CONFERENCE

in the matter of

Pollution of the Interstate Waters of the

UPPER MISSISSIPPI RIVER

VOLUME IV

St. Paul, Minnesota

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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VOLUME IV

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EXHIBITS

x #18-3

# WATER QUALITY SAMPLING PROGRAM

a compilation of minnesota sampling station records

## MINNESOTA LAKES and STREAMS

**VOLUME 3**
*1960-1961*

**BY THE SECTION OF WATER POLLUTION CONTROL**
**DIVISION OF ENVIRONMENTAL SANITATION**
**MINNESOTA DEPARTMENT OF HEALTH**

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WATER POLLUTION CONTROL COMMISSION

State of Minnesota



MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control
(Technical and Administrative Agency
for the Commission)

Volume 3

1960 - 1961

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## INTRODUCTION

This information has been obtained as part of a program to keep the Minnesota Water Pollution Control Commission, and others concerned, informed regarding the quality of the various surface waters in the State. The program includes routine collection and analysis of water samples at representative points from key rivers and lakes.

The data are being made available to those who frequently need such data in their work and are directly concerned with the quality of the surface waters in specific areas of the State.

As far as practicable, sampling stations were located near official gaging stations maintained by the United States Geological Survey. Analysis of the samples included tests for coliform group organisms, turbidity, suspended solids and volatile matter, pH, dissolved oxygen, 5-day biochemical oxygen demand, temperature, phosphorus, nitrates, total nitrogen, suspended and dissolved gross beta activity, and total gross beta activity.

The program started in 1952 with 16 streams; 29 sampling stations being selected at points considered reasonably representative of general conditions of the rivers, and also where pollution might be a consideration.

In February, 1955, the program was expanded to include a total of 19 rivers and 50 sampling stations. Late in 1956, sampling and analysis for radioactivity content of the water was added to the existing program. In 1958, further changes in the chemical analyses were made and the program was revised to include 25 major rivers and lakes at 71 stations. In 1959 the program included 53 stations on 22 lakes and streams.

In 1960 the program included 57 stations on 26 lakes and streams, and in 1961 it included 61 stations on 29 lakes and streams. The latest additions include mainly stations in the Twin Cities Metropolitan Area and on interstate waters.

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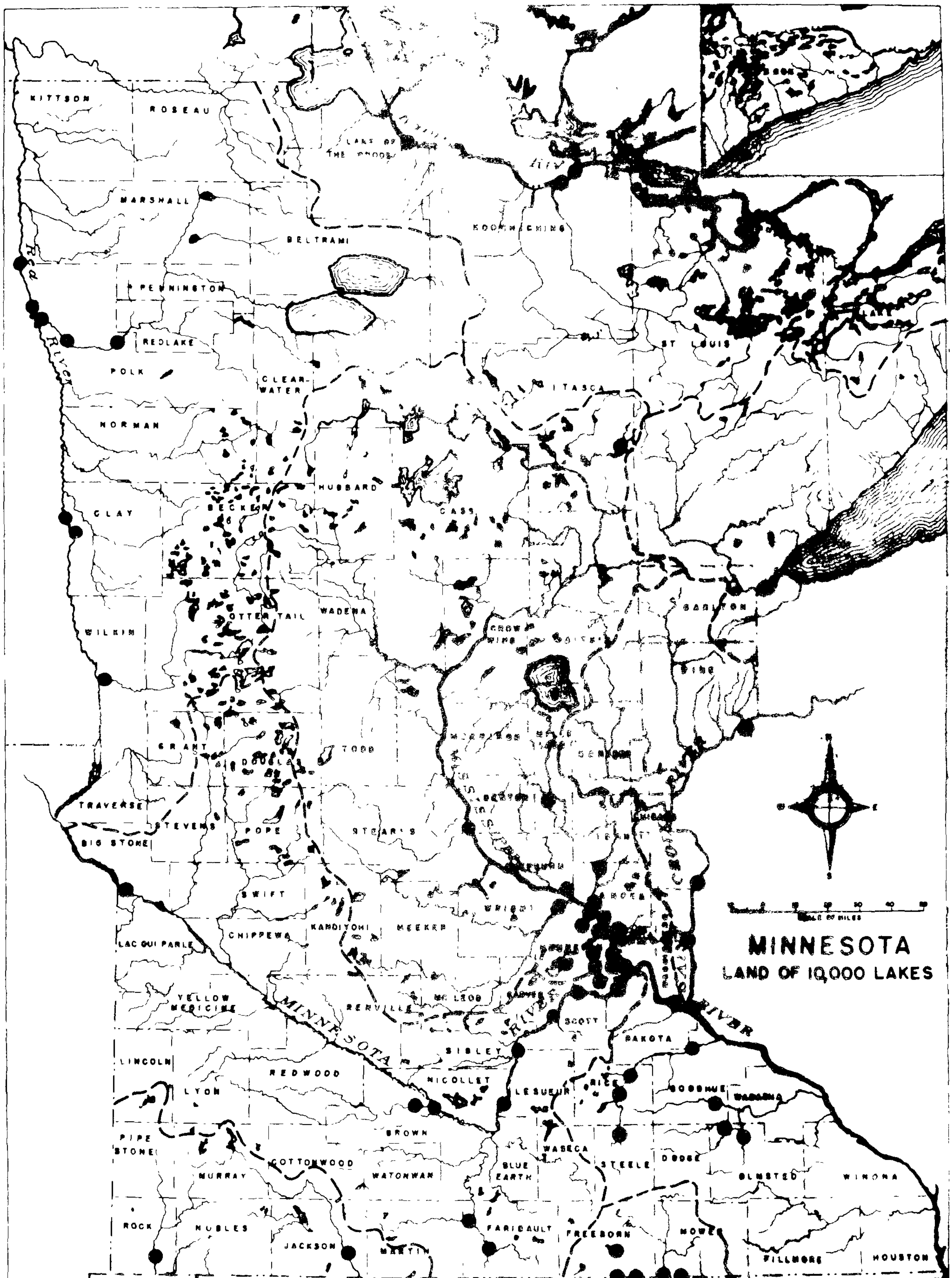
## LOCATION OF WATER QUALITY SAMPLING PROGRAM STATIONS

1961




MINN DEPT OF HEALTH
SEC. W. PC.
APRIL, 1963

## COLLECTION OF SAMPLES

The water samples were collected by personnel of the Section of Water Pollution Control, generally by means of a "double" sampler. The "double" sampler is constructed to permit simultaneous collection of three separate samples; for determination of dissolved oxygen, coliform organisms, and general chemical content. Sampling was usually done from a bridge, or when necessary from a bank, by immersing the sampler to a depth of about one foot in the main flow of the stream.

Whenever possible, the samples obtained at each station were always collected at the same spot and as nearly as possible in the same part of the flow, in order to minimize changes caused by differences in sampling. The samples were preserved with ice and shipped promptly to the Section of Engineering Laboratories in Minneapolis for analysis.

The temperature, pH, and dissolved oxygen of the samples were determined in the field, and a record was also made of pertinent physical conditions at the time of sampling.

## ANALYTICAL PROCEDURES

### Ammonia Nitrogen:

The ammonia is distilled from the sample at pH 7.4. The distillate is treated with Nessler reagent and the color developed is read in a spectrophotometer. Results are reported as ammonia nitrogen in mg/l.

### Chlorides:

Chlorides are determined by measuring the potential of a silver-silver chloride electrode immersed in the acidified sample. The potential is measured against another silver-silver chloride electrode immersed in a standard chloride solution. Sample and standard are connected by means of an asbestos fiber bridge. Results are reported as chloride ion in mg/l.

### Coliform Group Organisms:

Portions of the sample are planted in three or more series of five tubes containing lactose broth. The volume of sample planted in the five tubes of one series is always ten times greater than the volume planted in the next succeeding series. The prepared samples are incubated for 48 hours at 35°C, and the presence or absence of gas in each tube is noted and recorded at 24 hour intervals. After incubation is completed, results are obtained by reference to statistical tables and reported as the most probable number of coliform organisms per 100 ml.

### Dissolved Oxygen:

This determination is made by the Winkler technique, where manganous sulfate is added to the sample and made to react with the dissolved oxygen by raising the pH with a strong base containing potasium iodide. The manganic hydroxide precipitate formed is dissolved by the addition of concentrated sulfuric acid. Under these conditions, the manganic ions oxidize the iodide present to free iodine, which is titrated with standard sodium thiosulfite, using starch as an indicator. Results are reported as DO in mg/l.

This determination is made in the field at the time of sample collection.

### Five-Day Biochemical Oxygen Demand:

The sample is diluted with distilled water fortified with mineral nutrients. The dissolved oxygen is determined with a polarograph before and after five days of incubation in the dark at 20°C. The oxygen consumed is calculated and reported as BOD in mg/l.

### pH:

A battery powered portable pH meter is used in the field. Reported in pH units.

### Radioactivity:

1. Suspended gross beta activity:

The sample is filtered through a membrane filter and the residue on the filter is washed into a planchet, dried, and counted for beta activity in either an internal proportional counter or an end

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window counter and reported as suspended gross beta activity in micro-micro-curies per liter.

2. Dissolved gross beta activity:

The filtrate from the suspended gross beta activity determination is evaporated to dryness in a planchet, and counted for beta activity and reported as dissolved gross beta activity in micro-micro-curies per liter.

3. Total gross beta activity:

Total gross beta activity is the sum of the suspended and the dissolved gross beta activity.

4. Suspended gross alpha activity:

The sample is filtered through a membrane filter and the residue on the filter is washed into a planchet, dried, and counted for alpha activity by an internal proportional counter and reported as suspended gross alpha activity in micro-micro-curies per liter.

5. Dissolved gross alpha activity:

The filtrate from the suspended gross alpha activity determination is evaporated to dryness in a planchet, and counted for alpha activity and reported as dissolved gross alpha activity in micro-micro-curies per liter.

Suspended Solids:

The sample is filtered through a weighed glass fiber filter disc. The disc is then dried at 103 - 105°C and re-weighed. The results are reported as suspended solids in mg/l.

Suspended Volatile Matter:

After the suspended solids have been determined, the filter disc used in that determination is ignited at 600°C, cooled, and re-weighed. The loss in weight is reported as suspended volatile matter in mg/l.

Temperature:

Determined in the field and reported in °F.

Turbidity:

Read from a Hellige turbidimeter which has been calibrated with a Jackson candle turbidimeter, and reported as turbidity units.

## FLOW GAGING RECORDS

The records of stream discharge used in conjunction with the analytical data are published in U. S. Geological Survey reports on the surface water supply of the United States, although in some cases unpublished, provisional data have been used.

A detailed description of the gaging stations may be found in U.S.G.S. Water Supply Papers, Reports Nos. 1388, 1507, 1399 and 1280, Hudson Bay and Upper Mississippi River Basins, St. Lawrence River Basin, Missouri River Basin Above Sioux City, Iowa, and Missouri River Basin Below Sioux City, Iowa, respectively, and "1961 Surface Water Records of Minnesota," U.S.G.S.

It should be noted that in a number of instances the flow was not gaged at the sampling station but at some other point on the river. In these instances, the data for the nearest gaging station are given and an explanatory note to this effect may be found under "Remarks."

## SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| CAR | County Aid Road |
| °C | Degrees Centigrade |
| Cl | Chlorides |
| cfs | Cubic feet per second |
| DO | Dissolved Oxygen |
| °F | Degrees Farenheit |
| 5-Day BOD | 5-Day Biochemical Oxygen Demand |
| IFB | Indistinguishable From Background |
| uuc/l | Micro-micro-curies per liter |
| mg/l | Milligrams per liter |
| MPN/100 | Most probable number per 100 milliliters |
| N | Nitrogen |
| NF | Not found |
| pH | The common logarithm of the reciprocal of the hydrogen ion concentration |
| SAR | State Aid Road |
| SH | State Highway |
| SS | Suspended Solids |
| SVM | Suspended Volatile Matter |
| USH | United States Highway |
| < | Less than |
| > | More than |

Bassett Creek
Lower Mississippi River Basin

LOCATION: Golden Valley; bridge on 6th Avenue North

STATION: Ba-2.3

RECORDS AVAILABLE: None
REMARKS: Flow data not available

WATER QUALITY DATA, 1960 - 1961

| Date | Temp (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3/16/60 | 36 | 8.0 | 200 | 12 | 7 | 12 | 50 | - | 7.8 | 6.8 |
| 5/24/60 | 66 | 7.8 | 9,200 | 41 | - | 20 | 10 | 0.08 | 7.6 | 3.5 |
| 6/15/60 | 75 | 8.3 | 9,200 | 19 | 6 | 10 | 11 | 0.22 | 8.6 | 4.3 |
| 7/18/60 | 78 | 7.7 | 4,600 | 26 | 10 | 13 | - | 0.06 | 7.1 | 7.3 |
| 8/16/60 | 71 | 7.7 | 160,000 | 30 | 8 | 18 | 9 | 0.20 | 4.1 | 5.3 |
| 9/29/60 | 57 | 7.1 | 9,500 | 44 | 15 | 45 | 16 | 0.14 | 6.7 | 5.3 |
| 10/18/60 | 52 | 7.7 | 2,100 | 50 | 11 | 17 | 16 | 0.16 | 7.1 | 2.8 |
| 12/22/60 | - | 7.8 | 78 | 22 | 8 | 10 | 30 | 0.14 | 22.5 | 1.5 |
| 2/23/61 | 35 | 7.6 | 13,000 | 26 | 10 | 20 | 100 | 0.16 | 12.2 | 11 |
| 4/12/61 | 48 | 8.1 | 200 | 32 | 8 | 20 | 18 | 0.16 | 11.1 | 7.3 |
| 7/11/61 | 76 | 7.4 | 180,000 | 58 | 13 | 20 | 18 | 0.04 | 5.8 | 5.3 |
| 8/30/61 | - | 7.0 | 13,000 | 23 | 8 | 13 | 32 | NF | 7.9 | 11.0 |

Big Cottonwood River
Minnesota River Basin

LOCATION: New Ulm; bridge on SAR 3 above Flandreau State Park — STATION: BC - 5.3
RECORDS AVAILABLE: Water Quality Sampling Program, 1953 - 1957, and 1958 - 1959
Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at New Ulm

WATER QUALITY DATA, 1960 - 1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/11/60 | 64 | 8.0 | 1240 | 7,900 | 170 | 35 | 70 | - | - | 8.6 | 5.5 |
| 7/28/60 | 79 | 7.7 | 142 | 13,000 | 50 | 10 | 50 | 3.6 | 0.08 | 5.8 | 6.5 |
| 10/3/60 | 55 | 8.4 | - | 35,000 | 43 | 13 | 30 | 9.0 | NF | 7.9 | 3.3 |
| 3/1/61 | 32 | 7.2 | - | 13,000 | 64 | 13 | 20 | 6.2 | 0.50 | 10.2 | 14 |
| 5/12/61 | 63 | 8.0 | - | 7,900 | 35 | 10 | 11 | 18 | .06 | 9.8 | 5.8 |
| 12/20/61 | 32 | 7.5 | - | 4,900 | 10 | 3 | 18 | 6.4 | .56 | 8.4 | 3.2 |

Blue Earth River
Minnesota River Basin

LOCATION: Winnebago; bridge on CAR 2 which continues east from CAR 136 for ½ mile to the Blue Earth River near Winnebago

STATION: BE-63

RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station near Rapidan

WATER QUALITY DATA 1960 - 1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/16/60 | 32 | 8.2 | 146 | 160,000 | 10 | - | 2 | - | - | 10 | 3 |
| 4/12/60 | 64 | 7.8 | 1,300 | 7,900 | 78 | 14 | 36 | - | - | 7.4 | 5.3 |
| 7/27/60 | 78 | 7.9 | 545 | 22,000 | 265 | 41 | 90 | 4.5 | 0.04 | 6.5 | 7.2 |
| 10/4/60 | 59 | 8.2 | 728 | 350,000 | 81 | 17 | 16 | 30 | NF | 8.9 | 68 |
| 3/2/61 | 32 | 7.3 | 385 | 170,000 | 110 | 29 | 30 | 11 | 0.60 | 8.4 | 28 |
| 5/10/61 | 56 | 8.0 | 1,010 | 1,300 | 34 | 10 | 13 | 18 | 0.02 | 10 | 6.5 |
| 12/20/61 | 33 | 7.4 | - | 11,000 | 5 | 3 | 15 | 5 | 0.54 | 8.2 | 2.8 |

Blue Earth River
Minnesota River Basin

**LOCATION:** Blue Earth; bridge at golf course 5 miles north of Blue Earth — STATION: BE -84
**RECORDS AVAILABLE:** Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
**REMARKS:** Provisional flow data from gaging station near Rapidan.

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/16/60 | 32 | 8.1 | 146 | 7,900 | 7 | - | 8 | - | - | 13 | 2.2 |
| 4/12/60 | 66 | 7.6 | 1320 | 7,900 | 32 | 6 | 16 | - | - | 9.3 | 4.0 |
| 7/27/60 | 74 | - | 545 | 920,000 | 240 | 32 | 88 | 6.0 | 0.08 | 5.7 | 5.0 |
| 10/4/60 | 58 | 8.2 | 728 | 17,000 | 74 | 14 | 16 | 40 | 0.16 | 9.6 | 5.0 |
| 3/2/61 | 32 | 7.2 | 385 | 540,000 | 60 | 15 | 25 | 10 | 0.68 | 7.5 | 29 |
| 5/10/61 | 57 | 8.1 | 1,010 | - | 32 | 8 | 12 | 25 | 0.06 | 10 | 5.8 |
| 12/20/61 | 32 | 7.4 | - | 35,000 | 8 | 4 | 10 | 4.5 | 0.36 | 8.4 | 4.3 |

Cannon River
Lower Mississippi River Basin

STATION: Ca 13.4

LOCATION: Welch; bridge on SAR 7
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Departmepartment of Health
REMARKS: Provisional flow data from gaging station at Welch

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/20/60 | 32 | 7.6 | 350 | 13,000 | 31 | - | 15 | - | - | 10 | 3.0 |
| 4/7/60 | 45 | 7.9 | 1,050 | 7,900 | 33 | 6 | 16 | - | 0.58 | 11 | 4.3 |
| 7/20/60 | 75 | 8.2 | 493 | 3,300 | 18 | 4 | 10 | 88 | 0.04 | 8.2 | 5.0 |
| 11/1/60 | 45 | 8.1 | 195 | 54,000 | 72 | 26 | 6 | 16 | 0.08 | 8.1 | 4.3 |
| 2/22/61 | 40 | 8.0 | 360 | 7,900 | 13 | 6 | 9 | 18 | 0.52 | 12 | 8.5 |
| 5/4/61 | 56 | 7.8 | 461 | 3,300 | 17 | 8 | 11 | 11 | 0.04 | 13 | 6.5 |
| 11/29/61 | 36 | 7.5 | - | 11,000 | 25 | 9 | 15 | 16 | 0.24 | 12 | 3.3 |

Cannon River
Lower Mississippi River Basin

STATION: Ca 37.6

LOCATION: Northfield; 1 mile N.E. on SAR 3 from the junction of USH 3 to first road to S.E., and S.E. to bridge on river.

RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station at Cannion Falls

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/19/60 | 32 | 7.7 | 4.0 | 14,000 | 11 | - | 10 | - | - | 12 | 2.5 |
| 7/19/60 | 73 | 8.2 | - | 17,000 | 48 | 11 | 13 | 14 | 0.18 | 6.0 | 5.8 |
| 11/7/60 | 40 | 8.1 | - | 22,000 | 44 | - | 10 | 18 | 0.42 | 9.5 | 6.0 |
| 2/21/61 | 33 | 7.6 | - | 17,000 | 8 | 8 | 9 | 25 | 1.5 | 8.2 | 7.5 |
| 5/3/61 | 45 | 8.3 | - | 13,000 | 13 | 6 | 9 | 22 | 0.12 | 10 | 4.8 |
| 11/28/61 | 33 | 7.9 | - | 92,000 | 6 | 4 | 10 | 18 | 0.40 | 11 | 2.2 |

Cannon River
Lower Mississippi River Basin

**LOCATION:** Faribault; bridge on CAR 29.3 miles north of Faribault — **STATION:** Ca 49.0
**RECORDS AVAILABLE:** None
**REMARKS:** Provisional flow data from the gaging station at Cannon Falls

## WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/19/60 | 33 | 7.6 | 440 | 54,000 | 13 | - | 15 | - | - | 9.9 | 6.0 |
| 4/6/60 | 39 | 7.1 | 1,170 | 7,000 | 23 | 5 | 10 | - | 0.54 | 10 | 4.8 |
| 7/19/60 | 74 | 8.0 | 493 | 160,000 | 48 | 12 | 18 | 14 | 0.22 | 5.7 | 5.3 |
| 11/7/60 | 38 | 8.0 | - | 35,000 | 52 | 20 | 12 | 16 | 0.72 | 9.1 | 6.3 |
| 2/21/61 | 34 | 8.1 | - | 92,000 | 14 | 6 | 9 | 25 | 1.1 | 4.8 | 9.5 |
| 5/3/61 | 50 | 7.8 | - | 79,000 | 22 | 7 | 11 | 18 | 0.12 | 9.6 | 6.0 |

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Coon Creek
Upper Mississippi River Basin

LOCATION: Coon Rapids; bridge on private road 1 mile south of junction of U.S. Highway 10 and CAR 1 STATION: Co-0.7
RECORDS AVAILABLE: None
REMARKS: Provisional flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Turbidity Value | Suspended Volatile Matter | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 9/29/60 | 51 | 7.1 | 2,300 | 24 | 9 | 9 | 7.0 | 0.08 | 9.0 | 6.5 |
| 10/17/60 | 50 | 8.0 | 3,300 | 12 | 6 | 3 | 4.0 | 0.08 | 9.8 | 2.0 |
| 12/22/60 | 33 | 7.5 | 780 | 12 | 8 | 6 | 5.4 | 0.30 | 8.8 | 3.3 |
| 2/16/61 | 32 | 7.9 | 1,3000 | 3 | 8 | 2 | 5.6 | 0.16 | 12 | 2.5 |
| 4/7/61 | 38 | 7.1 | 780 | 6 | 11 | 4 | 8 | 0.12 | 12 | 2.0 |
| 7/11/61 | 66 | 7.2 | 16,000 | 23 | 10 | 9 | 4.5 | 0.02 | 7.7 | 3.0 |
| 8/29/61 | 65 | 6.0 | 22,000 | 18 | 10 | 6 | 11 | 0.04 | 7.0 | 5.3 |

Crow River
Upper Mississippi River Basin

LOCATION: Dayton; bridge on SH 101 at Dayton
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at Rockford

STATION: Cr-0

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/18/60 | 56 | 6.2 | - | 5,400 | 31 | 9 | 11 | 20 | 0.04 | 7.7 | 5.8 |
| 9/29/60 | 57 | 7.4 | - | 450 | 32 | 14 | 15 | 13 | 0.04 | 9.1 | 8.0 |
| 10/17/60 | 53 | 8.2 | 80 | 3,300 | 18 | 8 | 9 | 16 | 0.02 | 9.5 | 7.8 |
| 12/20/60 | 33 | 7.8 | 47 | 1,100 | 17 | 10 | 8 | 3.5 | 0.14 | 13 | 3.9 |
| 2/17/61 | 32 | 7.8 | 22 | 2,100 | 10 | 1 | 9 | 13 | 0.30 | 10 | 2.5 |
| 4/6/61 | 40 | 8.4 | 162 | 1,300 | 16 | 10 | 11 | 28 | 0.06 | 17 | 6.5 |
| 7/11/61 | 74 | 8.0 | 141 | 1,300 | 56 | 23 | 15 | 11 | 0.02 | 4.2 | 9.3 |
| 8/29/61 | 74 | 8.0 | 42 | 780 | 49 | 16 | 19 | 22 | 0.02 | 7.2 | 8.0 |

Minnehaha Creek
Lower Mississippi River Basin

LOCATION: Minneapolis, Minnehaha Creek at inlet to Lake Nokomis
RECORDS AVAILABLE: None
REMARKS: None

STATION: Min-2

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Nitrate ($NO_3$) | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/24/60 | 70 | 7.7 | 9,200 | 18 | - | 8 | 14 | 0.10 | 17 | 5.8 | 3.8 |
| 6/15/60 | 71 | 8.0 | 130,000 | 14 | 7 | 9 | 16 | 0.04 | 1.1 | 5.3 | 11 |
| 7/18/60 | 87 | 8.2 | 92,000 | 5 | 4 | 7 | - | 0.04 | 0.8 | 6.6 | 3.3 |
| 8/18/60 | 69 | 7.1 | 24,000,000 | 43 | 23 | 22 | 9 | 0.12 | NF | 0.7 | 33 |
| 9/28/60 | 58 | 7.2 | 130,000 | 100 | 64 | 60 | 13 | 0.32 | 1.2 | 5.5 | 26 |
| 2/23/61 | 32 | 7.8 | 11,000 | 73 | 25 | 80 | 180 | 0.56 | - | 12 | 33 |

Minnehaha Creek
Lower Mississippi River Basin

LOCATION: Minneapolis; Minnehaha Creek at Mississippi River — STATION: Min-3
RECORDS AVAILABLE: None
REMARKS: Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/24/60 | 68 | 7.4 | | 3,500 | 44 | - | 15 | 16 | 0.14 | 7.2 | 4.8 |
| 7/18/60 | 79 | 7.4 | | 3,300 | 4 | 4 | 6 | - | 0.1 | 5.9 | 3.3 |
| 8/18/60 | 72 | 7.6 | | 160,000 | 19 | 11 | 15 | 13 | 0.08 | 7.9 | 7.5 |
| 9/28/60 | 62 | 7.0 | | 2,400 | 13 | 8 | 10 | 13 | 0.12 | 9.2 | 8.3 |
| 2/23/61 | 31 | 7.8 | | 2,300 | 4 | 4 | 11 | 50 | 0.36 | 11 | 3.3 |
| 4/12/61 | 44 | 7.9 | | 1,100 | 6 | 3 | 12 | 45 | 0.10 | 12 | 4.0 |
| 8/29/61 | - | 7.3 | | 3,100 | 24 | 4 | 10 | 36 | NF | 7.7 | 4.5 |

Minnehaha Creek
Lower Mississippi River Basin

LOCATION: Edina; bridge at Xerxes Avenue South and W. 54th St — STATION: Minn-7.6
RECORDS AVAILABLE: None
REMARKS: Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3/16/60 | 36 | 7.8 | 200 | 60 | 23 | 40 | 1,000 | - | 12 | 20 |
| 5/24/60 | 70 | 7.7 | 9,200 | 22 | - | 11 | 10 | 0.16 | 6.1 | 3.8 |
| 6/15/60 | 73 | 8.6 | 3,500 | 7 | 4 | 5 | 14 | 0.16 | 14 | 4.0 |
| 7/18/60 | 77 | 8.4 | 22,000 | 1 | - | 6 | - | NF | 11 | 1.5 |
| 8/18/60 | 73 | 7.6 | 240,000 | 12 | 2.0 | 12 | 7.0 | 0.02 | 4.2 | 6.5 |
| 9/28/60 | 59 | 7.1 | 2,200 | 33 | 1.5 | 10 | 13 | 0.02 | 9.7 | 6.0 |
| 10/18/60 | 50 | 7.6 | 22,000 | 38 | 14 | 6 | 13 | 0.08 | 9.8 | 3.0 |
| 2/23/61 | 32 | 7.9 | 18,000 | 51 | 13 | 30 | 80 | 0.34 | 10 | 16 |
| 4/12/61 | 44 | 7.9 | 3,300 | 12 | 8 | 11 | 28 | 0.02 | 12 | 8.5 |
| 7/12/61 | 70 | 7.8 | 35,000 | 7 | 3 | 9 | 11 | 0.08 | 3.6 | 1.0 |
| 8/30/61 | 78 | 7.6 | 28,000 | 3.2 | 1.2 | 6 | 8 | 0.04 | 7.1 | 2.8 |

Minnesota River
Minnesota River Basin

**LOCATION:** Shakopee; bridge on Highway 169 at Shakopee
**RECORDS AVAILABLE:** None
**REMARKS:** Provisional flow data from gaging station at Carver.

