,300 | 12,200 | 6,280 | 6,000 | 4,730 | 7,350 | 9,140 | 6,860 |
| 28 | 12,200 | 8,540 | 5,210 | 4,030 | 19,700 | 11,600 | 4,810 | 4,750 | 5,780 | 8,550 | 9,010 | 6,650 |
| 29 | 10,400 | 8,530 | 5,870 | 4,330 | ------ | 10,500 | 5,140 | 4,860 | 5,930 | 8,070 | 8,510 | 7,770 |
| 30 | 11,700 | 8,510 | 5,810 | 3,780 | ------ | 10,200 | 5,660 | 4,880 | 6,400 | 8,480 | 8,100 | 5,560 |
| 31 | 11,700 | ------ | 5,160 | 3,050 | ------ | 10,100 | ------ | 4,360 | ------ | 8,120 | 8,040 | ------ |
| TOTAL | 337,100 | 280,760 | 233,080 | 140,150 | 326,270 | 436,820 | 199,730 | 201,520 | 183,520 | 248,810 | 257,750 | 199,590 |
| MEAN | 10,870 | 9,359 | 7,519 | 4,521 | 11,650 | 14,090 | 6,658 | 6,501 | 6,117 | 8,026 | 8,315 | 6,653 |
| MAX | 20,500 | 12,400 | 11,100 | 6,590 | 21,300 | 26,100 | 9,260 | 10,400 | 9,230 | 12,200 | 11,000 | 10,100 |
| MIN | 7,490 | 5,740 | 4,780 | 3,050 | 4,430 | 7,410 | 4,740 | 4,140 | 4,540 | 4,980 | 7,540 | 4,620 |

CAL YR 1970 TOTAL 4,269,490 MEAN 11,700 MAX 83,200 MIN 2,800
WTR YR 1971 TOTAL 3,045,100 MEAN 8,343 MAX 26,100 MIN 3,050

PEAK DISCHARGE (BASE, 25,000 CFS).--Mar. 16 (1230) 27,100 cfs (6.14 ft).

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(a) Source: U.S. Department of the Interior, Geological Survey, "Water Resources Data for Illinois," 1971, p. 117.

The locations of flow gaging stations in the State of Illinois are shown in Figure 3.1.

The maximum predicted discharge rate at the Marseilles gaging station for a 100-year flood is 106,222 cubic feet per second as calculated by the Gumbel method for flood prediction.

The observed lowest 7-day flow at Marseilles is 3,110 cubic feet per second. The estimated 7-day low flow at Marseilles with a 10-year recurrence interval is 3,480 cubic feet per second. A partial flow-duration curve of the daily flows below 6,000 cubic feet per second for the Illinois River at Marseilles for the 1961 through 1964 water years is shown in Figure 3.2. The basic data for the partial flow-duration curve are given in Table 3.2, which shows that the daily flow at Marseilles during 1961 through 1964 water years exceeded 3,000 cubic feet per second on 98 percent of the days and 4,000 cubic feet per second on 87 percent of the days.

At the point where water is withdrawn for the cooling lake, the Illinois River consists principally of waters from the Kankakee River and the DesPlaines River (approximately 35% and 65%, respectively). About 90% of the Des Plaines River flow, or 60% of the total flow at the withdrawal point, is contributed by the Chicago Sanitary and Ship Canal, which is composed largely of sanitary flows and dilution releases. Flow in the Illinois River is this region is heavily regulated by operation of the lock and dam system. These factors, rather than natural phenomena, largely govern the low flow of the river.

The seasonal distribution of streamflow of the Illinois River at Marseilles, Illinois, for water years 1961 through 1964 is shown in Figure 3.3.

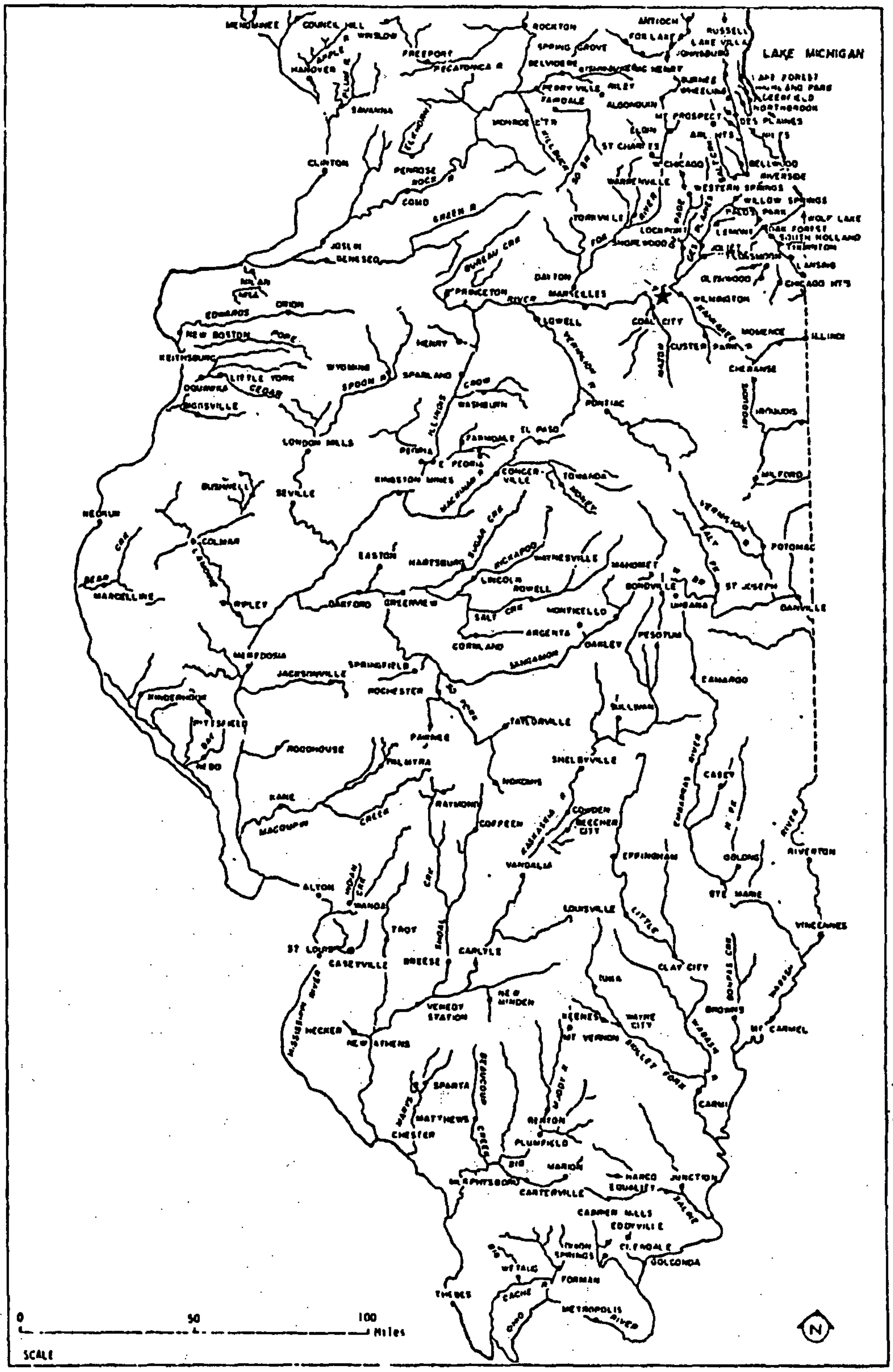


Figure 3.1 Flow gaging stations in Illinois.

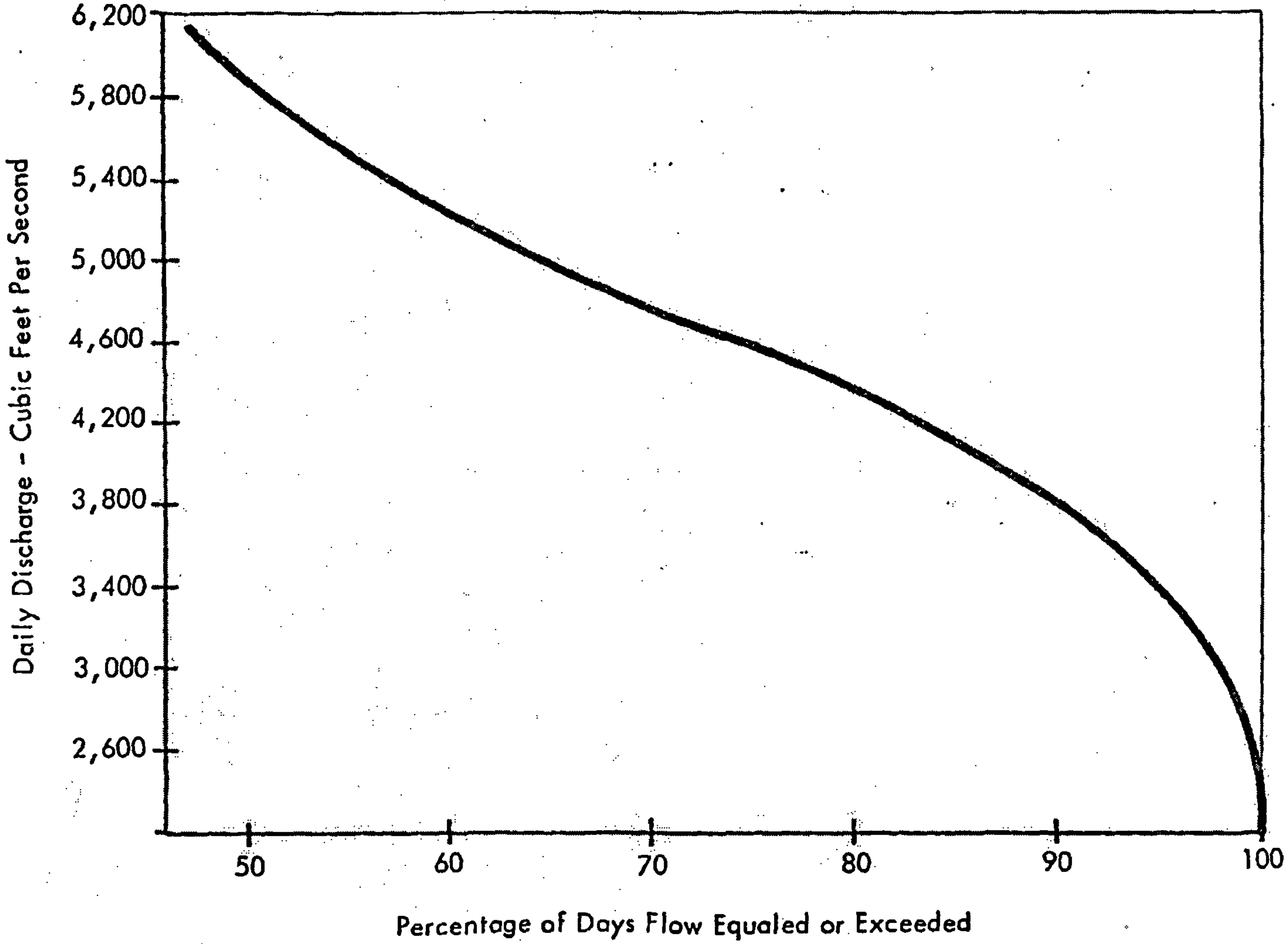


Figure 3.2 Partial flow-duration curve for Illinois River at Marseilles, Illinois, 1961-1964.

Table 3.2

Flow-Duration
Illinois River at Marseilles, Illinois
1961-1964 Water Years

| Daily Discharge (cfs) | Number of Days | Days Equaled or Exceeded (%) |
|---|---|---|
| 2,430-(minimum) | 1 | 100 |
| 2,431-2,600 | 2 | 99.9 |
| 2,601-2,800 | 9 | 99.0 |
| 2,801-3,000 | 17 | 98.0 |
| 3,001-3,200 | 20 | 96.6 |
| 3,201-3,400 | 17 | 95.4 |
| 3,401-3,600 | 27 | 93.4 |
| 3,601-3,800 | 46 | 90.5 |
| 3,801-4,000 | 50 | 87.0 |
| 4,001-4,200 | 51 | 83.6 |
| 4,201-4,400 | 62 | 79.1 |
| 4,401-4,600 | 71 | 74.3 |
| 4,601-4,800 | 79 | 68.9 |
| 4,801-5,000 | 82 | 63.4 |
| 5,001-5,200 | 56 | 59.5 |
| 5,201-5,400 | 40 | 56.8 |
| 5,401-5,600 | 45 | 53.7 |
| 5,601-5,800 | 44 | 50.7 |
| 5,801-6,000 | 33 | 48.4 |

Source: U. S. Geological Survey, "Surface Water Records of Illinois," 1961, 1962, 1963, and 1964.

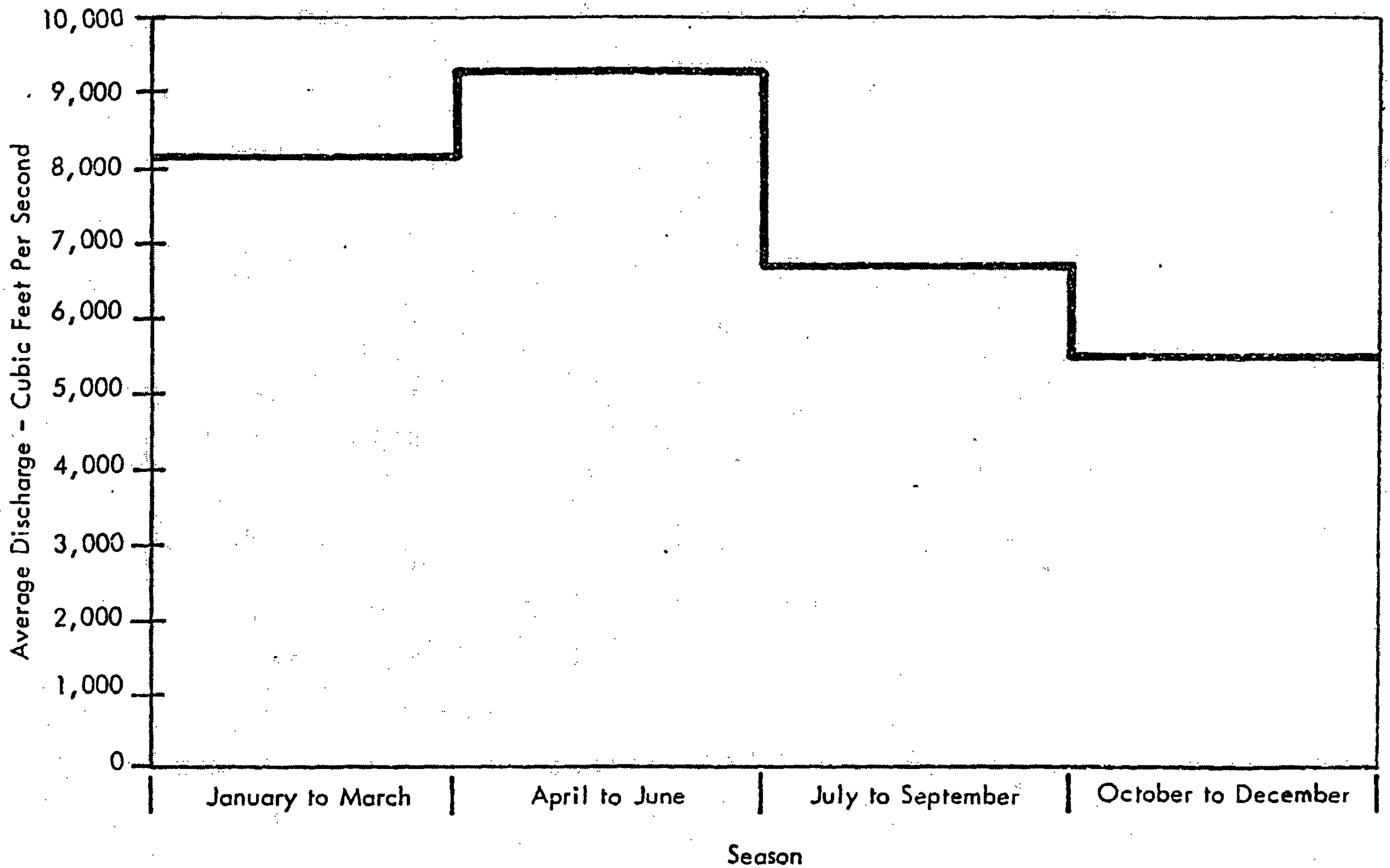


Figure 3.3 Seasonal distribution of streamflow, Illinois River at Marseilles, 1961-1964 water years.

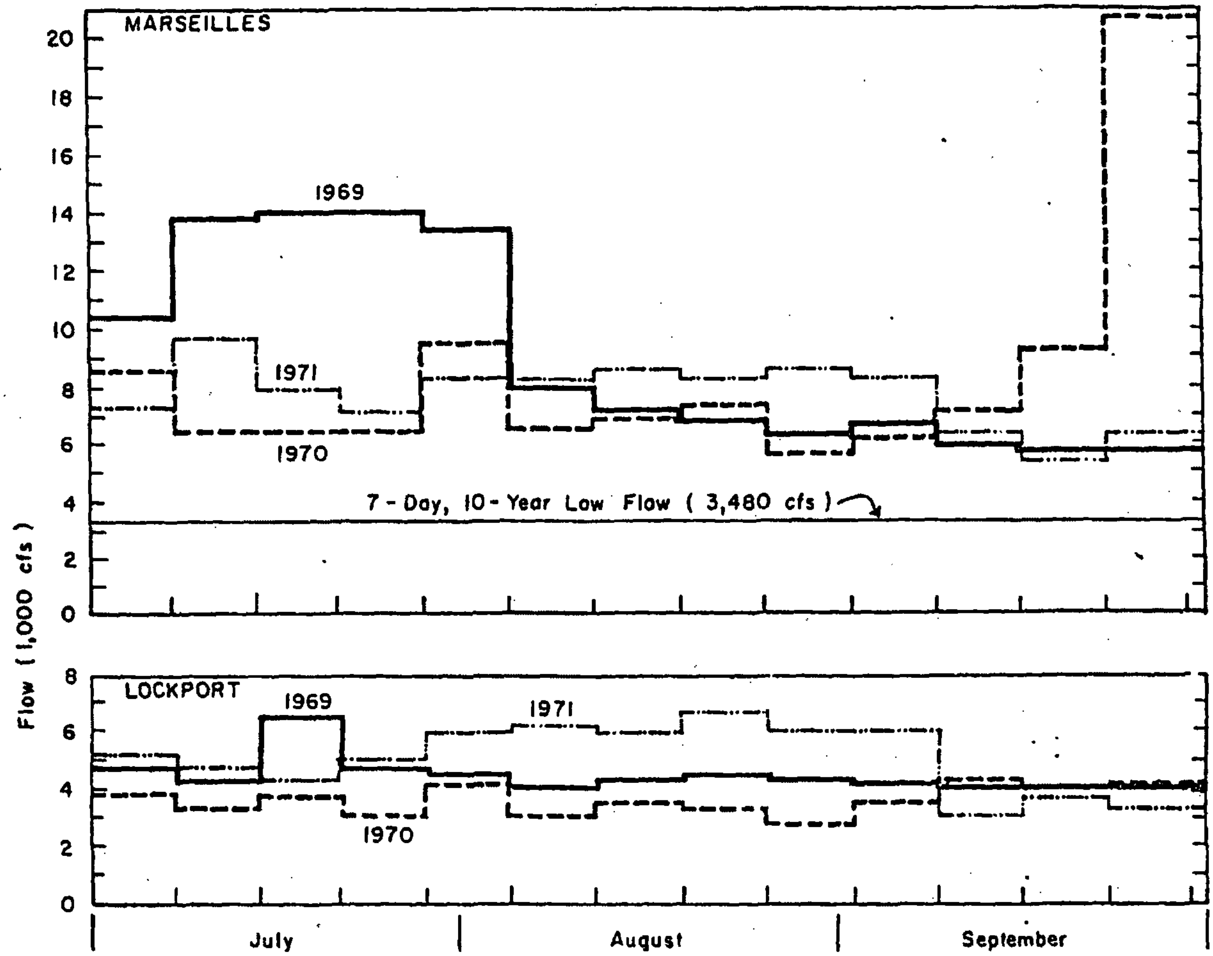


Figure 3.4 Weekly average flow hydrographs, Illinois River at Marseilles, and Chicago Sanitary and Ship Canal at Lockport.

Weekly average streamflows during July, August, and September for 1969, 1970, and 1971 as recorded at Lockport and Marseilles are shown in Figure 3.4.

## 3.2 Water Quality

Physical and chemical parameters were sampled in the Illinois River in 1972 and 1973. See Figure 3.5 for sampling locations.

Water temperatures in the Illinois River exhibited a normal seasonal pattern reflecting climatic changes. The highest temperature (26.0° C) was recorded in August 1972 and the lowest temperature (5.0° C) was observed in January 1973 (see Table 3.3). Temperature profiles in August 1972 at the upstream (A) station, and in October 1972 and January 1973 at Station 8 did not reveal any thermal stratification in this section of the Illinois River.

Dissolved oxygen concentrations also showed normal seasonal variations. The lowest dissolved oxygen value (5.6 mg/liter) was recorded at Station B in August 1972 and the highest (11.3 mg/liter) was observed at Station 8 in Janury 1973 (see Table 3.3). Because oxygen solubility in water decreases with increasing water temperatures, the lowest dissolved oxygen concentrations corresponded with the highest water temperatures recorded in August 1972. The percent oxygen saturation in August (68%), however, indicated that the oxygen in the Illinois River was not controlled entirely by temperature-solubility relationships. The low dissolved oxygen concentration correlated with indicators of organic loading. The highest total organic carbon, chemical oxygen demand, and relative biochemical oxygen demand also occurred in August 1972. Oxygen

# TABLE 3.3

**WATER QUALITY OF THE ILLINOIS RIVER IN THE VICINITY OF THE LSCS**

(All Values Expressed as mg/liter Except as Noted and are an Average of Duplicate Measurements)

| | AUGUST 30, 1972 | | OCTOBER 26, 1972 | | JANUARY 26, 1973 | | WATER QUALITY STANDARDS[a] | |
|---|---|---|---|---|---|---|---|---|
| | UPSTREAM(A) SURFACE | DOWNSTREAM(B) SURFACE | STATION 8 SURFACE | STATION 8 3 M. DEPTH | STATION 8 SURFACE | STATION 8 3 M. DEPTH | GENERAL | PUBLIC WATER SUPPLY |
| Temperature[b] | 26.0 | 26.0 | 12.6 | 12.6 | 5.0 | 5.2 | c | d |
| Dissolved Oxygen (% Saturation) | 6.4(78) | 5.6(68) | 10.3(96) | 10.2(95) | 11.3(88) | 11.3(89) | 5.0 | d |
| pH[b] | 7.7 | 7.7 | 8.45 | 8.05 | 8.14 | 8.11 | 6.5-9.0 | d |
| Total Alkalinity | 156 | 155 | 195 | 195 | 176 | 175 | d | d |
| Specific Conductance[b] | | | 568 | 562 | 682 | 685 | d | d |
| Hardness | 252 | 257 | 307 | 308 | 282 | 283 | d | d |
| Total Dissolved Solids | | | 444 | 422 | 448 | 442 | 1000 | 500 |
| Total Suspended Solids | | | 64 | 72 | 32 | 32 | d | d |
| Turbidity[b] | 66 | 63 | 38 | 41 | 20 | 20 | d | d |
| Total Solids | | | 540 | 542 | 448 | 442 | d | d |
| Calcium | 60 | 62 | 79 | 70 | 31 | 31 | d | d |
| Magnesium | 24.9 | 24.8 | 30 | 30 | 27 | 27 | d | d |
| Potassium | | | 5 | 5 | 4 | 4 | d | d |
| Sodium | 23.1 | 23.1 | 8 | 9 | 27 | 28 | d | d |
| Chloride | 34.5 | 34.5 | 32.0 | 32.5 | 40.8 | 41.8 | 500 | 250 |
| Sulfate | 95 | 84 | 90 | 90 | 90 | 90 | 500 | 250 |
| BOD | 6.4 | 6.1 | 4.5 | 4.6 | 3 | 3 | d | d |
| COD | 40 | 40 | 29.6 | 29.6 | 18.7 | 19.6 | d | d |
| TOC | 22 | 22 | 8.0 | 6.0 | 11 | 9.0 | d | d |
| Organic Nitrogen | | | 1.08 | 1.16 | 0.90 | 0.90 | d | d |
| Ammonia Nitrogen | 0.44 | 0.44 | <0.03 | <0.03 | <0.03 | <0.03 | 1.5 | d |
| Nitrite Nitrogen | 0.12 | 0.12 | 0.076 | 0.082 | 0.057 | 0.061 | d | 10[e] |
| Nitrate Nitrogen | 4.7 | 4.8 | 4.55 | 4.80 | 3.70 | 3.20 | d | 10[e] |
| Orthophosphate, Soluble | 0.22 | 0.22 | 0.31 | 0.30 | 0.212 | 0.212 | d | d |
| Total Phosphate | 0.72 | 0.71 | 0.51 | 0.51 | 0.412 | 0.412 | d | d |
| Phenols | <0.001 | <0.001 | 0.009 | 0.008 | <0.008 | <0.008 | 0.1 | 0.001 |
| Oil and Grease (hexane soluble) | 10 | 7.6 | 3.5 | 3.8 | 13.22 | 4.54 | d | 0.1 |
| Cyanide | | | <0.004 | <0.004 | <0.004 | <0.004 | 0.025 | 0.01 |

[a]Illinois Pollution Control Board Rules and Regulations, Chapter 3, Water Pollution, Effective March 29, 1975, Section 203 General Standards and Section 204 Public and Food Processing Water Supply.

[b]Temperature expressed as °C;
pH expressed as units;
Specific Conductance expressed as µmhos/cm; and
Turbidity expressed as Jackson Turbidity Units (JTU).

[c]The water temperature at representative locations in the river shall not exceed 15.6° C December, January, and February or 32.2° C March through November during more than 1% of the hours in the 12-month period ending with any month. Moreover, at no time shall the water temperature at these locations exceed the above temperatures by more than 1.7° C.

[d]No Illinois Standards established for this parameter.

[e]Nitrite Nitrogen plus Nitrate Nitrogen as N.

profiles taken in conjunction with the temperature profile measurements did not reveal substantial differences in oxygen content as depth increased.

Total dissolved solids (TDS) of natural waters consist mainly of carbonates, bicarbonates, chlorides, sulfates, phosphates, and nitrates of calcium, magnesium, potassium, and sodium, with traces of iron, manganese, and other substances (McKee and Wolf 1963). Specific conductance, which is the measure of the ion concentrations in water, is related to the presence of the dissolved solids in the water. TDS and specific conductance remained fairly constant between October 1972 and January 1973 (see Table 3.3). TDS values in the Illinois River (422 to 448 mg/liter) were well below the general water quality standard (1000 mg/liter) established in Illinois and the recommended criterion of 2000 mg/liter for the safety of fish and aquatic life (McKee and Wolf 1963).

Total suspended solids in natural waters are composed of sand, clay, silt, bacteria, detritus, and algae. Suspended solids cause water to be turbid, reduce light penetration and vision of aquatic animals, interfere with feeding, and may be abrasive to sensitive structures such as the gills of fish (Warren 1971). Suspended solids can come from agricultural runoff, storm sewers, or municipal and industrial wastes. Levels can change rapidly with wind intensity, rainfall, and river level. Concentrations of suspended solids in the Illinois River were relatively high in October 1972 (64 mg/liter) but decreased in January 1973 (32 mg/liter). On both dates these concentrations exceeded the maximum level of 25 mg/liter recommended by the National Academy of

Sciences (1973) for high-level protection of aquatic organisms. High suspended solids in the Illinois River may be attributed to the disturbance of the bottom sediments by barge traffic and to agricultural runoff in the area.