**STATION:** Mi-25.1

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand 5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/11/61 | 44 | 7.9 | 4,700 | 35,000 | 110 | 22 | 55 | 13 | 0.10 | - | 5.5 |
| 7/12/61 | 75 | 7.6 | 1,130 | 160,000 | 74 | 20 | 26 | 23 | 0.06 | 6.5 | 7.8 |
| 8/29/61 | - | 7.2 | 1,040 | 170,000 | 66 | 24 | 24 | 36 | 0.04 | 14 | 17.0 |

Minnesota River
Minnesota River Basin

LOCATION: Jordan; bridge on SAR 29, 1 mile north of Jordan

STATION: Mi-39

RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station at Carver

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/11/61 | 43 | 7.8 | 4,700 | 22,000 | 110 | 22 | 35 | 13 | 0.10 | 10.9 | 5.5 |
| 7/12/61 | 75 | 7.5 | 1,130 | 18,000 | 60 | 16 | 25 | 25 | 0.04 | 7.4 | 7.0 |
| 12/19/61 | 33 | 7.5 | - | 4,900 | 8 | 3 | 22 | 9 | 0.20 | 7.3 | 4.8 |

Minnesota River
Minnesota River Basin

STATION: Mi-70

**LOCATION:** Henderson; bridge on SH 19
**RECORDS AVAILABLE:** Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
**REMARKS:** Provisional flow data from gaging station at Carver

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/15/60 | 32 | 8.0 | 560 | 33,000 | 15 | - | 10 | - | - | 5.6 | 3.9 |
| 4/11/60 | 52 | 7.6 | 20,400 | 4,500 | 82 | 17 | 72 | - | - | 8.3 | 4.5 |
| 7/27/60 | 79 | 7.2 | 2,460 | 11,000 | 190 | 8 | 40 | 5.5 | 0.06 | 5.0 | 4.3 |
| 10/3/60 | 55 | 8.4 | 2,000 | 160,000 | 130 | 64 | 23 | 20 | NF | 7.6 | 5.5 |
| 3/1/61 | 32 | 7.6 | 850 | 7,900 | 35 | 6 | 13 | 20 | 0.48 | 8.2 | 8.5 |
| 5/11/61 | 61 | 7.8 | 3,020 | 24,000 | 80 | 18 | 25 | 20 | 0.06 | 11 | 7.3 |
| 12/19/61 | 32 | 7.5 | - | 35,000 | 11 | 4 | 8 | 9 | 0.26 | 7.2 | 5.0 |

Minnesota River
Minnesota River Basin

LOCATION: St. Peter; bridge on US Highway 169 south of St. Peter — STATION: Mi-97
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at Mankato

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/15/60 | 36 | 7.9 | 303 | 7,800 | 6 | - | 9 | - | - | 6.2 | 4.1 |
| 4/12/60 | 56 | 7.4 | 15,100 | 13,100 | 120 | 18 | 80 | - | - | 6.9 | 2.0 |
| 7/27/60 | 80 | 7.6 | 1,740 | 54,000 | 140 | 31 | 45 | 5.5 | 0.18 | 5.6 | 6.0 |
| 10/4/60 | 60 | 7.9 | - | 350,000 | 81 | 18 | 25 | 27 | NF | 8.4 | 7.3 |
| 3/1/61 | 32 | 7.5 | - | 79,000 | 28 | 8 | 16 | 16 | 0.56 | 8.8 | 14 |
| 5/11/61 | 63 | 8.0 | - | 7,000 | 110 | 26 | 21 | 16 | 0.08 | 10.3 | 7.5 |

Minnesota River
Minnesota River Basin

LOCATION: Courtland; North of Junction S.H. 83 and SAR 15 to bridge over River, south of Courtland

STATION: Mi-129

RECORDS AVAILABLE: Water Quality Sampling Program 1953-1957, and 1958-1959, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station at Mankato

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/15/60 | 34 | 8.1 | 303 | 33,000 | 8 | - | 9 | - | - | 8.5 | 2.5 |
| 4/11/60 | 60 | 8.0 | 15,300 | 2,000 | 72 | 16 | 54 | - | - | 9.3 | 4 |
| 7/28/60 | 84 | 7.7 | 1,660 | 54,000 | 220 | - | 46 | 4.8 | 0.76 | 9.3 | 12 |
| 10/3/60 | 55 | 8.2 | - | 24,000 | 100 | 18 | 30 | 16 | 0.71 | 6.3 | 9.7 |
| 3/1/61 | 34 | 7.2 | - | 6,400 | 24 | 6 | 17 | 12 | 0.52 | 9.7 | 11 |
| 5/11/61 | 61 | 8.4 | - | 7,900 | 85 | 21 | 18 | 14 | NF | 11 | 7.3 |
| 12/20/61 | 32 | 7.6 | - | 92,000 | 13 | 4 | 10 | 9 | 0.50 | 8.7 | 4.5 |

Minnesota River
Minnesota River Basin

LOCATION: Ortonville; above dam at outlet of Big Stone Lake — STATION: Mi-298

RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station at Ortonville

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/3/60 | 34 | 6.6 | 3.1 | 170,000 | 23 | - | 35 | - | - | 0.9 | 170 |
| 9/6/60 | 83 | 7.4 | 44 | 2,300 | 34 | 23 | 12 | 10 | - | 7.3 | 14 |
| 11/16/60 | 37 | 7.7 | 15 | 22,000 | 26 | 17 | 19 | 21 | - | 0.2 | 100 |
| 3/14/61 | 37 | 8.0 | 10 | 200 | 12 | 6 | 9 | 18 | 0.40 | 5.9 | 8.3 |
| 6/27/61 | 78 | 7.4 | 10 | 3,500 | 32 | 14 | 20 | 16 | 0.28 | 2.2 | 7.3 |
| 11/7/61 | 36 | 7.7 | - | 1,300 | 21 | 8 | 14 | 6.4 | 0.06 | 11.9 | 4.5 |

Mississippi River
Upper Mississippi River Basin

LOCATION: Anoka; bridge on USH 169 — STATION: UM-14

RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health

REMARKS: Provisional Flow Data From gaging station near Anoka

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/18/60 | 52 | 7.5 | 12,600 | 4,900 | 30 | 6 | 11 | 8.0 | <0.04 | 8.6 | 5.5 |
| 9/29/60 | 56 | 7.2 | 3,160 | 1,700 | 13 | 5.6 | 7 | 8.6 | <0.02 | 8.8 | 4.0 |
| 10/17/60 | 54 | 8.4 | 7,580 | 2,300 | 19 | 5 | 6 | <7 | 0.02 | 9.9 | 2.8 |
| 12/20/60 | 33 | 8.1 | 2,000 | 1,300 | - | - | 8 | <1 | 0.06 | 13 | 1.6 |
| 2/17/61 | 33 | 7.7 | 2,050 | 3,300 | 2.8 | 2.4 | 6 | 5.6 | 0.16 | 9.7 | 1.5 |
| 7/11/61 | 75 | 7.3 | 1,820 | 6,400 | 22 | 12 | 10 | 6.4 | 0.06 | 7.0 | 5.3 |
| 8/29/61 | 75 | 7.6 | 1,190 | 1,700 | 23 | 10 | 12 | 16 | 0.02 | 8.1 | 6.5 |

Mississippi River
Upper Mississippi River Basin

LOCATION: Elk River; bridge on SH 101 STATION: UM-26.7
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near Anoka

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/18/60 | 52 | 7.6 | 12,600 | 11,000 | 32 | 6 | 11 | 6.0 | 0.04 | 7.5 | 5.2 |
| 9/29/60 | 54 | 7.2 | 3,160 | 1,700 | 16 | 7.2 | 8 | 14 | 0.02 | 10 | 4.0 |
| 10/17/60 | 54 | 8.1 | 2,580 | 13,000 | 9 | 2 | 5 | 8 | 0.04 | 9.4 | 3.0 |
| 12/20/60 | 33 | 7.7 | 2,000 | 1,300 | - | - | 8 | 1 | 0.14 | 14 | 3.0 |
| 2/17/61 | 32 | 7.8 | 2,050 | 7,000 | 3.2 | 3.2 | 9 | 5 | 0.08 | 8.9 | 2.5 |
| 4/6/61 | 40 | 8.6 | 4,330 | 780 | 7 | 6 | 11 | 6.4 | NF | 15 | 3.0 |
| 7/11/61 | 74 | 7.7 | 1,820 | 4,900 | 14 | 7 | 9 | 4.5 | 0.04 | 6.8 | 3.5 |
| 8/29/61 | 74 | 8.0 | 1,190 | 6,400 | 15 | 8 | 10 | 18 | 0.02 | 6.2 | 5.0 |

Mississippi River
Lower Mississippi River Basin

LOCATION: Hastings; above Lock and Dam No. 2 STATION: LM-38
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at St. Paul

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/25/60 | 66 | 7.5 | 32,600 | - | 140 | 26 | 92 | 6.5 | 0.28 | 5.9 | 5.3 |
| 7/20/60 | 80 | 7.7 | 7,420 | 17,000 | 38 | 9 | 20 | 16 | 0.34 | 5.0 | 4.0 |
| 9/28/60 | 63 | 7.7 | 5,480 | 240,000 | 35 | 14 | 14 | 13 | 0.64 | 5.2 | 6.5 |
| 11/1/60 | 43 | 7.7 | 3,160 | 160,000 | 61 | 19 | 10 | 18 | 0.84 | 7.6 | 7.3 |
| 2/17/61 | 36 | 7.2 | 2,460 | 4,500 | 5.6 | 5.2 | 10 | 20 | 1.1 | 0.7 | 6.8 |
| 4/11/61 | 45 | 7.6 | 8,610 | 79,000 | 23 | 8 | 22 | 14 | 0.28 | 11.3 | 6.0 |
| 7/10/61 | 90 | 7.8 | 2,600 | 7,800 | 42 | 20 | 21 | 18 | 0.04 | 14.6 | 8.5 |
| 8/30/61 | 80 | 7.4 | 1,920 | 4,900 | 49 | 19 | 15 | 20 | 0.56 | 5.9 | 10 |

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Mississippi River
Upper Mississippi River Basin

LOCATION: Sauk Rapids; bridge on SH 152 at Sauk Rapids — STATION: UM-68
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near Royalton

WATER QUALITY DATA, 1960-1961

| Date | Temp (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9/8/60 | 73 | 7.9 | 59 | 24,000 | 18 | 7.2 | 9 | 1.2 | 0.06 | 7.6 | 5.5 |
| 12/20/60 | 33 | 7.7 | 1,420 | 1,300 | 24 | 10 | 9 | <1.0 | 0.14 | 13 | 4.1 |
| 3/16/61 | 33 | 8.6 | 1,980 | 3,300 | 12 | 6 | 12 | 2.8 | 0.02 | 12 | 5.8 |
| 3/24/61 | 38 | 8.4 | 2,090 | 1,100 | 21 | 13 | 9 | 3.4 | 0.02 | 12 | 4.2 |
| 6/29/61 | 78 | 7.3 | 1,450 | 17,000 | 16 | 8 | 9 | 2.8 | 0.04 | 7.1 | 5.8 |
| 11/9/61 | 38 | 7.5 | - | 2,300 | 17 | 9 | 9 | 6.0 | 0.10 | 11 | 6.3 |

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Nine Mile Creek
Minnesota River Basin

LOCATION: Bloomington; bridge on France Avenue (SAR #17) STATION: NM-5.5
RECORDS AVAILABLE: None
REMARKS: No flow data available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4/12/61 | 41 | 8.1 | - | 780 | 18 | 6 | 12 | 16 | NF | 11 | 4.8 |
| 7/12/61 | 67 | 7.6 | - | 16,000 | 56 | 16 | 23 | 14 | 0.18 | 6.0 | 3.5 |
| 8/30/61 | 77 | 7.4 | - | 13,000 | 79 | 25 | 24 | 16 | 0.16 | 4.9 | 12 |

O'Brien Brook
Upper Mississippi River Basin

STATION: OB-5

**LOCATION:** Pengilly; bridge on CAR #171 east of Pengilly
**RECORDS AVAILABLE:** Water Sampling Program, 1958-1959, Minnesota Department of Health
**REMARKS:** Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/12/60 | 50 | 7.4 | - | 330 | 16 | - | 10 | - | 0.12 | 9.6 | 2.5 |
| 9/30/60 | 70 | 7.4 | - | 230 | 3.2 | 3.2 | 9 | 4.0 | NF | 7.5 | 2.5 |
| 10/25/60 | 42 | 7.6 | - | 450 | 38 | 16 | 6 | 8.0 | 0.10 | 12 | 7.5 |
| 12/7/60 | 32 | 7.4 | - | 2,400 | 13 | 4 | 7 | 8.0 | 0.4 | 12 | 1.8 |
| 3/23/61 | 39 | 7.7 | - | 2,300 | 7 | 4 | 9 | 10 | 0.58 | 11 | 4.0 |
| 10/17/61 | 55 | 8.4 | - | 200 | 18 | 6.8 | 10 | 5.8 | 0.06 | 10 | 3.8 |

Rice Creek
Upper Mississippi River Basin

LOCATION: Fridley; ablve Dam on East River Road — STATION: Ri-O.2
RECORDS AVAILABLE: None
REMARKS: Provisional flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2/10/60 | 32 | 8.2 | 450 | 11 | 3 | 9 | 70 | - | 3.4 | 3 |
| 3/16/60 | 36 | 7.5 | 490 | 30 | 15 | 25 | 64 | - | 0.1 | 11 |
| 5/18/60 | 50 | 7.6 | 490 | 20 | 9 | 11 | 40 | 0.04 | 7.1 | 7.2 |
| 6/15/60 | 72 | 8.3 | 220 | 24 | 8 | 14 | 16 | 0.04 | 8.4 | 6.3 |
| 7/18/60 | 73 | 8.5 | 700 | 21 | 13 | 17 | - | 0.16 | 5.8 | 5.3 |
| 8/18/60 | 70 | 7.2 | 4,900 | 56 | 27 | 21 | - | 0.02 | 6.3 | 6 |
| 9/29/60 | 57 | 7.2 | 1,300 | 33 | 18 | 19 | 16 | 0.06 | 9.4 | 9.8 |
| 10/17/60 | 55 | 8.0 | 1,700 | 20 | 9 | 11 | 16 | 0.06 | 9.4 | 3.5 |
| 12/22/60 | 33 | 7.8 | 1,100 | 12 | 8 | 7 | 18 | 0.32 | 13.6 | 5.3 |
| 2/16/61 | 33 | 8.1 | 610 | 33 | 23 | 10 | 45 | 0.30 | 18 | 15 |
| 4/7/61 | 39 | 7.2 | 6,400 | 10 | 6 | 11 | 34 | 0.16 | 11.7 | 4.3 |
| 7/11/61 | 73 | 7.8 | 9,200 | 18 | 11 | 12 | 25 | 0.02 | 7.1 | 8 |
| 8/30/61 | 74 | 7.5 | 17,000 | 23 | 14 | 13 | 60 | 0.12 | 6.4 | 12 |

Rum River
Upper Mississippi River Basin

LOCATION: Anoka; bridge on U. S. Highway 10 STATION: Ru-O
RECORDS AVAILABLE: Water Quality Sampling Program 1953-1957, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near St. Francis

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/18/60 | 46 | 7.8 | 388 | 2,300 | 33 | 8 | 11 | 6.0 | <.04 | 8.9 | 4.2 |
| 9/29/60 | 52 | 7.4 | 181 | 2,700 | 47 | 16 | 8 | 4.8 | 0.02 | 8.2 | 6.0 |
| 10/17/60 | 54 | 8.2 | 135 | 780 | 18 | 5 | 9 | 8.9 | 0.04 | 9.5 | 2.3 |
| 12/22/60 | 33 | 8.0 | 114 | 450 | 8 | 5 | 6 | 7.0 | 0.10 | 14 | 1.5 |
| 2/16/61 | 34 | 8.0 | 113 | 1,700 | 3 | 2 | 10 | 9.0 | 0.12 | 13 | 2.5 |
| 4/6/61 | 40 | 8.8 | 233 | 1,700 | 8 | 5 | 10 | 10 | 0.12 | 13 | 4.0 |
| 7/11/61 | 74 | 7.5 | 144 | 13,000 | 26 | 14 | - | 7.0 | 0.04 | 7.4 | 7.5 |
| 8/29/61 | 71 | 8.1 | 112 | 11,000 | 24 | 12 | 11 | 5.0 | 0.06 | 8.1 | 7.3 |

Rum River
Upper Mississippi River Basin

LOCATION: St. Francis; bridge on SAR 8

STATION: Ru-18

RECORDS AVAILABLE: Water Quality Sampling Program 1958-1959,
Minnesota Department of Health

REMARKS: Provisional flow data from the gaging station near St. Francis

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/25/60 | 66 | 7.8 | 758 | - | 58 | 14 | 18 | 4.2 | 0.10 | 6.2 | 3.5 |
| 10/17/60 | 52 | 8.4 | 135 | 3,100 | 7 | 2 | 6 | 8.9 | 0.02 | 9.6 | 1.5 |
| 12/20/60 | 33 | 7.9 | 118 | 1,700 | 12 | 5 | 9 | 1.2 | 0.24 | 12 | 2.7 |
| 2/16/61 | 32 | 7.9 | 113 | 24,000 | 3 | 2 | 6 | 8 | 0.16 | 2.7 | 3.3 |
| 4/6/61 | 40 | 8.7 | 233 | 4,900 | 8 | 6 | 11 | 10 | 0.08 | 14 | 3.3 |
| 7/11/61 | 73 | 8.1 | 144 | 1,100 | 40 | 16 | 15 | 4.5 | 0.08 | 8.3 | 9.0 |

Rum River
Upper Mississippi River Basin

**LOCATION:** Pease; bridge on SAR 4; 3 miles east of Pease — STATION: Ru-102

**RECORDS AVAILABLE:** Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health

**REMARKS:** Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Turbidity Value | Suspended Solids | Suspended Volatile Matter | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 5/9/60 | 50 | 7.6 | 3,500 | 7 | 6 | - | - | 0.10 | 9.1 | 2.3 |
| 10/17/60 | 50 | 7.1 | 3,400 | 6 | 5 | 2 | 11 | 0.02 | 8.8 | 2.8 |
| 12/20/60 | 33 | 7.1 | 780 | 8 | 14 | 8 | 3.0 | 0.16 | 16 | 3.0 |
| 3/24/61 | 36 | 8.3 | 200 | 11 | 8 | 6 | 8.0 | 0.44 | 8.3 | 5.0 |
| 10/16/61 | 58 | 7.8 | 1,700 | 10 | 17 | 7 | 3.5 | 0.1 | 5.8 | 2.0 |

St. Croix River
St. Croix River Basin

LOCATION: Prescott; bridge on USH 10 — STATION: SC-O

RECORDS AVAILABLE: Water Sampling Program 1953-1957, and 1958-1959, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station near St Croix Falls, Wisconsin

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/25/60 | 66 | 7.6 | 9,720 | 1,300 | 14 | 4 | 5 | 1.8 | 0.02 | 8.6 | 5.0 |
| 7/20/60 | 79 | 8.8 | 1,920 | 210 | 8 | 2 | 8 | 2.8 | 0.06 | 11 | 6.8 |
| 9/28/60 | 60 | 7.8 | 3,100 | 200 | 63 | 21 | 7 | 2.5 | 0.24 | 5.1 | 3.0 |
| 11/1/60 | 50 | 7.9 | - | - | 19 | 5 | 6 | 3.2 | 0.20 | 7.1 | 3.3 |
| 2/17/61 | 36 | 7.7 | - | < 20 | 2 | 2 | 9 | 4.5 | 0.02 | 14 | 2.3 |
| 4/11/61 | 39 | 7.6 | - | 130 | 5 | 3 | 11 | 6.4 | 0.12 | 11 | 2.5 |
| 7/10/61 | 78 | 7.8 | - | 130 | 13 | 4 | 9 | 5.0 | 0.02 | 8.4 | 2.8 |
| 8/30/61 | 78 | 7.4 | - | 78 | 10 | 4 | 6 | 4.5 | 0.02 | 7.0 | 5.3 |

St. Croix River
St. Croix River Basin

LOCATION: Stillwater; bridge on STH 212 STATION: SC-22.6
RECORDS AVAILABLE: Water Quality Sampling Program 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station near St. Croix Falls, Wisconsin

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Ammonia Nitrogen | Chlorides (Cl) | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/25/60 | 66 | 7.3 | 9,720 | - | 30 | 9 | 8 | 0.12 | 2.7 | 7.4 | 5.0 |
| 5/29/60 | 57 | 7.2 | 2,950 | 1,300 | 27 | 8 | 5 | 0.06 | 4.0 | 9.3 | 3.5 |
| 11/1/60 | 46 | 7.6 | - | 11,000 | 38 | 18 | 6 | 0.10 | 4.7 | 7.9 | 3.5 |
| 2/17/61 | 33 | 7.8 | - | 1,300 | 4.4 | 3.6 | 9 | NF | 4.0 | 11 | 2.5 |
| 4/11/61 | 46 | 8.2 | - | 2,300 | 10 | 4 | 10 | 0.10 | 4.5 | 11 | 4.0 |
| 7/10/61 | 77 | 7.8 | - | 700 | 5 | 5 | 9 | 0.04 | 4.5 | 7.8 | 4.3 |
| 10/19/61 | 50 | 8.2 | - | 780 | 14 | 1.8 | 3.5 | 0.10 | 3.5 | 11 | 2.3 |

St. Croix River
St. Croix River Basin

LOCATION: Osceola, Wisconsin; bridge on SH 243 at Osceola, Wisconsin — STATION: SC-45
RECORDS AVAILABLE: Water Quality Sampling Program 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Provisional flow data from gaging station at St. Croix Falls, Wisconsin

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/11/60 | 56 | 7.3 | 1,740 | 1,100 | 19 | - | 8 | - | NF | 9.9 | 3.5 |
| 9/22/60 | 62 | 7.4 | 1,260 | 2,400 | 15 | 5.2 | 10 | 1.1 | NF | 9.3 | 2.5 |
| 10/27/60 | 46 | 7.6 | 2,360 | 2,300 | 18 | 3 | 6 | 3.2 | 0.02 | 10 | 3.5 |
| 12/8/60 | 32 | 7.8 | 2,620 | 2,300 | 14 | 4 | 9 | 4.7 | 13 | 10 | 2.0 |
| 4/11/61 | 46 | 7.9 | 3,460 | 700 | 6 | 3 | 10 | 5.0 | 0.04 | 11 | 3.5 |
| 7/10/61 | 73 | 7.7 | 1,700 | 2,200 | 8 | 4 | 9 | 4.0 | 0.04 | 6.7 | 2.8 |
| 10/19/61 | 53 | 8.2 | - | 2,300 | 8 | 16 | 3.5 | 3.2 | 0.08 | 7.9 | 2.0 |

St. Croix River
St. Croix River Basin

**LOCATION:** Danbury, Wisconsin; bridge on SH 48 west of Danbury, Wisconsin  **STATION:** SC-111
**RECORDS AVAILABLE:** Water Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
**REMARKS:** Provisional flow data from gaging stations at Danbury, Wisconsin

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (Mpn/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5/11/60 | 53 | 7.3 | 2,880 | <200 | 26 | - | 8 | - | NF | 10 | 2.0 |
| 9/22/60 | 62 | 7.5 | 1,260 | 2,400 | 13 | 6.8 | 7 | 1.1 | NF | 8.6 | 2.3 |
| 10/27/60 | 46 | 7.6 | 1,090 | 1,700 | 16 | 7 | 7 | 2.1 | 0.08 | 11 | 5.3 |
| 12/8/60 | 32 | 7.6 | 1,400 | 450 | 5 | 2 | - | 2.8 | NF | 8.1 | 2.3 |
| 3/20/61 | 40 | 8.5 | 1,200 | < 200 | 4 | 4 | 9 | 5.6 | 0.02 | 12 | 5.3 |
| 10/19/61 | - | 7.8 | - | 330 | 6.8 | 3.2 | 2 | 3.5 | 0.04 | 8.5 | 1.8 |

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Shingle Creek
Upper Mississippi River Basin

LOCATION: Minneapolis; bridge on Lyndale Avenue North in Minneapolis — STATION: Sh-1
RECORDS AVAILABLE: None
REMARKS: Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2/10/60 | 33 | 8.3 | 54,000 | 10 | 21 | 6 | 45 | - | 12 | 1.3 |
| 5/24/60 | 70 | 7.9 | 13,000 | 29 | - | 9 | 9.0 | 0.14 | 7.5 | 5.3 |
| 6/15/60 | 75 | 8.4 | 1,300 | 15 | 4 | 10 | 11 | 0.20 | 6.6 | 3.5 |
| 7/18/60 | 76 | 8.0 | 92,000 | 61 | 17 | 17 | - | 0.06 | 6.7 | 6.5 |
| 8/18/60 | 70 | 7.7 | 5,400,000 | 54 | 18 | 23 | 11 | 0.32 | 6.7 | 11 |
| 9/29/60 | 57 | 7.2 | 1,100 | 19 | 8 | 7 | 50 | 0.12 | 8.0 | 1.8 |
| 10/18/60 | 51 | 7.4 | 7,000 | 34 | 16 | 10 | 14 | 0.18 | 9.4 | 5.0 |
| 12/22/60 | 33 | 7.8 | 450 | 4 | 3 | 6 | 20 | 0.16 | 15 | 2.5 |
| 2/16/61 | 33 | 7.8 | 1,400 | 4 | 2 | 7 | 16 | 0.06 | 14 | 4.0 |
| 4/7/61 | 40 | 7.4 | 2,300 | 6 | 4 | 11 | 16 | 0.09 | 13 | 1.5 |
| 7/11/61 | 76 | 8.1 | 35,000 | 6 | 2 | 8 | 18 | 0.10 | 7.3 | 3.5 |

Shingle Creek
Upper Mississippi River Basin

LOCATION: Brooklyn Center; bridge on U.S.H. 100 in Brooklyn Center

STATION: Sh-2

RECORDS AVAILABLE: None
REMARKS: Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 5/24/60 | 63 | 7.6 | 9,200 | 54 | - | 11 | 9.0 | 0.06 | 5.7 | 5.3 |
| 6/15/60 | 74 | 8.3 | 490 | 15 | 5 | 8 | 7.8 | 0.12 | 8.2 | 6.9 |
| 7/18/60 | 73 | 9.0 | 1,300 | 6 | 6 | 7 | - | 0.06 | 7.3 | 3.5 |
| 8/18/60 | 69 | 7.5 | 92,000 | 12 | 3.2 | 9 | 24 | <0.02 | 1.0 | 3.0 |
| 9/29/60 | 54 | 7.2 | 680 | 23 | 9 | 7 | 27 | 0.08 | 6.2 | 4.3 |
| 10/18/60 | 48 | 8.1 | 3,300 | 52 | 16 | 9 | 12 | 0.24 | 9.5 | 1.8 |
| 12/22/60 | 33 | 7.6 | 78 | 34 | 12 | 10 | 18 | 0.14 | 9.0 | 2.5 |
| 4/7/61 | 38 | 7.3 | 1,100 | 2 | 2 | 11 | 20 | 0.06 | 13 | 4.3 |
| 7/11/61 | 74 | 7.7 | 16,000 | 9 | 4 | 8 | 13 | NF | 10 | 2.3 |
| 8/29/61 | 79 | 8.0 | 4,900 | 23 | 9 | 11 | 24 | 0.14 | 13 | 8.5 |

Straight River
**Lower Mississippi River Basin**

**LOCATION:** Clinton **Falls**; bridge on second undesignated road east and one mile south of Clinton Falls

STATION: St-18

RECORDS AVAILABEL: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health

**REMARKS:** Flow data not available

## WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/19/60 | 34 | 7.4 | 13,000 | 20 | - | 11 | - | - | 12 | 4.3 |
| 4/19/60 | - | 7.4 | 7,900 | 16 | 5 | 10 | - | 0.48 | 10 | 3.3 |
| 7/19/60 | 73 | 8.3 | 7,900 | 38 | 8 | 16 | 13 | 0.24 | 5.8 | 3.8 |
| 11/7/60 | 40 | 8.1 | 7,900 | 53 | 10 | 12 | 14 | 1.4 | 9.5 | 4.0 |
| 2/21/61 | 34 | 8.0 | 240,000 | 32 | 15 | 11 | 64 | 1.7 | 6.8 | 21 |
| 5/3/61 | 52 | 8.2 | 33,000 | 6 | 4 | 10 | 16 | 0.14 | 15 | 5.0 |
| 11/28/61 | 3.5 | 8.0 | 540,000 | 16 | 8 | 15 | 20 | 0.70 | 8.3 | 7.5 |

North Branch of Zumbro River
Lower Mississippi River Basin

**LOCATION:** Zumbrota; bridge on SAR 10, 1½ miles east of Zumbrota — STATION: NBZ-72

**RECORDS AVAILABLE:** Water Quality Sampling Program, 1953-1957, Minnesota Department of Health

**REMARKS:** Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/20/60 | 32 | 7.6 | 130,000 | 31 | - | 13 | - | 0.24 | 9.1 | 5.0 |
| 4/7/60 | 48 | 7.9 | 79,000 | 29 | - | 13 | - | 0.08 | 10 | 3.5 |
| 7/20/60 | 78 | 8.2 | 11,000 | 13 | - | 8 | 6.0 | 0.22 | 6.5 | 2.8 |
| 11/8/60 | 38 | 7.8 | 240,000 | 12 | - | 12 | 8.0 | - | 7.1 | 7.0 |
| 2/22/61 | 34 | 7.5 | 4,500 | 22 | 11 | 9 | 8.0 | 0.4 | 6.7 | 12 |
| 5/4/61 | 55 | 7.7 | 350,000 | 19 | 5 | 11 | 13 | 0.16 | 9.0 | 40 |
| 11/29/61 | 34 | 7.6 | 79,000 | 17 | 12 | 19 | 14 | 0.74 | 8.0 | 28 |

North Middle Branch of Zumbro River
Lower Mississippi River Basin

STATION: NMBZ-9

LOCATION: Oronoco; 3/4 mile northwest on USH 52 to first road west, 3/4 miles west to first road south, and south to bridge
RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, and 1958-1959, Minnesota Department of Health
REMARKS: Flow data not available

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1/20/60 | 32 | 7.6 | 92,000 | 27 | - | 15 | - | - | 11 | 6.0 |
| 4/7/60 | 47 | 7.9 | 1,700 | 30 | 5 | 20 | - | 0.24 | 9.7 | 1.0 |
| 7/2/60 | 69 | 8.2 | 3,300 | 20 | 4 | 11 | 7 | 0.02 | 7.4 | 3.0 |
| 11/8/60 | 40 | 8.0 | 1,700 | 45 | 8 | 12 | 4.2 | 0.10 | 9.4 | 1.0 |
| 2/22/61 | 35 | 7.8 | 4,900 | 6 | 4 | 9 | 8.0 | 0.16 | 11 | 5.3 |
| 5/4/61 | 55 | 8.0 | 780 | 16 | 4 | 9 | 10 | 0.08 | 10 | 3.3 |
| 11/29/61 | 34 | 7.7 | 2,300 | 12 | 3 | 6 | 10 | 0.30 | 8.0 | 1.4 |

South Branch of the Zumbro River
Lower Mississippi River Basin

LOCATION: Rochester; North on USH 63 to SAR 14, west on SAR 14, ½ mile to first road north, north 2 miles and west to bridge

STATION: SBZ-17

RECORDS AVAILABLE: Water Quality Sampling Program, 1953-1957, Minnesota Department of Health

REMARKS: Provisional flow data from gaging station at Rochester

WATER QUALITY DATA, 1960-1961

| Date | Temp. (°F) | pH | Flow (cfs) | Coliform Group (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Chlorides (Cl) | Ammonia Nitrogen | Dissolved Oxygen (DO) | Biochemical Oxygen Demand (5-Day BOD) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/20/60 | 32 | 7.6 | 61 | 130,000 | 43 | - | 15 | - | - | 9.3 | 7.3 |
| 4/7/60 | 49 | 7.4 | 99 | 70,000 | 43 | 8 | 22 | - | 0.68 | 8.1 | 2.5 |
| 7/[illegible]/60 | 70 | 7.8 | 116 | 24,000 | 61 | 11 | 21 | 20 | 0.16 | 5.4 | 4.3 |
| 11/8/60 | 42 | 7.9 | 53 | 13,000 | 55 | 10 | 25 | 23 | 0.15 | 5.8 | 9.4 |
| 2/22/61 | 43 | 7.6 | 39 | 220,000 | 8 | 7 | 8 | 42 | 1.5 | 8.6 | 8.2 |
| 5/4/61 | 55 | 7.8 | 82 | 130,000 | 12 | 5 | 13 | 25 | 0.86 | 8.3 | 5.0 |
| 11/29/61 | 37 | 7.5 | - | 350,000 | 37 | 11 | 20 | 20 | 1.7 | 8.1 | 4.0 |

WATER QUALITY SAMPLING PROGRAM
1960 and 1961

| Station and Date | Total Gross Beta | Dissolved Gross Alpha | Dissolved Gross Beta | Suspended Gross Alpha | Suspended Gross Beta | Total Gross Alpha |
|---|---|---|---|---|---|---|
| **Mississippi River** | | | | | | |
| Anoka, UM-14. Bridge on U.S.H. 169 at Anoka | | | | | | |
| May 18, 1960 | 14 | | IFB | | | |
| Sept. 29, 1960 | 4 | | IFB | | | |
| Feb. 6, 1961 | IFB | | 16 | | | |
| Aug. 29, 1961 | 40 | | 15 | | | |
| Elk River, UM 26.7. Bridge on S.H. 101 at Elk River | | | | | | |
| May 18, 1960 | IFB | | | | IFB | |
| Sept. 29, 1960 | 4 | | | | 4 | |
| Feb. 17, 1961 | 9 | | | | 9 | |
| April 6, 1961 | 21 | | | | 4 | |
| Aug. 29, 1961 | 144 | | | | 23 | |
| Minneapolis, at Minneapolis water works intake. | | | | | | |
| Jan. 5, 1960 | 12 | | | | | 1.0 |
| Jan. 12, 1960 | 7 | | | | | |
| Jan. 20, 1960 | 17 | | | | | |
| Jan. 26, 1960 | 14 | | | | | |
| Feb. 3, 1960 | 18 | | | | | |
| Feb. 8, 1960 | 12 | | | | | |
| Feb. 16, 1960 | 4 | | | | | |
| Feb. 23, 1960 | 8 | | | | | 1.0 |
| March 2, 1960 | 8 | | | | | |

## WATER QUALITY SAMPLING PROGRAM
## 1960 and 1961

| Station and Date | Total Gross Beta | Dissolved Gross Alpha | Dissolved Gross Beta | Suspended Gross Alpha | Suspended Gross Beta | Total Gross Alpha |
|---|---|---|---|---|---|---|
| **Mississippi River (cont.)** | | | | | | |
| Mpls. (cont.) March 8, 1960 | .5 | | | | | .28 |
| March 17, 1960 | 1 | | | | | |
| March 23, 1960 | 25 | | | | | |
| March 29, 1960 | 17 | | | | | |
| April 6, 1960 | 19 | | | | 14 | |
| April 11, 1960 | 20 | | | | | |
| April 19, 1960 | 24 | | | | | |
| April 28, 1960 | 12 | | | | | 2.0 |
| May 5, 1960 | 16 | | | | | |
| May 10, 1960 | 44 | | | | | |
| May 18, 1960 | 6 | | | | 16 | |
| St. Cloud. Water Treatment Plant Raw Water Intake | | | | | | |
| Jan. 14, 1960 | 11 | | | | | |
| Feb. 23, 1960 | 17 | | | | | 1.6 |
| March 8, 1960 | 13 | | | | | |
| April 6, 1960 | 18 | | | | | 1.1 |
| May 10, 1960 | IFB | | | | | |
| June 27, 1960 | 22 | | | | | |
| June 14, 1960 | 7 | | | | | |
| Aug 29, 1960 | 33 | | | | | |
| Sept. 7, 1960 | 6 | | | | | |
| Oct. 11, 1960 | 31 | | | | | |

WATER QUALITY SAMPLING PROGRAM
1960 and 1961

| Station and Date | Total Gross Beta | Dissolved Gross Alpha | Dissolved Gross Beta | Suspended Gross Alpha | Suspended Gross Beta | Total Gross Alpha |
|---|---|---|---|---|---|---|
| **Mississippi River (cont.)** | | | | | | |
| Nov. 10, 1960 | 9 | | | | | |
| Dec. 1, 1960 | 18 | | | | | |
| Jan. 10, 1961 | 12 | | | | | |
| Feb. 7, 1961 | 9 | | | | | |
| March 13, 1961 | 8 | | | | | |
| April 11, 1961 | 8 | | | | | |
| May 22, 1961 | 13 | | | | | |
| June 5, 1961 | 16 | | | | | |
| July 3, 1961 | 6 | | | | | |
| Aug. 7, 1961 | 6 | | | | | |
| Sept. 8, 1961 | 60 | | | | | |
| Oct. 4, 1961 | 60 | | | | | |
| Nov. 4, 1961 | 85 | | | | | |
| Nov. 29, 1961 | 34 | | | | | |

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# EXHIBIT XIX

## Summary Report

## on the

## Pollution Status of the Mississippi River

## and Major Tributaries from

## the Mouth of the Rum River to the Outlet of Lake Pepin

Prepared for the

Minnesota Water Pollution Control Commission

by the

Section of Water Pollution Control

Minnesota Department of Health

(technical and administrative

agency for the Commission)

MINNESOTA DEPARTMENT OF HEALTH

Division of Environmental Sanitation

Section of Water Pollution Control

## MISSISSIPPI RIVER

The Mississippi River rises in Hernando de Soto Lake in northeastern Becker County and flows 2,364 miles to the Gulf of Mexico. Approximately 510 miles of its course is above the Twin Cities Metropolitan Area. In the upper section of the river the flow is predominantly through forest and farm lands. In the metropolitan area the river flows through highly developed residential and industrial areas, and downstream it again flows through wooded terrain and farm lands.

Samples have been collected on the Mississippi River as a part of the Water Quality Sampling Program, Minnesota Lakes and Streams. For the data from Stations UM-14 at Anoka, LM-38 at Hastings, and LM-124 at Winona, during 1962-63, see the attached sheets.

The reach of the river of immediate concern is from the mouth of the Rum River downstream to the mouth of the Chippewa River. A survey of the Mississippi River from the mouth of the Rum River to the mouth of the St. Croix River was made by this Department during the summers of 1960 and 1961, and provided a basis for the classifications and standards subsequently adopted by the Water Pollution Control Commission. The results of this survey are presented in the report entitled, "Report on Investigation of the Mississippi River from the Mouth of the Rum River to the Mouth of the St. Croix River, July and August, 1960, and August and September, 1961." This report lists all discharges to the river in this reach and the treatment provided at that time.

Substantial work has also been sponsored by the Minneapolis-St. Paul Sanitary District, and is presented in a comprehensive report entitled "Pollution and Recovery Characteristics of the Mississippi River, 1961." This study encompasses river conditions from the northern part of Minneapolis through Lake Pepin.

Current data on separate sources on the main stem of the reach under consideration and significant tributaries are provided in the attached summary tables, but the general discussion of river conditions is restricted in the main to the reach from the mouth of the St. Croix River to the outlet of Lake Pepin, in order to avoid duplicating the material in the 1960-61 report. The interpretations of river conditions and value judgments are based on all the data and information currently available to this Department. Discussion is limited to discharges of some significance to the Mississippi River.

Uses of the River

The present and future uses of the Mississippi River in the reach under consideration are not expected to change significantly in kind, but the uses will increase considerably in most cases in the future. These uses include water supply, recreation, power generation, navigation, and disposal of treated sewage and wastes.

Considerable improvement is expected in the treatment of sewage and wastes in the Metropolitan Area in the near future so that conflicts in the use of the river for waste disposal and for other purposes will be minimized, but the use of the river for the ultimate disposal of treated sewage and waste effluents will continue to be a major necessary use in the future. Such uses can be held within limits from the viewpoint of possible conflicts, but cannot under any foreseeable circumstances ever be eliminated. Disposal of treated effluents is a basic necessity to maintenance of civilized life in the area.

The cities of Minneapolis and St. Paul are the only communities which obtain their municipal water supplies from the Mississippi River. Their intakes are located on the extreme upper reach of the river, north of Minneapolis.

Many suburban communities obtain their water supplies wholly or in part from either Minneapolis or St. Paul. Use of river water by industries in the area is substantial but is limited primarily to cooling water, because industrial process water requirements can be easily satisfied either by municipal supplies or by the abundant and renewable reserves of high quality ground water which are available throughout the area. The future use of the upper river for water supply will, without doubt, continue to increase in the future as the population increases. The use of the mid-city and lower reaches of the river for municipal or industrial water supply other than cooling and condensing or similar relatively low quality uses is considered highly unlikely in the foreseeable future.

Hydroelectric power generation in the river in this area is not a major river use and is not likely to increase. Most of the production of electric power is done by steam plants and this is likely to continue to be the case, whether fossil or nuclear fuels are used. Expansion of the existing steam plants and construction of new plants in the vicinity will require increasingly large amounts of relatively low quality water for condensing. This use is largely non-consumptive, although this may be changed somewhat by the use of cooling towers which may be required for purposes of heat dissipation.

Commercial barge traffic on the Mississippi River in this reach last year amounted to 9,949,405 tons, with the major commodities shipped being coal, grain, gasoline, and fuel oils, in decreasing order. This traffic increased some 1,000,000 tons over 1962. It is expected to continue to increase in the future.

## Analytical Data

The following table lists the total coliform count expressed as the MPN/100 ml (most probable number per 100 milliliters), for samples collected by this Department at the indicated stations (largely from WQSP data, since 1953):

| | Station | No. of Samples | Total Coliforms (MPN/100 ml) | | | |
|---|---|---|---|---|---|---|
| | | | Min. | Max. | Mean | Median |
| UM-14 | Anoka | 64 | 230 | 92,000 | 7,050 | 4,600 |
| LM-38 | Hastings | 27 | 2,300 | 9,200,000 | 437,811 | 34,000 |
| LM-124 | Winona | 3 | 790 | 6,300 | 1,060 | 1,100 |

These values indicate that the Mississippi River at Anoka is somewhat contaminated, and is much more so at

Hastings, but that by the time it reaches Winona it has recovered in large measure from the upstream bacterial pollution. The values obtained at Winona are indicative of a moderate degree of contamination.

The mean dissolved oxygen values at the Anoka, Hastings, and Winona sampling stations were 8.9, 5.0, and 8.3 mg/l (milligrams per liter) respectively. The following table lists these along with the minimum and maximum values:

| Station | No. of Samples | Dissolved Oxygen (mg/l) Min. | Max. | Mean |
|---|---|---|---|---|
| UM-14 (Anoka) | 64 | 5.3 | 15.0 | 8.9 |
| LM-38 (Hastings) | 29 | 0.3 | 14.6 | .0 |
| LM-124 (Winona) | 3 | 7.9 | 8.6 | 8.3 |

The samples collected at Anoka and Winona show the presence of sufficient dissolved oxygen for aquatic life, but the samples collected at Hastings show serious oxygen depletion at times. This indicates that there is serious organic overloading of the river upstream of Hastings which the river is not able to assimilate.

A summary of the 5-day BOD (biochemical oxygen demand) of the samples collected is presented in the following table:



| | No. of | 5-Day BOD | | |
|---|---|---|---|---|
| Station | Samples | Min. | Max. | Mean |
| UM-14 (Anoka) | 65 | 0.1 | 7.0 | 3.2 |
| LM-38 (Hastings) | 29 | 4.0 | 16.0 | 6.9 |
| LM-124 (Winona) | 3 | 3.0 | 6.8 | 4.5 |

The values obtained at the Anoka station are moderate, and not necessarily indicative of man-made pollution. The BOD values at the Hastings station are relatively high and indicative of the substantial waste load discharged to the river upstream. The values for the Winona station show that considerable improvement has taken place by the time the river reaches Winona.

The remaining analytical data substantiate the conclusions derived from the bacteriological, dissolved oxygen, and biochemical oxygen demand data, i.e., that the Mississippi River is in fair condition at Anoka and Winona, but that there is a substantial pollution load discharged to the river upstream from Hastings, which has a deleterious effect. For example, the mean suspended solids concentrations at Anoka, Hastings, and Winona were 1.9, 40 and 16 mg/l respectively, and the turbidity values were 14, 26 and

11, respectively.

Changes in Sewage and Waste Treatment and River Conditions

The MSSD (Minneapolis-St. Paul Sanitary District) is presently undergoing an extensive expansion to increase the capacity of the existing primary plant and add a secondary high-rate activated sludge unit. The new plant is designed for a flow of 218 mgd (million gallons/day) with a 5-day BOD of 260 mg/1. The flow is now about 180 mgd with a 5-day BOD of about 200 mg/1. The BOD removal efficiency will rise from 32 percent to about 75 percent, which will produce an effluent of approximately 64 mg/1. The projected design period is for 20 years, or to the year 1980 based on the anticipated growth of the Twin Cities and suburbs under contract at the time the design was established. Since that time contracts have been negotiated with a number of other suburbs and the North Suburban Sanitary Sewer District and such contracting is expected to continue in the future and to reduce the design period.

With the completion of the current enlargement of the MSSD plant, a very substantial improvement in the condition of the Mississippi River below the treatment plant is expected, although the improvement will occur gradually over a period of time as sludge deposits are dissipated. It should be noted also that the recently adopted river classifications and standards require maintenance of a minimum dissolved oxygen content in the river and optimum operation of the treatment works at all times. In view of the fact that the minimum dissolved oxygen content of one mg/1 is tied to a once-in-20-year minimum daily river flow (95 percent frequency) it is evident that the conditions generally prevailing will undoubtedly be much better than shown by the stated minimum oxygen levels, but further improvements will be necessary to maintain satisfactory conditions on a long-term basis.

The South St. Paul sewage treatment plant was expanded by adding an anaerobic effluent pond in 1962. The overall efficiency of this unit has not yet been evaluated. At the present time, the South St. Paul sewage plant treats about 13 mgd of sewage with a raw 5-day BOD of approximately 1,350 mg/1. The reduction in BOD is about 68 percent for an effluent BOD of 490 mg/1, without the anaerobic effluent pond. Improvement will result from the use of the pond but the removal efficiency of the pond is expected to be only 35 - 50 percent (of the plant effluent) and the final effluent concentration will therefore not yet be equivalent to that of the MSSD.

Maintenance of the dissolved oxygen content of the river in relation to various degrees of treatment is discussed thoroughly in the MSSD report on "Pollution and Recovery Characteristics of the Mississippi River." The following two tables, which were derived from this report, show the degree of treatment necessary to maintain the stated minimum of one mg/1 of dissolved oxygen in the Hastings pool for various conditions of flow and river temperature.

(Table 1 and Table 2 are as follows:)

Table 1
Mississippi River Flow Conditions, (M 13.8)

1. Minimum recorded daily flow during critical months. (August, 1892-1959) (February, 1924-9).
2. Minimum recorded daily flow for entire year.
3. Minimum daily flow exceeded 99% of time for the critical months (occurs once in 100 years).
4. Minimum daily flow exceeded 98% of time for the critical months (occurs once in 50 years).
5. Minimum daily flow exceeded 95% of time for the critical months (occurs once in 20 years). 5% frequency. (1270)
6. Minimum 5-day period of flow exceeded 99% of time for the critical months (occurs once in 100 years).
7. Minimum 5-day period of flow exceeded 98% of time for the critical months (occurs once in 50 years).
8. Minimum 5-day period of flow exceeded 95% of time for the critical months (occurs once in 20 years).

Table 2
Treatment Requirements to Maintain One ppm
Dissolved Oxygen in the Hastings Pool
of the Mississippi River

| Miss. R. Flow Conditions, (M 13.8)* | | Discharge, cfs: Uncorrected for Water Usage | Discharge, cfs: Mpls. & St. Paul Water Usage 1980 | 2000 | Corrected for Water Usage 1980 | 2000 | Degree of Treatment Required 1980 | 2000 |
|---|---|---|---|---|---|---|---|---|
| 1. | August | 632 | 468 | 674 | 164 | -42 | 95 | 100 |
| | February | 1100 | 234 | 338 | 866 | 762 | 86 | 88.8 |
| 2. | | 632 | 468 | 674 | 164 | -42 | 95 | 100 |
| 3. | August | 560 | 468 | 674 | 92 | -114 | 96.5 | 100 |
| | February | 575 | 234 | 338 | 341 | 237 | 96 | 97.5 |
| 4. | August | 790 | 468 | 674 | 322 | 116 | 93.4 | 96 |
| | February | 740 | 234 | 338 | 506 | 402 | 92.7 | 94.7 |
| 5. | August | 1270 | 468 | 674 | 902 | 696 | 89.3 | 92.1 |
| | February | 1050 | 234 | 338 | 816 | 712 | 87 | 89.7 |
| 6. | August | 710 | 460 | 665 | 250 | 45 | 94.2 | 97 |
| | February | 630 | 234 | 338 | 396 | 292 | 94.7 | 96.6 |
| 7. | August | 970 | 460 | 665 | 510 | 305 | 91.8 | 94.2 |
| | February | 800 | 234 | 338 | 566 | 462 | 91.7 | 93.7 |
| 8. | August | 1500 | 460 | 665 | 1040 | 835 | 87.5 | 90.5 |
| | February | 1130 | 234 | 338 | 896 | 792 | 85.5 | 88.3 |

*Correspond to Table 1

When effective chlorination of the effluent is provided at both the MSSD and South St. Paul plants, a marked improvement in the bacteriological quality of the entire lower river can be expected. However, the river in the near reach below these outfalls cannot in all probability be maintained in such quality as to permit bathing, swimming, or related recreational uses which involve prolonged intimate contact with the water, until adequate control is provided to eliminate all upstream sewage discharges to the river and tributaries from the storm sewers, combined sewers, and sanitary sewer regulators in the nearby areas, and even thereafter the bather would remain exposed to the hazards associated with unpredictable emergency by-passes of sewage from the metropolitan area sewage treatment works and collection systems.