The total organic nitrogen concentrations in the Illinois River did not vary between October 1972 and January 1973 (see Table 3.3). Ammonia concentrations were only detectable in the Illinois River on August 30, 1972, and never exceeded the general water quality standard of 1.5 mg/liter. Nitrate concentrations in the Illinois River ranged from 0.057 to 0.12 mg/liter with the highest levels occurring in August 1972. Nitrate concentrations in the Illinois River ranged from 3.20 to 4.8 mg/liter.

Total phosphorus and soluble orthophosphate concentrations showed little variation during the study period. Total phosphorus in the Illinois River ranged from 0.41 to 0.72 mg/liter while soluble orthophosphate ranged from 0.01 to 0.31 mg/liter. There are ample background concentrations of materials generally recognized as essential plant nutrients, including ammonia, nitrite, nitrate, soluble orthophosphate, and total phosphate in the Illinois River. High nutrient concentrations in the Illinois River are probably the result of runoff from the surrounding farmlands and treated sewage from further upstream.

Concentrations of most trace elements found in the Illinois River were low and fell below the established Illinois River standards. At certain times during the year, however, copper,

iron, manganese, and selenium concentrations exceeded either the general water quality standard or the public water supply standard or both (see Table 3.4). The concentrations of copper (0.036 mg/liter), iron (3.6 mg/liter), and manganese (0.11 mg/liter) were highest in August 1972, but selenium (0.5 mg/liter) reached a peak in October 1972. Iron was the only trace metal that was consistently high. Characteristically the water quality values collected by various investigators indicate marginal water quality. Other physical and chemical characteristics of the Illinois River near the station site are listed in Table 3.3

The navigability of the Illinois River has encouraged siting of petroleum-related industry along its shores. This has led to oil pollution of the river, due primarily to accidental spills during transfer operations. Information provided by the Illinois District Office of the U.S. Environmental Protection Agency indicated that the soluble oil content of the river near Morris is usually less than 10 mg/l. This is less than the 15 mg/l maximum set by the state for restricted-use waters, but in some cases may be more than the 0.1 mg/l maximum concentration allowed for public and food-processing water supplies. The U.S. Coast Guard, Chicago area office, has estimated that presently about one to two incidents of oil spills (defined as any visible oil) occur per year in the Illinois River near Morris.

## TABLE 3.4

**TRACE METALS IN WATER SAMPLES COLLECTED FROM THE ILLINOIS RIVER IN THE VICINITY OF THE LSCS**

(All Values Expressed as mg/liter and are an Average of Duplicate Measurements)

| | AUGUST 30, 1972 | | OCTOBER 26, 1972 | | JANUARY 26, 1973 | | WATER QUALITY STANDARD[a] | |
|---|---|---|---|---|---|---|---|---|
| | UPSTREAM (A) SURFACE | DOWNSTREAM (B) SURFACE | STATION 8 SURFACE | STATION 8 3M. DEPTH | STATION 8 SURFACE | STATION 8 3M. DEPTH | GENERAL | PUBLIC WATER SUPPLY |
| Aluminum | | | 0.2 | 0.2 | 0.7 | 0.8 | b | b |
| Antimony | | | <0.05 | <0.05 | 0.02 | 0.01 | b | b |
| Arsenic | 0.005 | 0.004 | 0.003 | 0.002 | 0.008 | 0.004 | 1.0 | 0.01 |
| Barium | 0.1 | 0.1 | 0.1 | 0.1 | 0.07 | 0.1 | 5.0 | 1.0 |
| Beryllium | | | <0.01 | <0.01 | 0.001 | 0.001 | b | b |
| Boron | | | 0.2 | 0.2 | <0.2 | <0.2 | 1.0 | b |
| Cadmium | 0.0034 | 0.0032 | <0.01 | <0.01 | <0.01 | <0.01 | 0.05 | 0.01 |
| Chromium, Hexavalent | <0.001 | <0.001 | - | - | - | - | 0.05 | b |
| Chromium, Total | <0.001 | <0.001 | <0.02 | <0.02 | 0.01 | 0.01 | 1.0 | b |
| Cobalt | | | <0.01 | <0.01 | 0.02 | 0.02 | b | b |
| Copper | 0.036[c] | 0.034[c] | 0.01 | 0.02 | <0.01 | <0.01 | 0.02 | b |
| Iron | 3.6[cd] | 3.2[cd] | 0.8[cd] | 1.1[cd] | 1.0[d] | 0.9[d] | 1.0 | 0.3 |
| Lead | 0.046 | 0.048 | <0.01 | <0.01 | <0.01 | <0.01 | 0.1 | 0.05 |
| Manganese | 0.11[d] | 0.11[d] | <0.02 | <0.02 | 0.08[d] | 0.08[d] | 1.0 | 0.05 |
| Mercury | | | <0.001[c] | <0.001[c] | <0.0002 | <0.0002 | 0.0005 | b |
| Molybdenum | <0.05 | <0.05 | - | - | - | - | b | b |
| Nickel | | | <0.05 | <0.05 | 0.02 | 0.02 | 1.0 | b |
| Selenium | <0.005 | <0.005 | 0.5[d] | 0.3[d] | 0.2[d] | 0.3[d] | 1.0 | 0.01 |
| Silver | | | <0.01[c] | <0.01[c] | 0.001 | 0.001 | 0.005 | b |
| Strontium | | | 0.2 | 0.2 | 0.4 | 0.5 | b | b |
| Tin | | | <0.05 | <0.05 | <0.05 | <0.05 | b | b |
| Zinc | 0.031 | 0.025 | 0.06 | 0.05 | <0.02 | <0.02 | 1.0 | b |

[a] Illinois Pollution Control Board Rules and Regulations, Chapter 3, Water Pollution; Effective March 20, 1975, Section 203 General Standards and Section 204 Public and Food Processing Water Supply Standards.

[b] No Illinois Standard Established for this Parameter.

[c] Exceeds General Water Quality Standard.

[d] Exceeds Public Water Supply Standard.

## 3.3 Biota of the Illinois River

Phytoplankton populations in the Illinois River at the LSCS site were sampled in August 1972 by NALCO and in October 1972 and January 1973 by Limnetics, Inc. Locations sampled included stations upstream (A) and downstream (B) of the proposed cooling lake discharge (NALCO; see Figure 3.5) and upstream of the site (Station 3).

Phytoplankton density (number of organisms per milliliter) in the August 1972 samples ranged from 1977 cells/ml upstream of the proposed cooling lake discharge to 3124 cells/ml downstream, averaging 2551 cells/ml (see Table 3.5). The phytoplankton community was dominated by diatoms, which made up approximately 90% of the community. Pennate diatoms (species that are generally pseudoplanktonic, or not truly planktonic, and are suspended in the plankton by river flow or turbulence) were somewhat more numerous than centric diatoms (generally euplanktonic, or true plankton). During August 1972, dominant diatom species (a dominant species comprises at least 5% of the total phytoplankton population) included the pennates *Navicula* sp. and *Nitzschia* sp. and the centrics *Cyclotella* sp., *Cyclotella meneghiniana* var. *plana*, and *Stephanodiscus* sp. Members of the Chlorophyta (green algae), Cyanophyta (blue-green algae), and Euglenophyta (euglenoids) were also present in the August 1972 samples.

During October 1972, phytoplankton populations exhibited typical seasonality and declined to 954 cells/ml (see Table 3.5).

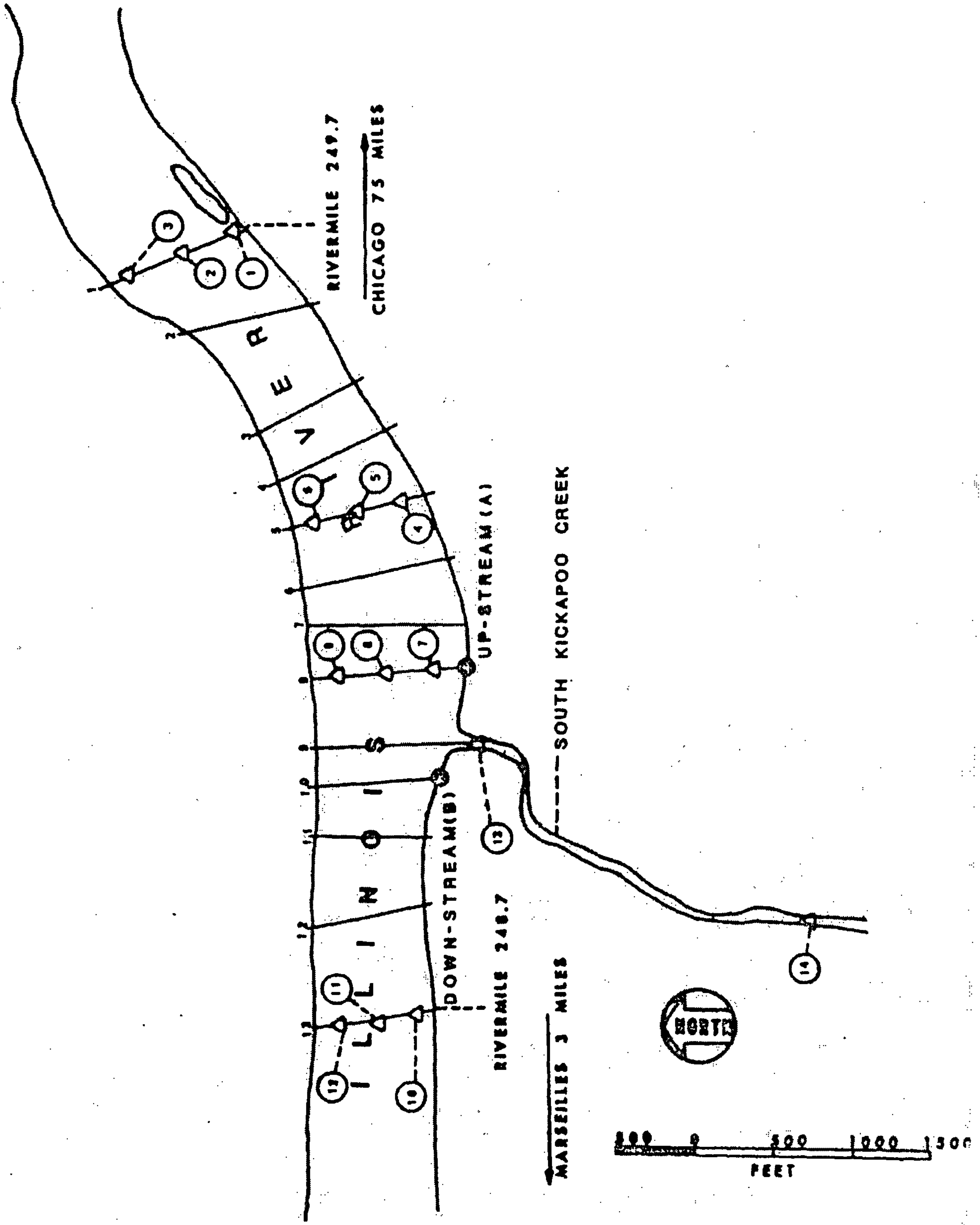


FIGURE 3.5
SAMPLING LOCATIONS FOR
LSCS BASELINE AQUATIC SURVEY

## TABLE 3.5

DENSITY AND RELATIVE ABUNDANCE OF ALGAL DIVISIONS IN ILLINOIS RIVER

## PHYTOPLANKTON SAMPLES

| | ILLINOIS RIVER | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | AUGUST 30, 1972 | | | | OCTOBER 26, 1972 | | JANUARY 26, 1973 | |
| | UPSTREAM (A) | | DOWNSTREAM (B) | | STATION 8 | | STATION 8 | |
| | UNITS/ml | R.A.[a]% | UNITS/ml | R.A.[a]% | UNITS/ml | R.A.[a]% | UNITS/ml | R.A.[a]% |
| Bacillariophyta (Diatoms) | 1761 | 89.07 | 2846 | 91.09 | 699 | 73.27 | 450 | 43.60 |
| Chlorophyta (Green algae) | 142 | 7.18 | 150 | 4.81 | 93 | 9.75 | 30 | 2.91 |
| Cyanophyta (Blue-green algae)[b] | 59 | 2.99 | 105 | 3.36 | 23 | 2.41 | 439 | 42.54 |
| Euglenophyta (Euglenoids) | 15 | 0.76 | 14 | 0.45 | 94 | 9.85 | 0 | 0 |
| Chrysophyta (Golden-yellow algae) | 0 | 0 | 4 | 0.13 | 42 | 4.40 | 113 | 10.95 |
| Pyrrhophyta (Dinoflagellates) | 0 | 0 | 5 | 0.16 | 3 | 0.31 | 0 | 0 |
| TOTAL | 1977 | 100.00 | 3124 | 100.00 | 954 | 99.99 | 1032 | 100.00 |

[a]R.A. = Relative Abundance

[b]Average of non-filamentous and filamentous forms

Diatoms were still dominant (73% of the population), and pennate forms made up the bulk of the population (68%, compared with 5% for the centrics). The pennates Navicula cryptocephala, Navicula sp., and Nitzschia palea were important species. Members of the Chlorophyta and Euglenophyta increased in October 1972 to about 10% each of the phytoplankton community. One species of each group was abundant enough to be considered dominant: the green alga Pyramimonas tetrarhynchus and the euglenoid Trachelomonas volvocina. Members of the Cyanophyta (blue-green algae), Chrysophyta (golden-yellow algae), and Pyrrhophyta (dinoflagellates) were also present.

Atypically, phytoplankton populations increased slightly in January 1973 to 1032 cells/ml. Diatoms decreased in importance relative to earlier months and comprised only 44% of the community. Centric diatoms made up two-thirds of the diatom population. The filamentous blue-green alga Oscillatoria limnetica comprised 41% of the phytoplankton community and was by far the most dominant member of the phytoplankton. The dominance of O. limnetica is not accountable from the data available since blue-green algae generally are dominant only during the warmest parts of the year. Green algae and golden-brown algae were also present, but not abundant.

Many of the dominant genera and species found in the Illinois River near the LSCS site are indicators of eutrophic conditions. Nitzschia and Navicula rank sixth and seventh on Palmer's (1962) list of the 60 most population-tolerant genera, and Cyclotella meneghiniana is listed in Palmer (1969) as one of

the 20 most pollution-tolerant species. The genus *Stephanodiscus* is also associated with eutrophic conditions, as are the large number of non-filamentous green algae species (Hutchinson 1967).

Zooplankton samples were taken from the Illinois River in October 1972 and January 1973. Sampling locations are shown in Figure 3.5. Zooplankton populations in the Illinois River were relatively low during October 1972, totaling only 0.25 organisms per liter. Almost 90% of the zooplankton population were copepods, with *Diaptomus oregonensis* comprising 64% (0.161 organisms per liter) of the total community and immature copepods contributing 25% (see Table 3.6). Three cladocerans and one rotifer species made up the remainder of the zooplankton community, but none was very abundant. Species diversity (H') was 0.2796. Species diversity is a measure of both the number of species (richness) and the number of individuals per species (equitability or evenness). Maximum diversity would occur if individuals were divided equally among all species.

Zooplankton populations increased greatly in January 1973 to 4.1 organisms per liter. Most of this increase was due to rotifers, especially *Bdelloidea*, *Polyarthra*, and *Synchaeta*, which had relative abundances of 29%, 14%, and 19%, respectively. Copepods and cladocerans showed slight population increases. Species diversity increased to 0.8582. Zooplankton population levels and species diversity generally decline during the winter (Hynes 1970). The January increase cannot be explained by the data available.

# TABLE 3.6

## ZOOPLANKTON POPULATION DENSITY AND RELATIVE ABUNDANCE IN THE ILLINOIS RIVER

| SPECIES | ILLINOIS RIVER (Station 8) OCTOBER 26, 1972 Units/l[a] | R.A.[b] (%) | JANUARY 26, 1973 Units/l[a] | R.A.[b] (%) |
|---|---|---|---|---|
| COPEPODA | | | | |
| *Cyclops bicuspidatus thomasi* | | | 0.092 | 2.2 |
| *Diaptomus ashlandi* | | | 0.013 | 0.3 |
| *D. oregonensis* | 0.161 | 64.4 | | |
| *D. sicilis* | | | | |
| *D. siciloides* | | | | |
| Copepodids | | | 0.106 | 2.6 |
| Immature copepods | 0.062 | 24.8 | 0.476 | 11.5 |
| TOTAL | 0.223 | 89.2 | 0.687 | 16.6 |
| CLADOCERA | | | | |
| *Bosmina longirostris* | 0.009 | 3.6 | 0.185 | 4.5 |
| *Bosmina* sp. (immature) | | | 0.013 | 0.3 |
| *Ceriodaphnia quadrangula* | 0.009 | 3.6 | | |
| *Chydorus sphaericus* | 0.003 | 1.2 | | |
| *Daphnia galenta mendotae* | | | 0.079 | 1.9 |
| *D. parvula* | | | 0.013 | 0.3 |
| *Daphnia* sp. (immature) | | | 0.013 | 0.3 |
| TOTAL | 0.021 | 8.4 | 0.303 | 7.3 |
| ROTIFERA | | | | |
| *Asplanchna priodonta* | 0.006 | 2.4 | 0.026 | 0.6 |
| *Bdelloidea* sp. | | | 1.215 | 29.3 |
| *Brachionus calyciflorus* | | | 0.132 | 3.2 |
| *Filinia longisetae* | | | 0.013 | 0.3 |
| *Kellicottia bostoniensis* | | | 0.013 | 0.3 |
| *K. longispina* | | | 0.145 | 3.5 |
| *Keratella cochlearis* | | | 0.092 | 2.2 |
| *K. quadrata* | | | 0.092 | 2.2 |
| *Notholca* sp. | | | 0.079 | 1.9 |
| *Polyarthra* spp. | | | 0.581 | 14.0 |
| *Synchaeta* spp. | | | 0.766 | 18.5 |
| TOTAL | 0.006 | 2.4 | 3.154 | 76.1 |
| TOTAL ZOOPLANKTON | 0.250 | 100.0 | 4.144 | 100.0 |

[a] Mean of duplicate surface and duplicate 3 meter samples.

[b] R.A. = Relative abundance.

[c] Column does not add up exactly due to rounding.

Periphyton samples were collected in the Illinois River from natural substrates on August 30, 1972 (NALCO 1974) and from artificial substrates on January 26, 1973 (Limnetics 1973). Sampling locations are shown in Figure 3.5. During the August 1972 survey, 30 species representing 13 genera of diatoms (Bacillariophyta) comprised approximately 75% of the periphyton community at the upstream sampling location (see Table 3.7). Almost all the diatoms identified were pennate forms. This was expected since periphytic diatoms are predominantly pennate (Hynes 1970). Dominant diatoms, those species with a relative abundance greater than 5%, were Navicula atomus (6.1%), N. cryptocephala (6.7%), Nitzschia amphibia (6.1%), N. fonticola (8.3%), and N. frustulum var. perpusilla (8.3%) (see Table 3.7).

Green algae (Chlorophyta) and blue-green algae (Cyanophyta) were also present in the samples. Stigeoclonium sp. (6.7%) was the only representative of the green algae, while four blue-green algae species, comprising 18.9% of the total community, were identified. Anacystis montana (7.2%) and Lyngbya sp. (5.0%) were the dominant blue-green algae.

Diatoms also dominated the periphyton community at the downstream sampling area in August 1972, comprising 94% of the community. Seventy-three species belonging to 17 diatom genera, mostly pennate, were found. The green algae (0.3%) were represented by one species and the blue-green algae (5.9%) by two species.

## TABLE 3.7

RELATIVE ABUNDANCE OF PERIPHYTIC ALGAL TAXA IN THE ILLINOIS RIVER

| TAXON | AUGUST 30, 1972 UPSTREAM (A) RELATIVE ABUNDANCE (%)[a] | AUGUST 30, 1972 DOWNSTREAM (B) RELATIVE ABUNDANCE (%)[a] | JANUARY 26, 1973 Station 1 RELATIVE ABUNDANCE (%)[b] | JANUARY 26, 1973 Station 7 RELATIVE ABUNDANCE (%)[b] |
|---|---|---|---|---|
| BACILLARIOPHYTA (DIATOMS) | | | | |
| Achnathes exigua | | 0.3 | | |
| A. lanceolata | 2.8 | 0.7 | | |
| A. minutissima | 2.8 | 1.0 | | |
| Amphora ovalis | | 0.3 | | |
| A. ovalis v. pediculus | 2.2 | 1.3 | | |
| A. perpusilla | 0.6 | 0.3 | | |
| Cocconeis diminuta | 0.6 | 0.3 | | |
| C. pediculus | | 1.3 | | 1.92 |
| C. placentula | | 1.6 | | 0.96 |
| Cymbella prostrata | | 0.7 | | |
| C. ventricosa | | 0.7 | | |
| Diatoma anceps | 2.2 | 0.7 | | |
| D. tenue v. elongatum | | 0.3 | | |
| D. vulgare | | 0.3 | | |
| Epithemia sp. | | 0.3 | | |
| Fragilaria crotonesis | | 1.3 | | |
| F. intermedia | | 0.3 | | |
| F. pinnata | 1.7 | 1.3 | | |
| F. vaucheriae | | | 7.84 | |
| F. spp. | 1.1 | 1.0 | | |
| Gomphonema acuminatum v. trigonocephala | | 0.3 | 1.96 | 4.79 |
| G. angustatum | | 0.3 | | |
| G. bohemicum | | 0.3 | | |
| G. lanceolata v. insignis | | 0.3 | | |
| G. olivaceum | 2.8 | 3.0 | | |
| G. parvulum | 2.2 | 2.3 | | |
| Gyrosigma scalproides | | 0.7 | | |
| G. spencerii | | 0.3 | | |
| Melosira binderana | | 0.7 | | |
| M. granulata | | 1.3 | | |
| M. islandica | | 0.7 | | |
| M. varians | 0.6 | 1.3 | | |
| Navicula accomoda | | 1.0 | | |
| N. atomus | 6.1 | 2.3 | | |
| N. canalis | | 1.3 | | |
| N. confervacea | 1.7 | 3.6 | | |
| N. cryptocephala | 6.7 | 4.6 | 17.65 | 15.34 |
| N. cuspidata | | 0.3 | | |
| N. exigua | | | | |
| N. graciloides | 1.1 | 3.3 | | 3.83 |
| N. heufleri | 2.2 | 1.3 | | |
| N. integra | | 0.3 | | |
| N. mutica | | 4.6 | | |
| N. mutica v. stigma | | 2.3 | | |
| N. mutica v. tropica | 2.2 | 1.3 | | |
| N. mutica v. undulata | 0.6 | | | |
| N. notha | | 1.0 | | |
| N. oblongata | | 0.3 | | |
| N. pygmaea | | 0.7 | | |
| N. radiosa | | | 43.14 | 20.14 |
| N. rhynchocephala | | | 3.92 | 1.92 |
| N. tripunctata | 0.6 | 2.0 | 5.88 | 10.54 |
| N. tripunctata v. schizonemoides | | 0.7 | | |
| N. viridula | | 0.7 | | |
| N. vitabunda | 0.6 | 1.3 | | |
| N. zononi | 1.1 | 0.3 | | |
| N. spp. | 3.3 | 4.3 | | |
| Neidium dubium | | 0.3 | | |
| Nitzschia amphibia | 6.1 | 0.7 | | |
| N. angustata | | 1.3 | | |
| N. apiculata | | 1.0 | | |
| N. clausii | | 4.9 | | |
| N. dissipata | | 0.3 | | 16.30 |
| N. filiformis | 1.1 | 3.6 | 1.96 | 4.79 |
| N. fonticola | 8.3 | | | |
| N. frustulum v. perpusilla | 8.3 | 2.0 | | |
| N. hungarica | | 0.7 | | |
| N. incrustans | | 0.3 | | |

[a]Collected from natural substrates.

[b]Collected from artificial sul strate samplers.

## TABLE 3.7 (Cont'd)

| TAXON | AUGUST 30, 1972 UPSTREAM (A) RELATIVE ABUNDANCE (%)[a] | DOWNSTREAM (B) RELATIVE ABUNDANCE (%)[a] | JANUARY 26, 1973 Station 1 RELATIVE ABUNDANCE (%)[b] | Station 7 RELATIVE ABUNDANCE (%)[b] |
|---|---|---|---|---|
| *N. linearis* | | | | 0.96 |
| *N. palea* | | | | 6.71 |
| *N. paradoxa* | | 1.0 | | |
| *N. parvula* | | 1.3 | | |
| *N. recta* | | 0.3 | | |
| *N. tryblionella* | | 1.3 | | |
| *N.* spp. | | | 3.92 | 2.88 |
| *Opephora martyi* | | 0.7 | | |
| *Pinnularia* sp. | 1.1 | | | |
| *Rhoicosphenia curvata* | 2.8 | 2.3 | 7.84 | |
| *Surirella angustata* | | 3.6 | | |
| *S. ovalis* | | | 3.92 | 1.25 |
| *S. ovata* | | 1.6 | | |
| *Synedra acus* | | 0.3 | | |
| *S. ulna* | 0.6 | 2.3 | 1.96 | |
| *S. ulna* v. *oxyrhychus* | | 1.0 | | |
| *Tabellaria flocculosa* | 0.6 | | | |
| Diatom Relative Abundance | 74.7 | 93.8 | 100.0 | 92.33 |
| Number of Diatom Taxa | 30 | 73 | 11 | 14 |
| CHLOROPHYTA (GREEN ALGAE) | | | | |
| *Stigeoclonium* sp. | 6.7 | 0.3 | | |
| Green Algae Relative Abundance | 6.7 | 0.3 | 0 | 0 |
| Number of Green Algae Taxa | 1 | 1 | 0 | 0 |
| CYANOPHYTA (BLUE-GREEN ALGAE) | | | | |
| *Anacystis montana* | 7.2 | | | |
| *Lyngbya aeruginea-caerulea* | 3.9 | 1.0 | | |
| *Lyngbya* sp. | 5.0 | | | |
| *Oscillatoria limosa* | | | | 7.67 |
| *Phormidium tenue* | 2.8 | | | |
| *P. retzii* | | 4.9 | | |
| Blue-green Algae Relative Abundance | 18.9 | 5.9 | 0 | 7.67 |
| Number of Blue-green Algae Taxa | 4 | 2 | 0 | 1 |
| Total Relative Abundance | 100.3 | 100.0 | 100.0 | 100.0 |
| Total Algae Taxa | 35 | 76 | 11 | 15 |

[a]Collected from natural substrates.
[b]Collected from artificial substrate samplers.

The community was highly diverse since no species dominated the samples. Differences in periphyton community structure between upstream and downstream stations may have been due to a variety of factors, including the age of the community, substrate type, current velocity, water quality, and light penetration.

Periphyton samples of January 26, 1973, were taken from artificial periphyton samplers placed in the river on October 26, 1972. Only diatoms were present at Station 1 and all 11 species were pennate forms. Navicula radiosa was the most dominant species, comprising over 43% of the community. Other dominant species were Fragilaria vaucheriae (7.8%), Navicula cryptocephala (17.65%), N. tripunctata (5.88%), and Rhoicosphenia curvata (7.84%).

Diatoms (14 pennate species representing 5 genera) also dominated the periphyton community at Station 7 in January 1973, comprising 92% of the population. Navicula radiosa was again dominant, but exhibited a reduced relative abundance, 20.14%, compared with Station 1 (see Table 3.7). Other dominant diatoms included N. cryptocephala (15.34%), N. Tripunctata (10.54%), Nitzschia dissipata (16.3%), and N. palea. The blue-green algae were represented by one species, Oscillatoria limosa (7.67%).

Periphyton samples from both sampling station in August 1972 and January 1973 were dominated by pennate diatoms chiefly belonging to the genera Navicula and Nitzschia. Green algae and blue-green algae were often present but were rarely dominant. August 1972 samples were characterized by relatively large numbers

of sub-dominant species, forming a diverse periphyton community. In contrast, January 1973 samples were dominated by a few species. This difference in composition and diversity is probably due more to the type of sampling than the season. Differences between stations on the same sampling date are probably due to a variety of factors, including substrate differences between the natural substrates (August 1972 only) and differences such as current velocity, light intensity, and water quality. Natural substrates may support different periphyton species and abundance than artificial substrates (Battelle 1975).

Table 3.8 lists the abundance of benthos collected in August 1972 from two locations in the Illinois River (see Figure 3.5). Pollution-tolerant tubificids were the most common organisms. An average of four organisms per sample is very small. The paucity of benthos from these river locations is probably due to the sandy substrate noted there (NALCO 1974). Sandy substrate is generally rated poor habitat for benthic organisms.

A total of 143 organisms representing 15 genera were collected from 12 locations (see Figure 3.5) on the Illinois River in October 1972. Four genera of Oligochaeta comprised nearly 54% of the total (see Table 3.9). Six genera of dipterans (flies) were collected, mostly from Location 10. Other genera representing mayflies, snails, clams, stoneflies, and flatworms were also collected. The ephemeropteran, Stenonema sp., comprised 15% of the total number of organisms collected during October 1972.

## TABLE 3.8

**NUMBERS OF BENTHIC ORGANISMS COLLECTED FROM THE ILLINOIS RIVER, AUGUST 30, 1972**

| TAXA | UPSTREAM (STATION A) REPLICATES A | B | C | MEAN | RANGE |
|---|---|---|---|---|---|
| Total Benthos | 4 | 3 | 3 | 3.3 | 3-4 |
| Tubificidae | | | | | |
| Immature, without capilliform chaetae | 1 | 1 | 1 | | |
| Immature, with capilliform chaetae | 0 | 1 | 1 | | |
| *Limnodrilus hoffmeisteri* | 1 | 0 | 0 | | |
| *L. cervix* | 1 | 0 | 0 | | |
| *L. udekemianus* | 1 | 1 | 0 | | |
| Nematoda | 0 | 0 | 1 | | |

| TAXA | DOWNSTREAM (STATION B) REPLICATES A | B | C | MEAN | RANGE |
|---|---|---|---|---|---|
| Total Benthos | 8 | 2 | 5 | 5 | 2-8 |
| Tubificidae | | | | | |
| Immature, without capilliform chaetae | 1 | 1 | 4 | | |
| Immature, with capilliform chaetae | 1 | 0 | 0 | | |
| *Limnodrilus cervix* | 0 | 1 | 1 | | |
| *L. udekemianus* | 2 | 0 | 0 | | |
| Chironomidae | | | | | |
| *Dicrotendipes* | 3 | 0 | 0 | | |
| *Orthocladius* | 1 | 0 | 0 | | |

## TABLE 3.9

**NUMBERS OF BENTHIC ORGANISMS COLLECTED FROM**

**12 STATIONS ON THE ILLINOIS RIVER ON OCTOBER 25, 1972**

| TAXA | STATION 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL | RELATIVE ABUNDANCE (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **DIPTERA (Flies)** | | | | | | | | | | | | | | |
| *Atherix variegata* | | | | | | | | | | 2 | | | 2 | 1.40 |
| *Cricotopus* sp. | | | | | | | | | | | | 1 | 1 | .70 |
| *Cryptochironomus* sp. | | | | | | | | | 1 | 1 | | | 2 | 1.40 |
| *Glyptotendipes* sp. | | | | | | | | | 2 | 1 | | | 3 | 2.10 |
| *Pentaneura* sp. | | | | | | | | | | 2 | | | 2 | 1.40 |
| *Polypedilum* sp. | | | | | | | | | | 2 | | | 2 | 1.40 |
| **EPHEMEROPTERA (Mayflies)** | | | | | | | | | | | | | | |
| *Stenonema* sp. | | | 9 | 10 | | 2 | 1 | | | | | | 22 | 15.38 |
| **GASTROPODA (snails)** | | | | | | | | | | | | | | |
| *Ferrissia* sp. | | | 5 | 6 | | 2 | 2 | | | | | | 15 | 10.49 |
| **OLIGOCHAETA (segmented worms)** | | | | | | | | | | | | | | |
| *Aulodrilus* spp. | 5 | | | | | 11 | 2 | | 9 | 6 | | 12 | 45 | 31.47 |
| *Limnodrilus* sp. | 4 | | | | | | 1 | | 3 | 2 | | 4 | 14 | 9.79 |
| *Peloscolex* spp. | | | | | | 5 | 3 | | 3 | | | 3 | 14 | 9.79 |
| *Ilyodrilus* sp. | | | | | | | | | 1 | | | 3 | 4 | 2.80 |
| **PELECYPODS (clams)** | | | | | | | | | | | | | | |
| *Sphaerium* sp. | | | | | | | | | | | | 7 | 7 | 4.90 |
| **PLECOPTERA (Stoneflies)** | | | | | | | | | | | | | | |
| *Isoperla* sp. | | | | | 1 | | | | | | | | 1 | .70 |
| **TURBELLARIA (Flatworms)** | | | | | | | | | | | | | | |
| *Dugesia* sp. | | | 3 | 4 | | | 2 | | | | | | 9 | 6.29 |
| TOTAL | 9 | 0 | 17 | 20 | 1 | 20 | 11 | 0 | 19 | 16 | 0 | 30 | 143 | |

Locations void of organisms during October 1972 included 2, 8, and 11. Location 12 provided more organisms, primarily Oligochaetes, than any other station.

In January 1973, a total of 658 organisms representing 20 genera were collected from the Illinois River stations. Four genera and immature Oligochaeta comprised 91% of the total population density (see Table 3.10). Ten dipteran genera were collected, mostly from Location 3. Other genera of mayflies, beetles, snails, caddisflies, and flatworms were collected in lesser numbers. Locations 2, 5, 6, and 11 were void of organisms in January 1973. More benthic organisms, primarily Aulodrilus spp., were collected from Station 3 than from any other station. Location 12 also had large numbers of Oligochaetes (see Table 3.10).

The benthic organisms in the Illinois River study area were generally confined to the shallow bank areas. Few if any were found in the deeper mid-water channel. During both surveys, a total of only four organisms was found in the mid-channel, one in October 1972 and three in January 1973. The lack of benthos in the mid-channel may have been due to reduced periphyton populations at the deeper mid-channel stations, water current, poor substrate, or scouring of the bottom from barge traffic. Large numbers of Oligochaeta caught at Stations 3 and 12 account for the increased numbers of organisms found along the north bank during the January survey.

Oligochaetes, the most numerous benthic species found in the river during both surveys, were followed in abundance by

## TABLE 3.10

**NUMBERS OF BENTHIC ORGANISMS COLLECTED FROM 12 STATIONS ON THE ILLINOIS RIVER ON JANUARY 24, 1973**

| TAXA | STATION 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | TOTAL | RELATIVE ABUNDANCE (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COLEOPTERA (Beetles) | | | | | | | | | | | | | | |
| *Stenelmis* sp. | | | 1 | | | | | | | | | | 1 | 0.15 |
| DIPTERA (Flies) | | | | | | | | | | | | | | |
| *Atherix variegata* | | | 8 | | | | | | | | | | 8 | 1.22 |
| *Cricitopus* spp. | | | 5 | | | | 1 | | 1 | 1 | | | 8 | 1.22 |
| *Cryptochironomus* spp. | 2 | | 1 | | | | | | | | | | 3 | 0.46 |
| *Diplocladius* sp. | | | 1 | | | | | | | | | | 1 | 0.15 |
| *Orthocladius* spp. | | | 1 | | | | | | | | | | 1 | 0.15 |
| *Pentaneuri* sp. | | | 7 | | | | | | | | | | 7 | 1.06 |
| *Polypedilum* sp. | 1 | | 11 | | | | | | | | | | 12 | 1.82 |
| *Psectocladius* sp. | | | | 1 | | | | | | | | | 1 | 0.15 |
| Unident. Orthocladiinae I | | | 1 | | | | | | | | | | 1 | 0.15 |
| Unident. Orthocladiinae II | | | | | | | | | 2 | 1 | | | 3 | 0.46 |
| EPHEMEROPTERA (Mayflies) | | | | | | | | | | | | | | |
| *Stenonema* sp. | | | 1 | 1 | | | | | 2 | 1 | | | 5 | 0.76 |
| GASTROPODA (Snails) | | | | | | | | | | | | | | |
| *Ferrissia* sp. | | | 1 | 1 | | | | | 2 | | | | 4 | 0.61 |
| OLIGOCHAETA (segmented worms) | | | | | | | | | | | | | | |
| *Aulodrilus* spp. | 4 | | 299 | | | | 1 | | 2 | | | 27 | 333 | 50.67 |
| *Ilyodrilus* spp. | | | | | | | 2 | | 1 | | | | 3 | 0.46 |
| *Limnodrilus* spp. | 17 | | | | | | 9 | 1 | 2 | | | 144 | 173 | 26.23 |
| *Potamothrix* sp. | | | | | | | | 2 | | | | | 2 | 0.30 |
| Immature w/o capilliform chaeta | 5 | | 35 | | | | 2 | | | | | 46 | 88 | 13.37 |
| TRICHOPTERA (Caddisflies) | | | | | | | | | | | | | | |
| *Hydropsyche* sp. | | | | | | | | | | 1 | | | 1 | 0.15 |
| TURBELLARIA (Flatworm) | | | | | | | | | | | | | | |
| *Dugesia* sp. | | | | 1 | | | | | 1 | | | 1 | 3 | 0.46 |
| TOTAL | 29 | 0 | 372 | 4 | 0 | 0 | 15 | 3 | 13 | 4 | 0 | 218 | 658 | |

chironomids. These findings compare well with the data presented in Mills et. al. (1966). Oligochaetes are common in mud and debris of streams, lakes, ponds, and stagnant pools. They feed on bottom mud, detritus, and algae. Aulodrilus spp. and Limnodrilus spp., the two most commonly found oligochaetes, were located mainly at the stations where mud and silt comprised a large portion of the substrate.

Chironomids or midges (Diptera) occur in all freshwater aquatic environments. They can vary in numbers from solitary organisms to over 50,000 individuals per square meter (Pennak 1953). Midge larvae are one of the most important food items for both young and adult fishes. Starrett and Paloumpis (unpublished) have found that midge larvae were more abundant in fish stomachs than in their benthic collections (Mills et al. 1966).

Mills et al. have described the general biological characteristics of the Illinois River in 1966 and noted the decline of diversity in benthic organisms compared to earlier reports. Populations in 1965 were predominantly tubificid worms. Below Beardstown (in the Alton Pool) mayfly nymphs (Hexagenia) and fingernail clams (Sphaeriidae) were noted, but here also tubificid worms were abundant. A once-flourishing population of 38 kinds of mussels reported in the upper Illinois River from 1870 to 1900 has been virtually eliminated by pollution. Dredging of the channel to maintain navigability for barge traffic, and high turbidity contribute to prevent establishment of a more stable benthic community.

## 4.0 FISHERY INFORMATION

### 4.1 Historical Changes in the Fish Populations of the Illinois River

Historical accounts indicate that, prior to 1871, the Illinois River was highly productive of fish especially in the middle and lower sections of the river below Hennepin (river mile 208). These sections were and still are the most productive because, below Hennepin, the Illinois River follows a large valley within which it has developed lateral levee lakes, side channels, backwaters, and marshes which provide excellent habitat for fish.

In 1871, the flow of the Chicago River was reversed in order to conduct sanitary wastes from the city of Chicago away from Lake Michigan, which served as the drinking water supply for the city. The polluted waters of the Chicago River were directed through the Illinois-Michigan Canal, which was completed in 1848, into the Des Plaines River and utimately into the Illinois. The effect of the polluted water on the fishes of the Kankakee and Illinois Rivers was dramatic, causing large and extensive fish kills (Nelson 1878).

The carp, Cyprinus carpio, was introduced into the Illinois River in 1885, from an European stock which had been brought into the United States a few years earlier. The carp population increased extremely rapidly. From 1894 to 1897, the yield of native fishes dropped 22.2 percent, attesting to the importance of carp (Forbes and Richardson 1919) By 1898, the carp catch exceeded the value of all other commercial fish from the Illinois River (Thompson 1928).

In 1900 the Sanitary and Ship Canal was opened at Chicago, connecting the Des Plaines and Illinois Rivers with Lake Michigan. The canal was used to flush municipal and industrial wastes into the Illinois River system. The quantity and quality of this diverted water had a large impact on the Illinois River. There was an average rise in water levels at Havana of 2.8 feet, and during the normal low flow period between June and September the rise was 3.6 feet (Forbes and Richardson 1919). As a result the tree line along the river retreated leaving zones of dead trees bordering the river. The last of these trees collapsed in the 1940's.

Initially the diversion had one beneficial effect by increasing the surface area of water in lakes and backwaters which apparently improved the fishery. After approximately 1910, however, as the pollution load increased, critically low dissolved oxygen levels occuppied farther and farther downstream with detrimental effects on food organisms and fish (Richardson 1921).

Another major impact on the Illinois River was the leveeing and draining of bottomland areas, primarily in the period 1903-1926. The reduction in backwater areas and bottomland lakes resulted in a reduction of wildlife and fish habitat.

In the 1930's high navigation dams were constructed at Dresden, Marseilles, Starved Rock and La Grange. The navigation dams temporarily increase dissolved oxygen levels as the water passes over and through the dams (Mills, Starrett and Bellrose 1966). Starrett (1971) indicated that the reduction of water diversion from Lake Michigan (in 1938 the U.S. Supreme Court

limited the amount of water that could be diverted from Lake Michigan to a yearly average of 42.48 $m^3$/sec.) coupled with the higher dams on the river have resulted in a decrease of average current velocity. Pools behind navigation dams on the upper river have filled with oxygen demanding sediment (Butts 1974).

Starrett (1971) felt that the increase in sluggishness of the river and the increased planting of row crops in the Illinois basin have made siltation in the last 30 years an important factor adversely affecting the survival of mussels and other organisms in the Illinois River and its bottomland lakes. So it physically removes habitat by filling in areas.

The increased barge traffic (Starrett 1972) associated with the improved navigation channel increases the turbidity of the river. The turbulence produced in mid channel, as well as the washing action along shore, resuspends sediment, thereby increasing the turbidity. The washing action along the shore may have a detrimental effect on benthic organisms and fishes that make nests in shallow water, such as sunfishes. Sparks and Starrett (1975) indicate that turbidity levels in bottomland lakes and backwaters along the Illinois River are within the ranges that reduce fish production. Buck (1956) found that the decline in production in turbid ponds resulted from a decline in both reproduction and growth.

Starrett (1972) reported that during the past 100 years, 121 species of fish have been collected from the Illinois River and its many bottomland lakes. Between 1957 and 1970, 101 species are known to have been collected from these waters, and 20 species are presumed to have been eliminated from 1908 to

1970. One exotic species, the goldfish (Carassius auratus), was not present in the Illinois River prior to 1908 (Lopinot 1968). In 1894, the total commercial catch in the Illinois River was less than 6 million pounds; the total catch in 1908 was about 24 million pounds (Mills, Starrett and Belrose 1966). The over-stimulated commercial fishing industry and the detrimental aspects of carp behavior placed stress on the native fish populations. Increased industrial and municipal pollution, drainage of many bottomland lakes, increased sedimentation and increased turbidity also contributed to the decline of the native fishery.

Although catfish seem to benefit from turbid waters because it provides protection from predators most game species are detrimentally affected by these conditions. Sunfishes prefer to construct nests on firm substrates rather than mud. Their eggs and fry are probably more susceptible to smothering by sediment than those of catfish and rough fish. The disappearance of yellow perch from the Illinois River and its bottomland lakes is probably also associated with the disappearance of the plant beds and clean sandy or pebbly bottoms the perch use for spawning.

In 1964, carp was the only species that occurred abundantly throughout the river (Mills et al 1966). Despite its relative tolerance for pollution, carp in the Illinois River, particularly upstream of Beardstown, exhibit length-depth ratios greater than three, malformed heads and gill covers and fin rot (Mills et al 1966). Disappearance of fingernail clams and low dissolved oxygen are the factors suggested (Mills et al 1966) to explain the small size of carp in the middle and upper Illinois River.

The once abundant growth of aquatic plants along the Illinois River and its lakes has all but disappeared (Illinois Water Survey 1972). Increased turbidity and rising water levels combined with unknown factors have contributed to the eradication of this vegetation, which is important as food for certain waterfowl and as a habitat for fish.

Forbes and Richardson (1913) reported the status of the entire Illinois River fishery for 1911 and 1912. No fish were present at the Des Plaines River mouth. In the Morris-to-Marseilles section, a few fish were present in the vicinity of tributary stream mouths during cooler seasons; however, in summer, all fish appeared to move up tributaries. Below the Marseilles Dam, in the Peoria pool, small populations of carp, bullhead, and shiners were found. Gizzard shad, redhorse, carp, bullhead, and bass were collected slightly downstream in the Ottawa-Starved Rock area. Food organisms, such as mussels and macrocrustaceans, were also found. The diversity of fish food organisms increased downstream to Spring Valley. Moving farther downstream in the Peoria pool, from Hennepin to Henry, suckers, crappie, warmouth, and bluegill were collected, but large catfish and buffalo were lower in numbers than upstream.

Low flows from 1962 to 1964 and consequent low oxygen levels and reduced dilution of toxic wastes, apparently are responsible for the decline during the same period of game species such largemouth bass, crappies, and bluegill. Catches of these species showed recoveries following the high-water period 1971-1973. In 14 years of electrofishing, covering the period 1959-1974, the largest numbers of the following species were obtained

in 1974, following the high-water period; black crappie, white crappie, flathead catfish, white bass, bluegill, bigmouth buffalo and black buffalo (Sparks and Starrett 1975). High water increases the space available for spawning activities of fish that build nests in shallow waters and the amount of protected habitat available for juvenile fish, in shallow, flooded areas and around brush and tree stumps. Higher oxygen levels have occurred in the Illinois River in association with high flows, with beneficial effects on fish and fish food organisms.

In October 1976, the President of the United States signed a bill which will allow a greater diversion of water from Lake Michigan to the Illinois River waterway for a five year period. The exact amount of diversion the Illinois River will receive and the biological effects has not yet been determined.

4.2 Commercial Fishing

The commercial and sport fisheries in the Illinois River have generally declined from levels around the turn of the century (Sparks and Starrett 1975). The decline is attributable to a loss of habitat and increasing pollution. Habitat was lost due to leveeing and draining of bottomland areas in the period 1903-1926 and due to Sedimentation in the remaining areas. Sedimentation has resulted in undesirable habitat modification, as well as habitat reduction.

In spite of the improvement in the electrofishing catch in 1973 and 1974, apparently due to high water levels in 1971-1973, the commercial catch of fish in the Illinois River continued its historic decline in the 1970's. Depending on

whether the Illinois Department of Conservation figures or the National Marine Fisheries Service statistics are used, the catch fell under 1 million pounds in 1971 or 1972 (Sparks and Starrett 1975) and has remained below 1 million pounds through 1975 (Table 4.1).

Since 1950, carp, buffalo and catfish have comprised the majority of the commercial fish catch from the Illinois Waterway (Sparks and Starrett 1975). Carp and buffalo species accounted for 82.9% of the commercial catch for the four year period, 1972 through 1975 (87.4, 82.5, 82.4 and 79.2 respectively) while catfish species comparison 10.2% of the catch during the same period (8.3, 11.3, 9.4 and 11.6 respectively). Carp and buffalo are rough fish with the majority of the catch being used in pet food and fertilizer production. The only game fish commercial fishermen seem to be actively seeking is catfish.

The number of commercial fishermen utilizing the Illinois River has decreased in the last twenty-five years (Table 4.2 ). In 1950 there were 106 full-time fishermen and 169 part-time fishermen while in 1975 there was only 1 full-time fisherman and 34 part-time fishermen.

Table 4.1 - Reported catch in pounds of fish taken from Illinois River by Illinois commercial fishermen in 1972-1975, as reported by the Illinois Department of Conservation

| | Illinois River | | | |
|---|---|---|---|---|
| Kind of Fish | 1972 | 1973 | 1974 | 1975 |
| Carp | 310,780 | 212,953 | 263,164 | 214,196 |
| Buffalo | 260,312 | 117,828 | 207,764 | 161,149 |
| Drum | 16,910 | 7,239 | 4,929 | 13,601 |
| Catfish | 54,261 | 45,429 | 53,675 | 54,972 |
| Bullheads | 6,620 | 15,113 | 25,036 | 14,358 |
| Sturgeon | -- | 100 | -- | 20 |
| Paddlefish | 3,123 | 807 | 16,365 | 3,438 |
| White Carp | 600 | 600 | 190 | 5,550 |
| Suckers | -- | 200 | -- | 1,020 |
| Gars | -- | -- | -- | 3,240 |
| Bowfin | 600 | 500 | -- | 2,100 |
| Mooneye (a) | -- | 2 | -- | 100 |
| Eel | -- | -- | 35 | 6 |
| Crappies | -- | -- | -- | -- |
| Y. Perch | -- | -- | -- | -- |
| Grass Carp | (b) | (b) | (b) | 135 |
| TOTAL | 653,206 | 400,771 | 571,158 | 473,885 |

(a) Mooneye also includes Goldeye

(b) Grass Carp not included

Table 4.2 - Reported number of full-time and part-time commercial fishermen actively engaged in Illinois River fishing from 1950 to 1975. (Only those fishermen were included in this or following tables who had purchased tags or licenses for five or more nets.)

| Type of Fisherman | 1950 | 1960 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|---|---|
| Full-time | 106 | 69 | 22 | 9 | 13 | 13 | 15 | 1 |
| Part-time | 169 | 73 | 46 | 47 | 42 | 56 | 38 | 34 |
| TOTAL | 275 | 142 | 68 | 56 | 55 | 69 | 53 | 35 |

## 4.3 Introduction - Methods and Materials of the Preoperational Monitoring Program

The fisheries field and analytical procedures described herewith is part of a five year construction phase aquatic monitoring program that began in 1974. Sampling techniques include electrofishing and seining in the Illinois River with collections being conducted on a quarterly basis during February, May, August and November.

### Electroshocking

Electroshocking is conducted in the Illinois River at Locations 1 and 2 (Figure 4.1). Samples are collected on four consecutive days at each location. The electroshocking device used is a boat-mounted boom shocker powered by a 230 volt, A.C., three phase generator. Sampling is conducted each day for 10 to 20 minutes at two transects, each approximately 600 feet in length and parallel to the shoreline. Surface water temperatures are recorded at each location on each sampling day.

### Seining

Seining is conducted during all four sampling periods at Locations 1 and 2 (Figure 4.1) on four consecutive days during each sampling period. A seine 50 ft. in length and 6 ft. in depth with a 0.25 inch mesh is employed in making two or three hauls at each river location.

### 4.3.1 Data Collection

All fish collected by electroshocking are identified to species, and individual lengths (mm) and weights (g) are recorded

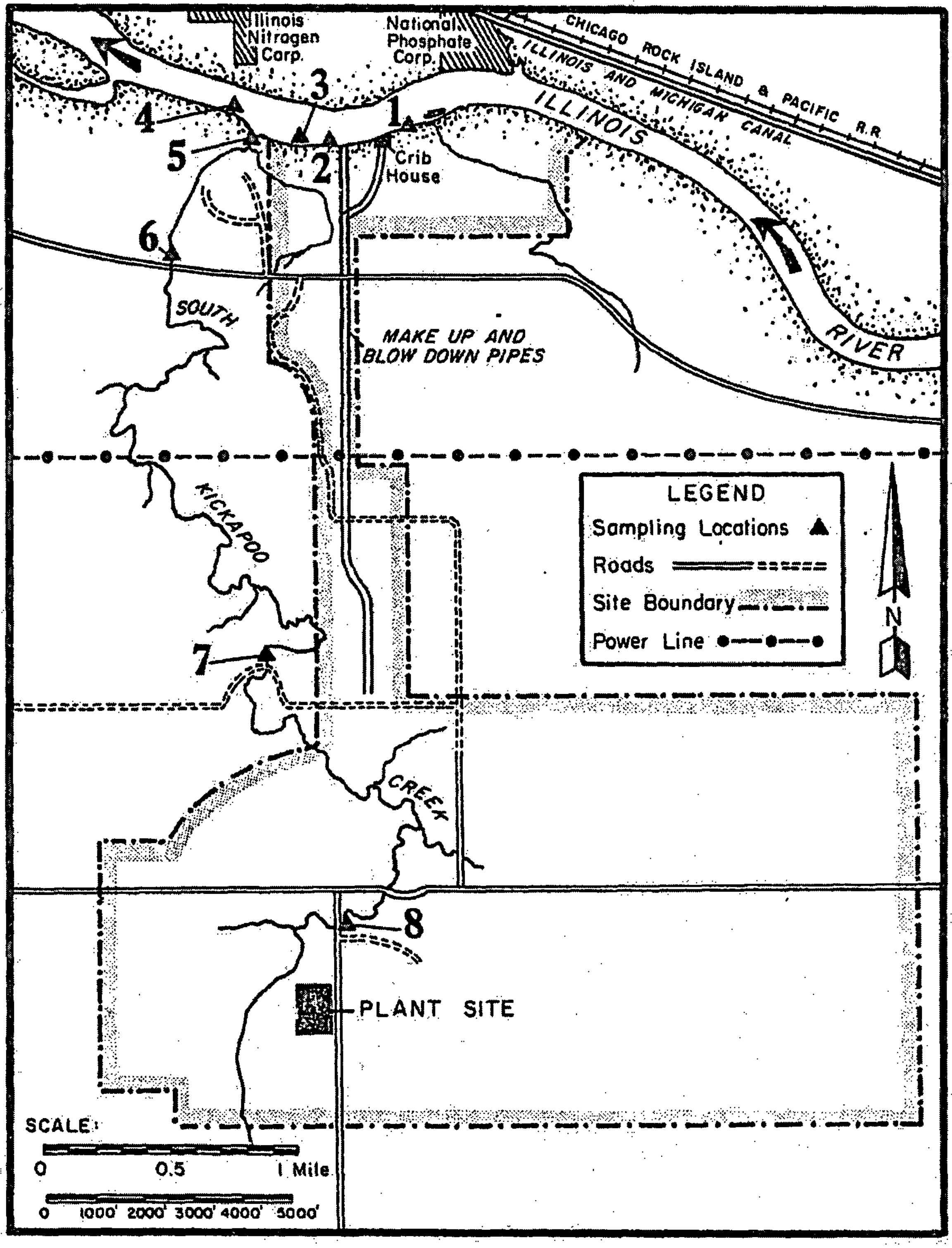


Figure 4.1 Sampling Locations for Fish in the Illinois River near LaSalle County Station.

in the field. Fish obtained by seining at river locations are preserved in formalin, labeled and returned to the laboratory for analysis. A maximum of ten fish of selected species collected on each day by electroshocking and by seining at river Locations 1 and 2, are examined for determination of sex, and the stomachs are excised and preserved for food habit analysis. Gross examination of all fish is made in the field for incidence of external disease, parasitism and physical abnormalities.

### 4.3.2 Data Analysis and Interpretation

Data obtained from electroshocking is reduced to catch-per-unit-of-effort (CPE) for each species. The Student's "t" test (Steel and Torrie 1960) and a 3 x 2 (season x sampling location) factorial analysis of variance (Steel and Torrie 1960) is used to investigate the $H_o$ of no significant difference in the CPE between Locations 1 and 2. Interaction of season with location is also investigated with the factorial analysis. Prior to these statistics, the data are $\log_e$ transformed to stabilize the variances. Scheffe's multiple comparison procedure is used to detect specific differences following analysis of variance.