The uses made of any river for recreation must always be reasonably consistent with attainable water quality, physical conditions, and upstream river usages, and this is also necessary with respect to the Mississippi River in the Minneapolis-St. Paul area.

The bacterial quality of the river water in the near reach below the Twin Cities is such now that recreational uses are limited. Disregarding the obvious hazards of barge and boat traffic, currents, and visibility limited by turbidity; swimming, and sometimes water skiing, involve a contact with the water which is too intimate and prolonged to be considered a reasonable use from a health standpoint. This may well continue to be true into the foreseeable future in spite of planned improvements in upstream sewage treatment, because of unavoidable and unpredictable discharges of sewage and wastes from the sewerage works in the metropolitan area and other sources.

Recreational boating is considered a reasonable use of the boundary waters, but some health hazards may be expected in the mid-city reach and the Hastings Pool for some time. The interstate boundary waters, including the Lake Pepin area, can be expected to be safely used for reasonable recreational boating when effective chlorination of all sewage and contaminated waste effluents is provided.

Fishing is light in most sections of this reach. Above the Twin Cities the river supports a moderate but significant sport fishery, but below the MSSD outfall the fishery has been affected by pollution with attendant low oxygen and tainting. The Lake Pepin area shows a partial recovery of the fishery and there a moderate sport fishery again exists. It is felt that the adverse conditions mentioned will become minimal in future years because of the improvements in sewage and waste disposal which will be made, many of which are underway. Existing sludge deposits must, however, be scoured away and assimilated before significant changes are likely to be noticeable and this may take several years. Both oxygen depletion and fish tainting are expected thereafter to be materially alleviated by the planned sewage works improvements, since both are related basically to the presence of excessive concentrations of organic pollutants most of which are subject to destruction by the biological methods of sewage treatment which are and will be used in this area.

WATER QUALITY DATA, MISSISSIPPI RIVER*

Location: Anoka, Bridge on USH 169
Station: UM-14

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Suspended Solids | Turbidity Value | Phosphorus | Ammonia | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|
| 7-20-62 | 72 | 7.4 | 13,000 | 20 | 12 | - | < 0.01 | - | 6.9 | 3.8 |
| 9-10-62 | 63 | 7.4 | 11,000 | 11 | 10 | - | < 0.14 | < 0.1 | 7.0 | 2.3 |
| 11-6-62 | 40 | 8.6 | 3,300 | 5.6 | 2 | 0.07 | < 0.01 | < 0.1 | 10.8 | 3.0 |
| 2-27-63 | 32 | 8.2 | 4,900 | 4.0 | - | 0.10 | 0.29 | < 0.1 | 5.7 | 2.3 |
| 6-19-63 | 71 | 77 | 4,900 | 53 | 18 | 0.15 | < 0.05 | < 0.1 | 5.3 | 4.0 |
| 7-18-63 | 76 | 7.8 | 2,800 | 23 | 20 | 0.17 | < 0.05 | 0.15 | 6.9 | 4.3 |
| 11-4-63 | 42 | 8.2 | 3,300 | 5.2 | 7 | 0.04 | < 0.05 | < 0.1 | 12.7 | 2.0 |

*As mg/l unless otherwise indicated
< means less than

Location: Hastings, Lock and Dam No. 2
Station: UM-38

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Total Solids | Suspended Solids | Turbidity Value | Phosphorus | Chlorides | Ammonia | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-7-62 | 46 | 7.7 | 21,000 | - | 58 | 32 | - | 3.2 | 0.01 | - | 7.6 | 4.3 |
| 7-25-62 | 66 | 7.8 | 9,200,000 | 440 | 20 | 45 | - | 3.5 | 0.20 | - | 6.5 | 5.3 |
| 8-27-62 | 74 | 7.7 | < 20,000 | 340 | 35 | 30 | - | 4.5 | 0.20 | - | 4.8 | 6.3 |
| 9-26-62 | 58 | 8.3 | 160,000 | 370 | 36 | 12 | 0.20 | 5.6 | 0.28 | < 0.1 | 7.5 | 4.0 |
| 11-7-62 | 42 | 8.4 | 230,000 | - | 23 | 15 | 0.23 | 10 | 0.44 | 0.13 | 6.4 | 4.3 |
| 2-5-63 | - | 8.2 | - | - | 8.0 | 10 | 0.47 | 13 | 1.9 | 0.31 | 3.7 | 14.0 |
| 2-26-63 | 32 | 9.0 | 22,000 | - | 8.8 | 32 | 0.45 | 21 | 1.6 | 0.30 | 2.2 | 8.0 |
| 6-18-63 | 74 | 7.8 | 160,000 | - | 73.0 | 50 | 0.28 | 10 | 0.26 | 0.14 | 5.2 | 4.8 |
| 7-16-63 | 75 | 7.9 | 13,000 | - | 41.0 | 35 | 0.32 | 15 | 0.66 | 0.24 | 6.4 | 6.0 |
| 11-5-63 | 48 | 7.7 | 350,000 | - | 18.0 | 18 | 0.27 | 24 | 0.92 | 0.22 | 5.3 | 7.0 |

< means less than

**Location: Winona, Lock and Dam No. 5A**
Station - LM-124

| Date | Temp. (°F) | pH Value | Total Coliforms MPN/100 ml) | Total Solids | Suspended Solids | Turbidity Value | Phosphorus | Chlorides | Ammonia | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-29-62 | 77 | 8.2 | 790 | 270 | 23 | 15 | 0.19 | 2.5 | < 0.01 | - | 8.6 | 3.8 |
| 1-29-63 | 32 | 8.3 | 1,300 | - | 6.4 | 6 | 0.23 | 10 | 0.58 | 0.15 | 7.9 | 3.0 |
| 7-9-63 | 77 | 9.2 | 1,100 | - | 18.0 | 12 | 0.28 | 10 | < 0.05 | 0.13 | 8.5 | 6.8 |

< means less than

17cmr

18cmr

Interstate Conference on Mississippi River
Water Quality Data, Minor Tributaries*
(January, 1964)

| Source, Sampling Period, and Number of Samples | Average Total Coliforms (MPN/100 ml) | Average DO (mg/l) | Average 5-Day BOD (mg/l) |
|---|---|---|---|
| Rum River (1953-63, incl.) | | | |
| 48 | 3,200 | 9.9 | 3.5 |
| Coon Creek (1960-1963) | | | |
| 13 | 9,100 | 8.5 | 3.5 |
| Rice Creek (1960-1963) | | | |
| 19 | 2,700 | 8.0 | 6.8 |
| Shingle Creek (1960-1963) | | | |
| 17 | 336,000 | 8.9 | 4.3 |
| Bassetts Creek (1960-1963) | | | |
| 17 | 666,000 | 6.4 | 9.5 |
| Minnehaha Creek (1960-1963) | | | |
| 13 | 35,500 | 8.3 | 4.8 |

*from Water Quality Sampling Program and special surveys.

# SEWAGE WORKS ON THE MISSISSIPPI RIVER

## Anoka

The Anoka sewage treatment plant was constructed in 1956 and is a secondary plant consisting of a grit chamber, primary settling tank, high rate trickling filters, final settling tanks, chlorination contact tank, and separate sludge digestion tanks. The sewage treatment plant is designed to treat sewage and waste flowing at the rate of 1.44 mgd with a 5-day BOD of 300 mg/l to produce an effluent BOD of approximately 75 mg/l.

## Minneapolis Combined Sewers

The City of Minneapolis has an active five-year program in progress for the separation of combined storm and sanitary sewers. The table below indicates progress to date and future plans. As the table indicates, the City of Minneapolis is divided into two drainage areas designated the upper pool and the lower pool. The division between the upper pool and the lower pool is the St. Anthony Falls Lock and Dam.

20cmr

| | Upper Pool | Lower Pool | Total |
|---|---|---|---|
| **Early 1960** | | | |
| Total acres with sanitary sewers | 5,584 | 22,126 | 27,710 |
| Total acres storm drained** | 3,128 | 12,719 | 15,847 |
| Percent of total acreage storm drained | 56% | 57.5% | 57.2% |
| **1962** | | | |
| Total acres sewered | 5,584 | 22,162 | 27,746 |
| Total acres storm drained | 3,161 | 13,326 | 16,487 |
| Percent of total acreage storm drained | 56.6% | 60.2% | 59.5% |
| 1962-63 program in progress | 665 | 635 | |
| 1963 | 225 | 0 | |
| 1964 | 0 | 1117 | |
| 1965 | 0 | 751 | |
| 1966 | 525 | 0 | |
| 1967 | 420 | 648 | |
| **At End of 1967** | | | |
| Total acres sewered | 5,584 | 22,162 | 27,746 |
| Total acres storm drained | 4,996 | 16,477 | 21,473 |
| Percent of total acreage storm drained | 89.4% | 74.5% | 77.5% |

*May be either separate or combined

**In these areas most of the sanitary sewers have been separated but a few storm water entrances may remain.

St. Paul Combined Sewers

The City of St. Paul has not yet adopted a long-range plan for the separation of combined sewers, but is proceeding with construction of separate storm sewers as funds become available.

The city has spent, or awarded contracts for, about $10 million during the last 2 or 3 years. The major portion of this expense was directed toward providing outlet structures for future storm sewers. The city is taking advantage of the interstate highway construction program and building separate storm sewers along these routes. In new development areas, such as the Downtown Renewal Project, the Riverview Industrial Park, and others, separate storm sewers are planned or have already been constructed. Where it is possible, all new connections to the city system from the suburbs will be to separate sanitary sewers.

On May 1 of this year, the city will begin a two-year study of the entire sewer system to determine in which areas of the city the sewers can be separated most economically. From this study, a possible program for the future can be developed.

Minneapolis-St. Paul Sanitary District

The existing sewage treatment plant was placed in operation during the summer of 1938. The plant was designed for an average flow of 134 mgd which was expected from a tributary population of 910,000 by the year 1945. It ordinarily provides primary treatment but can provide a slightly higher degree of treatment by means of chemical flocculation. This part of the plant is used only during unusually low river flow conditions. During 1962, the average flow to the plant was 178 mgd from an estimated tributary population of 1,135,000. The raw sewage total population equivalent was 1,690,000 (based on 0.18 pounds of BOD per PE)* (* 1,820,000 PE if based on 1/6 lb of 5-day BOD, which is used in the appended tables ) The proposed alterations and additions will convert the plant to a high-rate activated sludge plant designed to provide secondary treatment of sewage from the estimated 1980 population of 1,545,000 plus an industrial waste population equivalent of 1,065,000, for a total population equivalent of 2,610,000. The service area will include a majority of the suburban municipalities and the North Suburban Sanitary Sewer District.

The annual average design flow is 218 mgd with a 5-day BOD of 260 mg/1. The plant is designed to produce an effluent with a 5-day BOD of 64 mg/1. Construction of the plant has been started and is expected to be completed in 1966.

South St. Paul

This plant was constructed in 1940. It originally consisted of a grit chamber, grease flotation unit, flocculation tanks, primary settling tanks, trickling filters, final settling tanks, chlorination contact tanks, and raw sludge lagoons. The plant was designed to treat meat packing wastes and sewage at the rate of 10 mgd with a raw 5-day BOD of 800 mg/1. An average BOD reduction of about 68 percent is ordinarily achieved through the mechanical treatment units. An anaerobic effluent pond was constructed in 1962 to reduce the plant effluent by 50 percent. The overall system reduces the final effluent BOD to about 200 to 250 mg/1. The city has some combined storm and sanitary sewers.

Newport

At the present time Newport does not have a sewer system or sewage treatment plant, but plans for both were approved on April 26, 1963, and the facilities are presently under construction. It is expected that a secondary plant will be in operation by late summer of 1964. The design is for a modification of the activated sludge process and includes a contact tank, sludge reaeration tank, aerobic sludge digestion tank, final settling tank, and chlorination tank. The plant is designed to provide treatment for a flow of 0.30 mgd with a 5-day BOD of about 200 mg/1 to produce an effluent of about 40 mg/1.

St. Paul Park

A secondary treatment plant was constructed here in 1955 and enlarged in 1963. The plant consists of a primary settling tank, a high-rate trickling filter, secondary settling tank, chlorination contact tank, and separate sludge digestion tank. It is designed to treat sewage and waste at the rate of 0.4 mgd with a 5-day BOD of 200 mg/1 to produce an effluent of 40 mg/1.

Inver Grove Township, Dakota County

A sewage treatment plant to serve part of the South Grove Development was constructed in 1963. The plant consists of a comminutor, two extended aeration units, a settling tank, a sludge holding tank, and chlorination facilities. The units are designed to provide secondary treatment by the extended aeration modification of the activated sludge process for a sewage flow of about 0.03 mgd with a 5-day BOD of approximately 268 mg/1. The effluent is discharged to a ditch leading to the Mississippi River.

Cottage Grove Township, Washington County

The plant was constructed in 1962 and is designed to provide secondary treatment. The plant consists of a bar screen, primary settling tank, aeration tank, secondary settling tank, chlorinator, and chlorination contact tank, heated sludge digestion tank and sludge drying beds. It was designed to provide treatment by the activated sludge process for a flow of 0.4 mgd with a 5-day BOD of about 200 mg/1. The units are considered capable of producing an effluent with a 5-day BOD of approximately 20 mg/1.

Plans for a second stage addition were approved on May 22, 1963, and construction is underway. The changes include a mechanically cleaned bar screen and chamber, primary settling tank, aeration tank, secondary settling tank, chlorination tank, sludge digestion tank and alterations to the control building. The proposed changes will increase the treatment capacity of the plant to 0.80 mgd with a 5-day BOD of about 200 mg/1. The final effluent of the new plant will be approximately 20 mg/1 of 5-day BOD.

Hastings

The plant was constructed in 1956 and is designed to provide primary sedimentation and chlorination. The plant consists of a cutting screen, settling tank, chlorination facilities, sludge digestion tank, and sludge beds. It is designed to treat 0.6 mgd of sewage and wastes with a 5-day BOD of 300 mg/1 to produce an effluent of approximately 190 mg/1.

Red Wing

The plant was constructed in 1961 and consists of two primary settling tanks, two high-rate trickling filters, two secondary settling tanks, a chlorine contact tank, two sludge digestion tanks, sludge drying beds, and a control building. The plant is designed to provide secondary treatment for a sewage and waste flow of 3.0 mgd with a 5-day BOD of 300 mg/1 to produce an effluent of about 50 mg/1. The sewer system consists in part of combined sewers.

Lake City

The sewage plant was constructed in 1934 and provides primary treatment. The plant consists of a primary settling tank, chlorination facilities, sludge digestion tank and sludge beds. It was designed to treat a sewage and waste flow of 0.24 mgd with a 5-day BOD of about 260 mg/1 to produce an effluent of about 175 mg/1.

Plans for alterations were approved on March 21, 1961. This project consisted of replacement of the pumps at the main lift station, modification of the sludge digester, and installation of a chlorinator. The proposed improvements will not increase the capacity of the plant but will help to avoid by-passing of sewage, permit better operation, and provide effective disinfection of the plant effluent.

## INDUSTRIAL WASTE DISPOSAL ON THE RUM RIVER

### Cornelius Manufacturing Company

The Cornelius Manufacturing Company is located on the right bank of the Rum River in Anoka. The company is engaged in the manufacture of soda fountain dispensing equipment. Plant operations include plastic molding, painting, and metal plating. Wastes consist of cooling water, paint scrubber water, and plating rinse water, all of which are discharged directly to the Rum River without treatment. Secondary containment structures have not been provided to guard against accidental losses of chemicals from the plating tanks. Sanitary sewage is reportedly discharged to the municipal sanitary sewer.

Federal Cartridge Corporation

This plant is located in Anoka a short distance east of the Rum River. The company manufactures smokeless powder and ammunition for small arms. It is reported that sanitary sewage and plating rinse water are discharged to the municipal sanitary sewer, but a filtrate from the manufacture of nitrocellulose is discharged to a storm sewer which drains into the Rum River. Relatively high concentrations of copper and zinc have been found in samples collected of the flow from the sewer outfall at the Rum River. Secondary containment facilities to guard against losses of the plating solutions have not been provided.

INDUSTRIAL WASTE DISPOSAL ON THE MISSISSIPPI RIVER

Minneapolis Water Treatment Plant

The plant is located in Fridley a short distance upstream from the Camden bridge. It produces potable water for the City of Minneapolis and several suburbs. Raw water is drawn from the Mississippi River. The plant has a reported capacity of 158 mgd of finished water. Wastes consist of sand filter backwash water and a lime slurry from the softening process. The filter backwash water is discharged to the Mississippi River without treatment, while the lime slurry is pumped to a nearby clarification basin. The supernatant overflows to the river at a reported rate of about 1.5 mgd.

Northern States Power Company, Riverside Plant

This steam electric generating plant is located in Minneapolis about 2 miles below the Minneapolis water treatment plant. The present net capability is about 289,300 kilowatts. Expansion of this plant will be completed in mid-1964, to increase the net capability to about 505,000 kilowatts. Heat rejection to the river at present is about 2,338 x $10^6$ BTU/hr. and will be increased to about 3,268 x $10^6$ BTU/hr. after completion of the expansion, at maximum capacity. Cooling water flow is about 305,000 gpm and will be increased to about 400,000 gpm after expansion, at maximum generation capacity and high river temperatures. At present capacity under these conditions, a temperature rise of about 12°F occurs through the condensers and after the expansion the temperature rise will be about 16°F under the same conditions. The company has been conducting river temperature studies for some time to determine how the effluent affects the river and what control measures may be needed in the future.

Northern States Power Company, Southeast and Island Stations

The company also has two cold standby or peaking plants on the river in the Twin Cities area. One is known as the Southeast Station and is located upstream from the lower dam of St. Anthony Falls. The other is known as the Island Station and is located about 1 mile above the High Bridge Plant in St. Paul. Both are steam plants and are rarely used. The next capabilities are 40,000 and 22,400 kilowatts, repsectively.

Northern States Power Company, High Bridge Plant

This steam electric generating plant is located on the Mississippi River in St. Paul approximately 4 miles above the Minneapolis-St. Paul Sanitary District sewage treatment plant. The plant has a net capability of about 482,800 kilowatts and when operating at capacity under conditions of elevated river temperatures, rejects about

2,911 x $10^6$ BTU/hr. in a cooling water flow of about 296,000 gpm. Under these conditions, there would be about a 19°F temperature rise in the cooling water.

Minnesota Harbor Service

The company is engaged in cleaning of barges on the right bank of the Mississippi River upstream from the High Bridge in St. Paul. The barges cleaned are mostly coal and grain barges. Wastes from the operation consisting of wash water containing some coal or grain are discharged directly into the river without treatment. It is reported that the company does not clean barges which have been used to transport liquids, but occasionally will clean barges which have been used to transport sulfur, phosphate rock, or similar materials. These operations are seasonal. Recommendations have been made to the company to improve their waste disposal practices but no information has yet been received as to changes to be made.

Twin City Barge and Towing Company

The company operates mobile barge-cleaning facilities on the Mississippi River in the Port at St. Paul. The facilities are operated during the river shipping season only. In general, the operations consist of cleaning coal barges so that they can be loaded with grain. Wastes from the operations include coal and grain mixed with wash water, most of which is discharged directly into the river without treatment. It is reported that the company does not clean barges which have been used to transport liquids, but occasionally will clean barges which have been used to transport sulfur, phosphate rock, or similar materials. Studies are underway by the company to determine if dry cleaning methods can be substituted for the present method of wet cleaning of the barges.

Northern States Power Company, Proposed R. F. Pack Plant

This proposed steam electric generating plant will be located on the Mississippi River at the south city limits of St. Paul (between the Minneapolis-St. Paul Sanitary District sewage treatment plant and the South St. Paul sewage treatment works.) The initial stage of construction is scheduled for completion in 1968. It will produce 500,000 kilowatts and have a heat rejection to the river of about 2,100 x $10^6$ BTU/hr in a cooling water flow of about 250,000 gpm. Under these conditions, the condensing waters would have about a 17°F rise in temperature.

Ashes will be discharged to a backwater area which will be diked to provide a clarification basin. Cooling towers will be provided if necessary.

Northwestern Refining Company, St. Paul Park

The waste treatment facilities consist of a cooling tower for oxidation of phenolics, stripping unit for removal of sulfides, an API oil separator, a small oil recovery lagoon, a larger oxidation lagoon, and a hay filter. The system was designed to treat oil refinery water flowing at the average rate of about 1.8 mgd. The effluent of the large lagoon is discharged through hay filters directly to the Mississippi River. Spent caustic is segregated and disposed of separately. Reports on the effluent quality are submitted periodically to this Department

This company is engaged in washing sand and gravel on Grey Cloud Island in Inver Grove Township, Washington County. Waste water, together with tailings from the washing operation, is discharged to clarification basins. The effluent drains into the river.

St. Paul Ammonia Products, Inc., Dakota County

The waste treatment facilities consist of a basin for neutralization of spent process chemicals, pumps, an orifice meter and automatic flow-recording device, and a pH meter with automatic recorder. The system was designed for removal of floatable oil and the addition of chemicals as may be required to neutralize waste flowing at the rate of 0.65 mgd. The effluent is discharged through a force-main to the Mississippi River. The company submits a monthly report to this Department showing results of analysis of the waste for various constituents such as nitrates, pH, oil, chromates, and ammonia. The company has reduced waste losses substantially by various in-plant recovery and waste prevention methods and is continuing with studies to further control the effluent quality.

Liquid Carbonic, Division of General Dynamics Corporation, Dakota County

The wastes consist essentially of cooling water and a small amount of process chemicals used in the production of solid and liquid carbon dioxide from gas supplied by St. Paul Ammonia Products, Inc. The waste is pumped into the forcemain which also carries the waste from St. Paul Ammonia Products, Inc. Treatment consists of reaction with the ammonia plant waste in the pipeline. Reports are submitted monthly with the report of St. Paul Ammonia

Products, Inc.

Great Northern Oil Company, Dakota County

The waste treatment facilities consist of chemical neutralization and stripping for destruction of spent chemicals, two API oil separators, several storage and oxidation lagoons, a disposal pit, a biological filter and activated sludge unit. The system is designed to treat an average flow of about 2.88 mgd, including storm water.

The effluent of the final lagoon is pumped intermittently to the Mississippi River. Reports on the effluent quality and flow are submitted periodically, and studies are being made on possible improvements to the system.

Northwest Cooperative Mills, Inc., Dakota County

The waste disposal facilities for this phosphoric acid and ammonium phosphate fertilizer plant consist of a gypsum storage lagoon, pumping station, and storm water collection system with detention pond and conductivity sensing system. The lagoon is designed for an average waste flow of 4.32 mgd and is operated essentially as a closed system with the lagoon effluent being reused in the plant.

Gypsum is stored permanently in the lagoon. Plant area run-off is monitored, and when found to be of unsatisfactory quality is diverted to an emergency detention pond.

The company has recently found some small leaks from the gypsum pond to the river and corrective action is underway to locate and seal the leaks.

Minnesota Mining and Manufacturing Company, Washington County

Waste treatment facilities include pH adjustment, mechanically cleaned settling tanks, multicelled oxidation lagoons and sludge storage ponds. The system in use at present was designed to provide primary treatment of chemical wastes at the rate of about 2.16 mgd with a 5-day BOD of 430 mg/1, to accomplish a BOD removal of not less than 20 percent.

A permanent storage pit for acid sludge is presently under construction and design is progressing on incineration facilities for spent solvent disposal. Engineering is also underway on a chemical system to destroy phenolic compounds which are presently discharged to a temporary pit.

Studies are being made to evaluate data obtained recently from pilot plant studies of an activated sludge system for providing a higher degree of waste treatment.

H. D. Hudson Manufacturing Company

This plant is located upstream from the USH 61 bridge in Hastings. The company is engaged in the manufacture of spraying equipment. The wastes include paint scrubber water and metal finishing wastes, both of which are discharged to the Mississippi River. Waste treatment facilities consisting of chemical reduction and precipitation have been provided, and studies are in progress in regard to facilities for dispersion of the effluent.

Foot Tanning Company

This plant is located in Red Wing on a small creek a short distance from the Mississippi River. The company does both chrome and vegetable tanning The wastes are screened and discharged to a series of sedimentation basins which overflow to the creek. The existing facilities are considered the first stage of total waste treatment facilities which may be required to avoid unsatisfactory conditions.

Northern States Power Company, Red Wing Plant

This steam electric generating plant has a net capability of 29,000 kilowatts and is located on the Mississippi River at Red Wing. Heat rejection to the river at maximum capacity is about 174 x $10^6$ BTU/hr. The cooling water flow is about 37,000 gpm when operating at maximum capacity with the river temperature in excess of 70°F. Under these conditions the temperature rise through the condensers is about 9°F.

PRELIMINARY LIST OF LIQUID STORAGE DEPOSITS
ON THE MISSISSIPPI RIVER*

(* Not including those which are a part of a "wet" industry which is listed as having a separate waste outlet.)