The Chi-square test (uniformly most powerful unbiased test) (Siegel 1956) is applied to the electroshocking and seining data to test for significant differences in the catches of each species obtained between Locations 1 and 2 during each sampling period. The same test is applied to electroshocking and seining data to test for significant differences in the length distribution of each species between Locations 1 and 2. Length groups are defined using estimated age classes for each species. All hypothesis testing is performed at P 0.05.

Diversity indices are determined for each location during each sampling period using the equation of Brillouin as discussed by Pielou (1966).

K-factors for body condition (an index of plumpness) are determined by species, for each location and sampling gear, using the equation described by Carlander (1969). Data for immature and adult fish are treated separately. The Mann-Whitney U Test (Siegel 1956) is used on the data to test for significant differences in body condition of fishes between each river location.

Age of fishes is determined by length frequency distribution (Peterson method) as discussed by Ricker (1968), and comparison with average growth rates of fish in northeastern Illinois (Muench 1968).

## 4.4 Results and Discussion of the Preoperational Monitoring Program

4.2

Out of a total of 42 species (Table a) collected in 1974 and 1975 at sampling Locations 1 and 2, 29 (2172 individuals) were collected in 1974, and 34 (1716 individuals) were collected in 1975 (Table a). One hybrid sunfish (bluegill x green sunfish) and cyprinid (goldfish x carp) were also collected in the river. Twenty-one species were common to both sampling years.

The most abundant species obtained in the river in order of rank were the emerald shiner, gizzard shad, carp and green sunfish which comprised 49, 23, 10, and 7%, respectively, of the total river catch in 1975 and 79, 7, 8 and 2% respectively of the total river catch in 1974.

Species composition in the river were generally comparable between 1974 and 1975 with slight changes occurring among species of low abundance (Table 4.2). An overall decrease in the total catches was observed at both sampling areas in 1975. The species which demonstrated the greatest decrease in the total river catch was the emerald shiner, whereas the gizzard shad and green sunfish demonstrated substantial increases in the river in 1975.

### Electroshocking

Out of a total of 30 species collected by electroshocking during two years of sampling in the river, 24 were obtained at Location 1 and 25 at Location 2 (Table 4.3). Total CPE (catch-per-unit-of-effort) for 1975 was slightly higher at Location 1 than at Location 2 resulting from the higher catches of gizzard shad and green

Table 4.2

Species composition and abundance of fish collected in the Illinois River near LaSalle County Station, February - November 1975.

| Species | Number 1975 | Number 1974 | Percent of Catch 1975 | Percent of Catch 1974 |
|---|---|---|---|---|
| Illinois River | | | | |
| Emerald shiner | 832 | 1724 | 48.5 | 79.4 |
| Gizzard shad | 398 | 155 | 23.2 | 7.1 |
| Carp | 176 | 168 | 10.3 | 7.7 |
| Green sunfish | 126 | 43 | 7.3 | 2.0 |
| White sucker | 38 | 8 | 2.2 | 0.4 |
| Bluntnose minnow | 28 | 4 | 1.6 | 0.2 |
| Goldfish | 14 | 7 | 0.8 | 0.3 |
| Bigmouth buffalo | 12 | 4 | 0.7 | 0.2 |
| Largemouth bass | 11 | 4 | 0.6 | 0.2 |
| River carpsucker | 10 | 16 | 0.6 | 0.7 |
| Bluegill | 10 | 2 | 0.6 | 0.1 |
| Smallmouth buffalo | 8 | 9 | 0.5 | 0.4 |
| River shiner | 8 | 0 | 0.5 | 0.0 |
| Steelcolor shiner | 6 | 0 | 0.3 | 0.0 |
| Spotfin shiner | 6 | 1 | 0.3 | 0.0 |
| Smallmouth bass | 4 | 3 | 0.2 | 0.1 |
| Bullhead minnow | 3 | 0 | 0.2 | 0.0 |
| Common shiner | 3 | 1 | 0.2 | 0.0 |
| Sand shiner | 3 | 1 | 0.2 | 0.0 |
| Black bullhead | 2 | 3 | 0.1 | 0.1 |
| Quillback | 2 | 1 | 0.1 | 0.0 |
| Grass pickerel | 2 | 1 | 0.1 | 0.0 |
| Skipjack herring | 2 | 2 | 0.1 | 0.1 |
| Spottail shiner | 2 | 0 | 0.1 | 0.0 |
| Rock bass | 1 | 0 | 0.1 | 0.0 |
| White crappie | 1 | 0 | 0.1 | 0.0 |
| Pumpkinseed | 1 | 0 | 0.1 | 0.0 |
| Orangespotted sunfish | 1 | 0 | 0.1 | 0.0 |
| White bass | 1 | 1 | 0.1 | 0.0 |
| Redfin shiner | 1 | 0 | 0.1 | 0.0 |
| Silverjaw minnow | 1 | 0 | 0.1 | 0.0 |
| Red shiner | 1 | 0 | 0.1 | 0.0 |
| Goldfish and carp hybrid | 1 | 0 | 0.1 | 0.0 |
| Bluegill and green sunfish hybrid | 1 | 0 | 0.1 | 0.0 |
| Golden shiner | 0 | 4 | 0.0 | 0.2 |
| Shorthead redhorse | 0 | 2 | 0.0 | 0.1 |
| Fathead minnow | 0 | 2 | 0.0 | 0.1 |
| Suckermouth minnow | 0 | 2 | 0.0 | 0.1 |
| Black crappie | 0 | 1 | 0.0 | 0.0 |
| Longnose gar | 0 | 1 | 0.0 | 0.0 |
| Northern pike | 0 | 1 | 0.0 | 0.0 |
| Silver redhorse | 0 | 1 | 0.0 | 0.0 |
| Total | 1716 | 2172 | | |

Table 4.3

Number and catch-per-unit-of-effort (fish collected per hour of electroshocking) of each species at Locations 1 and 2 near the LaSalle County Station, May - November 1974 and 1975.[a]

| | Location 1 | | | | Location 2 | | | |
|---|---|---|---|---|---|---|---|---|
| | Number | | CPE | | Number | | CPE | |
| Species | 1975 | 1974 | 1975 | 1974 | 1975 | 1974 | 1975 | 1974 |
| Gizzard shad | 241 | 81 | 81.7 | 21.7 | 152 | 52 | 51.5 | 13.7 |
| Carp | 105 | 86 | 35.6 | 25.2 | 70 | 82 | 23.7 | 20.0 |
| Green sunfish | 76 | 15 | 25.8 | 4.1 | 29 | 15 | 9.8 | 3.5 |
| Emerald shiner | 39 | 11 | 13.2 | 2.6 | 56 | 20 | 19.0 | 4.6 |
| White sucker | 5 | 3 | 1.7 | 0.7 | 33 | 5 | 11.2 | 1.2 |
| Bigmouth buffalo | 4 | 0 | 1.4 | 0.0 | 8 | 4 | 2.7 | 1.3 |
| River carpsucker | 5 | 7 | 1.7 | 1.7 | 5 | 9 | 1.7 | 2.4 |
| Goldfish | 5 | 2 | 1.7 | 0.6 | 9 | 5 | 3.1 | 1.1 |
| Smallmouth buffalo | 2 | 1 | 0.7 | 0.2 | 6 | 8 | 2.0 | 1.8 |
| Bluegill | 3 | 0 | 1.0 | 0.0 | 5 | 1 | 1.7 | 0.2 |
| Largemouth bass | 1 | 0 | 0.3 | 0.0 | 4 | 1 | 1.4 | 0.2 |
| Smallmouth bass | 3 | 2 | 1.0 | 0.4 | 0 | 1 | 0.0 | 0.2 |
| Bluntnose minnow | 0 | 1 | 0.0 | 0.2 | 3 | 1 | 1.0 | 0.2 |
| Black bullhead | 2 | 2 | 0.7 | 0.5 | 0 | 1 | 0.0 | 0.2 |
| Quillback | 1 | 0 | 0.3 | 0.0 | 1 | 1 | 0.3 | 0.2 |
| Grass pickerel | 1 | 1 | 0.3 | 0.2 | 1 | 0 | 0.3 | 0.0 |
| Skipjack herring | 0 | 1 | 0.0 | 0.2 | 2 | 1 | 0.7 | 0.2 |
| White bass | 1 | 0 | 0.3 | 0.0 | 0 | 1 | 0.0 | 0.2 |
| Common shiner | 0 | 0 | 0.0 | 0.0 | 1 | 0 | 0.3 | 0.0 |
| Orangespotted sunfish | 0 | 0 | 0.0 | 0.0 | 1 | 0 | 0.3 | 0.0 |
| Pumpkinseed | 1 | 0 | 0.3 | 0.0 | 0 | 0 | 0.0 | 0.0 |
| White crappie | 0 | 0 | 0.0 | 0.0 | 1 | 0 | 0.3 | 0.0 |
| Golden shiner | 0 | 1 | 0.0 | 0.2 | 0 | 1 | 0.0 | 0.2 |
| Shorthead redhorse | 0 | 0 | 0.0 | 0.0 | 0 | 2 | 0.0 | 0.5 |
| Northern pike | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 0.2 |
| Fathead minnow | 0 | 1 | 0.0 | 0.2 | 0 | 0 | 0.0 | 0.0 |
| Silver redhorse | 0 | 1 | 0.0 | 0.2 | 0 | 0 | 0.0 | 0.0 |
| Longnose gar | 0 | 0 | 0.0 | 0.0 | 0 | 1 | 0.0 | 0.3 |
| Bluegill x green sunfish hybrid | 1 | 0 | 0.3 | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Goldfish x carp hybrid | 1 | 0 | 0.3 | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Total Number | 497 | 216 | | | 387 | 213 | | |
| Total CPE | | | 168.3 | 58.9 | | | 131.0 | 52.4 |

[a] Represents the average of three periods (May, August and November).

sunfish at Location 1. During 1974 CPE was generally comparable for each species between River Locations 1 and 2. The highest CPE values were recorded for carp and gizzard shad at both locations. In combination, these two species comprised 70 and 57 percent of the total CPE at Locations 1 and 2, respectively in 1975 and 80 and 64 percent respectively in 1974. Other investigators (Sparks and Starrett 1975, Stinauer 1974) also reported carp and gizzard shad as being the most abundant species collected by electroshocking in the Marseilles Pool of the Illinois River. Sparks and Starrett further noted these two species were abundant in the collections in all pools of the river. As noted by Sparks and Starrett, and as evident during the present study, catch results on gizzard shad underestimate their actual abundance in the river. The average catch-effort for carp as reported by Sparks and Starrett for the Marseilles pool during the period 1959-1974 and during the present site-specific study were similar, whereas gizzard shad catches were noticeably higher during the present study.

The total number of species collected in the river by electroshocking, was similar in 1974 and 1975 (Table 4.3). Total CPE values were substantially higher at both locations in 1975 than in 1974; gizzard shad, green sunfish, and emerald shiners accounted for most of the increase at both locations. A noticeably higher CPE value was noted for carp at Location 1 and white sucker at Location 2 in 1975 than in 1974. The high catches of gizzard shad at both locations in 1975 were mostly represented by young-of-the-year individuals.

Higher CPE values were observed at Locations 1 and 2 in 1975 than in 1974 during each seasonal period (Figure 4.2). The most apparent differences in CPE values between the two years were noted in August. The species showing the greatest increase in CPE at both locations in August was gizzard shad, most of which were young-of-the-year individuals (Table 4.4). Species showing the highest increases in CPE values at both locations in May 1975 were green sunfish and emerald shiner, and carp at Location 1. A noticeably higher CPE value was recorded at Location 2 in November 1975 than during the same period in 1974; gizzard shad accounted for most of the increase.

The generally greater individual and species assemblages observed in the CPE data were reflected in the higher diversity indices recorded for Locations 1 and 2 in 1975 than in 1974 during May and November (Patulski 1975). Lower diversity indices recorded at both locations in August 1975 than in 1974 were attributed to the high percent abundance of gizzard shad in the August catches in 1975 which were not as evident in 1974. As noted by Pielou (1966), the more species there are and the more nearly even the representation, the greater the diversity.

K-factor values calculated for fish obtained at Locations 1 and 2 were generally similar during 1974 and 1975 (Patulski 1975) (Tables 4.5, 4.6, 4.7 and 4.8). Greatest variability between years occurred among species of which only a few individuals were represented, in which case those comparisons were not considered a reliable index of the real differences in body condition which exist.

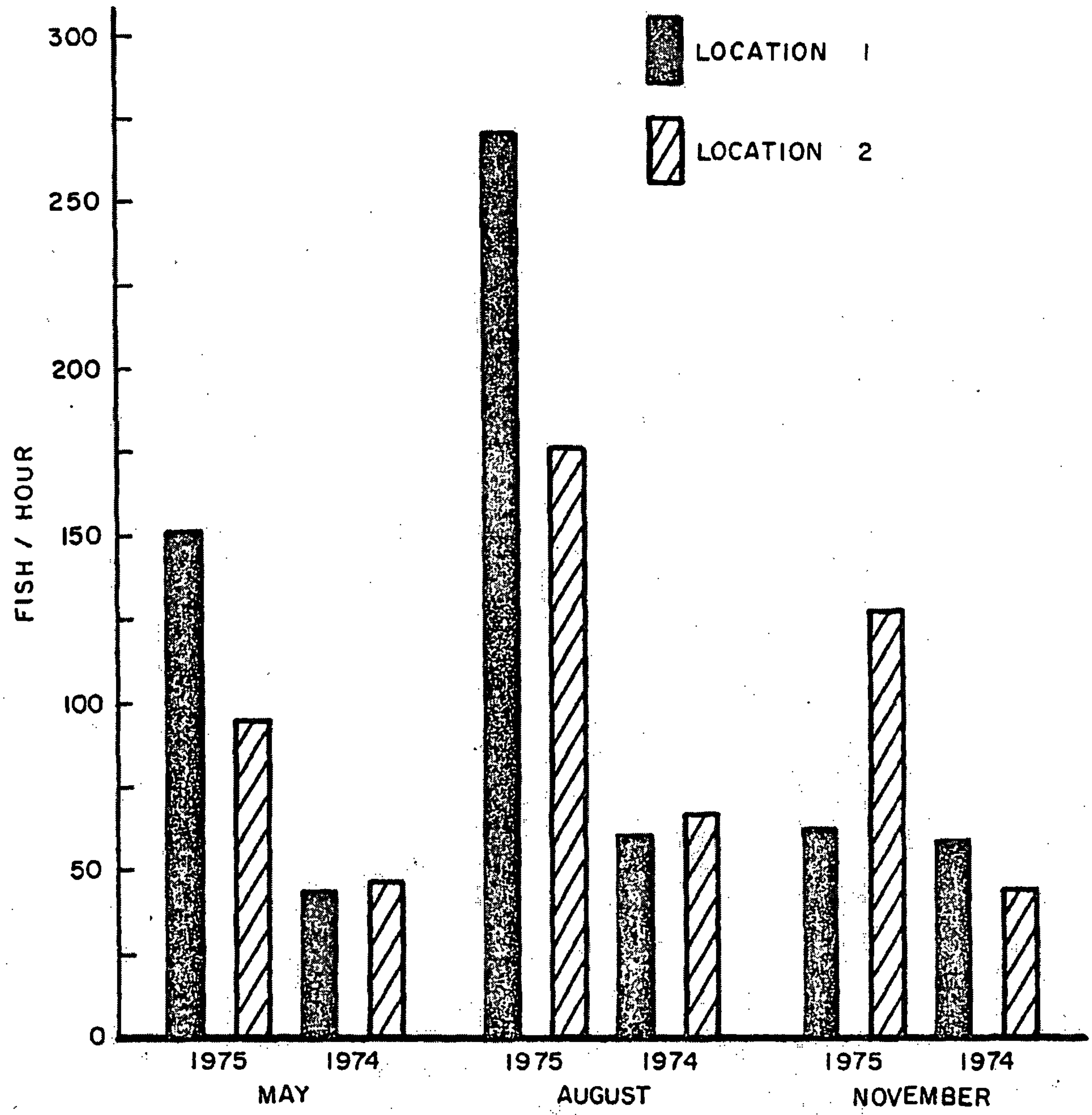


Figure 4.2 Fish collected per hour of electroshocking at Locations 1 and 2 during each sampling period near the LaSalle County Station, 1974 and 1975.

# Table 4.4

Abundance of the most common species of fish collected in the Illinois River during each sampling period near the LaSalle County Station, 1974 and 1975.

| Location | Species | February 1974 | May 1974 | August 1974 | November 1974 | February 1975 | May 1975 | August 1975 | November 1975 |
|---|---|---|---|---|---|---|---|---|---|
| 1 (Electroshock)[a] | Gizzard shad | -[b] | 0.7 | 31.3 | 33.0 | - | 0.9 | 205.0 | 44.7 |
| | Carp | - | 34.7 | 12.0 | 16.0 | - | 70.9 | 19.0 | 3.8 |
| | Green sunfish | - | 0.0 | 5.3 | 7.0 | - | 41.9 | 24.0 | 3.8 |
| | Emerald shiner | - | 4.0 | 2.7 | 1.0 | - | 18.8 | 11.0 | 7.7 |
| | White sucker | - | 1.3 | 0.7 | 0.0 | - | 2.6 | 2.0 | 0.0 |
| | River carpsucker | - | 1.3 | 2.7 | 1.0 | - | 3.4 | 1.0 | 0.0 |
| 1 (Seine) | Emerald shiner | 411 | 26 | 198 | 28 | 143 | 44 | 12 | 37 |
| | Green sunfish | 4 | 1 | 4 | 1 | 5 | 9 | 3 | 0 |
| 2 (Electroshock) | Gizzard shad | - | 3.4 | 18.7 | 19.0 | - | 0.9 | 86.0 | 83.0 |
| | Carp | - | 31.0 | 16.0 | 13.0 | - | 35.9 | 11.0 | 21.7 |
| | Emerald shiner | - | 4.8 | 8.0 | 1.0 | - | 20.5 | 27.0 | 6.4 |
| | Green sunfish | - | 0.7 | 8.7 | 1.0 | - | 18.8 | 2.0 | 6.4 |
| | White sucker | - | 0.7 | 2.0 | 1.0 | - | 2.6 | 30.0 | 0.0 |
| | River carpsucker | - | 0.0 | 3.3 | 4.0 | - | 2.6 | 1.0 | 1.3 |
| 2 (Seine) | Emerald shiner | 624 | 18 | 299 | 89 | 72 | 42 | 221 | 166 |
| | Green sunfish | 1 | 2 | 0 | 0 | 3 | 1 | 0 | 0 |

[a] Values represent the number of fish collected per hour of electroshocking.
[b] Not sampled.

## Table 4.5

**K-factor for body condition of adult and juvenile fish by sex, collected by electroshocking at Locations 1 and 2 near the LaSalle County Station, 10-13 November 1975.**

| Species | Number | Maturity | Sex | Mean K-factor |
|---|---|---|---|---|
| Location 1 | | | | |
| Carp | 2 | Adult | Male | 1.51 |
| | 1 | Adult | Female | 1.39 |
| Gizzard shad | 10 | Adult | -[a] | 1.07 |
| | 25 | Juvenile | - | 1.12 |
| Green sunfish | 2 | Adult | Female | 2.56 |
| Location 2 | | | | |
| Carp | 11 | Adult | Male | 1.38 |
| | 6 | Adult | Female | 1.47 |
| Gizzard shad | 13 | Adult | - | 1.00 |
| | 37 | Juvenile | - | 1.09 |
| Green sunfish | 1 | Adult | Male | 1.80 |
| | 1 | Adult | Female | 1.80 |
| | 2 | Juvenile | - | 1.50 |
| Bigmouth Buffalo | 4 | Adult | - | 1.69 |

[a] Sex not determined.

## Table 4.6

K-factor for body condition of adult and juvenile fish by sex collected by electroshocking at Locations 1 and 2 near the LaSalle County Station, 14-16 May 1974.

| Species | Number | Maturity | Sex | Mean K-factor |
|---|---|---|---|---|
| Location 1 | | | | |
| Carp | 18 | Adult | Male | 1.52 |
| Carp | 9 | Adult | Female | 1.52 |
| Carp | 3 | Juvenile | -[a] | 1.26 |
| Goldfish | 1 | Adult | Female | 1.93 |
| Gizzard shad | 1 | Adult | - | 0.82 |
| White sucker | 1 | Adult | Female | 1.19 |
| White sucker | 1 | Juvenile | - | 1.06 |
| Silver redhorse | 1 | Adult | Male | 1.18 |
| River carpsucker | 1 | Adult | Male | 0.99 |
| River carpsucker | 1 | Juvenile | Male | 1.12 |
| Black bullhead | 1 | -[b] | - | 1.19 |
| Location 2 | | | | |
| Carp | 13 | Adult | Male | 1.15 |
| Carp | 16 | Adult | Female | 1.62 |
| Carp | 1 | Juvenile | - | 1.63 |
| Goldfish | 4 | Adult | Male | 2.13 |
| Goldfish | 1 | Juvenile | - | 1.61 |
| Gizzard shad | 1 | Adult | Male | 0.61 |
| Gizzard shad | 1 | Adult | Female | 1.16 |
| White bass | 1 | Adult | Male | 1.46 |
| Smallmouth buffalo | 1 | Juvenile | - | 1.39 |
| White sucker | 1 | Juvenile | - | 1.19 |
| Shorthead redhorse | 1 | - | - | 1.29 |

[a] Sex not determined.
[b] Maturity not determined.

Table 4.7

K-factor for body condition of adult and juvenile fish by sex collected by electroshocking at Locations 1 and 2 near the LaSalle County Station, 19-22 August 1974.

| Species | Number | Maturity | Sex | Mean K-factor |
|---|---|---|---|---|
| Location 1 | | | | |
| Carp | 9 | Adult | Male | 1.50 |
| | 4 | Adult | Female | 1.55 |
| Green sunfish | 1 | Adult | Male | 1.97 |
| | 3 | Adult | Female | 2.22 |
| | 2 | Juvenile | -[a] | 2.04 |
| Gizzard shad | 23 | Adult | - | 1.12 |
| Smallmouth bass | 2 | Juvenile | - | 1.40 |
| Location 2 | | | | |
| Carp | 8 | Adult | Male | 1.49 |
| | 7 | Adult | Female | 1.49 |
| | 2 | Juvenile | - | 1.62 |
| Green sunfish | 6 | Adult | Male | 2.69 |
| | 3 | Adult | Female | 2.27 |
| Gizzard shad | 23 | Adult | - | 1.10 |
| Smallmouth bass | 1 | Juvenile | - | 1.22 |

[a] Sex not determined.

## Table 4.8

**K-factor for body condition of adult and juvenile fish by sex collected by electroshocking at Locations 1 and 2 near the LaSalle County Station, 12-15 November 1974.**

| Species | Number | Maturity | Sex | Mean K-factor |
|---|---|---|---|---|
| Location 1 | | | | |
| Carp | 5 | Adult | Male | 1.38 |
| | 11 | Adult | Female | 1.40 |
| Green sunfish | 6 | Juvenile | -[a] | 2.12 |
| Gizzard shad | 31 | Adult | - | 1.05 |
| | 2 | Juvenile | - | 1.58 |
| Location 2 | | | | |
| Carp | 9 | Adult | Male | 1.42 |
| | 4 | Adult | Female | 1.38 |
| Gizzard shad | 17 | Adult | - | 1.07 |
| | 2 | Juvenile | - | 1.57 |
| Bigmouth buffalo | 4 | -[b] | - | 1.62 |
| River carpsucker | 4 | - | - | 1.30 |

[a] Sex not determined.
[b] Maturity not determined.

During the 1974 study, K-factors indicated that adult gizzard shad were more plump in August and November than in May. Bodola (1966) also reported gizzard shad condition factors in Lake Erie to be lowest during the spawning period in May and June. K-factors recorded for gizzard shad during 1974 and 1975 and by Limnetics (1973) were similar. Patulski (1975, unpublished) also reported similar results for the Illinois River in the area of the Dresden Station.

Significant differences in the length distribution of fish, collected by electroshocking, were not observed between Locations 1 and 2 during 1974 and 1975 (Patulski 1975).

<u>Seining</u>

The number of species obtained by seining at Location 1 was the same in 1974 and 1975, whereas a two-fold increase was observed at Location 2 in 1975 (Patulski 1975). However, additional species obtained in 1975 at Location 2 represented only 5% of the total seining catch and comprised species common to South Kickapoo Creek. The greater number of creek species found in the river at Location 2 in 1975 than in 1974 may relate to the differences in creek conditions which existed between the two years at the times of sampling. A substantial decrease in the total number and weight of fishes was observed at both locations in 1975; resulting from a decrease in the emerald shiner catches.

The most apparent decrease in the seasonal catches of emerald shiners in 1975 occurred in February at both locations and in

August at Location 1 (Table 4.4). The decreased catches observed in February may have resulted from the high water level encountered in the river, which reduced sampling efficiency and may have altered the distribution of emerald shiners in the river.

Diversity indices were slightly higher at Locations 1 and 2 in 1975 than in 1974 during most seasonal periods; however, diversity was generally low at both locations during the two years.

Significant differences were observed in the length distribution of emerald shiners between Locations 1 and 2 during 1974 and 1975 (Patulski 1975). These differences were most pronounced in August and November when young-of-the-year individuals were present in the river.

Age and Size Distribution

Inconsistencies in the age group representation were noted between 1974 and 1975 for carp, gizzard shad and emerald shiners. An overall increase in the number of carp from lower age groups and a decrease from higher age groups was noted in 1975 (Patulski 1975). Individuals from Age Group II demonstrated the greatest overall increase in 1975 even though their numbers were low in 1974 collections as Age Group I. Young-of-the-year carp were not represented in the collections during both years.

An appreciable increase in young-of-the-year gizzard shad was observed in the 1975 catches indicating greater spawning success in 1975 than in 1974.

The overall dominance of Age Group 0 in the 1974 emerald shiner catches was also observed in 1975 as Age Group I. These data suggest a strong 1974 year class. Poor spawning success of emerald shiners was apparent in 1975 as evidenced by the low catches of young-of-the-year individuals, especially in August where only 36% of the emerald shiner catch consisted of Age Group 0 fish compared to 92% in August 1974.

Mean lengths and weights of carp and gizzard shad and mean lengths of emerald shiners were generally comparable for each age group between 1974 and 1975. The greater mean length of Age Group 0 gizzard shad in 1975 than in 1974 was attributed to the high November catch in 1975 which was not observed in 1974.

## Food Habits

Sufficient data were obtained at Locations 1 and 2 for carp and green sunfish for 1974-1975 food habit comparison. The overall as well as the seasonal importance of food items found in carp stomachs were similar at Locations 1 and 2 during both years (Table 4.9 and 4.10). Sludge worms and midges were the most frequently identified food items; sludge worms showing greatest occurrence in May and midges in August during both years. Crayfish was an important food item of green sunfish during both years. Terrestrial insects, which were also an important food item in 1974, were of minor importance in 1975.

## External Parasites Disease and Physical Abnormalities

External parasites, disease and physical abnormalities

# Table 4.9

Relative imporatnce of food items found in the stomachs of selected fish near the LaSalle County Station, February-November 1974, all sampling methods.

| Fish Species | Stomachs Examined: With Food Loc. 1 | With Food Loc. 2 | Empty Loc. 1 | Empty Loc. 2 | Food Items | Number Loc. 1 | Number Loc. 2 | Percent Occurrence Loc. 1 | Percent Occurrence Loc. 2 | Volume (ml) Loc. 1 | Volume (ml) Loc. 2 | Percent of total Volume Loc. 1 | Percent of total Volume Loc. 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carp (190-640mm) | 19 | 17 | 42 | 42 | Chironomidae | 1883 | 381 | 63.2 | 52.9 | 1.7 | 0.5 | 6.0 | 21.8 |
| | | | | | Tubificidae | -[a] | - | 26.3 | 52.9 | 0.5 | 0.3 | 1.8 | 3.8 |
| | | | | | *Limnodrilus udekemianus* | - | 0 | 5.3 | 0.0 | 0.1 | 0.0 | 0.4 | 0.0 |
| | | | | | *Limnodrilus cervix* | 0 | - | 0.0 | 5.9 | 0.0 | 0.3 | 0.0 | 3.8 |
| | | | | | Crayfish | 1 | 0 | 5.3 | 0.0 | 0.2 | 0.0 | 0.7 | 0.0 |
| | | | | | Mullusk shells | - | - | 5.3 | 5.9 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | Cladocera | 10 | 0 | 5.3 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| | | | | | Filamentous algae | - | - | 15.8 | 23.5 | 24.0 | 2.0 | 84.2 | 25.6 |
| | | | | | Sand | - | - | 21.1 | 5.9 | 0.2 | 0.1 | 0.7 | 1.3 |
| | | | | | Unrecognizable | - | - | 73.7 | 82.4 | 1.7 | 4.5 | 6.0 | 57.7 |
| Green sunfish (77-147mm) | 10 | 11 | 10 | 1 | Terrestrial insects | 8 | 18 | 50.0 | 45.5 | 0.3 | 1.2 | 8.1 | 28.6 |
| | | | | | Crayfish | 4 | 4 | 40.0 | 36.4 | 3.3 | 2.8 | 87.9 | 66.7 |
| | | | | | Chironomidae | 14 | 0 | 20.0 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| | | | | | Isopoda | 1 | 2 | 10.0 | 9.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | Gastropoda | 0 | 1 | 0.0 | 9.1 | 0.0 | <0.1 | 0.0 | <0.1 |
| | | | | | Cerridae | 1 | 0 | 10.0 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| | | | | | Fish (Sunfish) | 0 | 1 | 0.0 | 9.1 | 0.0 | 0.1 | 0.0 | 2.4 |
| Smallmouth buffalo (285-315mm) | 0 | 2 | 0 | 0 | Chironomidae | 0 | 1000 | 0.0 | 50.0 | 0.0 | 0.7 | 0.0 | 77.8 |
| | | | | | Sand | 0 | - | 0.0 | 50.0 | 0.0 | <0.1 | 0.0 | <0.1 |
| | | | | | Unrecognizable | 0 | - | 0.0 | 100.0 | 0.0 | 0.2 | 0.0 | 22.2 |
| White sucker (250-260mm) | 1 | 1 | 1 | 0 | Chironomidae | 1800 | 100 | 100.0 | 100.0 | 1.0 | 0.5 | 71.4 | 71.4 |
| | | | | | Tubificidae | - | 0 | 100.0 | 0.0 | 0.3 | 0.0 | 21.4 | 0.0 |
| | | | | | Sand | - | 0 | 100.0 | 0.0 | 0.1 | 0.0 | 7.1 | 0.0 |
| | | | | | Unrecognizable | 0 | - | 0.0 | 100.0 | 0.0 | 0.2 | 0.0 | 28.6 |
| Largemouth bass (71-220mm) | 2 | 1 | 0 | 1 | Fish (Emerald shiner) | 3 | 1 | 100.0 | 100.0 | 0.6 | 0.1 | 100.0 | 100.0 |
| Black crappie (65mm) | 1 | 0 | 0 | 0 | Copepoda | 2 | 0 | 100.0 | 0.0 | <0.1 | 0.0 | 50.0 | 0.0 |
| | | | | | Tipulidae | 1 | 0 | 100.0 | 0.0 | <0.1 | 0.0 | 50.0 | 0.0 |
| Black bullhead (210mm) | 1 | 0 | 0 | 0 | Gastropoda | 1 | 0 | 100.0 | 0.0 | 0.1 | 0.0 | 100.0 | 0.0 |

[a] Uncountable.

# Table 4.10

**Relative importance of food items found in the stomachs of selected fish near the LaSalle County Station, February - November 1975, all sampling methods.**

| Fish Species | Stomachs examined: With Food Loc.1 | With Food Loc.2 | Empty Loc.1 | Empty Loc.2 | Food items | Number Loc.1 | Number Loc.2 | Percent occurrence Loc.1 | Percent occurrence Loc.2 | Volume (ml) Loc.1 | Volume (ml) Loc.2 | Percent of total volume Loc.1 | Percent of total volume Loc.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Carp (200-485 mm) | 25 | 19 | 32 | 37 | Algae | -[a] | - | 16.0 | 10.5 | 6.0 | 1.0 | 46.9 | 8.5 |
| | | | | | Plant fragments | 0 | - | 0.0 | 5.3 | 0.0 | 0.3 | 0 | 2.6 |
| | | | | | Tubificidae | - | - | 8.0 | 5.3 | 0.4 | <0.1 | 3.1 | <0.1 |
| | | | | | Tubificidae | | | | | | | | |
| | | | | | without capilliform setae | - | - | 52.0 | 31.6 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | with capilliform setae | - | 0 | 4.0 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| | | | | | _Limnodrilus hoffmeisteri_ | - | - | 8.0 | 5.3 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | _Limnodrilus cervix_ | 0 | - | 0.0 | 5.3 | 0.0 | <0.1 | 0 | <0.1 |
| | | | | | Cladocera (_Moina_ sp.) | - | - | 12.0 | 15.8 | 0.4 | 0.9 | 3.1 | 7.7 |
| | | | | | Chironomidae | 152 | 10 | 28.0 | 21.1 | 0.2 | 0.1 | 1.6 | 0.9 |
| | | | | | Copepoda | 0 | 1510 | 0.0 | 15.8 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | Limpets | 1 | 0 | 4.0 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| | | | | | Mollusk shells | 0 | - | 0.0 | 10.5 | 0.0 | 0.3 | 0 | 2.6 |
| | | | | | Crayfish | 1 | 0 | 4.0 | 0.0 | 0.6 | 0.0 | 4.7 | 0.0 |
| | | | | | Terrestrial insects | 3 | 0 | 4.0 | 0.0 | 0.1 | 0.0 | 0.8 | 0.0 |
| | | | | | Unrecognizable | - | - | 72.0 | 78.9 | 5.1 | 9.1 | 39.8 | 77.8 |
| Smallmouth buffalo (240-255 mm) | 0 | 1 | 2 | 0 | Tubificidae | | | | | | | | |
| | | | | | with capilliform setae | 0 | - | 0 | 100 | 0.0 | <0.1 | 0.0 | <0.1 |
| | | | | | Unrecognizable | 0 | - | 0 | 100 | 0.0 | 0.1 | 0.0 | 100 |
| Bluegill (105-155 mm) | 0 | 3 | 0 | 0 | Chironomidae | 0 | 260 | 0.0 | 33.3 | 0.0 | 0.2 | 0.0 | 50.0 |
| | | | | | Hydropsychidee | 0 | 2 | 0.0 | 33.3 | 0.0 | <0.1 | 0.0 | <0.1 |
| | | | | | Limpets | 0 | 2 | 0.0 | 33.3 | 0.0 | <0.1 | 0.0 | <0.1 |
| | | | | | Terrestrial insects | 0 | 9 | 0.0 | 100 | 0.0 | 0.2 | 0.0 | 50.0 |
| White bass (255 mm) | 1 | 0 | 0 | 0 | Crayfish | 1 | 0 | 100 | 0 | 2.8 | 0.0 | 100 | 0 |
| Largemouth bass (215 mm) | 0 | 0 | 0 | 1 | | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Smallmouth bass (125 mm) | 0 | 0 | 1 | 0 | | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Green sunfish (88-180 mm) | 38 | 16 | 21 | 7 | Crayfish | 17 | 4 | 39.5 | 25.0 | 11.6 | 4.6 | 61.4 | 79.3 |
| | | | | | Fish eggs | - | 0 | 2.6 | 0.0 | 0.3 | 0.0 | 1.6 | 0.0 |
| | | | | | Fish | | | | | | | | |
| | | | | | Emerald shiner | 3 | 0 | 2.6 | 0.0 | 4.5 | 0.0 | 23.8 | 0.0 |
| | | | | | Unidentified | 0 | 1 | 0.0 | 6.3 | 0.0 | 0.4 | 0.0 | 6.9 |
| | | | | | Gastropoda | | | | | | | | |
| | | | | | _Physa_ sp. | 20 | 6 | 10.5 | 25.0 | 0.7 | 0.1 | 3.7 | 1.7 |
| | | | | | _Ferrissia_ sp. | 4 | 5 | 7.9 | 18.8 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | Gerridae | 1 | 0 | 2.6 | 0.0 | <0.1 | 0.0 | <0.1 | 0.0 |
| | | | | | Isopoda | 6 | 9 | 7.9 | 18.8 | 0.1 | 0.3 | 0.5 | 5.2 |
| | | | | | Cladocera (_Moina_ sp.) | 540 | 0 | 13.2 | 0.0 | 0.2 | 0.0 | 1.0 | 0.0 |

## Table 4.10 (Cont'd.)

| Fish Species | Stomachs examined: With Food Loc.1 | With Food Loc.2 | Empty Loc.1 | Empty Loc.2 | Food items | Number Loc.1 | Number Loc.2 | Percent occurrence Loc.1 | Percent occurrence Loc.2 | Volume (ml) Loc.1 | Volume (ml) Loc.2 | Percent of total volume Loc.1 | Percent of total volume Loc.2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Green sunfish (35-180 mm) (continued) | 33 | 16 | 21 | 7 | Lumbricidae | 2 | 0 | 2.6 | 0.0 | 0.7 | 0.0 | 3.7 | 0.0 |
| | | | | | Chironomidae | 3 | 10 | 7.9 | 12.5 | <0.1 | <0.1 | <0.1 | <0.1 |
| | | | | | Hydropsychidae | 0 | 1 | 0.0 | 6.3 | 0.0 | <0.1 | 0.0 | <0.1 |
| | | | | | Snails | 1 | 1 | 2.6 | 6.3 | <0.1 | 0.1 | <0.1 | 1.7 |
| | | | | | Terrestrial insects | 24 | 0 | 21.1 | 0.0 | 0.7 | 0.0 | 3.7 | 0.0 |
| | | | | | Plant fragments | - | 0 | 2.6 | 0.0 | 0.1 | 0.0 | 0.5 | 0.0 |
| | | | | | Unrecognizable | 0 | - | 0.0 | 12.5 | 0.0 | 0.3 | 0.0 | 5.2 |

1 Uncountable items.

observed on fish in the river were similar in 1974 and 1975. The most common physical abnormalities observed on fish in the river during both years were deformed and eroded fins, and carp was the most affected species.

External parasites, disease or physical abnormalities were identified on 13 species of fish during the study (Table 4.11 and 4.12). Physical abnormalities, primarily deformed and eroded fins, were frequently observed on fish collected at Locations 1 and 2. Carp was the most affected species. Similar observations were made by Starrett and Crum (1964), by Limnetics (1973) and by Patulski (1976) for carp in the Illinois River and by Industrial BIO-TEST Laboratories, Inc. (1974) for the Des Plaines River.

Mills et al. (1966) and Starrett and Crum (1964) each reported nearly 80% incidence of knothead condition on carp collected in the Marseilles area of the Illinois River. This condition was also observed on carp at Locations 1 and 2 during the present study; however, the percentage was much lower. A low incidence of knothead condition on carp was also reported for the Illinois River near Marseilles by Limnetics (1973) and near the Dresden Station by Patulski (1976).

Exophthalmus, or popeye, was a common disease on goldfish at Locations 1 and 2. Similar observations were made on goldfish in the Illinois River by Patulski (1976) and Des Plaines River by Industrial BIO-TEST Laboratories, Inc. (1974). The most common external parasite identified on fish in the river was Neascus sp.; green sunfish and emerald shiners were the two most affected species.

# Table 4.11

**Incidence of external parasites, disease or physical abnormalities of fish collected at Locations 1, 2,6 and 8 near the LaSalle County Station, February-November 1974, all sampling methods.**

| Species | Location | Parasite or Disease | Physical Abnormalities | Number Affected | Percent Affected |
|---|---|---|---|---|---|
| Carp | 1 | *Saprolegnia* sp. (Fungus) | | 4 | 4.7 |
| | | *Lernea* sp. (Anchorworm) | | 1 | 1.2 |
| | | | Deformed fins | 19 | 22.1 |
| | | | Eroded fins | 9 | 10.5 |
| | | | Knothead | 7 | 8.1 |
| | | | Deformed mouth | 1 | 1.2 |
| | 2 | *Saprolegnia* sp. | | 2 | 2.4 |
| | | *Lernea* sp. | | 1 | 1.2 |
| | | | Deformed fins | 19 | 23.2 |
| | | | Eroded fins | 24 | 29.3 |
| | | | Knothead | 17 | 20.7 |
| | | | Loss of eye | 3 | 3.7 |
| River carpsucker | 1 | | Eroded fins | 4 | 57.1 |
| | 2 | | Deformed fins | 1 | 11.1 |
| | | | Eroded fins | 2 | 22.2 |
| Goldfish | 1 | Popeye | | 1 | 50.0 |
| | | | Eroded fins | 1 | 50.0 |
| | 2 | Popeye | | 1 | 20.0 |
| | | | Eroded fins | 2 | 40.0 |
| | | | Loss of eye | 1 | 20.0 |

**Table 4.[illegible] (Cont'd.)**

| Species | Location | Parasite or Disease | Physical Abnormalities | Number Affected | Percent Affected |
|---|---|---|---|---|---|
| Smallmouth buffalo | 2 | | Eroded fins | 7 | 87.5 |
| Bigmouth buffalo | 2 | | Deformed fins | 1 | 25.0 |
| Shorthead redhorse | 2 | _Lernea_ sp. | | 1 | 50.0 |
| | | | Eroded fins | 2 | 100.0 |
| Largemouth bass | 1 | _Neascus_ sp. (Black spot) | | 1 | 50.0 |
| Silver redhorse | 1 | | Eroded fins | 1 | 100.0 |
| Quillback | 2 | | Deformed fins | 1 | 100.0 |
| Gizzard shad | 2 | | Deformed fins | 1 | 1.9 |
| | | | Eroded fins | 1 | 1.9 |
| Black bullhead | 2 | _Saprolegnia_ sp. | | 1 | 100.0 |
| Bluntnose minnow | 1 | _Lernea_ sp. | | 1 | 33.3 |
| | 6 | _Neascus_ sp. | | 2 | 4.4 |
| | 8 | _Neascus_ sp. | | 1 | 1.5 |
| White bass | 2 | _Glossatella_ sp. | | 1 | 100.0 |
| Emerald shiner | 1 | _Neascus_ sp. | | 2 | 0.3 |
| | | _Lernea_ sp. | | 1 | 0.1 |

## Table 4.11 (Cont'd.)

| Species | Location | Parasite or Disease | Physical Abnormalities | Number Affected | Percent Affected |
|---|---|---|---|---|---|
| Green sunfish | 1 | *Neascus* sp. | | 4 | 16.0 |
| | | | Deformed fins | 1 | 4.0 |
| | 6 | *Neascus* sp. | | 2 | 7.1 |
| | 8 | *Neascus* sp. | | 18 | 25.0 |
| Stoneroller | 6 | *Neascus* sp. | | 24 | 4.2 |
| | | *Lernea* sp. | | 1 | 0.2 |
| | 8 | *Neascus* sp. | | 7 | 2.2 |
| Creek chub | 6 | *Neascus* sp. | | 57 | 22.3 |
| | 8 | *Neascus* sp. | | 20 | 6.4 |
| Fathead minnow | 8 | *Neascus* sp. | | 4 | 9.8 |
| | | *Clinostomum* sp. (Yellow grub) | | 1 | 2.4 |
| Common shiner | 6 | *Neascus* sp. | | 1 | 9.1 |

## Table 4.12

Incidence of external parasites, disease or physical abnormalities of fish collected at Locations 1, 2, 5, 6 and 8 near the LaSalle County Station, February - November 1975, all sampling methods.

| Species | Location | Parasite or Disease | Physical Abnormalities | Number Affected | Percent Affected |
|---|---|---|---|---|---|
| Carp | 1 | | Deformed fins | 18 | 17.1 |
| | | | Eroded fins | 8 | 7.6 |
| | | | Knothead | 9 | 8.6 |
| | | | Deformed body | 1 | 1.0 |
| | 2 | | Deformed fins | 24 | 33.8 |
| | | | Eroded fins | 3 | 4.2 |
| | | | Knothead | 6 | 8.5 |
| | | | Loss of eye | 1 | 1.4 |
| Green sunfish | 1 | *Neascus* sp. (Black spot) | | 11 | 11.8 |
| | | *Lernea* sp. (Anchorworm) | | 1 | 1.1 |
| | | Exophthalmus (Popeye) | | 1 | 1.1 |
| | | | Deformed fins | 1 | 1.1 |
| | | | Eroded fins | 1 | 1.1 |
| | | | Mechanical damage | 1 | 1.1 |
| | 2 | Black spot | | 8 | 24.2 |
| | | Anchorworm | | 1 | 3.0 |
| | 5 | Blackspot | | 2 | 50.0 |
| | 6 | Blackspot | | 6 | 66.7 |
| | 8 | Blackspot | | 9 | 75.0 |
| Goldfish | 1 | Popeye | | 2 | 40.0 |
| | | | Eroded fins | 1 | 20.0 |
| | 2 | Popeye | | 3 | 33.3 |
| | | | Eroded fins | 1 | 11.1 |

## Table 4.12 (Cont'd.)

| Species | Location | Parasite or Disease | Physical Abnormalities | Number Affected | Percent Affected |
|---|---|---|---|---|---|
| Bigmouth buffalo | 1 | | Eroded fins | 2 | 50.0 |
| | 2 | | Eroded fins | 5 | 62.5 |
| Smallmouth buffalo | 1 | | Eroded fins | 1 | 50.0 |
| | 2 | | Eroded fins | 4 | 66.7 |
| White sucker | 1 | | Eroded fins | 1 | 20.0 |
| | | | Mechanical damage | 1 | 20.0 |
| | 2 | Anchorworm | | 1 | 3.0 |
| | | Popeye | | 1 | 3.0 |
| | | | Eroded fins | 2 | 6.1 |
| | 5 | Anchorworm | | 1 | 14.3 |
| River carpsucker | 1 | | Eroded fins | 2 | 40.0 |
| | 2 | Nematoda (Round worms) | | 1 | 20.0 |
| Bluegill | 1 | *Saprolegnia* sp. (Fungus) | | 1 | 20.0 |
| | 2 | Anchorworm | | 1 | 20.0 |
| Emerald shiner | 1 | Black spot | | 24 | 8.7 |
| | 2 | Black spot | | 11 | 2.0 |
| | | Anchorworm | | 1 | 0.2 |
| White crappie | 2 | Black spot | | 1 | 100 |

## Table 4.12 (Cont'd.)

| Species | Location | Parasite or Disease | Physical Abnormalities | Number Affected | Percent Affected |
|---|---|---|---|---|---|
| Bluntnose minnow | 1 | Black spot | | 1 | 5.3 |
| | 2 | Black spot | | 1 | 11.1 |
| | 6 | Black spot | | 7 | 11.7 |
| Creek chub | 6 | Black spot | | 4 | 3.5 |
| Steelcolor shiner | 5 | Black spot | | 1 | 3.4 |

## 5.0 INTAKE EFFECTS

### 5.1 Entrainment

A preliminary analysis of the projected impact of entrainment by the La Salle Station on drifting larval fish populations in the Illinois River was made considering the monthly mean flows of the river in the vicinity of the station location. The analysis is based on two assumptions, which may require modifications based on additional studies of the hydraulic characteristics of the river and the spacial distribution of drift within the river. These assumptions are: (1) drift is distributed evenly across the river; and (2) the proportion of the river drift entrained is approximately the same as the proportion of the river flow entering the Station.

#### 5.1.1 Method, Analysis and Conclusions

Monthly mean flows of the Illinois River at Marseilles, Illinois (Table 5.1) for the period 1920-1974 (55 years) were statistically analyzed to determine the flows corresponding to various non-exceedence probabilities in each month of a year. The magnitudes of monthly flows for given exceedence probabilities were determined using log Pearson Type III method, and the results are given in Table 5.2. Non-exceedence probability curves for each month of a year are given in Figures 5.1 through 5.12.

Figure 5.13 represents the lateral distribution of depth, mean velocity and flow in the Illinois River in the vicinity of the La Salle Station intake. These data were determined from field measurements of depth and velocities at the site on November 1, 1976.

Table 5.1

MONTHLY MEAN FLOW OF ILLINOIS RIVER - MARSEILLES POOL - FOR 55 YEARS

| YEAR | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1920. | 10500. | 11000. | 21700. | 23900. | 17400. | 10200. | 9300. | 8830. | 9020. | 9380. | 9330. | 9310. | 12500. |
| 1921. | 9680. | 10100. | 12900. | 14400. | 11800. | 9350. | 9120. | 9130. | 9920. | 10500. | 15300. | 17900. | 11700. |
| 1922. | 14000. | 12300. | 19900. | 33200. | 15200. | 11800. | 10300. | 9660. | 9960. | 10400. | 10600. | 9910. | 13900. |
| 1923. | 9600. | 9500. | 17000. | 12500. | 14300. | 11500. | 9700. | 10600. | 11200. | 12700. | 12900. | 18800. | 12600. |
| 1924. | 13800. | 17200. | 20600. | 20000. | 14100. | 18700. | 16000. | 19200. | 12700. | 11400. | 10400. | 11800. | 15500. |
| 1925. | 10300. | 14500. | 16300. | 11700. | 10500. | 9720. | 9660. | 9050. | 9250. | 9150. | 9450. | 92501. | 7000. |
| 1926. | 9760. | 13600. | 15400. | 23200. | 12800. | 14900. | 10600. | 11800. | 19100. | 21100. | 18900. | 13900. | 15400. |
| 1927. | 11100. | 23600. | 20300. | 26900. | 23800. | 16600. | 10200. | 10900. | 11400. | 15600. | 16600. | 25200. | 17600. |
| 1928. | 18300. | 17700. | 16200. | 18000. | 12500. | 13100. | 17700. | 11900. | 11700. | 11700. | 14700. | 16300. | 15000. |
| 1929. | 17600. | 14700. | 24200. | 24300. | 17000. | 17600. | 12200. | 11100. | 11800. | 13000. | 13200. | 12100. | 15700. |
| 1930. | 15600. | 17000. | 15400. | 21700. | 12600. | 9980. | 8660. | 10700. | 9450. | 7820. | 7540. | 8380. | 12000. |
| 1931. | 8970. | 8580. | 9390. | 10600. | 12700. | 13500. | 10500. | 9360. | 9610. | 10600. | 13900. | 14000. | 11000. |
| 1932. | 17600. | 14200. | 13800. | 12600. | 11500. | 10600. | 10200. | 9940. | 9430. | 9930. | 10100. | 12600. | 11900. |
| 1933. | 13000. | 12600. | 16200. | 25600. | 28300. | 11700. | 10700. | 10000. | 9980. | 11470. | 10830. | 11210. | 14300. |
| 1934. | 9972. | 9806. | 9953. | 12130. | 7990. | 9834. | 9183. | 9631. | 10690. | 10080. | 12300. | 12800. | 10530. |
| 1935. | 16140. | 15750. | 21670. | 15650. | 20100. | 15390. | 12240. | 9775. | 8730. | 9103. | 12270. | 10580. | 13950. |
| 1936. | 9919. | 11960. | 15170. | 10740. | 13560. | 7841. | 8150. | 8240. | 9878. | 9303. | 10680. | 7435. | 10240. |
| 1937. | 17210. | 12140. | 10920. | 18660. | 13550. | 11600. | 9907. | 9264. | 8203. | 9079. | 9065. | 9182. | 11560. |
| 1938. | 9118. | 16200. | 17800. | 19560. | 11870. | 13960. | 13340. | 8959. | 11560. | 7665. | 8026. | 7670. | 12100. |
| 1939. | 5447. | 14600. | 17100. | 14630. | 7475. | 9901. | 7811. | 4242. | 3670. | 4497. | 4275. | 4915. | 8214. |
| 1940. | 4087. | 4111. | 6819. | 6551. | 10380. | 7986. | 5585. | 5631. | 4768. | 4841. | 4627. | 7763. | 6108. |
| 1941. | 5815. | 5998. | 7848. | 9188. | 7803. | 8566. | 5842. | 4854. | 5070. | 13360. | 14130. | 8462. | 8082. |
| 1942. | 6432. | 21020. | 18170. | 14000. | 7145. | 7251. | 5299. | 8486. | 8754. | 5186. | 11360. | 12070. | 10390. |
| 1943. | 13690. | 17740. | 16010. | 10790. | 35180. | 13340. | 9048. | 7731. | 5302. | 4708. | 4867. | 3739. | 11850. |
| 1944. | 4812. | 5548. | 17210. | 26280. | 15540. | 10740. | 5447. | 4986. | 4747. | 4982. | 5181. | 4571. | 9163. |
| 1945. | 4408. | 5946. | 8065. | 12870. | 21730. | 10650. | 6777. | 6112. | 7489. | 10160. | 7066. | 6629. | 9010. |
| 1946. | 17450. | 10150. | 18300. | 7273. | 10000. | 12850. | 6776. | 5476. | 4941. | 4317. | 5600. | 5163. | 9031. |
| 1947. | 7704. | 8899. | 8670. | 22670. | 16670. | 16870. | 5486. | 6696. | 5505. | 4736. | 5079. | 9394. | 9843. |
| 1948. | 6326. | 8603. | 21060. | 11380. | 16290. | 7682. | 7743. | 6227. | 5345. | 4495. | 3993. | 4789. | 8677. |
| 1949. | 12180. | 16800. | 11080. | 9380. | 8651. | 8746. | 8662. | 6454. | 5336. | 5238. | 4071. | 11650. | 8980. |
| 1950. | 23820. | 17770. | 19930. | 32300. | 11200. | 12880. | 10500. | 6399. | 6236. | 5085. | 4201. | 6274. | 13000. |
| 1951. | 10120. | 18180. | 14150. | 18200. | 14080. | 9046. | 15990. | 7389. | 6790. | 7333. | 13690. | 8203. | 11880. |
| 1952. | 16410. | 10600. | 16250. | 16910. | 10810. | 16180. | 7486. | 6499. | 5097. | 4245. | 4688. | 5695. | 10060. |
| 1953. | 5522. | 6671. | 13840. | 9396. | 9173. | 8218. | 10990. | 6240. | 5831. | 4029. | 4464. | 4857. | 7447. |
| 1954. | 4578. | 5558. | 10630. | 16420. | 9218. | 9811. | 8476. | 6812. | 5073. | 15000. | 6970. | 6455. | 8767. |
| 1955. | 12290. | 9213. | 12310. | 12160. | 10400. | 12030. | 6348. | 5463. | 4628. | 5313. | 5298. | 5495. | 8403. |
| 1956. | 4431. | 6647. | 8140. | 7429. | 15830. | 8593. | 6410. | 5705. | 4514. | 4272. | 4034. | 7679. | 7143. |
| 1957. | 11590. | 11450. | 5578. | 17740. | 16940. | 11650. | 21020. | 6525. | 4857. | 5666. | 8268. | 11270. | 11050. |
| 1958. | 8737. | 7671. | 10530. | 7738. | 6211. | 20510. | 13430. | 7981. | 4962. | 4605. | 5761. | 5459. | 8629. |
| 1959. | 6813. | 18360. | 16590. | 15190. | 15020. | 6852. | 7015. | 6350. | 4637. | 7247. | 9876. | 10480. | 10320. |
| 1960. | 13810. | 14910. | 11000. | 19760. | 10340. | 12850. | 6919. | 5503. | 4953. | 4231. | 4746. | 4969. | 9458. |
| 1961. | 4118. | 5132. | 10540. | 12180. | 11290. | 8224. | 6140. | 6487. | 14250. | 7969. | 9504. | 7905. | 8647. |
| 1962. | 8340. | 10820. | 25290. | 12210. | 11370. | 8071. | 8743. | 5908. | 5074. | 4736. | 4788. | 4716. | 9176. |
| 1963. | 3202. | 3264. | 13130. | 7893. | 8539. | 6065. | 6967. | 5256. | 4195. | 3707. | 4302. | 4362. | 5932. |
| 1964. | 3629. | 3843. | 5153. | 10180. | 7407. | 7264. | 7037. | 5018. | 5131. | 4125. | 4880. | 5130. | 5731. |
| 1965. | 10240. | 10390. | 13780. | 21240. | 11660. | 6133. | 5412. | 6406. | 10710. | 7725. | 6025. | 12580. | 10180. |
| 1966. | 10350. | 8605. | 13310. | 13130. | 23150. | 7264. | 5510. | 5689. | 4897. | 4209. | 6194. | 11860. | 9540. |
| 1967. | 5919. | 9557. | 16730. | 20070. | 14360. | 10200. | 5799. | 5463. | 5572. | 7040. | 9490. | 16370. | 10550. |
| 1968. | 7699. | 17900. | 7818. | 12360. | 8675. | 12070. | 10270. | 8896. | 5946. | 5101. | 6667. | 9084. | 9397. |
| 1969. | 12540. | 10750. | 7916. | 18270. | 12210. | 11730. | 13300. | 7518. | 5940. | 7558. | 6677. | 5308. | 9963. |
| 1970. | 5268. | 8178. | 8242. | 21960. | 28590. | 15210. | 7186. | 6963. | 11030. | 10870. | 9359. | 7519. | 11700. |
| 1971. | 4521. | 11650. | 14090. | 6658. | 6501. | 6117. | 8026. | 8315. | 6653. | 5839. | 4875. | 10080. | 7769. |
| 1972. | 8617. | 4352. | 12360. | 19570. | 13670. | 10940. | 10940. | 16890. | 15100. | 15090. | 19500. | 14820. | 13680. |
| 1973. | 20610. | 11460. | 20070. | 27600. | 15140. | 18670. | 8099. | 5437. | 4862. | 5210. | 4288. | 8865. | 12520. |
| 1974. | 18190. | 17840. | 18080. | 16670. | 25340. | 17530. | 5758. | 4560. | 4355. | 3518. | 6062. | 7790. | 12110. |
| MEAN: | 3.966 | 4.029 | 4.130 | 4.176 | 4.112 | 4.036 | 3.940 | 3.875 | 3.853 | 3.855 | 3.887 | 3.955 | |
| STDEV | .2171 | .2004 | .1626 | .1791 | .1653 | .1345 | .1418 | .1381 | .1746 | .1961 | .2012 | .2333 | |
| SKEW: | -0.246 | -0.639 | -0.595 | -0.153 | 0.416 | 0.057 | 0.457 | 0.603 | 0.380 | 0.283 | 0.203 | 1.387 | |