Western Oil and Fuel Company, Minneapolis

The company is located on the right bank of the Mississippi River upstream from the Minneapolis municipal dock. The company is engaged in the marketing of gasoline and fuel oils which are received by barge, stored and shipped by tank truck. The total storage capacity at this site is about 7 million gallons in 20 tanks. Dikes are provided around all of the tanks and each dike reportedly provides secondary containment capacity of about 120 percent of the capacity of the tanks enclosed.

Industrial Molasses Company, St. Paul

The company is located on the left bank of the river upstream from the Minneapolis-St. Paul District plant. The operation consists of receiving, storing and shipping of industrial molasses. The company has dock facilities on the river, and generally receives the molasses by barge or rail, and ships by truck or rail. No dikes or other secondary containment structures are provided around the molasses storage tanks and in the event of a major tank rupture molasses could drain into the river.

Pittsburg Plate Glass Company, Red Wing

The plant is located on the right bank of the river. Operations include the production, refining and shipping of soybean and linseed oils. Liquid wastes from the plant processes are discharged to the municipal sanitary sewer system. The plant has a total liquid storage capacity of about 1 million gallons in some 100 tanks which range upward to 140,000 gallons in capacity. Dikes or other secondary containment structures have not been provided. and in the event of a major tank rupture the contents could drain directly into the river.

# MINNESOTA RIVER

Big Stone Lake, on the western border of the State in Big Stone County, is generally considered to be the headwaters of the Minnesota River in Minnesota. From Big Stone Lake, the river flows southeasterly to Mankato, where it turns abruptly and flows northeasterly to its confluence with the Mississippi River in St. Paul at mile 844.0. The following discussion is limited mainly to the middle and lower reaches of the river, i.e., from Mankato to Carver Rapids, and Carver Rapids to the mouth, respectively.

The river flows through farm land most of the way. The reach of the river below Belle Plaine has an extremely low gradient, causing a low flow velocity which allows silt and sand from erosion of the watershed to settle in the lower reaches. The average flow at Carver over a 28-year period of record is 3,051 cfs.

Samples have been collected from the Minnesota River as a part of the Water Quality Sampling Program continuously since 1953. The anlytical data and the sampling locations are presented in Volumes 1, 2, and 3, "Water Quality Sampling Program, Minnesota Lakes and Streams," and in supplementary sheets for 1962-63 which are attached. Preliminary data from a survey presently being conducted from the Carver Rapids (mile 35) to the mouth are on separate sheets.

Uses of the River

The present uses of the lower river are recreation, stock watering, barge traffic, and disposal of sewage and industrial waste, both treated and untreated

Stock watering is limited primarily to the upper river, although some stock watering has been seen near Chaska. The present bacteriological quality of the water is such as to create some doubt as to its suitability for this use. This use is not expected to increase in the future.

The recreational uses of the river are primarily boating and fishing. The present quality of the river is not conducive to either of these uses. In a report of the Division of Game and Fish of the Minnesota Department of Conservation, it is stated that the river has a relatively low fish population, and that the proportion of game fish in the river from Shakopee to the mouth is only 6.9 percent of the total fish population, the remaining 9<.1 percent being rough fish. The Conservation Department report indicates that there will be an increase in fishing on the lower river in the future "if the human population increases as predicted, and particularly if stream conditions improve and the river becomes more favorable for fish."

Boating is presently the largest recreational use of the river but the quality of the river water for boating is questionable from a bacteriological standpoint. In the future, it is expected that boating will greatly increase and considerable developmental activities are underway. There are already preliminary plans for establishing canoe routes throughout the entire river. With effective treatment of all sewage and wastes the river water quality probably can be maintained satisfactorily for recreation, possibly including swimming, but the high turbidity of the water may detract seriously from the otherwise high recreational potential of the river.

In 1963 a total of 2.5 million tons of cargo was shipped by barge on the Minnesota River. The materials shipped consisted primarily of grain and coal, and some oil. Barge traffic now is limited to the lower river, with the dock near Shakopee being the farthest upstream. The U. S. Corps of Engineers maintains a 9-foot channel from mile 14.7 to 21.8. It is expected that barge traffic will increase significantly in the future and the channel may be extended.

Granite Falls, which is located on the far upper reach, is the only municipality to obtain its water supply from the river. It is possible that the lower river may be considered for a source of municipal water supply in the long-term future but it is not considered probable in the short-term future because of the abundance of high-quality ground water in the area.

At present there are only two municipalities, Henderson and North Mankato, which have sanitary sewer systems which discharge untreated sewage to the river. All other municipalities with sewer systems on the main stem have provided treatment facilities. North Mankato has contracted for a connection to the Mankato plant and this connection is under construction. Henderson has not yet announced specific plans for treatment although an engineer has been retained.

There are three industries downstream from Mankato which discharge raw process wastes to the river. They are the Minnesota Valley Milk Processing Cooperative Association in Belle Plaine, American Crystal Sugar Company in Chaska, and the Rahr Malting Company in Shakopee. The Minnesota Valley Milk Processing Association has retained a consulting engineer to prepare plans and specifications for a waste disposal system. Plant waste surveys were made recently by this Department at the American Crystal Sugar Company and the Rahr Malting Company to evaluate the waste discharges and the extent of treatment to be recommended for these wastes.

In summary, the quality of the Minnesota River appears to be poor. Detailed studies are underway leading toward classification and adoption of standards by the Water Pollution Control Commission as a preliminary to further sewage and waste treatment requirements consistent with existing and future uses of the river.

Analytical Data

Table 1 shows the minimum, maximum and mean values for the total coliform counts at the indicated sampling stations.

Table 1

Total Coliforms (MPN/100 ml), 1953-1963 incl.

| Station | Henderson | Jordan | Shakopee | Nichols |
|---|---|---|---|---|
| River Mile | 70 | 39 | 16.8 & 25.1 | 7.4 |
| Minimum | 2,000 | 1,100 | 330 | 2,600 |
| Maximum | 350,000 | 35,000 | 920,000 | 540,000 |
| Mean | 44,039 | 11,925 | 73,730 | 74,935 |
| Median | - | - | 13,000 | 16,500 |

The bacteriological quality of the lower river as indicated by these data is poor. In general, most of the high values shown for the Shakopee and Nichols stations were found during the period when the American Crystal Sugar plant in Chaska was in operation, but these are not necessarily indicative of fecal contamination because the values are for presumptive total coliforms undifferentiated as to fecal types. High values are also shown by the results obtained from sampling of cross-section stations below the sugar plant during the 1963 summer and fall, part of the current river study. Deterioration in the bacteriological quality of the river from the wastes from the Rahr Malting Company is also noticeable.

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Table 2

Total Coliforms (MPN/100 ml)

| Station | Sub-Station | August 13, 1963 | October 23 and November 11, 1963 |
|---|---|---|---|
| 27.7, immediately below American Crystal Sugar Company | Right | 35,000 | 54,000 |
| | Center | 54,000 | 54,000 |
| | Left | 18,000 | 920,000 |
| 25.2 immediately below Rahr Malting | Right | 160,000 | 9,200,000 |
| | Center | 35,000 | 1,600,000 |
| | Left | 24,000 | 3,500,000 |

Provisional Flow Date: August 13 - 6,540 cfs; October 23 - 1,270 cfs; November 11 - 1,160 cfs.

The Rahr Malting Company operates throughout the year, and the American Crystal Sugar Company generally operates from late September to late January or early February. The untreated wastes from the American Crystal Sugar Company enter on the left bank (facing downstream), and the Rahr Company wastes enter on the right bank.

In general, the dissolved oxygen content of the Lower Minnesota River is low during the warm months. This can be attributed to the pollution load imposed on the river, both natural and man-made, and the high turbidity of the river water. In turbid water, the penetration of sunlight is reduced, thereby handicapping the growth of algae which are a source of dissolved oxygen through photosynthesis. The dissolved oxygen in the river ranged from about 1 mg/1 to super-saturation. The dissolved oxygen has in the past been completely exhausted in certain areas during periods of ice cover, but recent data are not available for this period. Further studies are planned for this winter Samples collected during August, 1963, generally showed dissolved oxygen concentrations of about 5 mg/1.

The 5-day BOD values of the samples collected as a part of the Water Quality Sampling Program averaged about 6.0 mg/1, and ranged from 1.1 to 17 mg/1. The samples collected on the Lower Minnesota River, as a part of the current study, had a mean 5-day BOD value of about 4 mg/1 before the American Crystal Sugar Company in Chaska began operations and about 10 mg/1 after. In general, the 5-day BOD values are indicative of organic pollution, particularly in certain reaches and periods.

The remaining analytical data including suspended solids, suspended volatile matter, phosphorus, chlorides, ammonia and surfactants, generally substantiate the interpretations given above and indicate a fair degree of pollution.

Biology

The Lower Minnesota River is biologically poor. There are relatively few organisms present in it in any number. It is believed that this condition may not be ascribable to any one cause but is rather a result of a combination of factors including the natural character of the stream, pollution by sewage and industrial wastes, and dredging of the channel.

Bottom sampling in August and again in October, 1963, between the mouth of the Minnesota River and mile 33 yielded a total of only 6 species of organisms in the bottom fauna. Only 8 of 15 stations sampled in cross-section yielded organisms of any kind. All organisms found in this reach were classified as pollution tolerant or facultative except at Station 25.6 where one clean water caddis larvae was taken. Such a paucity of life in a river indicates that conditions are not satisfactory for growth and continued development of many species and that those species which were present did not find favorable conditions or they would have been present in greater numbers.

One factor limiting the biota is the natural character of the stream. The lower river has predominantly a sandy bottom with few areas of gravel or rubble or even mud to which organisms might attach, crawl under or burrow in. The current is frequently strong in this reach and scours large portions of the bottom and causes shifting of sand in many areas.

The dredging of the lower reach has probably accentuated this scouring characteristic by creating a more chute-like channel. The dredging of the river for barge traffic has eliminated some natural cover of the biota and reduced the natural multiplicity of environmental conditions. Normally one would expect to find a host of detritus feeders in this type of river; i.e., worms, various insect larvae and many snails and clams should be present but were not.

It is known that the Lower Minnesota River as recently as 1935 supported a rich and varied mussel fauna. The shells of this former population are found in profusion on the river bank today, yet no living clams or snails could be found in this reach in 1963. In a collecting session of not more than two hours, old shells representing 16 species of clams were collected from the banks. Apparently none of these species have survived, their disappearance being a consequence presumably of both dredging and pollution. From the marked adverse effect upon the stream biota, it would appear that at least two degrading influences have been felt. Likely possibilities are oxygen depletion by organic wastes, and periodic conditions of toxicity possibly caused by oil spills. The almost complete absence of clean water organisms in this reach is indicative of the effects of organic pollution with concurrent oxygen depletion, while the scarcity of even pollution-tolerant organisms points toward intermittent slugs of toxic wastes.

Another degrading influence of significant effect upon the river is the high silt load and consequent turbidity. This is believed to have increased during the past 30 years and it, too, has a detrimental effect upon river biota. The basis of the aquatic food chain, the algae, is suppressed by high turbidities because of reduced light penetration. Although algal growth and photosynthetic replenishment of dissolved oxygen are thereby limited, high turbidity does limit the action of bacteria which break down organic wastes and ordinarily consume oxygen in the process as long as oxygen is available

Effect of Minnesota River on Mississippi River

From review of all of the data available, it appears that the Minnesota River has some detrimental effects on the Mississippi River from a chemical and a bacteriological standpoint

The mean 5-day BOD of the Mississippi River above the mouth of the Minnesota River is about 2.5 mg/1 while that of the Minnesota River near the mouth is about 4.0 mg/1. During the period of the year when the American Crystal Sugar plant is in operation, the BOD of the Minnesota River is substantially increased, and during the winter period especially, may result in a higher BOD in the Mississippi River. The flow in the Mississippi River above the confluence of the two rivers is generally three times that in the Minnesota River.

The dissolved oxygen content of the Minnesota River is generally lower than that of the Mississippi River at the junction. The mean value for the Mississippi River just above the confluence of the Minnesota River is about 9.8 mg/1, while that of the Minnesota River 1.9 miles above the mouth is 7.8 mg/1.

The bacteriological quality of the Mississippi

River and Minnesota River at their confluence is of the same order. The median total coliform counts of the Mississippi and Minnesota rivers is 11,000 and 8,000 MPN/100 ml, respectively.

# 1962-63 WATER QUALITY DATA, MINNESOTA RIVER*

**Station: Mi - 1.9**

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phospho-rous | Ammonia (N) | Sur-factants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-15-63 | 77 | 7.8 | 5,400 | 1,700 | 110 | 16 | 38 | 0.21 | 0.05 | <0.1 | 4.9 | 3.8 |
| 10-22-63 | 64 | 7.7 | 240,000 | 7,900 | 54 | 14 | 30 | 0.270 | 0.05 | 0.26 | 3.0 | 7.5 |

**Station: Mi - 7.4**
**Location: Nichols, Cedar Avenue Bridge on SH 13**

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/00 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phospho-rous | Ammonia (N) | Sur-factants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7-24-62 | 75 | 7.6 | 9,200 | | 174 | | 125 | - | <0.20 | - | 6.0 | 7.7 |
| 9-12-62 | 65 | 7.2 | 13,000 | | 110 | | 45 | - | 0.02 | - | 5.9 | 3.0 |
| 11-7-62 | 45 | 8.4 | 17,000 | | 46 | | 22 | 0.19 | <0.01 | <0.1 | 9.2 | 8.0 |
| 11-24-62 | 56 | 7.9 | 2,600 | | 44 | | 40 | - | 0.14 | - | 9.8 | 3.3 |
| 2-28-63 | 34 | 8.1 | 4,900 | | 8 | | 15 | 0.25 | 0.78 | 0.21 | 3.9 | 4.0 |
| 6-20-63 | 72 | 7.2 | 35,000 | | 140 | | 50 | 0.24 | 0.05 | 0.1 | 5.2 | 4.0 |
| 8-5-63 | 78 | 8.0 | 16,000 | 1,300 | 110 | 17 | 50 | 0.32 | <0.05 | <0.1 | 4.7 | 5.8 |
| 8-15-63 | 79 | 7.8 | 9,200 | 790 | 120 | 18 | 38 | 0.20 | <0.05 | <0.1 | 4.7 | 4.3 |
| 8-20-63 | 73 | 7.6 | 16,000 | 1,700 | 82 | 15 | 45 | 0.28 | 0.06 | 0.17 | 5.7 | 7.3 |
| 9-25-63 | 67 | 8.6 | 24,000 | 1,000 | 68 | 18 | 35 | 0.28 | 0.06 | 0.17 | 9.9 | 5.0 |
| 10-8-63 | 65 | 8.6 | 350,000 | 24,000 | 61 | 19 | 40 | 0.25 | 0.06 | <0.1 | 8.3 | 8.8 |
| 10-22-63 | 65 | 7.7 | 540,000 | 11,000 | 52 | 15 | 26 | 0.230 | <0.05 | <0.1 | 3.7 | 7.9 |
| 11-6-63 | 50 | 8.1 | 160,000 | | 67.0 | | 40 | 0.19 | 0.05 | 0.12 | 10.3 | 10.0 |
| 11-19-63 | 45 | 7.9 | 35,000 | 2,200 | 124 | 20 | 75 | 0.35 | <0.05 | <0.1 | 11.5 | 13.0 |

**Station: Mi - 12.8**

| Date | Temp. (°F) | pH Value | Total Coliform (MPN/100 ml) | Fecal Coliform (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phospho-rous | Ammonia (N) | Sur-factants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-15-63 | 74 | 8.0 | 24,000 | 5,400 | 120 | 16 | 40 | 0.22 | 0.10 | <0.1 | 4.5 | 4.3 |
| 10-22-63 | 62 | 7.7 | 920,000 | 170,000 | 60 | 16 | 35 | 0.28 | <0.05 | 0.18 | 4.0 | 11.0 |

* as mg/l unless otherwise indicated
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1962-63 WATER QUALITY DATA, MINNESOTA RIVERS (Cont'd.)

Station: Mi - 14.3
Location: Normandale Ave. Bridge

| Date | (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Sur-factants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-5-63 | 76 | 8.1 | 22,000 | 2,200 | 53 | 12 | 95 | 0.31 | 0.05 | 0.1 | 4.9 | 5.3 |
| 8-22-63 | 71 | 8.7 | 35,000 | 3,300 | 70 | 16 | 25 | 0.21 | 0.06 | 0.1 | 7.5 | 6.3 |
| 9-18-63 | 68 | 8.2 | 24,000 | 500 | 52 | 16 | 30 | 0.25 | 0.18 | 0.1 | 5.4 | 5.8 |
| 10-9-63 | 62 | 8.5 | 920,000 | 24,000 | 48 | 17 | 28 | 0.16 | 0.06 | 0.1 | 9.1 | 6.8 |
| 11-20-63 | 41 | 7.8 | 170,000 | 9,500 | 64 | 16 | 35 | 0.25 | 0.05 | 0.1 | 14.5 | 18.0 |

Station: Mi - 14.5

| Date | (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Sur-factants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-15-63 | 75 | 8.0 | 54,000 | 790 | 190 | 25 | 40 | 0.21 | 0.06 | 0.1 | 4.2 | 4.3 |
| 10-23-63 | 62 | 7.8 | 920,000 | 92,000 | 56 | 16 | 30 | 0.28 | 0.05 | 0.1 | | 10.0 |

Station: Mi - 16.8
Location: Highway 25 Bridge

| Date | (°F) | pH Value | Total Coliform (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Sur-factants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-5-63 | 77 | 8.1 | 92,000 | 1,700 | 200 | 30 | 75 | 0.38 | 0.05 | 0.1 | 4.7 | 4.5 |
| 8-22-63 | 71 | 8.5 | 22,000 | 1,300 | 84 | 18 | 30 | 0.23 | 0.10 | 0.1 | 7.4 | 6.5 |
| 9-18-63 | 69 | 8.4 | 24,000 | 7,900 | 66 | 19 | 40 | 0.50 | 0.05 | 0.1 | 6.9 | 6.0 |
| 10-9-63 | 62 | 8.4 | 540,000 | 2,200 | 39 | 16 | 28 | 0.26 | 0.06 | 0.1 | 9.5 | 7.8 |
| 11-20-63 | 41 | 7.9 | 130,000 | 2,300 | 50 | 15 | 31 | 0.27 | 0.5 | 0.1 | 14.7 | 17.0 |

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# 1962-63 WATER QUALITY DATA, MINNESOTA RIVERS (Cont'd.)

Station - Mi - 19.0

| Date | Temp. (F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-13-63 | 76 | 8.0 | 54,000 | 1,700 | 240 | 30 | 75 | 0.24 | 0.05 | 0.12 | 4.6 | 4.3 |
| 10-23-63 | 63 | 6.8 | 1,700,000 | 92,000 | 42 | 14 | 25 | 0.46 | 0.05 | < 0.1 | | 32.0 |

Station - Mi - 23.9

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-13-63 | 76 | 7.9 | 54,000 | 5,400 | 280 | 32 | 65 | 0.26 | < 0.05 | 0.12 | 4.9 | 3.8 |
| 10-23-63 | 63 | 7.6 | 1,600,000 | 54,000 | 54 | 17 | 40 | 0.20 | < 0.05 | 0.1 | | 13.0 |

Station - Mi - 25.1
Location: Shakopee Bridge on U.S.H. 169

| Date | Temp (F) | pH Value | Total Coliform (MPN/100 ml) | Fecal Coliforms MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-24-62 | 52 | 8.0 | 4,900 | | 54 | | 30 | - | 0.10 | - | 10.0 | 5.3 |
| 7-24-62 | 74 | 8.7 | 11,000 | | 120 | | 75 | - | < 0.1 | - | 5.3 | 5.7 |
| 9-12-62 | 66 | 7.3 | 35,000 | | 110 | | 30 | - | < 0.01 | - | 5.0 | 3.0 |
| 11-8-62 | 40 | 8.4 | 54,000 | | 49 | | 20 | 0.17 | < 0.01 | < 0.1 | 10.0 | 7.8 |
| 2-28-63 | 32 | 7.7 | 35,000 | | 4 | | 20 | 0.23 | 1.0 | 0.23 | 1.5 | 4.5 |
| 6-18-63 | 73 | 7.5 | 13,000 | | 260 | | 75 | 0.35 | < 0.05 | < 0.1 | 5.9 | 5.0 |
| 8-5-63 | 78 | 8.1 | 54,000 | 3,500 | 230 | 31 | 90 | 0.32 | < 0.05 | < 0.1 | 4.8 | 5.3 |
| 8-20-63 | 71 | 7.8 | 54,000 | 3,100 | 110 | 19 | 45 | 0.26 | < 0.05 | < 0.1 | 5.8 | 7.0 |
| 9-25-63 | 67 | 8.4 | 35,000 | 1,700 | 77 | 18 | 45 | 0.27 | 0.06 | 0.16 | 10.3 | 3.8 |
| 10-8-63 | 63 | 8.2 | 920,000 | 92,000 | 64 | 19 | 35 | 0.47 | < 0.05 | - | 9.2 | 12.0 |
| 11-6-63 | 46 | 8.2 | 240,000 | | 50 | | 27 | 0.15 | 0.06 | 0.11 | 12.7 | 13.0 |
| 11-19-63 | 40 | 7.8 | 54,000 | 400 | 70 | 18 | 35 | [illegible] | < 0.05 | 0.22 | 15.0 | 14.0 |

# 1962-63 WATER QUALITY DATA, MINNESOTA RIVERS (Cont'd.)

**Station: Mi - 25.2**

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-13-63 | 77 | 8.2 | 35,000 | 3,500 | 270 | 32 | 65 | 0.02 | 0.28 | 0.10 | 4.5 | 3.8 |
| 10-23-63 | 63 | 7.6 | 1,600,000 | 54,000 | 54 | 17 | 40 | 0.20 | 0.05 | 0.1 | | 13.0 |

**Station: Mi - 25.6**

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-13-63 | 76 | 8.1 | 35,000 | 790 | 250 | 30 | 75 | 0.28 | <0.05 | 0.12 | 4.9 | 4.0 |

**Station Mi - 27.7**

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (N) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-12-63 | 79 | 8.1 | 54,000 | 1,300 | 270 | 39 | 80 | 0.26 | 0.05 | 0.1 | 4.9 | 4.8 |
| 11-3-63 | 41 | 8.2 | 54,000 | 1,300 | 60 | 18 | 35 | 0.22 | 0.05 | 0.1 | 13.4 | 10.0 |

Station: Mi - 30.8

| Date | Temp. (°F) | pH Value | Total Coliforms (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia (n) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-12-63 | 79 | 7.9 | 28,000 | 1,100 | 260 | 37 | 65 | 0.30 | < 0.05 | < 0.1 | 4.6 | 4.5 |
| 11-12-63 | 41 | 7.9 | 3,300 | < 200 | 61 | 18 | 40 | 0.22 | < 0.05 | < 0.1 | 14.5 | 12.0 |

Station: Mi - 32.0

| Date | Temp. (°F) | pH Value | Total Coliform (MPN/100 ml) | Fecal Coliforms (MPN/100 ml) | Suspended Solids | Volatile Water | Turbidity Value | Phosphorus | Ammonia (n) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-12-63 | 79 | 8.2 | 5,400 | 490 | 220 | 33 | 50 | 0.30 | < 0.05 | < 0.1 | 5.0 | 4.5 |
| 11-12-63 | 42 | 7.9 | 1,700 | < 200 | 70 | 18 | 35 | 0.27 | < 0.05 | < 0.1 | 14.0 | 11.0 |

Station: Mi - 33.3

| Date | Temp. (°F) | pH Value | Total Coliform (MPN/100 ml) | Fecal Coliform (MPN/100 ml) | Suspended Solids | Volatile Water | Turbidity Value | Phosphorus | Ammonia (n) | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8-12-63 | 80 | 8.4 | 35,000 | 790 | 210 | 32 | 75 | 0.25 | 0.06 | < 0.1 | 4.8 | 4.8 |
| 11-12-63 | 42 | 8.4 | 3,300 | 700 | 56 | 18 | 35 | 0.16 | < 0.05 | < 0.1 | 14.0 | 11.0 |

< Means less than

Station: Jordan, Bridge on SAR 29
Location: Mi - 39

| Date | Temp (°F) | pH Value | Total Coliforms (MPN/100ml) | Fecal Coliforms (MPN/100ml) | Suspended Solids | Suspended Volatile Matter | Turbidity Value | Phosphorus | Ammonia | Sur-factants | DO | 5-day BOD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4-24-62 | 56 | 8.1 | 1,100 | | 60 | | 48 | - | 0.14 | - | 10.0 | 5.3 |
| 7-24-62 | 74 | 8.6 | 13,000 | | 120 | | 100 | - | <0.1 | - | 5.9 | 5.3 |
| 9-12-62 | 65 | 7.4 | 28,000 | | 130 | | 40 | - | <0.01 | - | 6.0 | 3.5 |
| 11-8-62 | 40 | 8.4 | 11,000 | | 36 | | 17 | 0.18 | <0.01 | <0.1 | 10.7 | 7.0 |
| 2-28-63 | 35 | 8.3 | 3,300 | | 3.6 | | 15 | 0.22 | 0.90 | 0.21 | 1.1 | 2.5 |
| 6-18-63 | 72 | 7.3 | 17,000 | | 260 | | 65 | 0.38 | 0.05 | <0.1 | 6.1 | 6.8 |
| 7-15-63 | 75 | 8.0 | 17,000 | | 190 | | 70 | 0.34 | <0.05 | <0.1 | - | 5.8 |
| 8-5-63 | 78 | 8.1 | 35,000 | 230 | 160 | 26 | 75 | 0.31 | <0.05 | <0.1 | 4.7 | 4.8 |
| 8-20-63 | 70 | 7.9 | 92,000 | 3,300 | 120 | 30 | 75 | 0.34 | 0.22 | 0.1 | 6.3 | 6.5 |
| 9-25-63 | 63 | 8.3 | 13,000 | 1,700 | 81 | 19 | 35 | 0.24 | <0.05 | .16 | 25.0 | 4.8 |
| 10-8-63 | 63 | 8.3 | 4,900 | 500 | 82 | 22 | 40 | 0.29 | <0.05 | <0.1 | 10.7 | 10.0 |
| 11-6-63 | 46 | 7.9 | 17,000 | | 44 | | 25 | 0.26 | <0.05 | <0.1 | 13.4 | 7.8 |
| 11-19-63 | 42 | 7.8 | 7,900 | 500 | 49 | 14 | 75 | 0.18 | <0.05 | <0.1 | 16.6 | 8.3 |

# SEWAGE WORKS ON THE MINNESOTA RIVER

## Mankato

The Mankato plant was constructed in 1961 and is a primary plant consisting of a control building, two primary settling tanks, a chlorination contact tank, two sludge digesters, a sludge drying bed, and a sludge lagoon. The plant is designed for a sewage and waste flow of 5.82 mgd with a 5-day BOD of 250 mg/1. Part of the sewer system is combined sanitary and storm.