Table 5.2

FLOW VALUES FOR VARIOUS NON-EXCEEDENCE PROBABILITIES IN EACH MONTH

| MONTH | NON-EX. PROB. = | 1.0 | 5.0 | 10.0 | 25.0 | 50.0 | 75.0 | 80.0 | 85.0 | 90.0 | 95.0 | 96.0 | 98.0 | 99.0 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | FLOW RATE(CFS)= | 2612. | 3897. | 4786. | 6550. | 9435. | 13265. | 14201. | 15710. | 17381. | 20658. | 21384. | 24339. | 27253. | 301 |
| 2 | FLOW RATE(CFS)= | 2955. | 4637. | 5775. | 7919. | 11201. | 14952. | 15842. | 17120. | 18501. | 20916. | 21435. | 23349. | 25061. | 266 |
| 3 | FLOW RATE(CFS)= | 4815. | 6887. | 8206. | 10574. | 13995. | 17733. | 18593. | 19829. | 21147. | 23434. | 23920. | 25711. | 27307. | 287 |
| 4 | FLOW RATE(CFS)= | 5486. | 7476. | 8782. | 11280. | 15149. | 20098. | 21267. | 23169. | 25242. | 29295. | 30180. | 33790. | 37335. | 408 |
| 5 | FLOW RATE(CFS)= | 6008. | 7263. | 8111. | 9829. | 12614. | 16695. | 17657. | 19433. | 21386. | 25600. | 26537. | 30717. | 35194. | 400. |
| 6 | FLOW RATE(CFS)= | 5358. | 6564. | 7323. | 8736. | 10835. | 13487. | 14091. | 15105. | 16193. | 18342. | 18804. | 20724. | 22629. | 245 |
| 7 | FLOW RATE(CFS)= | 4551. | 5326. | 5841. | 6870. | 8494. | 10814. | 11349. | 12332. | 13401. | 15678. | 16178. | 18390. | 20726. | 232 |
| 8 | FLOW RATE(CFS)= | 4126. | 4716. | 5118. | 5941. | 7261. | 9214. | 9664. | 10511. | 11432. | 13444. | 13887. | 15875. | 18009. | 203 |
| 9 | FLOW RATE(CFS)= | 3135. | 3854. | 4342. | 5332. | 6952. | 9338. | 9905. | 10948. | 12100. | 14589. | 15146. | 17626. | 20288. | 231 |
| 10 | FLOW RATE(CFS)= | 2752. | 3538. | 4075. | 5175. | 7007. | 9730. | 10390. | 11586. | 12921. | 15810. | 16461. | 19353. | 22460. | 258 |
| 11 | FLOW RATE(CFS)= | 2813. | 3698. | 4304. | 5536. | 7587. | 10588. | 11318. | 12624. | 14081. | 17196. | 17898. | 20967. | 24246. | 277 |
| 12 | FLOW RATE(CFS)= | 4422. | 4802. | 5147. | 6089. | 8000. | 12129. | 13182. | 15613. | 18493. | 26314. | 28237. | 38461. | 52022. | 700 |

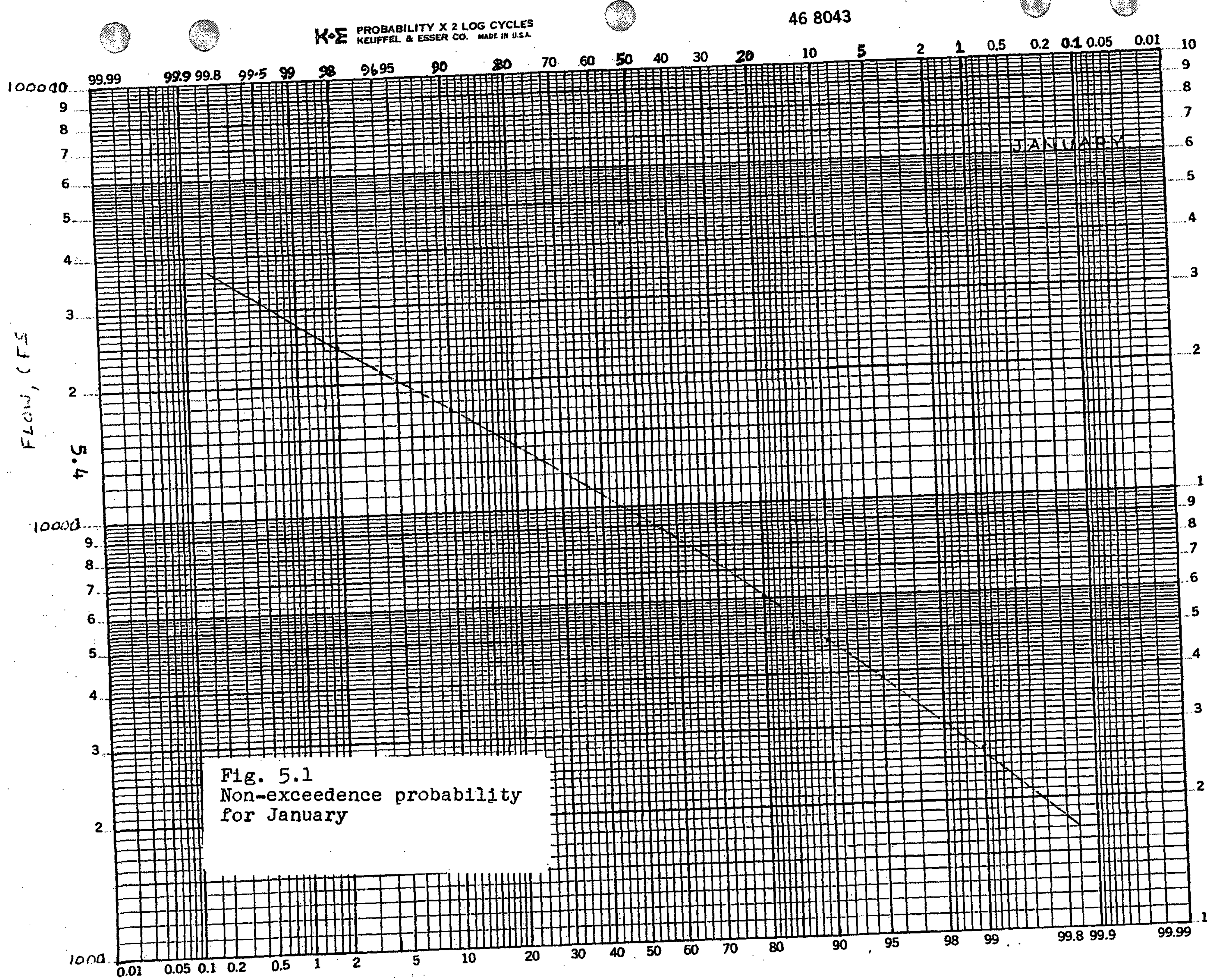


Fig. 5.1
Non-exceedence probability
for January

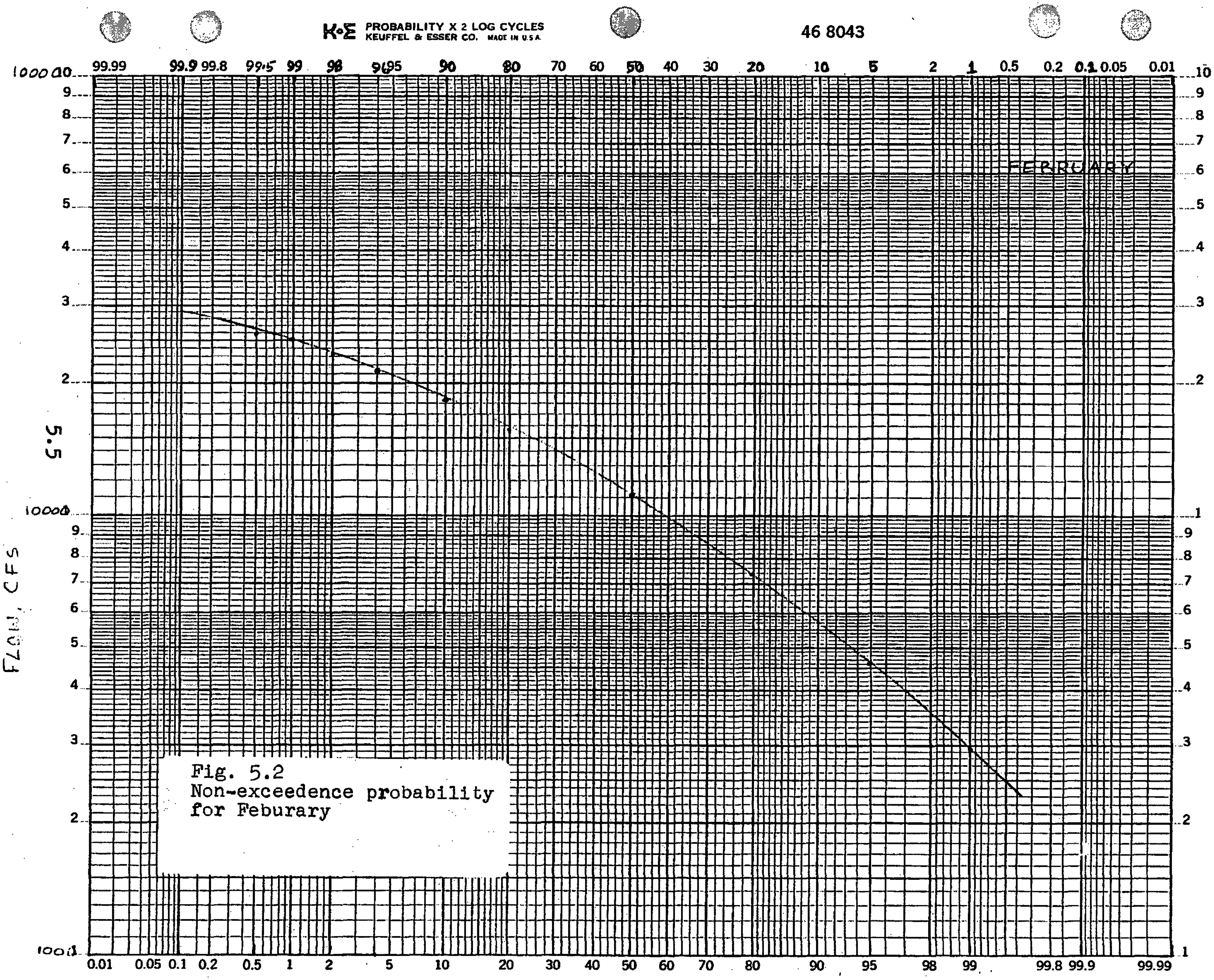


Fig. 5.2
Non-exceedence probability
for Feburary

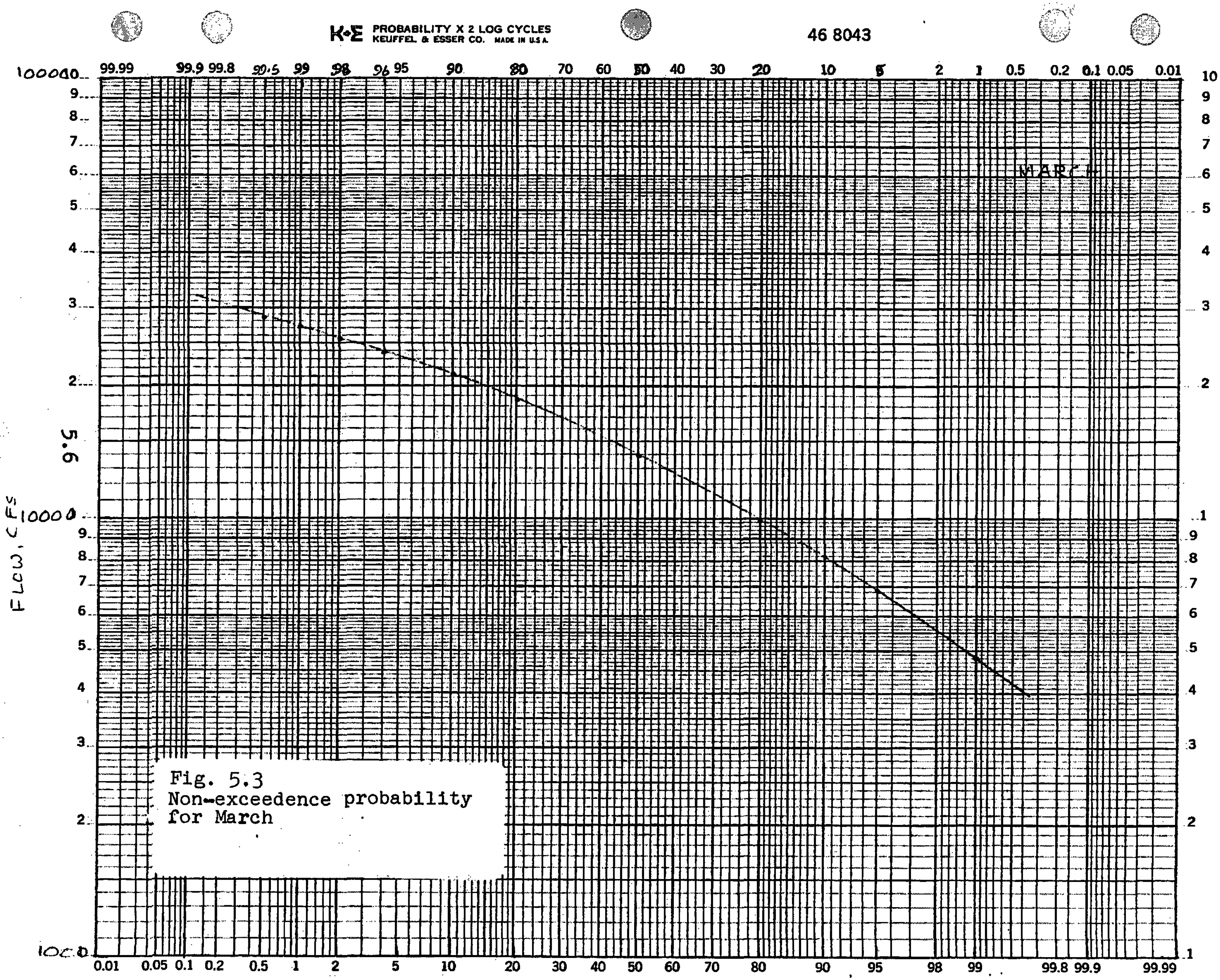


Fig. 5.3
Non-exceedence probability
for March

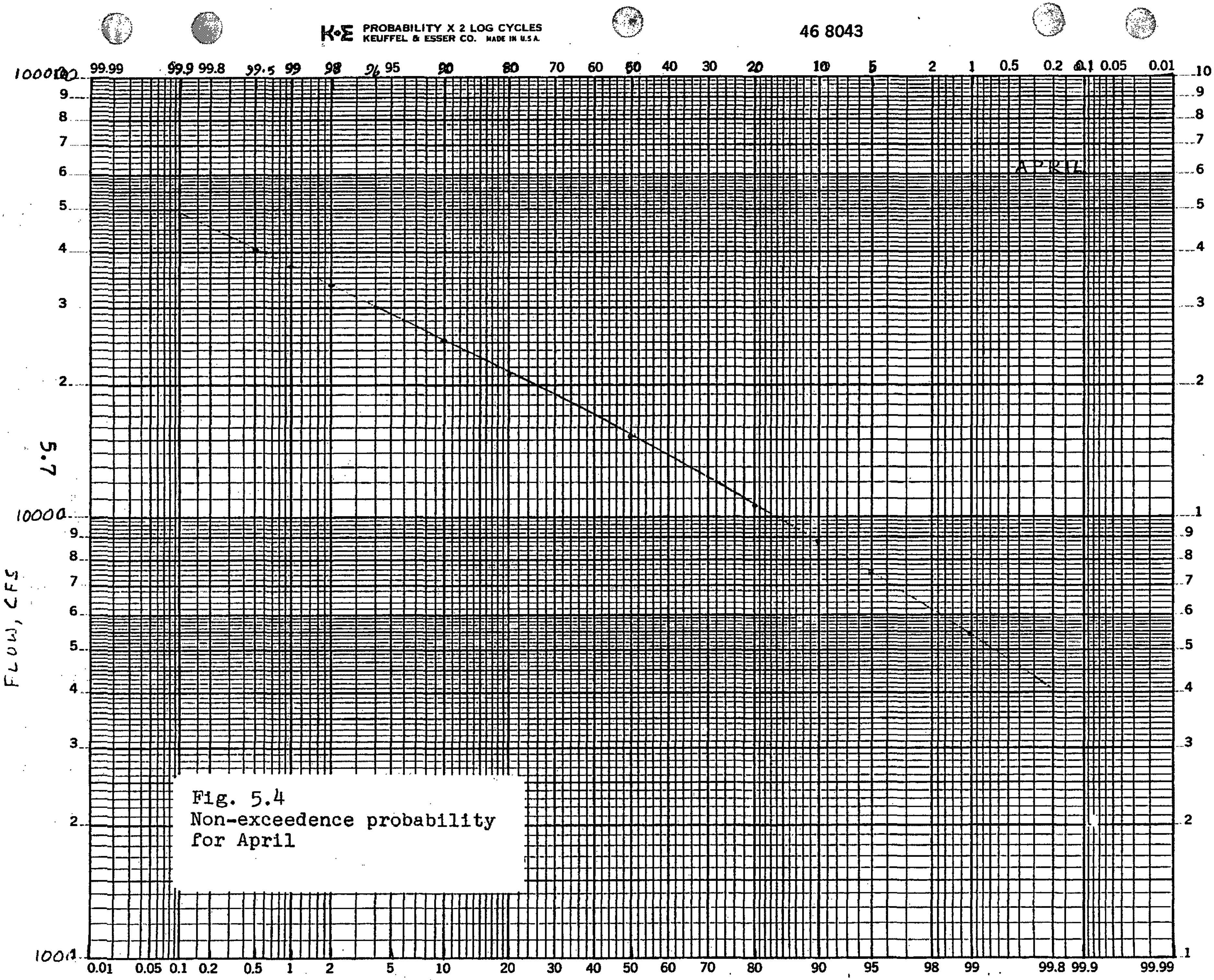


Fig. 5.4
Non-exceedence probability
for April

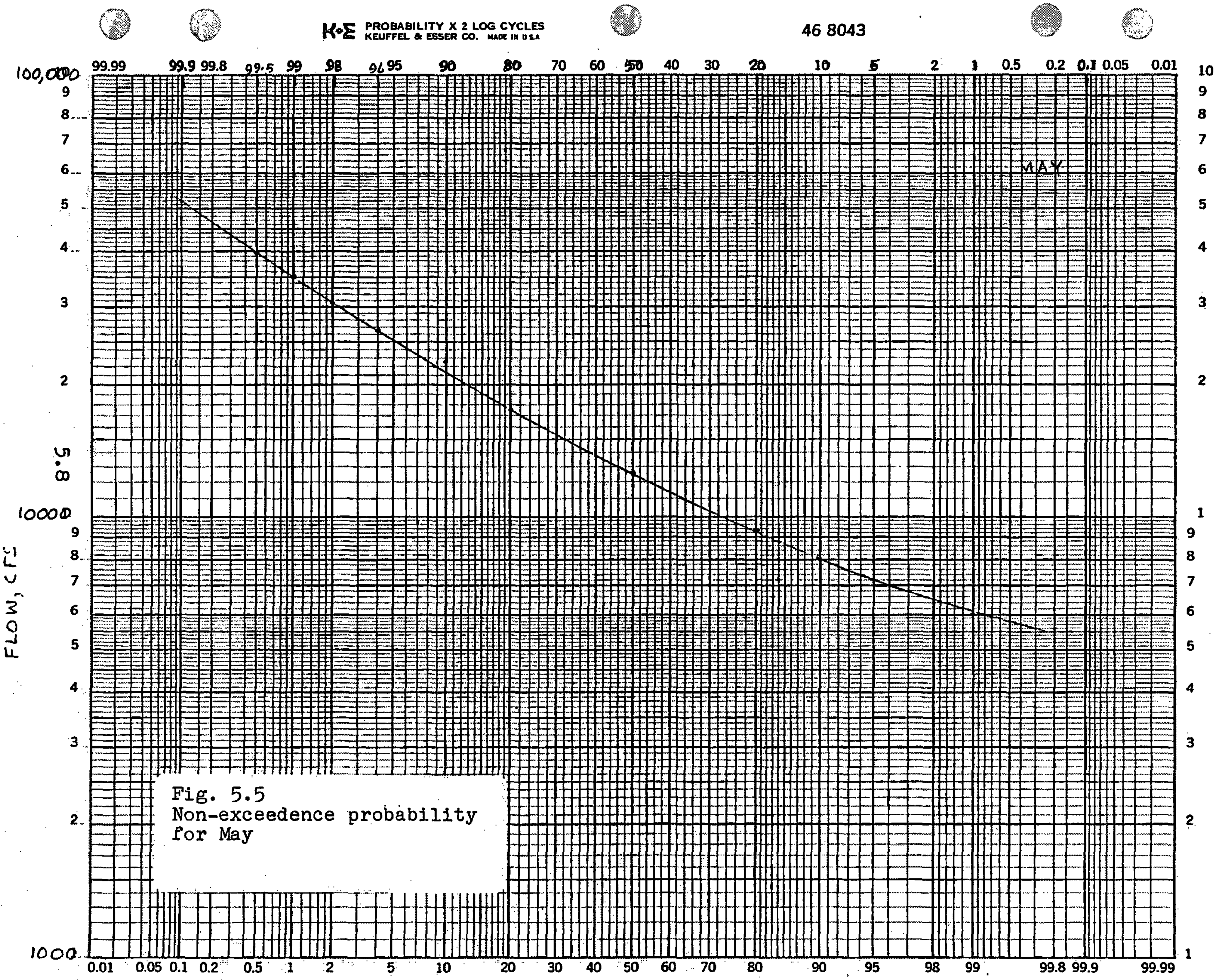


Fig. 5.5
Non-exceedence probability
for May

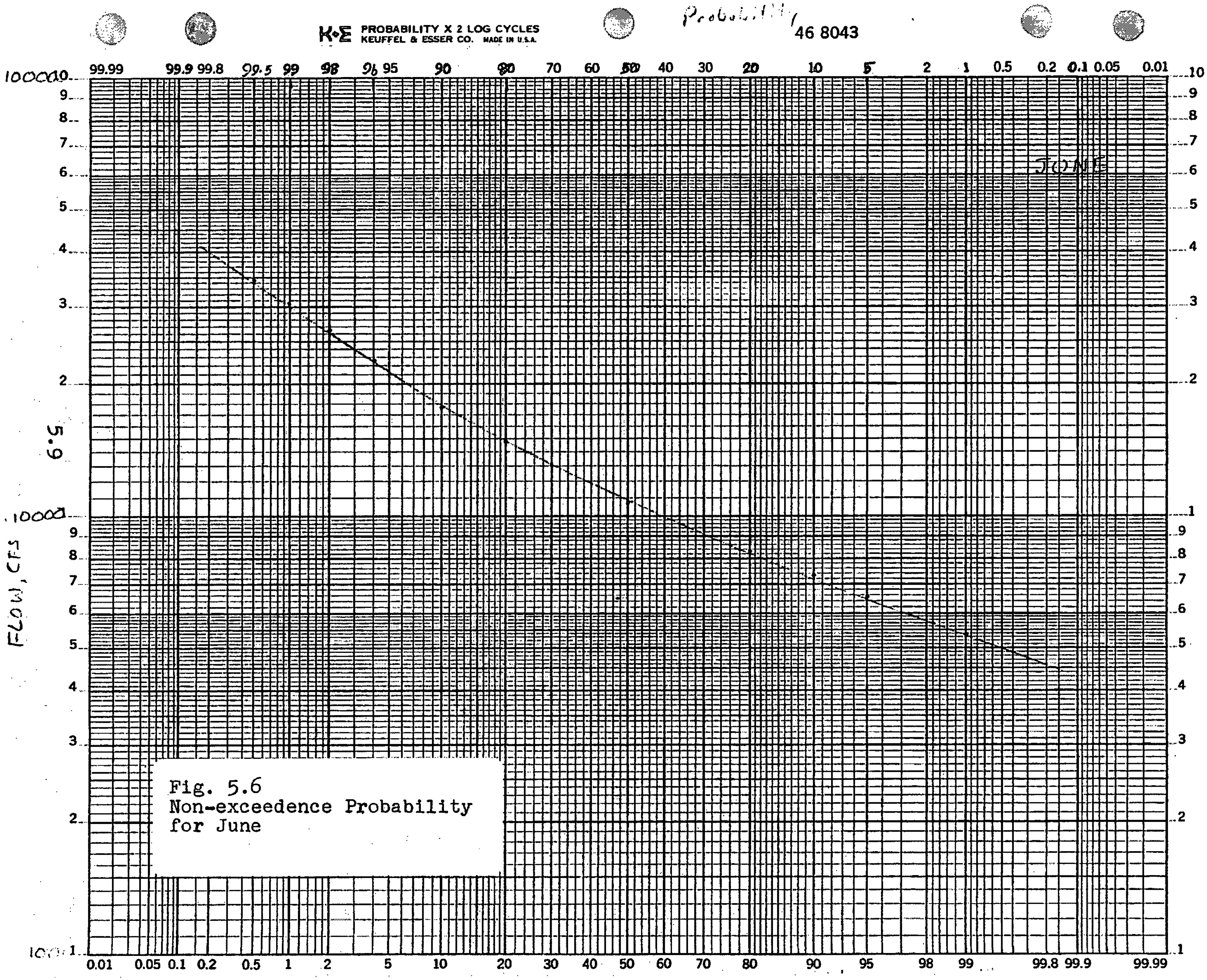


Fig. 5.6
Non-exceedence Probability
for June

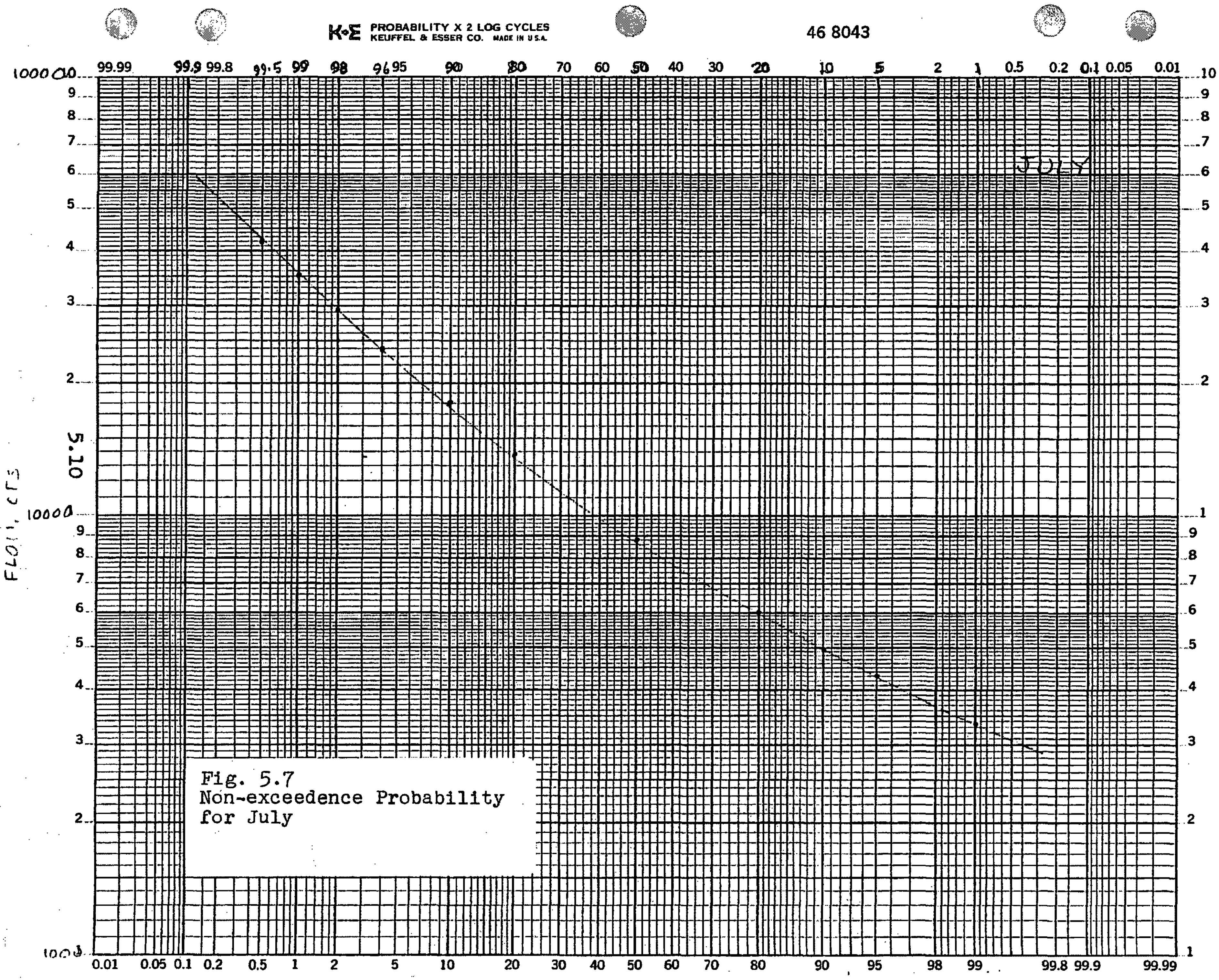


Fig. 5.7
Non-exceedence Probability
for July

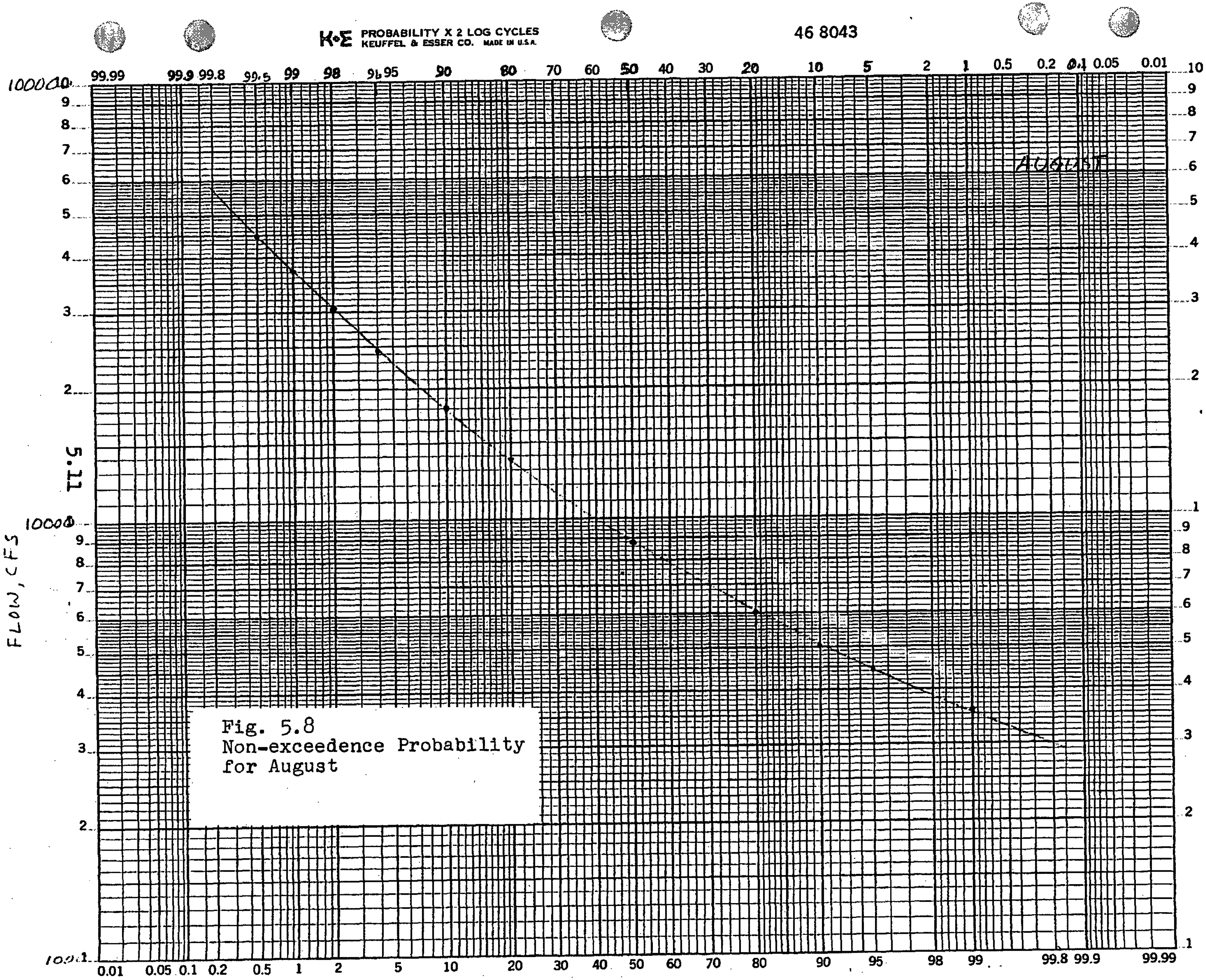


Fig. 5.8
Non-exceedence Probability
for August

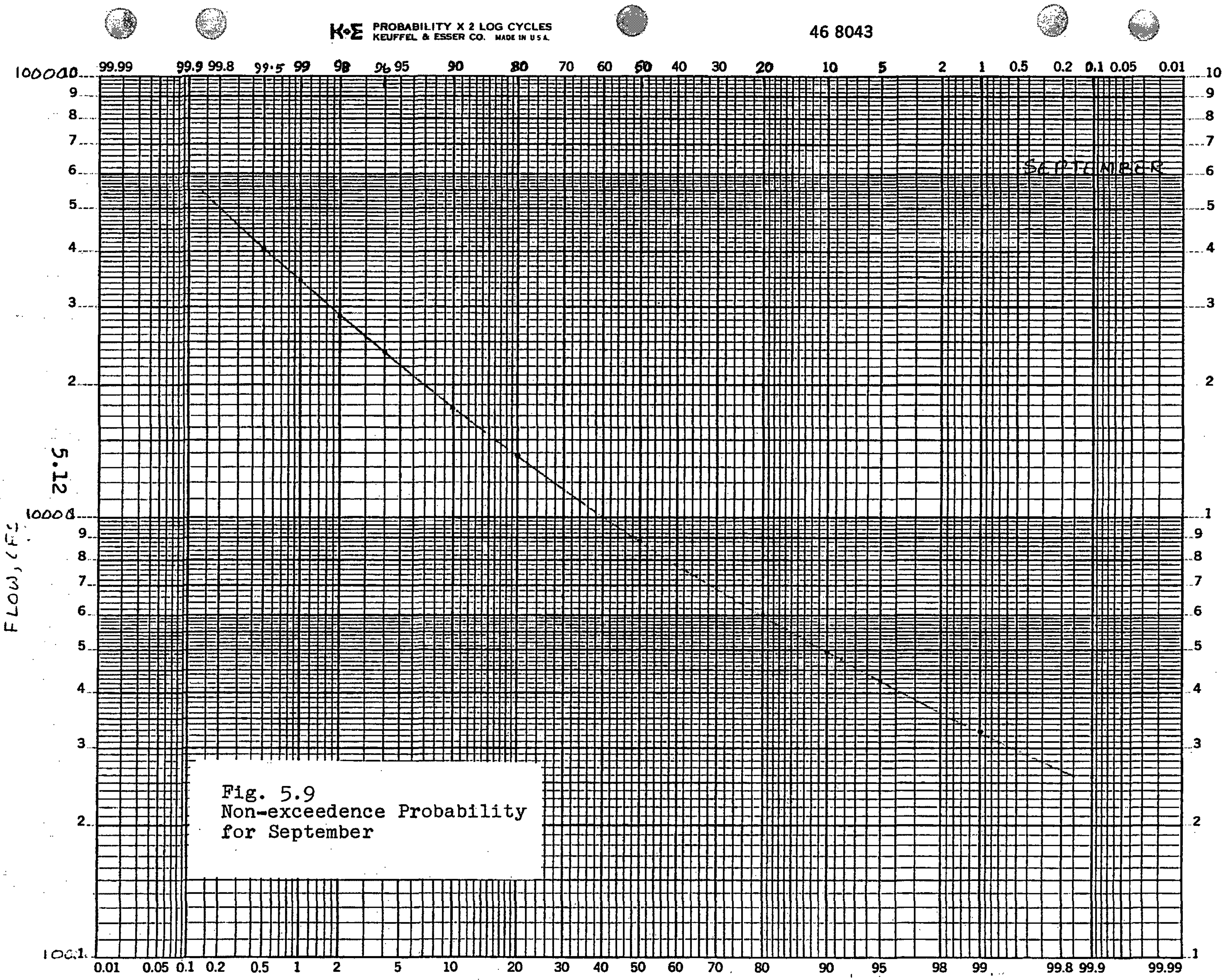


Fig. 5.9
Non-exceedence Probability
for September

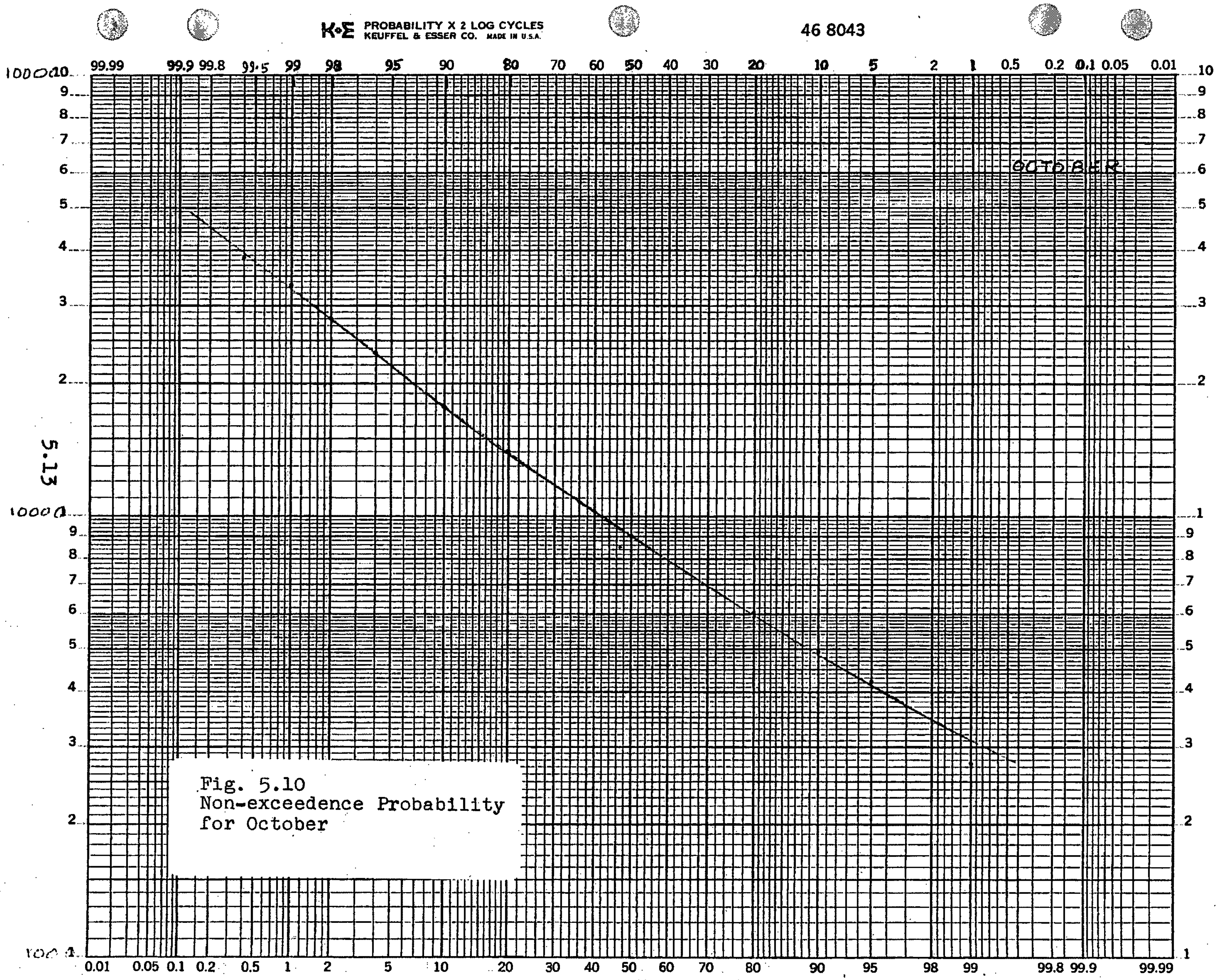


Fig. 5.10
Non-exceedence Probability
for October

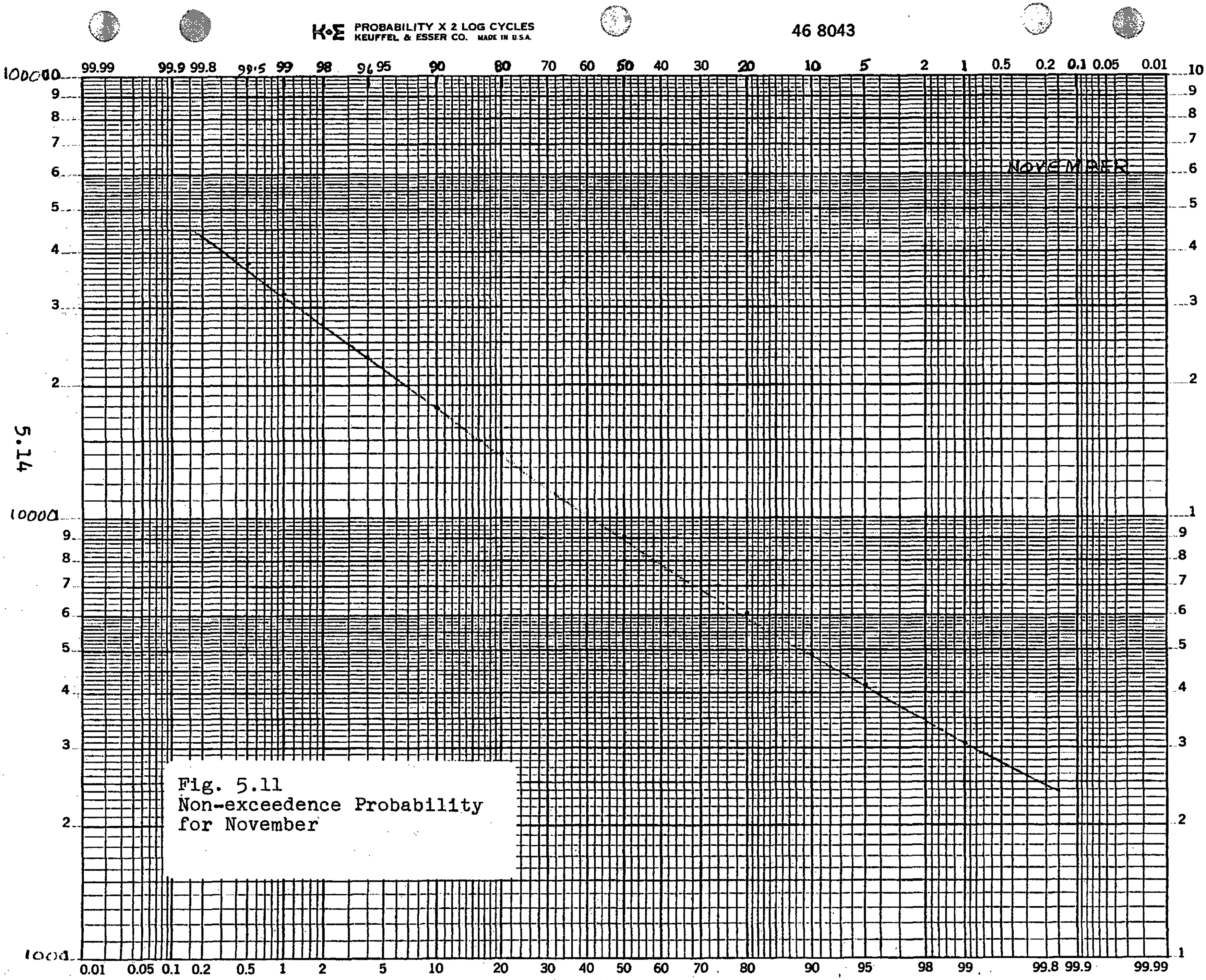


Fig. 5.11
Non-exceedence Probability
for November

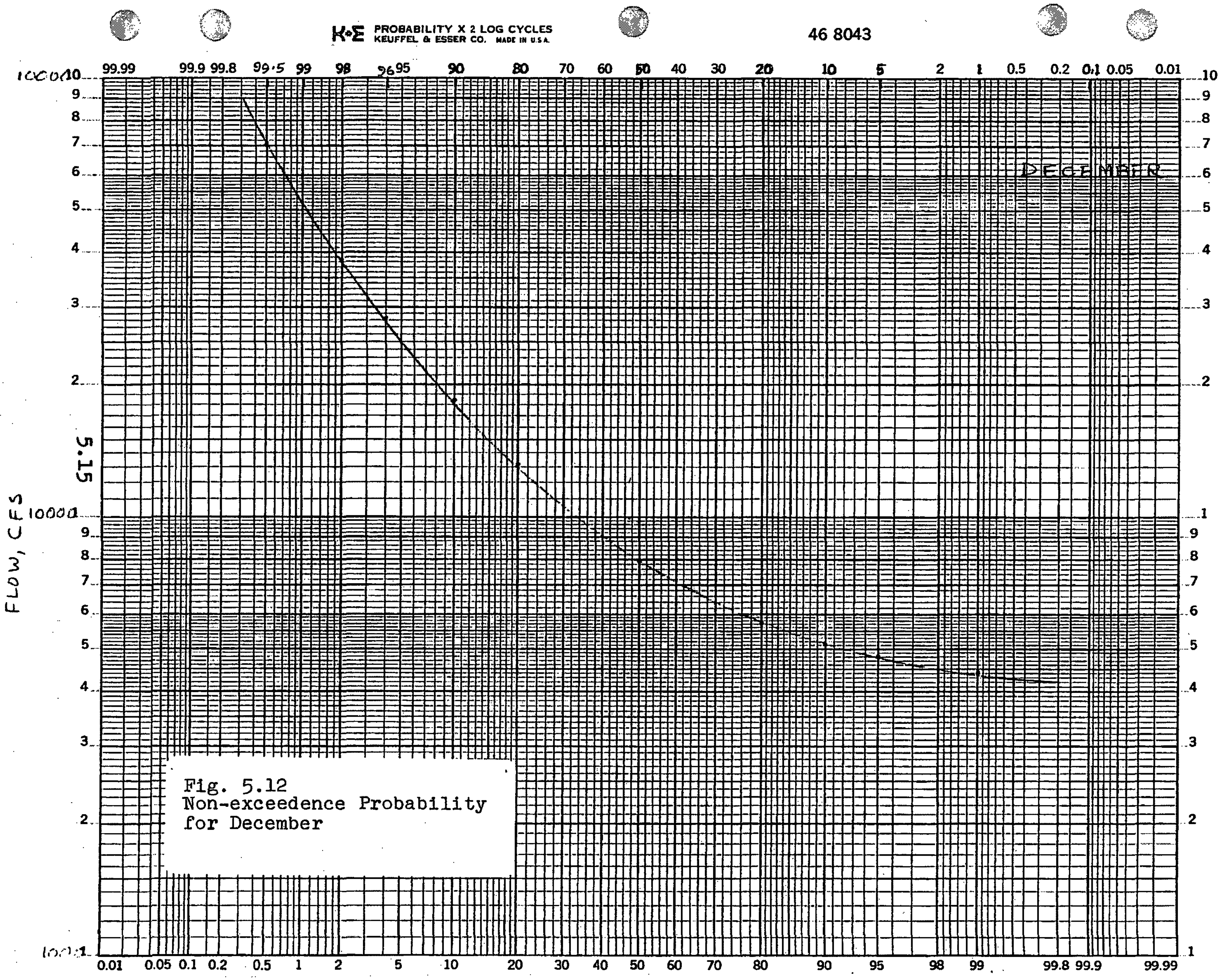


Fig. 5.12
Non-exceedence Probability
for December

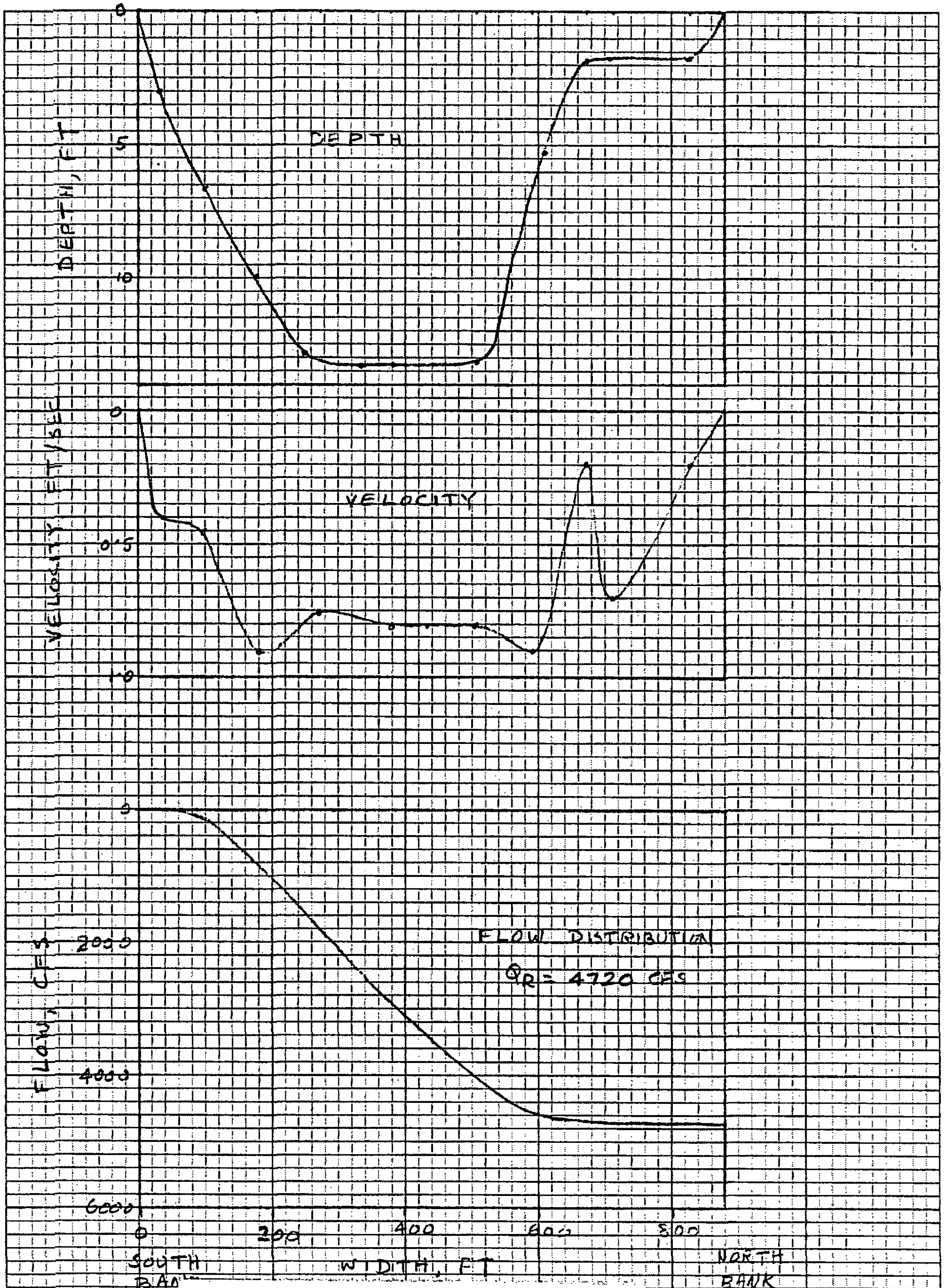


Figure 5.13 Depth, Velocity and Flow Distribution in the Illinois River at LaSalle Station.