## North Mankato

Plans for a forcemain to carry raw sewage from North Mankato across the Minnesota River to an existing interceptor sewer in Mankato were approved on August 7, 1963. A contract has been made for treatment of the North Mankato sewage in the Mankato sewage treatment plant. The forcemain is now under construction and is expected to be in operation early in the spring.

## St. Peter

The St. Peter sewage works were constructed in

1963, and consist of a lift station and forcemain, two primary and one secondary raw sewage stabilization ponds. The primary ponds have a total surface area of about 148 acres, and the secondary pond has a liquid surface of about 47 acres. The ponds are designed to treat a sewage and waste flow of about 1.1 mgd with a 5-day BOD of about 270 mg/l. The storage time at the design flow of 1.1 mgd is about 270 days, based upon a depth of 4 feet in the primary ponds and 5 feet in the secondary pond. These facilities also serve the State Hospital at St. Peter.

Le Sueur

A lift station and forcemain and two primary and one secondary raw sewage stabilization ponds were constructed in 1963. The ponds are designed to treat a sewage and waste flow of about 0.397 mgd with a 5-day BOD of about 345 mg/l. The primary ponds have a total surface area of about 60 acres. The secondary pond has a surface area of about 21 acres. The storage time in the ponds at the design flow is about 285 days, based on a storage depth of four feet in the primary ponds and five feet in the secondary pond.

Henderson

This is the only sewered municipality located on the Minnesota River which does not provide treatment, or has not yet made arrangements for treatment, of the sewage before discharging it to the river. On August 5, 1963, the Commission informed the village that planning for the orderly development of adequate facilities for treatment of the sewage and industrial waste for which they are responsible must proceed without delay. The village thereupon employed a consulting engineer to conduct an engineering study and prepare a preliminary report and so advised this Commission on November 21, 1963.

Belle Plaine

The borough sewage works were constructed in 1963 and consist of one primary and one secondary raw sewage stabilization pond. The ponds are designed to treat a sewage and waste flow of 0.20 mgd with a 5-day BOD of about 390 mg/l. The primary pond has a surface area of about 33 acres and the secondary pond has about 14 acres. A storage period of about 250 days is provided at the design flow.

Chaska

The Chaska sewage treatment plant was constructed in 1963 and is a secondary plant consisting of bar screens and comminutor, grit removal equipment, a contact aeration tank, a reaeration tank, an aerobic sludge digestion tank, settling tanks, and chlorine contact tanks. It is designed to treat a sewage and waste flow of 0.75 mgd with a 5-day BOD of about 200 mg/l. Since there are no other sewage treatment plants of this type in operation in Minnesota, the plans were approved with the reservation that modification to the plant would be required if performance is not satisfactory.

Shakopee

This plant was constructed in 1961. It is a primary plant and includes a control building, a dual primary settling tank, a dual chlorination tank, two sludge digestion tanks, and a sludge drying bed. The plant is designed to treat 0.90 mgd of sewage and waste at a 5-day BOD of about 300 mg/l to produce an effluent of about 200 mg/l. Provision is made in the design of the interceptor sewer for the possible future discharge of the Rahr Malting Company wastes to the municipal plant for treatment when secondary units are constructed.

Savage

A new sewage treatment plant was constructed in

1963 and replaced a plant which was constructed in 1939. The new plant consists of a control building, a primary settling tank, a high-rate trickling filter, a secondary settling tank, a heated sludge digester, and a sludge drying bed. Provision is also made for chlorination of the plant effluent. The plant is designed to treat 0.39 mgd of sewage and waste with a 5-day BOD of about 210 mg/l to produce an effluent of about 40 mg/l. Final disposal of the plant effluent is to a creek which joins the Minnesota River.

Burnsville Township, Dakota County

The Burnsville sewage treatment plant was constructed in 1963. It is a secondary treatment plant and employs the contact stabilization modification of the activated sludge process. The various units include a contact tank, sludge reaeration tank, aerobic sludge digestion tank, final settling tank and chlorine contact tank. The plant is designed to provide secondary treatment for a flow of 0.50 mgd with a 5-day BOD of about 200 mg/l. The plant was completed and started on January 20, 1964. A temporary sewage holding pond was used previously. The effluent drains to the Minnesota River by way of Black Dog Lake.

Cedar Grove Subdivision, Egan Township, Dakota County

A secondary treatment plant was constructed in

1960 and consists of a comminutor, dual aeration tanks, dual settling tanks, a chlorination tank, a sludge holding tank, a control building, and chlorination equipment. The plant is designed to treat 0.083 mgd of sewage with a 5-day BOD of 250 mg/l to produce an effluent of about 30 mg/l. Final disposal of the plant effluent is to Black Dog Creek and thence to the Minnesota River.

INDUSTRIAL WASTE DISPOSAL ON THE MINNESOTA RIVER

Honeymead Products Company, Mankato

The company is engaged principally in the production of soybean oil. Large quantities of soybeans, soybean oil and by-products from soybean oil processing are stored in tanks or similar containers on the plant site next to the Blue Earth River a short distance from the confluence with the Minnesota River. Plant process wastes are acidulated and treated in oil traps before being discharged to the Blue Earth River. A large quantity of soybean oil was lost to the Blue Earth River in January, 1963, when a large tank burst. The company has recently submitted preliminary plans for secondary containment structures, and is proceeding with studies aimed at reducing the discharge of plant wastes and increasing the degree of waste treatment.

North Star Concrete Products Company, Mankato

This company is engaged in the washing of sand and gravel at a site on the Minnesota River. Some of the material is obtained by dredging in the river. Waste water and tailings from the washing operations are treated in a clarification basin which overflows to the river.

Archer Daniels Midland Company, Mankato

The company is engaged in soybean oil extraction and refining. Cooling water and water conditioning wastes are discharged to a ditch which drains to the Minnesota River. The process wastes are discharged to the municipal sanitary sewer after passing through an oil separator.

Blue Cross Rendering Company, Mankato

This plant is located on the east bank of the Minnesota River in the northern part of Mankato. The plant processes dead animals, meat scraps and animal offal to produce non-edible fats and a high-protein feed additive. The liquid wastes are discharged to the river after treatment. The treatment facilities consist of a grease trap for the cooling water and condensate, and a biological filter plant for the process wastes.

Northern States Power Company, Wilmarth Plant, Mankato

This steam electric generating plant is located on the Minnesota River. It has a net capability of 27,900 kilowatts and a heat rejection to the river at maximum capacity of about 170 x $10^6$ BTU/hr. Cooling water flow is dependent on load and river temperature conditions. At maximum generation and with the river temperature in excess of 60°F, the cooling water flow is about 23,000 gpm. Under these conditions, the temperature rise through the condenser is about 15°F.

Gopher State Silica Company

The plant is engaged in the washing and grading of silica sand at a site near the Minnesota River a few miles down stream from St. Peter in LeSueur County. Water for plant operation is pumped from the pit and Cody Lake and discharged together with tailings from the washing and grading operations to a clarification basin which overflows to Cody Lake and the Minnesota River.

Green Giant Company, LeSueur

This plant is located adjacent to the Minnesota River and is engaged in the canning and freezing of peas and corn. Operation of the plant is seasonal. Liquid wastes from the operation include cooling water, corn silage stack liquor and water used for cleaning of the plant and equipment. The total waste flow is reportedly about 1 mgd. The process wastes and silage liquor are disposed of by means of a ridge and furrow irrigation field.

Minnesota Valley Milk Processing Cooperative Association, Belle Plaine

The plant is located on the right bank of the Minnesota River. The principal activity is the drying of non-fat milk for human consumption and it is one of the largest plants of its kind in the State. Liquid wastes consist of cooling and condensing water, losses from milk drying, and tank truck washings as well as equipment and floor washings. The cooling water is segregated from the process wastes. The sanitary sewage is segregated from the process wastes, and discharged to a septic tank followed by a soil absorption field. The company is currently engaged in making engineering studies for construction of process waste treatment facilities.

American Crystal Sugar Company, Chaska

This plant produces refined sugar from sugar beets. Operation is seasonal and generally is between September and February. The wastes consist of lime sludge, flume water, and process wastes. The total flow during maximum operation may approach 6 mgd. Treatment facilities consist of a lime sludge pond with no discharge. The remainder of the wastes are discharged without treatment directly to the river.

An attempt was made to operate a small broad-field irrigation system but without success. The company participated with this Department in a recent waste survey made to determine the volume and characteristics of the plant wastes.

Rahr Malting Company, Shakopee

This plant produces malt from barley. The processes consist of steeping, germination, and drying. The wastes produced consist of cooling and wash waters. The total waste water flow amounts to about 3 mgd of which about 75% is clean cooling water. Basket screens are located at points within the plant to catch residual grain. No further treatment is provided, but an allowance was made in the design of the city interceptor sewer to permit discharge of the process wastes into the city system at some future date when additional treatment facilities are provided by the city.

Owens-Illinois Glass Company, Scott County

This plant manufactures paper boxes and other containers from paper stock. Processes consist of cutting, forming and gluing. The major process waste consists of residual starch and this is treated with sanitary sewage in an activated sludge plant (package unit) which is designed for a flow of about 0.015 mgd. The effluent is discharged to the Minnesota River via a ditch.

Cargill, Inc., Savage

This plant is located on the right bank of the Minnesota River and is engaged in extracting and refining soybean and linseed oil. Waste treatment facilities consist of screens and an oil separator. Treated wastes are discharged to the Credit River near its confluence with the Minnesota River.

Extensive storage facilities are provided at Port Cargill in connection with barge shipment of vegetable oils and soybeans.

Northern States Power Company, Black Dog Plant, Burnsville Township, Dakota County

This steam electric generating plant is located on the Minnesota River about 8 miles above the mouth. The plant has a net capability of about 460,900 kilowatts and under maximum capacity operation rejects about 2,460 x $10^6$ BTU/hr. A condensing water recirculation pond is used so actual heat losses to the river are not known but are estimated to be considerably less than the plant rejection although this is to some degree dependent upon river levels and water temperatures. Maximum cooling water flow is about 300,000 gpm with recirculation dependent on river levels.

Ashes are handled hydraulically and used for fill on the plant grounds. The ash flume water is clarified by means of a settling pond.

Twin City Barge and Towing Company, Burnsville Township, Dakota County

This company operates stationary barge cleaning facilities on the right bank of the Minnesota River in Burnsville Township. The facilities are operated during the river shipping season only. In general, the operations consist of cleaning coal barges so that they can be loaded with grain. Wastes from the operations include coal and grain mixed with wash water, most of which is discharged directly into the river without treatment. The company does not usually clean barges which have been used to transport liquids, but occasionally will clean barges which have been used to transport sulfur, phosphate rock, or similar materials.

A study is being made by the company to determine if the wet cleaning now done can be replaced by dry cleaning methods.

PRELIMINARY LIST OF LIQUID STORAGE DEPOTS*, ON THE MINNESOTA RIVER

Richards Oil Company, Scott County

The company is located on the right bank of the Minnesota River up-stream from Savage. The company is engaged in receiving, blending and shipping asphalt and fuel oils, and has a barge dock on the river. In general, the materials are received by barge and shipped by truck, but soybean oil is sometimes received and loaded into barges at the company dock. A large quantity of petroleum oil was lost to the river in December 1962. All of the storage facilities have been enclosed with earth dikes with the exception of one or two tanks for which dike construction is currently underway. A large oil recovery basin and filter has been constructed on this property to remove oil from the plant area drainage.

*Not including those which are a part of a "wet" industry which is listed as having a separate waste outlet.

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## WATER QUALITY DATA, ST. CROIX RIVER

Location: Prescott, Wisc.; Bridge on USH 10, Station SC - 0

| Date | pH Units | Total Presumptive Coliforms (MPN/100 ml) | Suspended Solids | Turbidity Units | Phosphorous | Ammonia | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|
| 4-17-62 | 7.6 | 200 | 4.8 | 10 | | 0.2 | - | 9.2 | 2.8 |
| 7-25-62 | 7.9 | <200 | 7.2 | 11 | | 0.12 | - | 5.9 | 2.7 |
| 8-27-62 | 7.6 | <200 | 5.2 | 10 | | <0.01 | - | 5.9 | 4.0 |
| 9-26-62 | 8.1 | <200 | 5.6 | 5 | 0.08 | 0.14 | <0.1 | | 1.3 |
| 11-7-62 | 8.0 | <200 | 5.2 | 3 | 0.08 | 0.24 | <0.1 | 7.6 | 1.5 |
| 2-5-63 | 8.3 | - | 3.2 | 6 | 0.08 | 0.24 | <0.1 | 10.4 | 1.5 |
| 2-26-63 | 9.0 | <200 | 2.0 | 20 | 0.08 | 0.16 | <0.1 | 8.8 | 1.5 |
| 6-18-63 | 7.6 | 200 | 4.4 | 10 | 0.08 | 0.1 | <0.1 | 6.4 | 3.4 |
| 11-5-63 | 7.5 | 200 | 7.2 | 10 | 0.10 | 0.18 | <0.1 | 7.0 | 2.5 |

Location: Stillwater; Bridge on SH 212, Station SC - 22.6

| Date | pH Units | Total Presumptive Coliforms (MPN/100 ml) | Suspended Solids | Turbidity Units | Phosphorous | Ammonia | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|
| 4-17-62 | 7.8 | 610 | 8.4 | 10 | - | 0.2 | - | 11.4 | 2.5 |
| 7-25-62 | 8.2 | 1,300 | 20.0 | 15 | - | <0.1 | - | 7.9 | 4.5 |
| 9-11-62 | 7.0 | 800 | 4.0 | 15 | - | <0.1 | - | 7.0 | 1.8 |
| 11-6-62 | 8.6 | 2,300 | 6.0 | 1.0 | 0.08 | <0.1 | <0.1 | 6.1 | 2.3 |
| 3-26-63 | 8.8 | 4,900 | 2.8 | 19 | 0.11 | 0.10 | <0.1 | 7.6 | 2.0 |
| 6-18-63 | 7.7 | 500 | 11.0 | 12 | 0.14 | <0.06 | <0.1 | 4.8 | 4.5 |
| 11-5-63 | 7.9 | 1,100 | 6.4 | 10 | 0.03 | <0.05 | <0.1 | 11.9 | 3.8 |

Location: Osceola, Wisc.; Bridge on SH 243, Station SC - 45

| Date | pH Units | Total Presumptive Coliforms (MPN/100 ml) | Suspended Solids | Turbidity Units | Phosphorous | Ammonia | Surfactants | DO | 5-Day BOD |
|---|---|---|---|---|---|---|---|---|---|
| 4-17-62 | 8.2 | 200 | 7.6 | 10 | - | 0.2 | - | 11.5 | 5.5 |
| 7-25-62 | 8.1 | 200 | 6.8 | 13 | - | <0.1 | - | 7.6 | 5.9 |
| 9-10-62 | 7.5 | 200 | 5.6 | 15 | - | <0.01 | - | 7.0 | 1.3 |
| 11-6-62 | 8.7 | 1,700 | 8.4 | 2 | 0.08 | 0.04 | <0.1 | 9.6 | 2.5 |
| 2-26-63 | 8.6 | 2,200 | 4.4 | 11 | 0.11 | 0.10 | <0.1 | 7.7 | 2.3 |
| 6-6-63 | 7.3 | 1,300 | 11.0 | 10 | 0.16 | <0.05 | <0.1 | 6.1 | 5.0 |
| 11-5-63 | 7.9 | 500 | 3.2 | 8 | 0.03 | <0.05 | <0.1 | 12.1 | 2.8 |

## ST. CROIX RIVER

The St. Croix River rises in Uppser St. Croix Lake, Douglas County, Wisconsin, and follows a southerly course 164 miles through forests and farm lands to its confluence with the Mississippi River at mile 811.3 (miles above the Ohio River). The lower 120 miles of the river form a boundary between Minnesota and Wisconsin. Its mean flow over a 60-year period (1902 to 1962) is 4,043 cfs, measured at St. Croix Falls, Wisconsin.

There is very little development along the river bank on the Minnesota side upstream of Taylor Falls, with moderate development downstream. There are only three incorporated Minnesota municipalities located directly on the river which have public sanitary sewer systems, and all of these municipalities have provided sewage treatment facilities. All other smaller sources of sewage also have been required to provide treatment facilities. No major industries discharge directly to the river from the Minnesota side at the present time.

Samples have been collected on the St. Croix River by personnel of the Section of Water Pollution Control as part of a statewide routine water quality monitoring program since 1953. The points of sampling and analytical data are presented in Volumes 1, 2, and 3 of the publication of this Department entitled, "Water Quality Sampling Program, Minnesota Lakes and Streams." The data for samples collected in 1962 and 1963 are tabulated on separate sheets, because Volume 4 (for 1962 and 1963) has not yet been published.

Uses of the River

The present uses of the St. Croix River consist mainly of recreation, barge shipping, and disposal of relatively minor quantities of treated sewage and industrial waste effluents. Some harvesting of ice is done on the lower river for use in railroad refrigeration.

The major use of the river is for recreational purposes, such as boating, canoeing, fishing, and swimming. Because of the excellent recreational values of the river, this use is expected to increase substantially in the coming years. The natural quality of the river is suitable for such uses and pollutional effects are subject to control so as not to inhibit this use. From a bacteriological standpoint, the river is considered generally acceptable for bathing use in most areas, but sanitary surveys of individual areas are considered desirable to ascertain conditions in each specific instance.

There is a small amount of freight traffic on the

St. Croix, from the mouth to the one barge dock at Stillwater. Coal is the only commodity shipped, and this traffic is not expected to increase substantially.

No municipalities obtain their water supplies from the river at present. Some interest has been expressed in the possible use of water from the St. Croix River by St. Paul to supplement its Mississippi River supply, but it is not expected that these waters will be used as a source of water supply in the near future.

Presently, the river is capable of assimilating the treated effluents discharged to it without any deleterious effects. However, with an expanding population demanding more water, and increasing recreational use, the waste discharges should be reduced further by providing secondary treatment at all existing sources. The Water Pollution Control Commission has indicated by resolution in May 1963 its intention of requiring such secondary treatment of both existing and new sources in the future.

Analytical Data

The total coliform count of the samples collected during the 10 years of the Water Quality Sampling Program range from less than 20 to 24,000 MPN/100 ml (most probable number per 100 milliliters), with an arithmetic average or mean value of about 1,200 MPN/100 ml. In general, higher counts were found in the samples from immediately below Osceola, Wisconsin, with lower counts being found in the samples taken upstream from Osceola, and downstream from Bayport. The coliform count appears to have dropped slightly in the last five years.

The dissolved oxygen values obtained from the river sampling ranged from 4.0 to 12.2 mg/1 (milligrams per liter), with a mean value of 8.8 mg/1. There appears to be no significant change in the dissolved oxygen concentration of the river from Danbury, Wisconsin, to the mouth. This indicates that the river was able to readily assimilate any residual waste discharged to it and maintain a dissolved oxygen concentration capable of supporting all native game fish.

The 5-day BOD (biochemical oxygen demand) of the river samples collected during the ten-year period ranged from 0.2 to 6.8 mg/1, with an average of 2.6 mg/1. These values in themselves are not necessarily indicative of severe pollution; however, samples collected from the river below Osceola, Wisconsin, showed some indications of an organic load being added.

The other analytical data generally indicate a rather clean river with only slight evidence of pollution.

## Effect of St. Croix River on Mississippi River

The water quality of the St. Croix River above the confluence with the Mississippi River is significantly better than that of the Mississippi River, as may be seen from the following summary table:* (* Values are means of samples collected as part of WQSP, except coliforms which are medians of presumptive determinations. For specific data, see the attached table.)

| | Mississippi River at Hastings, Minnesota | St. Croix River at Prescott, Wisconsin |
|---|---|---|
| Total Coliform Group (MPN/100 ml) | 34,000 | < 200 |
| Dissolved Oxygen (mg/l) | 4.8 | 8.8 |
| 5-Day Biochemical Oxygen Demand (mg/l) | 4.1 | 2.4 |
| Chlorides (mg/l) | 12.4 | 2.4 |

< means less than.

Therefore, the effect of the St. Croix River on the quality of the Mississippi River would not be to lower it, but, in all probability, to improve it. The BOD load imposed on the Mississippi River from the St. Croix River is not significant.

## SEWAGE WORKS ON THE ST. CROIX RIVER

### Stillwater

This plant was constructed in 1960 and provides primary treatment. It consists of four rectangular primary tanks, a chlorine contact tank, two heated sludge digestion tanks, a six compartment sludge drying bed, and control building. The plant is designed to treat sewage and waste flowing at the rate of 2.18 mgd (million gallons per day) dry-weather flow. The raw sewage is estimated to have a dry-weather 5-day BOD of about 125 mg/1. Stillwater has a partially combined sewer system. The plant will provide a 35 percent reduction in 5-day BOD and a 60 percent reduction in SS (suspended solids) under dry-weather flow conditions. It will produce an effluent with a 5-day BOD of approximately 81 mg/1.

### Bayport

This is a secondary plant consisting of a primary settling tank, aeration tanks, final settling tanks, chlorination contact tank and separate sludge digestion tanks. It is designed to treat sewage from both Bayport and the State Prison at the rate of 0.337 mgd with a 5-day BOD of 205 mg/1 to produce an effluent of approximately 30 mg/1.

Plans and specifications were approved by the Water Pollution Control Commission on December 20, 1963, for additions and alterations. The additions and alterations will consist of a new control building, a contact aeration tank, a return sludge reaeration tank and two final settling tanks. The improved plant is designed to provide secondary treatment by a modification of the activated sludge process for sewage and waste from Bayport at the rate of 0.25 mgd and from the State Prison at the rate of 0.40 mgd. This flow will have a 5-day BOD of about 215 mg/1. A reduction in 5-day BOD of 75 to 90 percent is expected when design conditions are reached.

## VERMILLION RIVER

The Vermillion River rises in eastern Scott County near Lakeville, flows easterly through flat to rolling land and passes through the municipalities of

Farmington, Vermillion, and Hastings. At Hastings, the river falls precipitously to the valley of the Mississippi River, and flows along the west side of the flood plain in the valley for about 18 miles until it joins the Mississippi River above Red Wing. The official mouth of the Vermillion River is listed by the U. S. Corps of Engineers as being at Mississippi River mile 813.2 in Hastings, but a diversion structure at the mouth causes the river to flow southward so that it joins the Mississippi River at mile 796.7 below Lock and Dam No. 3, near Red Wing.

From records over 5 years, from 1943 to 1947, the mean flow as measured at Hastings was 81 cfs. No flow data are available for the period after 1947.

## Uses of the River

The present uses of the Vermillion River consist mainly of stock watering, some limited recreation, and disposal of treated sewage and industrial wastes.

No municipal water supplies are taken from the river. There is not known to be any boating on the river, and only limited fishing upstream from the mouth, but many fishermen have been observed fishing the river near the junction with the Mississippi River. Recreational use of the river may increase somewhat in the future.

All municipalities on the Vermillion River now have secondary sewage treatment works. There are no industries which discharge untreated wastes to the river.

Analytical Data

Samples have not been taken on a routine basis on the Vermillion River, but special surveys were made on the river in 1932, 1946, 1956, and 1960. The latest sampling data show the presence of a good supply of dissolved oxygen, low 5-day BOD, and moderate total coliform organism counts. These values average about 9 mg/1, 2 mg/1, and 5,000 MPN/100 ml, respectively.

Effect of Vermillion River on Mississippi River

The Vermillion River as it enters the Mississippi River below Lock and Dam No. 3 is of a quality comparable to the Mississippi River. Based on quality and the large difference in the flows of the two rivers, the Vermillion River is not expected to affect the Mississippi River in any way.

SEWAGE WORKS ON THE VERMILLION RIVER

Hastings State Hospital

The Hastings State Hospital sewage treatment plant was constructed in 1937, with additions in 1949. It is a secondary plant and consists of a flow measuring device, bar screen, comminutor, primary clarifier, two aerators, chlorination unit, heated sludge digester, and sludge beds. The plant is designed to treat sewage and laundry wastes by the activated sludge process. The waste flow is 0.15 mgd and has a 5-day BOD of 340 mg/1. The plant is designed to produce an effluent of approximately 20 mg/1. Discussions have recently been reported concerning a possible connection of the hospital to the Hastings sewer system.

CANNON RIVER

The Cannon River rises in the vicinity of Shields Lake in west central Rice County and flows through a series of lakes to its confluence with the Mississippi River upstream of Red Wing at mile 793. The flow is through agricultural lands for most of its course. A dam one and one-half miles upstream from Cannon Falls forms Byllesby

Lake, and largely regulates the flow downstream. The mean flow as measured at Welch is 470 cfs, from records over 31 years (1931 to 1962).