The total measured flow rate of Illinois River at La Salle Station site on November 1, 1976 was 4720 cfs. The monthly non-exceedence probability curve for the month of November (Fig. 5-11) shows that mean flows of 4720 cfs are exceeded 91.0% of the time in the Illinois River. The maximum design intake flow rate of the La Salle Station during 2 pump operation at the river screenhouse is 60,000 gpm (134 cfs) which is only 2.8 percent of the river flow of 4720 cfs. Hence, assuming that the larval drift is uniformly distributed within the river flow, it can be stated that the chances are only 1 in 91 for entrainment of 2.8 percent larval drift during an average November. The flow distribution curve shown in Figure 5.13 indicates that 134 cfs of river flow passes through a fractional river width of 90 ft., which is 10 percent of the total river width of 880 ft. Hence, even though only 2.8 percent of larval drift is entrained, 10 percent of the river width may be affected by the intake. The fractional river width affected is higher because the water intake to the station occurs from the shallower bank region of the river adjacent to the intake structure where the depth is much less than that of the main river channel. As shown in figure 5.13, the withdrawal of makeup water is from the deeper and, therefore, less productive side of the river.

Table 5.3 shows the river flows and percent plant intake flows for three exceedence probabilities in each month. A flow with 99% exceedence probability means that 99% of time of river flow will be greater than the given flow. In other words, a flow with 99% exceedence probability indicates a flow that might occur once in 100 years. Table 5.3 shows that the maximum percent plant

Table 5.3 - River Flows and Percent Plant Intakes for Various Exceedence Probabilities in Each Month

LaSalle Station - Intake = 134 cfs.

| Month | Exceedence Probability | | | | | |
|---|---|---|---|---|---|---|
| | 99% (1 in 100 year flow) | | 90% (1 in 10 year flow) | | 50% (Mean Flow) | |
| | River Flow (cfs) | % Intake | River Flow (cfs) | % Intake | River Flow (cfs) | % Intake |
| January | 2612 | 5.1 | 4786 | 2.8 | 9435 | 1.4 |
| February | 2955 | 4.5 | 5775 | 2.3 | 11201 | 1.2 |
| March | 4815 | 2.8 | 8206 | 1.6 | 13995 | 0.96 |
| April | 5486 | 2.4 | 8782 | 1.5 | 15149 | 0.88 |
| May | 6008 | 2.2 | 8111 | 1.6 | 12614 | 1.1 |
| June | 5358 | 2.5 | 7323 | 1.8 | 10835 | 1.2 |
| July | 4551 | 2.9 | 5841 | 2.3 | 8494 | 1.6 |
| August | 4126 | 3.2 | 5118 | 2.6 | 7261 | 1.8 |
| September | 3135 | 4.3 | 4342 | 3.1 | 6952 | 1.9 |
| October | 2752 | 4.9 | 4075 | 3.3 | 7007 | 1.9 |
| November | 2813 | 4.8 | 4304 | 3.1 | 7587 | 1.8 |
| December | 4422 | 3.0 | 5147 | 2.6 | 8000 | 1.7 |

withdrawal is only 5.1, corresponding to a very low river flow (1 in 100 year flow) of 2612 cfs in January. Hence, the maximum possible larval drift to be entrained by the La Salle Station is less than 5.1 percent, even considering a very unlikely low flow of 1 in 100 year flow. For other exceedence probabilities given in Table 5.3 (90% and 50%), the percent plant intake is lower than 4.1 percent.

Figures 5.14 through 5.16 show the flow distribution curves for five different river flows between 4720 cfs and 16,000 cfs. This is the range of mean flows (50% exceedence probability) for any month for Illinois River at the Station site. These figures show that the fractional river width affected by the plant operation is within 12 percent all the time. Again, fractional river width affected is higher than the fractional flow affected, because the water intake to the Station occurs from the shallower bank region of the river adjacent to the intake structure.

The period of time when drift is expected to occur in the Illinois River in the vicinity of the Station intake is from April through September. During this period, Table 5.2 shows that the lowest one-in-hundred year flow of the river of 3135 cfs occurs in September. Minimum one-in-ten year flow for the same period is 4342 cfs, again occuring in September and the mean flow for the period is 6952 cfs. For a station intake flow 134 cfs, the maximum percent plant intake during the period April through September for the three cases are:

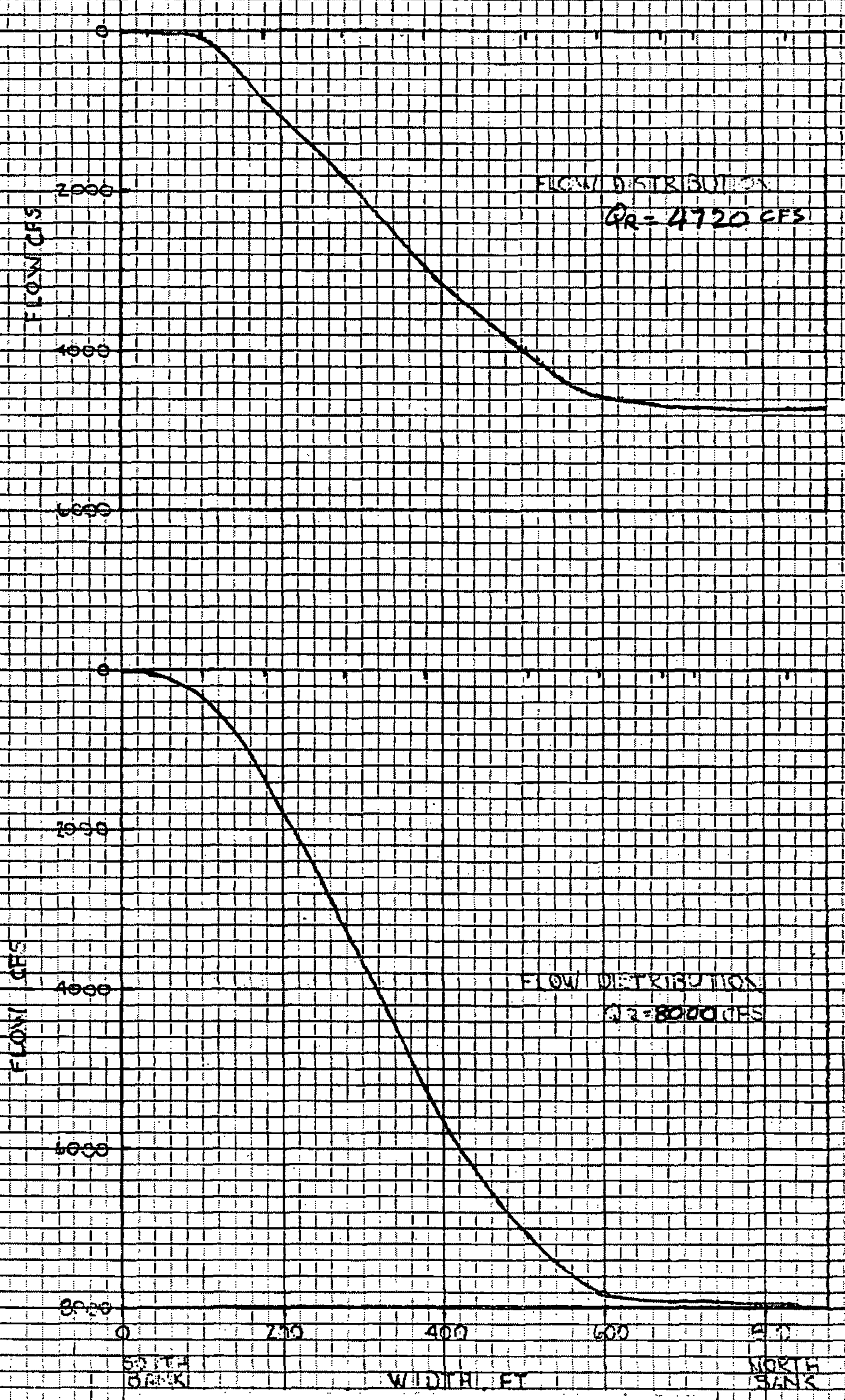


Figure 5.14 Illinois River Flow Distribution at 4,720 and 8,000 cfs.

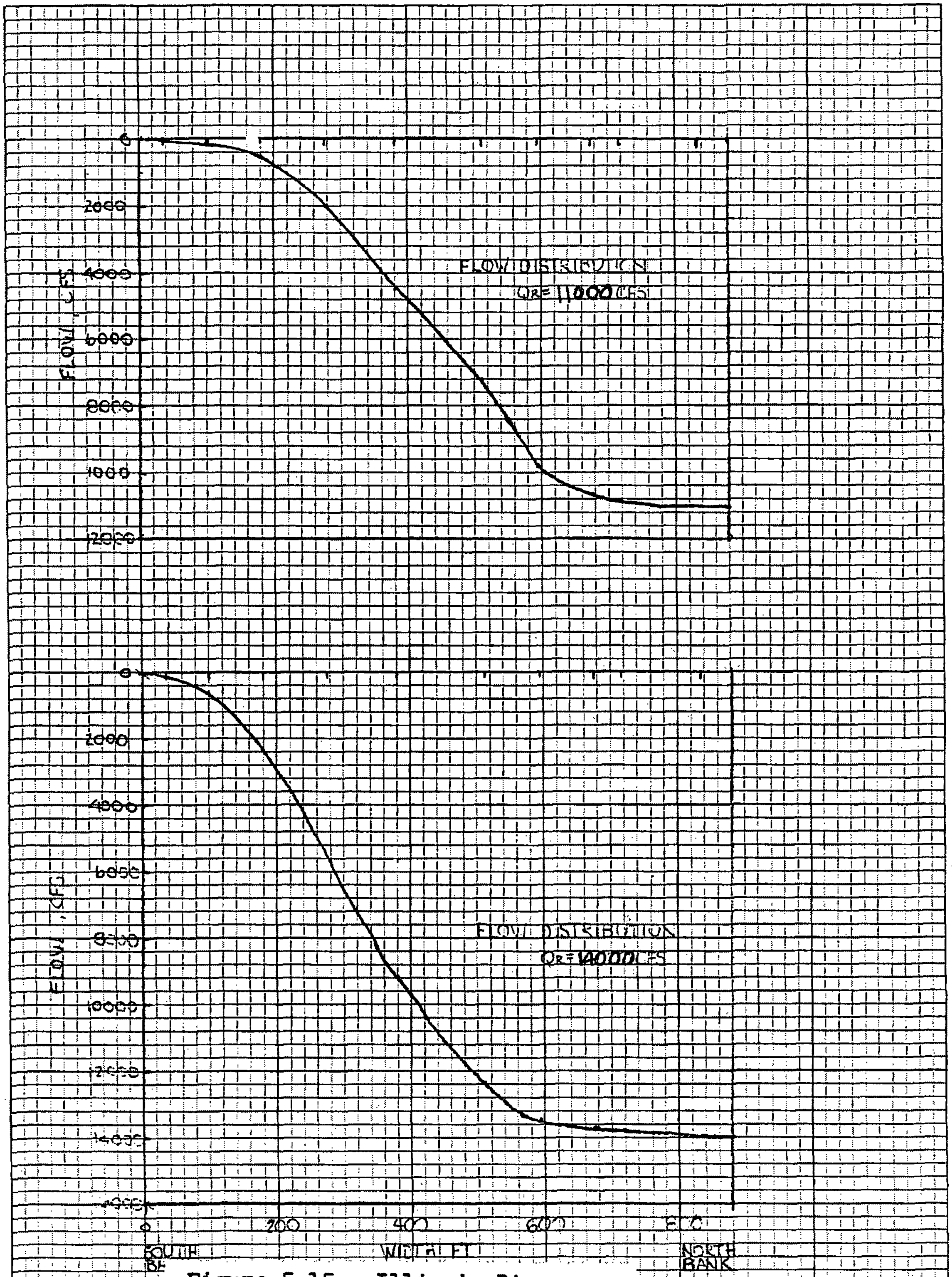


Figure 5.15 Illinois River
Flow Distribution at
11,000 and 14,000 cfs

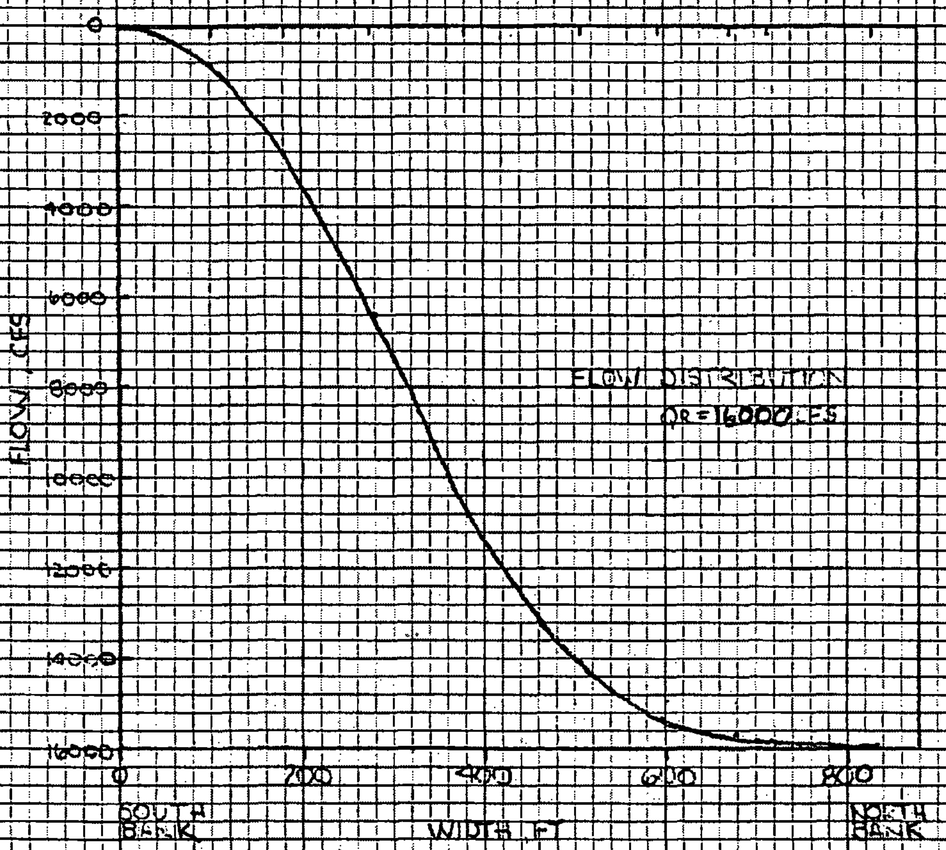


Figure 5.16 Illinois River Flow Distribution at 16,000 cfs.

| | |
|---|---|
| one-in-hundred year flow: | 4.3 percent |
| one-in-ten year flow: | 3.1 percent |
| mean flow: | 1.9 percent |

The above analysis shows that during the period when drift occurs in the Illinois River, the maximum drift affected by the station operation will be less than 4.3 percent. Figure 5.14 shows that when the river flow is 3135 cfs, the plant intake flow of 134 cfs passes through a river width of less than 90 ft. wide from the intake bank.

In view of the small portion of the Illinois River affected by the La Salle Station Cooling Pond Make-up intake, the effect on drifting fish eggs and larvae will be minimal.

5.2 Impingement

The intake to the cooling pond from the Illinois River is designed as a shoreline structure without a canal or other physical features which would attract juvenile or adult fish.

The normal operational makeup rate is approximately 30,000 gpm (one pump) however it is predicted that for approximately seven percent of the station's operating time a makeup rate of approximately 60,000 gpm (two pumps) will be required. Approach velocities calculated at the floating boom range between 0.4 to 0.6 feet per second (fps) at the normal makeup rate of 30,000 gpm and between 0.6 to 1.0 fps at 60,000 gpm depending upon river levels.

Calculations by the architect-engineer indicate that at the normal intake flow of 30,000 gpm, the velocity of the water passing through the traveling screens ranges from .3 to .4 fps while at a flow of 60,000 gpm the range is from 0.5 to 0.7 fps.

At these velocities most of the healthier adult fish which are found in the Illinois River are expected to be able to swim away from the intake and avoid impingement (Schuler 1967).

Since swimming speed generally increases with size within a species, more small than large fish are expected to be impinged. Temperatures as well as size influence impingement frequency. As water cools down during fall and early winter, increased impingement losses may occur because colder water temperatures reduce swimming speeds (Hocutt, 1970).

There will be no heated water, or other discharges, to attract fish around the intake. No deicing operation in the winter is required, and no deicing facilities have been installed. There are no provisions for the addition of biocides to the pond makeup water. The cooling pond blowdown structure is located approximately 200 yards downstream of the intake site. The distance between the makeup and blowdown structures should insure that recirculation of discharge water into the intake will not occur.

The fish populations of this sector of the river have been severely restricted in species composition because of poor habitat resulting from increased turbidity, sedimentation, chronic pollution and decreased oxygen. The biological status of the river now is such that few pollution sensitive (including temperature sensitive) organisms remain. The dominant fish species that are present (shinners, carp, green sunfish, goldfish and bullheads) are tolerant of relatively high water temperature and other pollution stresses. There is no significant sport fishery or commercial fishery in this portion of the river (Mills et al 1966). Due to

the poor quality of the environment and the resultant low diversity and quality of the fish species, the majority of the fish that could be impinged would be members of rough and forage species. Only a small percentage of the total annual impingement would be comprised of sport and commercial species.

In summary, there will be no significant entrapment of adult fish at the intake. Entrapment which may occur will have no measurable influence on fish population dynamics in the Illinois River.

## 6.0 CONCLUSIONS

The impingement of juvenile and adult fish and the entrainment of fish eggs and larvae in the area of the intake at the La Salle Station cooling pond make-up pumphouse is expected to be negligible. The intake design utilizes some of the more desirable intake location, design, and capacity factors that are considered in the document entitled "Development Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact" (U.S.EPA 1976).

The design and siting utilized in the La Salle intake incorporate the following features:

1) low volume of water for make-up purposes (108.3 cfs). This makeup volume will be achieved by operating one pump (normal operation) for approximately 93 percent of the station's operating time and two pumps (134 cfs) for the remaining 7 percent;

2) approach velocities during normal one pump operation are within the acceptable range for protecting fish (0.4 to 0.6 fps) as are the approach velocities during two pump operation (0.6 to 1.0 fps);

3) the location of the make-up house and related structures is on a straight portion of the riverbank with no back-water areas and is situated on the shoreline in order to prevent an embayment to which juvenile and adult fish would be attracted;

4) the intake structure has no provision for recirculating heated water for ice melt purposes thus avoiding the potential for attracting fish during winter months into the area of the intake;

5) there is no provision for injecting chemical biocides into pond make-up water at the river screenhouse;

6) during the one-in-one hundred year low flow, under two pump cooling pond make-up operation, the maximum drift affected will be less than 4.3 percent and limited to a region less than 90 ft. wide from the intake shoreline. Under the same operating conditions, the maximum drift affected will be less than 2 percent during mean flows;

7) because the cooling pond blowdown is located 200 yards downstream of the intake, there will be no interaction with the intake.

The Illinois River has experienced adverse ecological changes since the mid-1800's due to low flow, increased siltation, and various forms of domestic and industrial wastes. The physical and chemical changes in the Illinois River resulting from man's activities have so altered this aquatic habitat that in 1965 a 240 mile section of the river below Chicago was inhabited only by pollution tolerant organisms (Mills et al 1966).

The species composition of fish in the Illinois has changed drastically since 1900. The upper Illinois River, which includes the Marseilles Pool currently supports a limited number of species

primarily carp, gizzard shad, emerald shiner and green sunfish. The most abundant fish throught the length of the river is carp but even this very tolerant species is living under stressed conditions in this pool as evidenced by slow growth and frequent disease symptoms.

Prior to 1900, a thriving commercial fishery existed in the river for such species as largemouth bass, carp and crappie. Although there was a total commercial harvest of over 900,000 pounds of fish in the Illinois River in 1970, there was no harvest above the Starved Rock Pool (AEC, 1973). The commercial fishery, as evidenced by only one full-time and 34 part-time registered commercial fishermen for the entire Illinois River in 1975, is extremely limited.

The sport fishery has also been adversely affected by the changing conditions in the river. There is no significant sport fishery in the portion of the river that will be affected by the intake. (AEC, 1973) The low numbers of game fish collected during the construction phase monitoring programs at the La Salle site substantiate this conclusion.

The existing fisheries in the Marseilles Pool of the Illinois River are indicative of the poor quality and stressed habits. Consequently, it would be expected that low numbers of game and commercial species would be impinged or entrained.

Among the factors which make this a poor habitat are: 1) maintenance dredging to maintain a navigatable channel, and the disposal of this dredged material which destroys the immediate area being dredged, disrupts habitats downstream of the dredging because of increased siltation and turbidity and destroys habitats

in the areas where the spoil material is deposited; 2) marginal water quality; 3) industrialization along the Illinois Water upstream of the La Salle Station; 4) urban sewage contribution to the waterway; 5) barge traffic; and 6) nonpoint sources such as runoff from farmed land.

The environmental factors in the Illinois River near La Salle Station make-up intake and the engineering design and siting features of the intake system as previously discussed, are the best available intake technology for minimizing adverse environmental impacts at this location.

## 7.0 REFERENCES CITED


Battelle Pacific Northwest Laboratory, 1975, Environmental Impact Monitoring of Nuclear Power Plants, Prepared for Atomic Industrial Forum, Inc.

Bodola, A., 1966. Life history of the gizzard shad, Dorosoma cepedianum (LeSueur), in Western Lake Erie. U. S. Fish Wildlife Serv. Fish. Bull. 65(Z): 391-425.

Buck, D. H. 1956. Effects of Turbidity on Fish and Fishing. Trans. North Am. Wildlife 21st Conf. 249-261.

Carlander, K. D. 1969. Handbook of Freshwater Fishery Biology. Volume 1. Iowa State University Press, Ames, Iowa.

Forbes, S. A. and R. E. Richardson. 1913. Studies on the Biology of the Upper Illinois River. Ill. State Lab. Nat. Hist. Bull. 9(10): 481-574.

Forbes, S. A. and R. E. Richardson. 1919. Some Recent Changes in Illinois River Biology. Ill. Nat. Hist. Surv. Bull. 13(6): 139-156.

Hutchinson, G. E., 1967. A Treatise on Limnology, John Wiley & Sons, Inc., New York, Vol. 2. 1115 pp.

Hynes, H. B. N., 1970. The Ecology of Running Waters, University of Toronto Press, Toronto, Canada. 555 pp.

Hocutt, C. M., 1970. The Effects of Temperature on the Swimming Performance of the Largemouth Bass, Spotfin Shinner, and Channel Catfish. Ichthyological Associater, Holtwood, Pennsylvania, Muddy Run Studies Progress Report 5.

Industrial BIO-TEST Laboratories, Inc., 1974. Baseline Environmental Study of the Dow Site near Joliet, Illinois (IBT No. 3733). Report to Dow Chemical Company. Joliet, Illinois. 152 pp.

Limnetics, Inc., 1973. A Survey of the Illinois River near the Proposed LaSalle County Nuclear Power Station, Prepared for Commonwealth Edison Co., 94 pp.

Lopinot, A. C. (ed). 1968. Inventory of the Fishes of Nine River Basins in Illinois 1967. Ill. Dept. Cons. Fish. Sp. Rept. No. 25.

McKee, J. E. and H. W. Wolf, ed. 1963, Water Quality Criteria, California State Water Resources Control Board Publication No. 3-A. 548 pp.

Meunch, B. I. 1968. Average Growth Rate of Fish in Northeastern Illinois. Ill. Dept. Conserv. Springfield, Ill. 14 p.

Mills, H. B., W. S. Starrett, and F. C. Bellrose. 1966. Man's Effect on the Fish and Wildlife of the Illinois River. Ill. Nat. Hist. Surv. Biol. Notes No. 57. 24 pp.

NALCO Environmental Sciences (formerly Industrial Bio-Test Laboratories, Inc.), 1974. An Environmental Reconnaissance of the Illinois River near the Proposed Site of the LaSalle County Power Station, 30 August 1972. IBT No. W1705, Prepared for Commonwealth Edison Company, 45 pp.

National Academy of Science, 1973, Water Quality Criteria, 1972, United States Environmental Protection Agency Office of Research and Development, EPA-R3-73-033, Washington, D.C. 594 pp.

Nelson, E. W. 1878. Fisheries of Chicago and Vicinity. In: Report of the U. S. Commissioner of Fish and Fisheries for 1875-1876, Part 4, Appendix B, p. 783-800.

Palmer, C. M. 1962, Algae in Water Supplies. U. S. Dept. for Health, Education and Welfare, 88 pp.

Palmer, C. M. 1969, A Composite Rating of Algae Tolerating Organic Pollution, Journal of Phycology, Vol. 3, pp. 78-82.

Patulski, D. 1976. Fisheries IN: Environmental Monitoring (Thermal) of the DesPlaines, Kankakee and Illinois Rivers near the Dresden Nuclear Power Station, January through December, 1974. Fifth Annual Report by Industrial BIO-TEST Laboratories, Inc. to Commonwealth Edison Company, Chicago, Illinois. Chapter 7.

Patulski, D. 1975. Fisheries Studies. IN: Aquatic Monitoring Program for the Construction Phase of the LaSalle County Station 1974. First Annual Report by Industrial BIO-TEST Laboratories, Inc. to Commonwealth Edison Company, Chicago, Illinois. Chapter 6.

Pennak, R. W., 1953, Fresh-Water Invertebrates of the United States, The Ronald Press Co., New York, 769 pp.

Pielou, E. C. 1966. The measurement of Diversity in different types of biological collections. J. Theor. Biol. 13: 131-144.

Richardson, R. E. 1921. Changes in the Bottom and Shore Fauna of the Middle Illinois River and Its Connecting Lakes Since 1913-1915 as a Result of the Increase, Southward, of Sewage Pollution. Illinois Natural History Survey Bulletin 14 (4): 33-75.

Ricker, W. E. 1968. Methods for assessment of fish production in freshwater. IBP (Int. Biol. Programme) Handbook No. 3, Blackwell Scientific Publ. Oxford England. 313 pp.

Schuler, V.S. 1967. Progress Report on Swim Speed Study conducted on Fishes in Conowingo Reservoir, Icthyological Associates Report No. 1B.

Siegel, S., 1956. Non-parametric Statistics. McGraw-Hill Co. Inc., New York. 312 pp.

Sparks, R. E. and W. C. Starrett, 1975. An Electrofishing Survey of the Illinois River, 1959 - 1974. Illinois Natural History Survey Bulletin 31(8): 317-380.

Starrett, W. C. 1971. A Survey of the Mussels (Unionacea) of the Illinois River: a polluted stream. Illinois Natural History Survey Bulletin 30(5): 267-403.

Starrett, W. C. 1972. Man and the Illinois River, p. 131-169. In: R. T. Oglesby, C. A. Carlson, and J. A. McCann (eds.). River Ecology and Man. Proceedings of an International Symposium on River Ecology and the Impact of Man, held at the University of Massachusetts, Amherst, Massachusetts, June 20-23, 1971. Academic Press. New York. 465 p.

Starrett, W. C. and H. Crum, Jr. 1964. Comparison of two Illinois River Sections 100 miles apart. Monthly Fish. Res. Letter. 4(7): 1.

Steel, R. G. D. and J. H. Torrie, 1960. Principles and Procedures of Statistics. McGraw-Hill Co., Inc., New York. 481 pp.

Stinauer, R. 1974. 1973 Fishery survey of the Illinois River and backwater areas. Ill. Div. Fish. Spec. Fish. Rep. No. 45. 10 p.

Thompson, D. H. 1928. The knothead carp of the Illinois River. Ill. Nat. Hist. Surv. Bull. 17(8): 285-320.

U. S. Atomic Energy Commission. 1973. Final Environmental Statement related to the LaSalle County Nuclear Station. Commonwealth Edison Company Docket Nos. 50-373, 50-374.

U. S. Environmental Protection Agency, 1976. Development Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact. EPA 440/1-76/015-a, Washington, D. C.

Warren, C. E., 1971, Biology and Water Pollution Control, W. B. Saunders Co., Philadelphia, Pennsylvania.