Uses of the River

The present uses of the Cannon River consist mainly of stock watering, some recreation, and disposal of sewage and industrial wastes. There are no municipalities which take their water supply from the river.

In most reaches of the river, the water quality may not be unduly hazardous for stock watering, but is not generally satisfactory for bathing or boating. Most of the recreational activity on the river is on the lakes or reservoirs, such as Byllesby Lake.

The Cannon River presently does not offer high quality game fishing, and there have been a number of reports of fish kills. These episodes have been mostly well upriver near Faribault and Northfield, and before construction of sewage and waste treatment facilities at Faribault and Northfield.

The future recreational uses of the river can be expected to increase as the quality of the river water improves by virtue of the construction of additional sewage and waste disposal works. It is not expected that the river water will become a source of municipal water supply, even in the long-term future, but industrial and agricultural uses may increase somewhat.

Cannon Falls is the only municipality which presently discharges raw sewage and industrial wastes to the river, but plans for secondary treatment facilities have recently been approved by the Commission and the city council has accepted a federal grant (PL 660) to assist in financing construction of the proposed facilities. Both Faribault and Northfield have secondary treatment facilities which were constructed in 1956 and 1958, respectively. There are a few small industries along the Cannon River which discharge untreated process wastes to the river between Faribault and Cannon Falls.

Samples have been collected on the Cannon River since 1953 as a part of the Water Quality Sampling Program at a location above Welch. The analytical data are presented in volumes 1, 2 and 3 of "Water Quality Sampling Program, Minnesota Lakes and Streams," and in attached sheets for 1962-63.

## Analytical Data

The presumptive total coliform test is used as an indicator of sewage pollution. The following table gives an indication of the bacteriological quality of the river at the sampling station at Welch:

| | | |
|---|---|---|
| Min | 1,300 | MPN/100 ml |
| Max | 92,000 | MPN/100 ml |
| Mean | 18,100 | MPN/100 ml |

The high counts appear to be attributable to residual sewage bacteria from Faribault and Northfield, as well as the discharge of raw sewage from Cannon Falls.

The mean dissolved oxygen concentration found during the ten years of sampling at Welch was 9.9 mg/1. The minimum dissolved oxygen concentration found was 4.0 mg/1 at Welch on the basis of these records.

The mean 5-day BOD of the samples was 4.1 mg/1 for the station at Welch. This would not necessarily be indicative of significant pollution remaining at the junction with the Mississippi River some 13 miles downstream.

The other analytical data generally show much the same trends as do the total coliform, dissolved oxygen, and 5-day BOD data. For specific data see the attached table.

Effect of Cannon River on Mississippi River

The bacteriological quality of the waters of the Cannon River, as they enter the Mississippi River upstream from Red Wing, is in general comparable to that of the Mississippi River. Because of the large difference in the flows of the two rivers, the organic load imposed on the Mississippi River by the Cannon River is considered negligible and not likely to materially affect the Mississippi River.

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## WATER QUALITY DATA, CANNON RIVER*

Location: Welch, Bridge on SAR 7

Station: Ca-13.4

| Date | Temp (F) | pH Units | Total Presumptive Coliforms | Suspended Solids | Turbidity Units | Phosphorus | Ammonia | Surfactants | DO | 5-day BOD |
|---|---|---|---|---|---|---|---|---|---|---|
| 6-12-62 | 66 | 7.7 | 3,300 | 30 | 15 | - | - | - | 9.7 | 4.2 |
| 8-30-62 | 66 | 8.0 | 4,600 | 21 | 11 | 0.97 | 0.90 | - | 7.9 | 5.6 |
| 1-28-62 | 32 | 8.2 | 24,000 | 6.4 | 9 | 0.28 | 1.1 | 0.14 | 8.9 | 3.0 |

Location: Red Wing, Bridge on USH 61

Station: Ca-5.5

| Date | Temp (F) | pH Units | Total Presumptive Coliforms | Suspended Solids | Turbidity Units | Phosphorus | Ammonia | Surfactants | DO | 5-day BOD |
|---|---|---|---|---|---|---|---|---|---|---|
| 6-14-63 | 68 | 9.0 | - | 20 | 10 | 0.24 | 0.12 | $<$0.1 | 8.2 | 6.3 |
| 7-10-63 | 77 | 9.3 | 4,900 | 3 | 9 | 0.24 | $<$0.05 | 0.10 | 10.0 | 6.5 |

*as mg/l unless otherwise indicated

$<$ means less than

## SEWAGE WORKS ON THE CANNON RIVER

### Cannon Falls

Plans and specifications for the proposed plant were approved by the Commission on October 8, 1963. The plant will be a secondary plant consisting of a primary settling tank, a high-rate trickling filter, a secondary settling tank, a chlorine contact tank and chlorination equipment, sludge digesters, sludge drying beds, and control building. The plant is designed to provide treatment for sewage and waste at the rate of 0.50 mgd, including the malting plant wastes. The raw 5-day BOD of about 360 mg/1 will be reduced to about 75 mg/1.

## INDUSTRIAL WASTE DISPOSAL ON THE CANNON RIVER

### Minnesota Malting Company, Cannon Falls

This plant produces malt for the brewing industry. The plant waste flow reportedly averages about 0.144 mgd and is now discharged to the Cannon River without treatment. It is understood that the wastes from this plant will be treated in the proposed new municipal sewage treatment plant. An allowance for these wastes was made in the design of the treatment facilities. Contracts for construction of the plant have been awarded.

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Interstate Conference on Mississippi River
Table A
Municipal and Community Sewage Sources
(January, 1964)

| Source | 1960 Population | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|---|
| Mississippi River | | | | | |
| Anoka | 10,562 | 15,000 | Domestic & industrial, 1 mgd. | Secondary | 3,800 |
| Minneapolis, combined sewer by-passes | NA | Und. | Domestic & industrial | None | Und. |
| St. Paul, combined sewer by-passes | NA | Und. | Domestic & industrial | None | Und. |
| Minnesota River | | | | | |
| North Mankato | 5,927 | 4,400 | Domestic and industrial, 0.35 mgd. | None (connection to Mankato UC) | 4,400 |
| Mankato | 23,797 | 38,500 | Domestic and industrial, 3.0 mgd. | Primary | 25,000 |
| St. Peter | 9,111 | 13,800 | Domestic and industrial, 0.9 mgd. | Tertiary (Stabilization pond) | 1,380 |
| Le Sueur | 3,310 | 5,000 | Domestic and industrial, 0.3 mgd. | Tertiary | 500 |
| Henderson | 728 | 500 | Domestic and industrial, 0.04 mgd. | None | 500 |

(Table A cont'd.)

| | Source | 1960 Population | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|---|---|
| | <u>Minnesota River (cont'd.)</u> | | | | | |
| | Belle Plaine | 1,931 | 2,500 | Domestic and industrial, 0.15 mgd. | Tertiary | 250 |
| | Chaska | 2,501 | 6,000 | Domestic and industrial, 0.5 mgd. | Secondary | 1,200 |
| | Shakopee | 5,201 | 3,400 | Domestic and industrial, 0.26 mgd. | Primary | 2,300 |
| | Savage | 1,094 | 2,900 | Domestic and industrial, 0.215 mgd. | Secondary | 430 |
| 1. | Burnsville Township, Dakota County | - | 5,000 | Domestic, 0.5 mgd. | Secondary | 500 |
| 2. | Cedar Grove Subdivision, Egan Township, Dakota Co. | - | 1,300 | Domestic, 0.1 mgd. | Secondary | 200 |
| | <u>Mississippi River (cont'd.)</u> | | | | | |
| 3. | Minneapolis-St. Paul[(1)] Sanitary District, St. Paul | 1,135,000 | 1,820,000 | Domestic and industrial, 178 mgd. | Primary | 1,254,000 |
| 4. | South St. Paul | 22,032 | 818,000 | Domestic and industrial, combined sewer overflows | Secondary | 162,000 |
| 5. | Newport | 2,349 | - | Domestic, 0.3 mgd | Secondary (STP & sewer system UC) | 350 |
| 6. | St. Paul Park | 3,267 | 2,500 | Domestic, 0.25 mgd. | Secondary | 380 |

(Table A Cont'd)



| Source | 1960 Population | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|---|
| Mississippi River (cont'd.) | | | | | |
| 7. Inver Grove Township, Dakota County | 400 | 280 | Domestic, 0.02 mgd. | Secondary | 42 |
| 8. Cottage Grove Township, Washington County | 8,000 | 6,000 | Domestic and industrial, 0.3 mgd. | Secondary (2nd stage UC) | 600 |
| Hastings | 8,965 | 9,000 | Domestic and industrial, 0.6 mgd. | Primary | 5,700 |
| St. Croix River | | | | | |
| Stillwater | 8,310 | 8,300 | Domestic and industrial, 1.6 mgd. | Primary | 5,500 |
| Bayport | 4,305 | 4,000 | Domestic and industrial, 0.4 mgd. | Secondary | 800 |
| Vermillion River | | | | | |
| Hastings State Hospital, Hastings | 896 | 1,000 | Domestic and industrial 0.09 mgd. | Secondary | 100 |
| Cannon River | | | | | |
| Cannon Falls | 2,055 | 2,616 | Domestic and industrial, 0.206 mgd. | None (Secondary UC) | 2,600 |
| Mississippi River | | | | | |
| Red Wing | 10,528 | 10,000 | Domestic and industrial, 1.1 mgd. | Secondary | 1,400 |
| Lake City | 3,250 | 3,600 | Domestic and industrial, 0.26 mgd. | Primary | 2,200 |

(Table A Cont'd.)

(1) 30th Annual Report, Minneapolis-St. Paul Sanitary District, 1962
mgd - million gallons/day
NA - Not Applicable
Pop. Equiv. - Population equivalent based on 1/6 lb. 5-day BOD/capita/day
STP - sewage treatment plant
UC - Under Construction
Und. - Undetermined
Figures rounded in most cases, estimates used in many cases

MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Interstate Conference on Mississippi River
Table B
Industrial Waste Sources
(January, 1964)

| Source | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|
| Rum River | | | | |
| 1. Cornelius Manufacturing Co., Anoka | NA | Metal plating and fabricating, 0.5 mgd. | None | NA, metals and chemicals |
| 2. Federal Cartridge Company, Anoka | NA | Metal plating and fabricating, 0.3 mgd. | Und. (some wastes to municipal STP) | NA, metals and chemicals |
| Mississippi River | | | | |
| 3. Minneapolis Water Treatment Plant, Fridley | NA | Lime sludge, 1.5 mgd, and filter backwash water | Clarification basin | NA, suspended solids & pH |
| 4. Northern States Power Co., Riverside Plant, Minneapolis | NA | Condensing water, 593 mgd. max. | Ash recovery | NA, heat |
| Minnesota River | | | | |
| 5. Honeymead Products Co., Mankato | Und. | Vegetable oil processing, 4 mgd., tank farm | Oil trap and acidulation | Und., oil |
| 6. North Star Concrete Products Co., Mankato* | NA | Gravel washing, 0.6 mgd. | Clarification basin | NA, suspended solids |
| 7. Archer Daniels Midland Co., Mankato | - | Cooling water, tank farm | Process wastes to municipal STP, oil separator | - |

(Table B cont'd.)



| Source | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|
| **Minnesota River (cont.d)** | | | | |
| 8. Blue Cross Rendering Co., Mankato | 280 | Process and condenser water, 0.043 mgd. | Secondary, grease traps | 260 |
| 9. Northern States Power Co., Wilmarth Plant, Mankato | NA | Condenser water, 33 mgd. (max.) | Ash recovery | NA, heat |
| 10. Gopher State Silica Co., LeSueur County | NA | Sand washing, 0.5 mgd. | Clarification basin, some recycle | NA, suspended solids |
| 11. Green Giant Co., LeSueur* | Und. | Pea and corn canning, 1 mgd. | Ridge and furrow irrigation system | None |
| 12. Minnesota Valley Milk Processing Cooperative Assn., Belle Plaine | 2,500 | Milk drying, 0.12 mgd. | None | 2,500 |
| 13. American Crystal Sugar Co.,* Chaska | 200,000 | Beet sugar refining, 6 mgd. | Lime sludge pond | 200,000 |
| 14. Rahr Malting Co., Shakopee | 29,000 | Malt production 3 mgd. | Screens | 29,000 |
| 15. Owens-Illinois Glass Co., Paper Prod. Division Scott County | 1,300 | Paper box mfg., 0.007 mgd. | Secondary | 130 |
| 16. Cargill, Inc., Savage | Und. | Vegetable oil processing, 2 mgd. | Screens, oil separator | 1,800 |
| 17. Northern States Power Co., Black Dog Plant, Dakota Co. | NA | Condensing water, 427 mgd. max., fly ash | Cooling pond, clarification basin | NA, heat and suspended solids |

(Table B cont'd.)



| Source | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|
| Minnesota River (cont'd.) | | | | |
| 18. Twin City Barge and* Towing Co., Dakota Co. | NA | Barge cleaning, coal and grain | Proposed recovery unit | NA, suspended solids |
| Mississippi River | | | | |
| 19. Northern States Power Co., High Bridge Plant, St. Paul | NA | Condensing water 427 mgd. | Ash recovery | NA, heat |
| 20. Minnesota Harbor Service,* St. Paul | NA | Barge cleaning, coal and grain | None | NA, suspended solids |
| 21. Twin City Barge and* Towing Co., Dakota Co. | NA | Barge cleaning, coal and grain | Proposed recovery unit | NA, suspended solids |
| 22. Northwestern Refining Co., St. Paul Park | - | Petroleum refining, 1.8 mgd. | Secondary | 3,800, chemicals |
| 23. J. L. Shiely Sand & Gravel* Co., Washington County | NA | Gravel washing | Clarification basins 1.7 mgd. | NA, suspended solids |
| 24. St. Paul Ammonia Products, Inc., Dakota County | NA | Ammonia synthesis and fertilizer mfg., acids alkalies, nitrates and ammonia, 0.65 mgd. | Neutralization, oil separation, dispersion | NA, chemicals |
| 25. Great Northern Oil Co., Dakota County | - | Petroleum refining 2.88 mgd. | Tertiary | - Chemicals |
| 26. Northwest Cooperative Mills, Inc., Dakota County | NA | Phosphoric acid and fertilizer production, 4.32 mgd. | Sedimentation basin, with recycle | NA, chemicals |
| 27. Minnesota Mining & Mfg., Co., Washington County | Und. | Chemicals manufacturing, 2.16 mgd. | Primary | 35,200 |

(Table B (cont'd.)



| Source | Pop. Equiv. Raw Waste | Nature of Waste and Flow | Treatment or Control Provided | Pop. Equiv. to Watercourse |
|---|---|---|---|---|
| Mississippi River (cont'd.) | | | | |
| 28. Hudson Manufacturing Co., Hastings | NA | Metal fabricating, 0.187 mgd. | Chemical precipitation | NA, metals |
| Cannon River | | | | |
| 29. Minnesota Malting Company, Cannon Falls | 4,000 | Malt production, 0.144 mgd. | None (to go to STP) | 4,000 |
| Mississippi River | | | | |
| 30. Foot Tanning Co., Red Wing | 14,500 | Tanning, 1.10 mgd. | Screens and sedimentation basins | 7,200 |
| 31. Northern States Power Co., Red Wing | NA | Condensing water, 54 mgd. max. | Ash recovery | NA, heat |

* Seasonal operation only
Max. - maximum
mgd. - million gallons/day
NA - Not Applicable
Pop. Equiv. - Population equivalent based on 1/6 lb. 5-day BOD/capita/day
STP - sewage treatment plant
UC - Under Construction
Und. - Undetermined
Figures rounded in most cases and estimates used in many instances.

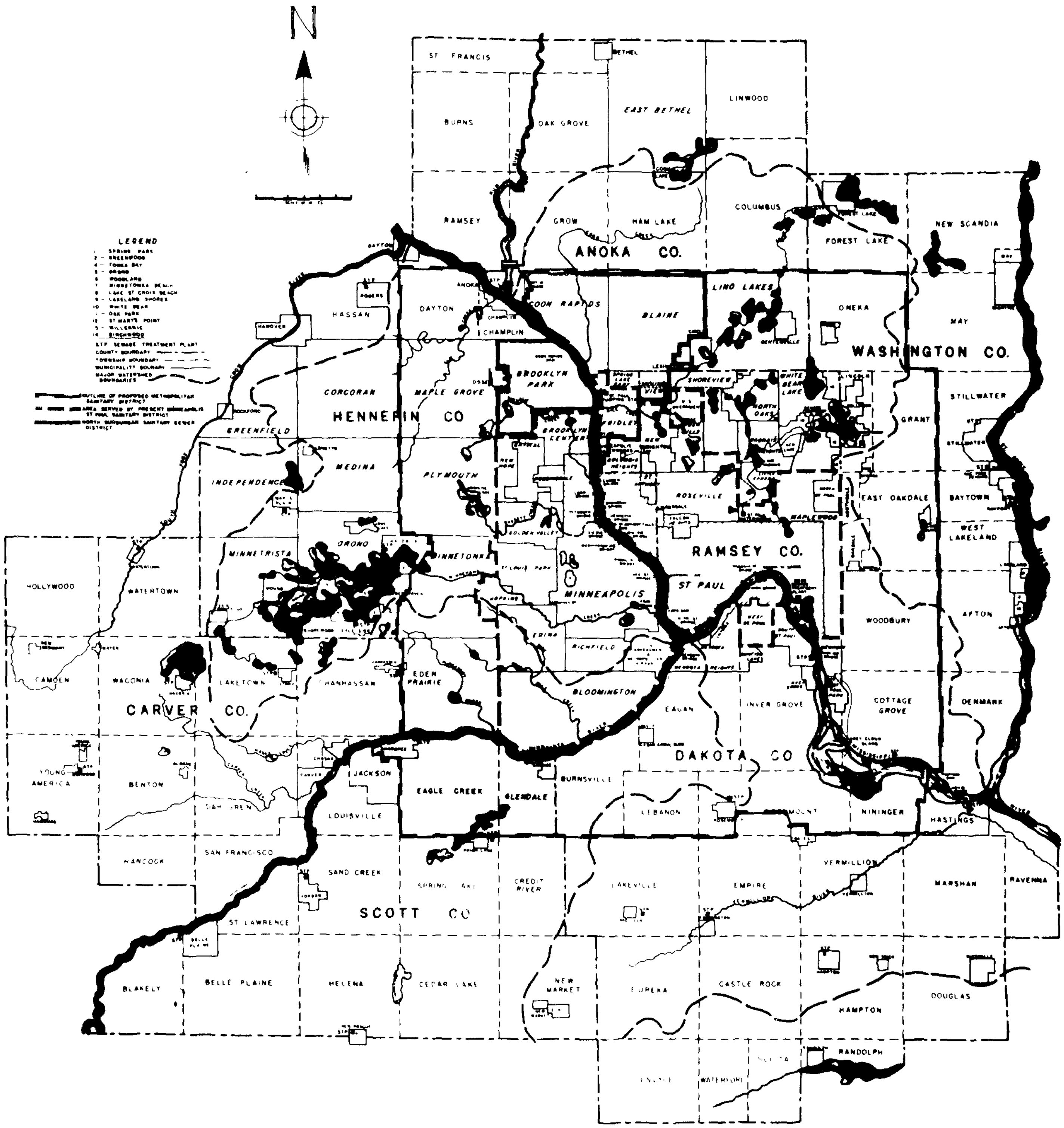
MINNESOTA DEPARTMENT OF HEALTH
Division of Environmental Sanitation
Section of Water Pollution Control

Interstate Conference on the Mississippi River
Table C
Major Liquid Storage Facilities*
(January, 1964)

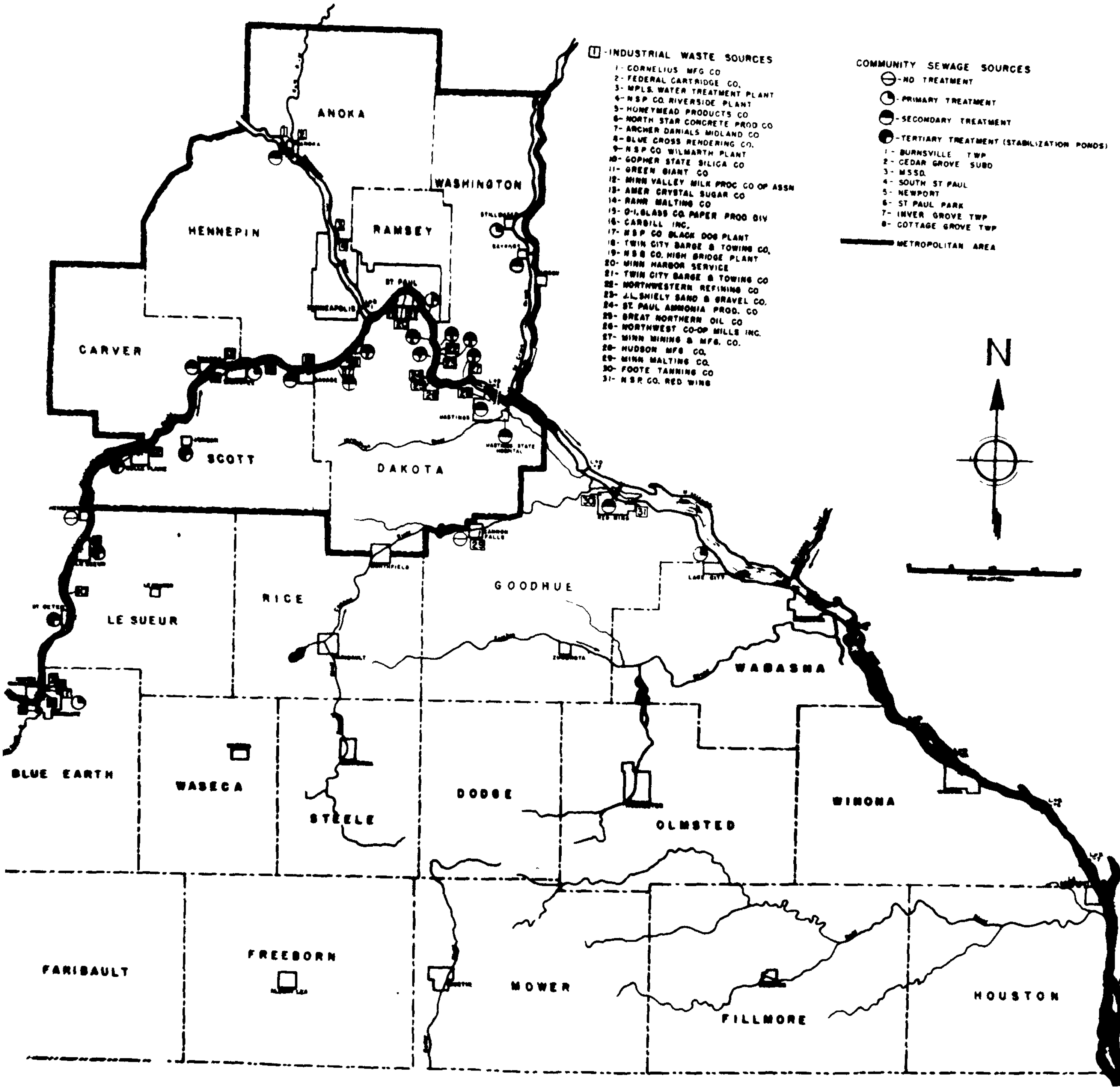
| Plant | Operations | Control Facilities |
|---|---|---|
| <u>Mississippi River</u> | | |
| Western Oil and Fuel Company, Minneapolis | Receiving and shipping fuel oils and gasoline | Diking |
| Industrial Molasses Company, St. Paul | Receiving and shipping molasses | None |
| Pittsburg Plate Glass Company, Red Wing | Extracting and refining of vegetable oils | None |
| <u>Minnesota River</u> | | |
| Richards Oil Company, Scott County | Receiving and blending or shipping fuel oils, asphalt, and soybean oil | Diking and oil recovery system |

*A number of others are listed in Table B, Industrial Waste Sources, because the plants are a source of process wastes, in contrast to these which are ordinarily classed as "dry" industries or do not have a separate outlet. This list represents only a preliminary inventory.

# TWIN CITIES METROPOLITAN AREA



# MISSISSIPPI RIVER AND SIGNIFICANT TRIBUTARIES
## IN AND BELOW TWIN CITIES METROPOLITAN AREA
FEBRUARY 1964



MR. STEIN: Thank you for a very comprehensive statement. I think it gives us all a very clear picture of what Minnesota is doing.

I find myself in essential agreement with the major points.

As a matter of fact, considering the magnitude of the tasks facing you and the size of your staff and appropriation, I think this notion of a cooperative study should be welcomed by both sides, because you certainly have enough work to keep you busy throughout the State.

Are there any comments or questions?

MR. SMITH: I would like to make one comment.

MR. STEIN: Yes, sir.

MR. SMITH: I believe Dr. Hargraves misspoke on the amount of the budget. There is a $100,000 contingency fund for the two-year period. In addition, the budget for this fiscal year is approximately $205,000, and for next year is $217,000.

MR. STEIN: I believe Mr. Poston may have a comment on that.

MR. POSTON: Well, you have answered my question. I knew that there were funds.

Maybe I am a bureaucrat and used to bigger figures, or something, but I felt that it was a little bit low from what I knew.

MR. SMITH: I should actually say of the $205,000, $83,000 of that is Federal money.

MR. STEIN: Yes. That is why we knew this was off.

DR. HARGRAVES: I misspoke primarily because this is essentially what the Legislature has given us -- and it is only this past Legislature that has done this -- and this contingency fund can only be spent at the moment upon conference with them, and with their agreement that it should be spent. So that the amount of Federal money we have is essentially on top of the figures that I quoted.

MR. STEIN: Well, the Federal grant, as I understand it, is about $83,000 a year. Obviously, in order to qualify for that money, you have to put in considerably more than $17,000 of State funds to match, and the budget must necessarily be high.

MR. SMITH: It would be approximately $122,000 added.

MR. STEIN: Yes. Mr. Wilson?

MR. WILSON: Mr. Chairman, it is now the noon hour and I assume you are going to adjourn shortly, but I would just like to add a brief comment pertaining to some of the points that Dr. Hargraves brought out. It will only take me a couple of minutes to do so, if you wish to hear me now or wait until after lunch.

MR. STEIN: I thought, depending upon how many people we have to hear, depending on the feeling of the conferees --

MR. WISNIEWSKI: I understand Minnesota has about 13 people who will be appearing.

MR. SMITH: I have statements from many more than 13.

MR. WISNIEWSKI: So that will take well into the afternoon. You will have to break for lunch sometime. That is what I mean.

MR. STEIN: All right. How long will your statement take?

MR. WILSON: Just two or three minutes.

MR. STEIN: Why don't you go ahead?

STATEMENT OF CHESTER S. WILSON, CONFEREE AND SPECIAL ASSISTANT ATTORNEY GENERAL, LEGAL COUNSEL, MINNESOTA WATER POLLUTION CONTROL COMMISSION

MR. WILSON: I simply wanted to call attention to this fact:

One of the speakers from the State of Wisconsin remarked that Mr. Wisniewski didn't have to ask people; he could go out and tell them. I think that everyone should be reminded that we cannot do that under our Minnesota law so promptly and with such effect.

Under our laws, as Dr. Hargraves pointed out, we were reminded a few years ago by a court decision, the first time the Minnesota Commission undertook to do that, to go out and tell somebody something, the court constantly slapped them down and told them that it was necessary for them first to hold a hearing and establish a standard for a small country ditch before they could tell the creamery to go and clean up its mess.

The same thing applies to every pollution situation in the State, and notably to this Twin Cities situation.

So, in preparation for backing up the expansion of the Twin Cities plant, which was already underway, in order to make sure that the results of that expansion will be effective and that all minor sources of pollution in this tremendous metropolitan area would be dealt with by the time that plant goes into operation in 1966, the Commission provided that beginning in the spring of 1962, long before these duck kills happened and long before this conference was conceived of, the Minnesota Commission, upon its own initiative, launched the program for adopting standards for this entire section of the Mississippi River that Dr. Hargraves described.

That took eight days of hearings, involved the taking of over 1,000 pages of testimony, at which, as I remarked, we were greatly aided by the witnesses from the Public Health Service; and, as a result of the adoption of those standards, the Minnesota Commission is now in a position to back up this effort to clean up this portion of the Mississippi River.

Now, I might say that we are not too sure that those standards are going to stick. Dr. Hargraves has mentioned that those standards involved loopholes. We are already in court on an appeal contesting the validity of those standards. We have to demonstrate that they are reasonable and based upon evidence, before we can enforce them; but the Commission is doing all it can to lay the foundation for the very thing that Wisconsin is able to do without going through all this trouble.

That is one of the reasons why we are very glad to acclaim our neighbor, Wisconsin, for progress in water pollution, that they have not been handicapped by the necessity of adopting a standard for all the waters in the State.

You can see what that is going to mean. If we do not get cooperation from these 41 towns that haven't got sewage treatment plants, if we do not get cooperation from the 450 industries that we are going to have to go after, we are going to have to go through that same process with every one of them -- hold a hearing and adopt a standard -- before we can issue them an order.

That is one of the things that I wanted to call attention to, Mr. Chairman. The thing that I should like to emphasize, from long, long experience as a prosecuting and law-enforcement attorney, is that this Commission has no inspection force and no police force.

With its small staff of engineers, if they have to go out and perform the service of investigating cases like these oil spills, or attempting to institute prosecutions of local violations, they simply have to neglect their tremendously important duties of advancing the progress of construction of sewage treatment plants.

It seems to me that one of the most important things for all people concerned with the advancement of pollution control in this State is to recognize the necessity of getting behind the efforts of the Minnesota Commission to get what it takes to do these things and put over the program.

MR. STEIN: Thank you, Mr. Wilson.

Are there any other comments or questions?

(No response.)

MR. STEIN: If not, may I suggest this: Can we adjourn for lunch for just one hour? Is that possible?

DR. HARGRAVES: How about fifty minutes and be back at one?

MR. STEIN: We will be back in fifty minutes, and I hope you will return promptly so that we can start.

(Whereupon, at 12:10 p.m., the conference was recessed for lunch.)

## AFTERNOON SESSION

(1:25 p.m.)

MR. STEIN: May we reconvene?

Dr. Hargraves?

DR. HARGRAVES: It is now time for the Minnesota conferees to call on our friends and critics to make contributions to this conference, so that we can have further constructive material go into this report.

However, before we start, I would like to augment what Mr. Stein said yesterday -- it seems like the other day, but what he said yesterday -- that this is a conference.

I think a lot of people do not understand the implications here. This is not a hearing. It has nothing to do with police power at the moment. It is a conference in which the States and the Federal Government, representatives of each, have gotten together to talk over the problems that exist and decide what is best to do.

You are here largely at our invitation, whether you know it or not, or the invitation of the Wisconsin Committee, and you are here to give us all help on better understanding the problem that exists.

Consequently, if you have a lot of criticism that we can take and have taken in hearings, there will be other times for that, and I am sure that you are sympathetic with what I say and will be cooperative in making your statement and not in reduplicating a lot that has been done, because we have practically two pages, if not three, of people who have been requesting an opportunity to air their views. We have asked many groups to combine their statements with the represented like types of organizations.

With that, I will ask Mr. Smith to start going down through our agenda, and we will call on these individuals in an order -- I shouldn't say necessarily of importance, but of stature, if you will, in government, and so on, as is done in most hearings.

I will turn this over at the moment to Mr. Smith.

MR. SMITH: The first group to be heard from this afternoon will be the Upper Mississippi River Conservation Committee.

Is Mr. Nord in the room? Is there anyone from that group here?

(No response.)

MR. SMITH: I have, Mr. Chairman, copies of a resolution by this group which I would like to present for the record.

DR. HARGRAVES: It is a short one. Can't it be read? Do you want me to read it, or do you want to read it?

"POLLUTION RESOLUTION OF THE TWENTIETH ANNUAL UMRCC MEETING, JANUARY 7, 1964, HELD AT PEORIA, ILLINOIS

"The Upper Mississippi River Conservation Committee, an organization consisting of representatives of the U. S. Fish & Wildlife Service, Conservation Agencies of the States of Minnesota, Wisconsin, Iowa, Illinois and Missouri, and cooperating agencies welcomes the opportunity to aid in evaluating the effect of pollution upon fish and wildlife and associated recreational uses of the Mississippi River. This committee believes that there is a profound effect of this pollution on fish and wildlife and it requests that particular consideration be given to this matter at the conference to be held in the Twin Cities on February 7, 1964.

"In providing service in this connection, the Committee offers material relative to fish and wildlife and aquatic recreation resulting from its surveys and studies conducted since 1944."

They offer this material. Is this to be offered as an exhibit?

MR. STEIN: That is included in the record right now.

Will you continue, unless there are comments or questions?

MR. SMITH: The next on the list will be any legislative committee representatives who may be present and wish to make a statement.

(No response.)

MR. SMITH: Also, any legislators present who would like to make a presentation?

(No response.)

MR. SMITH: Then we go from there to the State Departments represented. We do have a prepared report submitted in ten copies from the Department of Conservation, the Division of Game and Fish, Mr. Chairman.

This is rather detailed. Much of the material, I understand, has been discussed in one form or another by other persons participating.

MR. STEIN: Would you want that included in the record as if read?

MR. SMITH: I believe so. Dr. Moyle?

DR. MOYLE: Yes, we would prefer to have it included in the overall record.

MR. STEIN: This will be included.

(The statement of the State of Minnesota Department of Conservation, Division of Game and Fish, is as follows:

STATE OF MINNESOTA

Department of Conservation

Division of Game and Fish

# Game and Fish Values of the Mississippi River between the Rum River at Anoka and the Chippewa River below Lake Pepin

## SUMMARY

The Division of Game and Fish, Minnesota Department of Conservation, is concerned with the recreational and economic values of the fish and game resources of the Mississippi River between Anoka and the Chippewa River. This section of the Mississippi River includes such major tributaries as the St. Croix River below Taylors Falls and the Minnesota River below Henderson. The Division is carrying on limited management of these resources. Principal activities are fishery surveys of the Mississippi River below St. Paul, supervision of commercial fisheries, and acquisition and development of two wildlife management and public hunting areas and three public access areas along the Mississippi River below St. Paul.

Fish kills associated with insufficient dissolved

oxygen have occurred frequently in Pool 2 of the Mississippi River. Pollution is a probable cause of oxygen deficiency in parts of Pool 2.

Fisheries surveys of the Mississippi River have shown: (1) that several kinds of common warm-water game fish are present above and below St. Anthony Falls; (2) that fewer game fish and smaller rough fish were present in 1956 in Spring Lake, a part of Pool 2, than in Pools 3, 4 and 5; (3) that average numbers of fish and pounds of fish caught in Pools 3 and 4 were lower in 1963 than in 1957; and (4) that in Pool 3 the decrease in average numbers and pounds of fish caught in 1963 was more pronounced in areas in and near the main channel than in a backwater lake little affected by river flow. Similar surveys have not been made on the St. Croix or Minnesota Rivers but game and rough fish are known to be present in these rivers.

The value of commercial fish caught in Pools 2, 3, 4 and 5 of the Mississippi River in 1962 was approximately $97,500, of which $25,900 went to Minnesota fishermen. The catch in Pool 2 in recent years was higher than in Pools 3 and 5 but fish from Pool 2 are frequently off-flavor. Off-flavor has lowered the selling price and limited the market of fish from Pool 2. The value of commercial fish caught in the St. Croix River in 1962 was about $17,600. No commercial fishing is done in the Minnesota River.

There is sport fishing in nearly all the stretches of the Mississippi River, St. Croix River and Minnesota River under consideration, but sport fishing is heaviest in Pools 3 and 4 of the Mississippi River and in the St. Croix River. The Minnesota River is lightly fished. Sport fishermen have rarely been seen on Pool 2 of the Mississippi River during aerial counts in recent years. The aerial counts together with ground counts of fishermen indicate low angling pressure on all pools of the Mississippi River compared to Minnesota lakes. Success of anglers on Pools 4 and 5 was lower in 1956 and, due to more panfish caught, higher in 1962 than is usual on Minnesota lakes.

The expenditures of sport fishermen, based on an economic survey conducted by the Division of Game and Fish in 1957, are estimated to amount to about $750,000 for Pools 3, 4, and 5 for the twelve months, April 1, 1962 to March 31, 1963.

Waterfowl use the Mississippi River and its backwaters heavily and the St. Croix River and Minnesota River to a lesser extent during migration. Some waterfowl nest along these rivers. Furbearing animals are trapped along the Mississippi, St. Croix, and Minnesota rivers.

Future use of these areas by fishermen and hunters is expected to increase, particularly if stream conditions remain about the same or are improved. Greatest increase in use can be expected on the Mississippi River.

It is the opinion of the Division of Game and Fish that present water quality standards adopted for the Mississippi River in the Minneapolis-St. Paul area promise to prevent further deterioration and may result in some improvement of conditions for fish in the river above Lock and Dam No. 2. However, present and foreseeable conditions under the existing standards do not justify significant fisheries or game management work on the Mississippi River between St. Paul and Lock and Dam No. 2. To properly manage for fish, dissolved oxygen content should not be less than 5 ppm for more than 8 hours in any 24 hour period, and at no time less than 3 ppm.

STATE OF MINNESOTA

Department of Conservation

Division of Game and Fish

Game and Fish Values of the Mississippi River between the Rum River at Anoka and the Chippewa River below Lake Pepin

# INTRODUCTION

The Division of Game and Fish, Minnesota Department of Conservation, is concerned with the recreational and economic values of the fish and game resources of the Mississippi River, its bottom lands, backwaters, and tributaries between the Rum River at Anoka and the Chippewa River below Lake Pepin. Various parts of this area support commercial fishing, sport fishing, hunting and other recreational activities connected with fish and wildlife. Principal management programs other than regulation of limits and seasons include surveys to obtain information on fish populations and fisherman use, supervision of commercial fisheries, and acquisition and development of public accesses and of wildlife management and public hunting areas

Recreational uses of water other than those related to fish and wildlife are of substantial interest to the Division of Game and Fish, as is water pollution abatement, but primary responsibilities in these fields are assigned to other agencies.

In general, fish and game information contained herein is related to navigation pools as designated by the U.S. Corps of Engineers. However, a stretch of approximately 14 miles of river lying between the head of the Upper St. Anthony Pool at approximately Camden in north

Minneapolis and the Rum River is not included in a navigation pool. Although about 14 miles of river in Pool 4 lies below the mouth of the Chippewa River, Pool 4 is here considered in its entirety to utilize available fishery data. Navigation Pool 4, with reference to fishery data, is divided into Pool 4A comprising Lake Pepin, and the remainder of Pool 4 comprising the area above and below Lake Pepin. In several instances data from Pool 5 are included for further comparison.

## FISH

Fish management in the area of the river considered, other than for survey work, has been limited to supervision of commercial fisheries, diversion of flow into a backwater area in Pool 3 to prevent oxygen depletion in winter, and transfer of catchable size catfish in most winters from Spring Lake, a part of Pool 2, to the river above Minneapolis where greater utilization is expected.

Fish kills have been reported more frequently in Pool 2 than farther downstream in Pools 3 and 4. In Pool 2 fish kills have been associated with lack of or low levels of dissolved oxygen that are probably attributable to pollution. Fish kills probably due to pollution have been reported from Pool 2 both in late winter when there low flow and ice cover and in summer in the main channel in the lower part of Pool 2. Data regularly collected by Minneapolis-St. Paul Sanitary District personnel[1] ([1] Mississippi river analytical data tables, Minneapolis-St. Paul Sanitary District, Compiled annually.), and other data gathered by the State Department of Health[2] ([2] Report on investigation of the Mississippi River from the mouth of the Rum River to the mouth of the St. Croix River. Minnesota Department of Health, Section of Water Pollution Control, July and August, 1960 and August and September, 1961. 41 pages plus tables and figures.) indicate the occurrence at times of oxygen levels too low for fish life in parts of Pool 2 below St. Paul.

Fisheries survey work on the Mississippi River has included electrofishing, test netting, creel census, and fisherman counts. Commercial fishing records provide additional data.

## Fish populations

Common fish species known to be present in the several pools, both above and below St. Anthony Falls, are listed in Table 1 which is appended. This is not a complete species list but shows that common warm-water game fishes such as walleyes, sauger, northern pike, smallmouth bass and bluegill are present in those stretches of the river.

Both game fish and rough fish occur in the section of the Mississippi River including Pool 1 and above it as far as the Rum River. As to game fish, an electro-fishing survey in 7.5 miles of the Mississippi River below the Rum River in 1960 revealed at least moderate-sized populations of bluegills and smallmouth bass. In this area and downstream into Pool 1 fishermen report satisfactory fishing for walleyes and smallmouth bass.

Fish population data were obtained in Pools 2, 3, 4, 4A and 5 in 1956 by test netting with gillnets and trapnets. Mean catches of these nets are shown in Table 2 which is appended. It will be noted that both gillnet and trapnet catches of game fishes were lower in Spring Lake (part of Pool 2) than in the pools below (Pools 3, 4, 4A and 5). This relationship holds for both numbers and pounds of game fish taken. Poundage of rough fish taken per trapnet set was also lower in Spring Lake than in the other pools. In general at that time, it appeared the rough fish were fairly abundant in Spring Lake but those taken were smaller than rough fish from the other pools. The apparent smaller size might be attributed to removal of larger rough fish by commercial fishing on Spring Lake.

Comparative fish population data were obtained in Pools 3, 4 and 5 in 1957 and 1963 by test netting with trap-nets. The average numbers and pounds per set of all species game and rough fish, from each pool in the two years were:

| Pool | Number per set 1957 | Number per set 1963 | Pounds per set 1957 | Pounds per set 1963 |
|---|---|---|---|---|
| 3 | 90.7 | 38.0 | 82.0 | 52.3 |
| 4 | 152.3 | 43.6 | 121.0 | 51.3 |
| 5 | 49.0 | 30.1 | 36.2 | 34.6 |

It appears that fish were less abundant in Pools 3 and 4 in 1963 and about the same or slightly less abundant in Pool 5 in 1963. The differences between the catches in the two years is influenced considerably by greater abundance of carp in the 1957 catches, but it appears from the catch data that there has been some general decline in the size of the fish populations in Pools 3 and 4.

A breakdown of the above comparative fish population data from Pool 3 by areas within the Pool shows the decrease in average numbers and pounds of fish of all species per trapnet set in 1963 was most pronounced in tailwaters of the Hastings Dam and in North Lake and Sturgeon Lake through which there is a flow of the river. Least indication of change was found in Dushane Lake, a backwater area little influenced by river flow. The catch values for different areas in Pool 3 were:

| Pool 3 Areas | Number per set | | Pounds per set | |
|---|---|---|---|---|
| | 1957 | 1963 | 1957 | 1963 |
| Tailwaters of | | | | |
| Hastings Dam | 155.7 | 50.2 | 155.5 | 60.8 |
| North Lake | 55.2 | 28.8 | 70.2 | 44.9 |
| Sturgeon Lake | 91.3 | 33.6 | 46.7 | 49.6 |
| Dushane Lake | 54.2 | 40.8 | 42.7 | 55.6 |

Commercial fishing

Commercial fishing is carried on in Pools 2, 3, 4, 4A and 5 by fishermen licensed by Minnesota or Wisconsin. Fishing is done with gillnets, seines and set lines. The principal species taken are carp, buffalofish, drum (sheepshead) and channel catfish. Usually about two-thirds of the weight of the commercial catch is of carp.

The commercial catch for the years 1958-1962 is shown for Pools 2, 3, 4, 4A and 5 in Table 3 which is appended. Average yearly catch from these pools has been about 2.5 million pounds. Value of the catch in 1962 was approximately $97,500 of which about $25,900 went to Minnesota fishermen and about $71,600 went to Wisconsin fishermen.

It will be noted from Table 3 that greatest intensity of commercial take was in Pools 4 and 4A where, respectively, an average of 32.6 and 58.2 pounds of rough fish per acre per year were taken during the 1958-1962 period. However, the catch in Pool 2 averaged 28.0 pounds per acre per year for the four years 1959-1962. The commercial catch from Pool 2 (caught almost entirely in Spring Lake) indicates the presence of a commercially harvestable rough fish population in this part of the river. However, fish taken from Pool 2 are frequently off-flavor and such off-flavor lowers the selling price and limits sales. Usually the fish taken in Pool 2 are sold to buyers who can hold them in ponds until the off-flavor disappears.

Sport fishing

There is sport fishing throughout the stretch of Mississippi River under consideration but it is heaviest in Pools 3 and 4. Above Minneapolis there is considerable angling from the mouth of the Rum River downstream into Pool 2. Fishing is most concentrated at a few places such as near the Coon Rapids Dam, the Highway 100 Bridge and the Ford Dam. No quantitative estimate of fishing pressure in or above Pool 2 has been made. Spring Lake in Pool 2 has some angler use, probably more than the main part of Pool 2. However, on aerial censuses of fishermen on the River in recent years fishermen were rarely seen on Pool 2. This light fishing pressure is confirmed by the local State Game

Warden. Off-flavor in game fish taken from Pool 2 has been reported by sport fishermen. In 1956 fishing success for walleyes, northern pike and catfish in Spring Lake of Pool 2 was reported to be low and to have declined during the preceding 15 years.

Counts of fishermen on Pools of the Mississippi River were made from the air and from the ground during the fishing year, April 1, 1962 to March 31, 1963. Estimates of the total number of man-hours of fishing per acre per year in Pools 3, 4, and 5 of the Mississippi River are compared below with similar data from five south-central Minnesota lakes:

| Water | Fishing year | Total angling hours per acre per year |
|---|---|---|
| Pool 3 | 62-63 | 1.8 |
| Pool 4 | 62-63 | 10.9 |
| Pool 5 | 62-63 | 12.5 |
| Inland lakes | 57-58 | 47.4 |

A survey of the economic value of the sport fishery on the Mississippi River, which was conducted in 1957[3] ([3] The economic value of the Minnesota sport fishery on the Mississippi River, Section of Research and Planning, Minnesota Division of Game and Fish, 1957.), indicated the average yearly expenditure per person for fishing on the

Mississippi River was about $50. Based on the estimated numbers of fishermen using Pools 3, 4 and 5 in the fishing year, April 1, 1962 to March 31, 1963, the sport fishermen expenditures related to these pools were:

| Pool | Expenditure per year |
|---|---|
| 3 | $ 42,200 |
| 4 | $ 549,200 |
| 5 | $ 162,150 |
| | $ 753,550 |

Creel censuses on Pools 3, 4 and 5 during the summers of 1956 and 1962 indicate fairly good sport fishing success. The figures for average number of fish caught per hour of fishing are compared below with similar data from 14 Minnesota Lakes:

| Water | 1956 | 1962 |
|---|---|---|
| Pool 3 | 0.36 | - |
| Pool 4 | 0.37 | 0.84 |
| Pool 5 | 0.38 | 0.94 |
| Inland lakes | 0.71 | - |

The higher catch rate in 1962 reflects mostly larger catches of sunfish made in that year.

# GAME

Game management activities along the Mississippi River are principally development and maintenance of wildlife management and public hunting grounds and acquisition and development of public accesses for the benefit of fishermen and boaters as well as hunters.

At the present time there are seven public accesses recognized by the Division of Game and Fish for the part of the river being considered. Of these the Division of Game and Fish owns three as indicated below:

| | | | |
|---|---|---|---|
| Mississippi River | | At Champlin | (Champlin Village) |
| Mississippi River | Pool 2 | St. Paul | (Ramsey County) |
| Vermillion River | Pool 3 | Near Hastings | (Game and Fish) |
| North Lake | Pool 3 | Near Etter | (Game and Fish) |
| Sturgeon Lake | Pool 3 | Near Eggleston | (Game and Fish) |
| Lake Pepin | Pool 4 | Near Frontenac | (Minnesota Highway Department) |
| Lake Pepin | Pool 4 | Near Lake City | (Minnesota Highway Department) |

It is expected that more accesses will be acquired and developed in the future.

At the present time two Wildlife Management and Public Hunting Areas located on bottom lands of Pool 3 are influenced by the river. These areas are the Gores-Pool 3

Unit containing 5,430 acres in Dakota and Goodhue Counties and the Wood Duck Unit, now being acquired, to contain 463 acres in Dakota County.

Management of these areas will be intensified in the future and it is expected that hunter use will increase.

## Waterfowl

Migrating waterfowl use the Mississippi River and its backwaters, particularly below the Twin Cities. There also is some waterfowl nesting along the Mississippi River between the Rum River and the Chippewa River below Lake Pepin. Data obtained by the U. S. Fish and Wildlife Service indicate the largest number of birds using the river in the area below Pool 5 to the Iowa line on any one day during the spring ranged from 119,801 to 296,870 birds in the years 1959 through 1963. While these data were collected from the area downstream from Lake Pepin, it seems reasonable that they may be projected to indicate potential waterfowl use of Pools 4, 3 and 2 upstream. A decline in waterfowl use of Pool 2 during the past several years is reported by the local State Game Warden. Waterfowl hunter use of parts of Pools 2, 3 and 4 is considered moderate to heavy.

Ducks killed or affected by oil in Pools 2, 3 and 4 in the spring of 1963 give further indication of waterfowl use. In this instance, it was calculated that 4,800 birds were killed by oil (see report on Waterfowl Mortality Caused by Oil Pollution of the Minnesota and Mississippi rivers in 1963 which is appended). Following loss due to oil between March 28 and about April 2, 1963, an estimated 10,000 waterfowl were observed between St. Paul and Red Wing on April 9 and an estimated 20,000 were observed between Red Wing and the lower end of Lake Pepin on April 11.

## Furbearers

Muskrats, beaver and mink are common along the Mississippi River and in backwater areas. A considerable amount of trapping is done along the entire stretch of river under consideration, but no accurate statistics of the trapping pressure are available.

## TRIBUTARIES

### St. Croix River

Sport and commercial fishing is carried out on the St. Croix River between Taylors Falls and the mouth, a distance of approximately 45 miles. For the years 1958 through 1962 a yearly average of 369,225 pounds of rough fish (including catfish) were taken by commercial fishermen. The value of the commercial catch from the St. Croix River in 1962 was approximately $17,600. There is no quantitative information on the use of the St. Croix River by sport fishermen but letters, telephone reports, press releases and observations by Division of Game and Fish field personnel provide evidence of considerable sport fishing. Of 348 boats counted from the air on about 20 miles of river between Prescott and Stillwater on Memorial Day, 1963, 18 appeared to be engaged in fishing. Off-flavor in walleyes caught downstream from Hudson, Wisconsin has been reported by sport fishermen. Common species of fish in the St. Croix River are shown in Table 4 which is appended.

There are no Division of Game and Fish wildlife management or public hunting areas along the St. Croix River below Taylors Falls. One public access owned by the Minnesota Highway Department is located at Stillwater. Some waterfowl use the river during migration and some ducks, principally wood ducks, nest along the river. Waterfowl hunters use the river upstream from Stillwater. Trapping is done for beaver and mink and a limited amount for muskrat along the St. Croix River.

Minnesota River

The Minnesota River from the mouth of the river to Henderson, approximately 69 miles upstream, contains some game fish. Sport fishing, primarily for catfish and walleyes, is done at a few places such as the falls and rapids near Carver. No commercial fishing is carried out in this part of the Minnesota River.

Information on fish in the Minnesota River was obtained in a survey conducted in 1958[4/]. ([4/]Survey of the Minnesota River. Section of Research and Planning, Minnesota Division of Game and Fish, March, 1960.) The common species of fish recorded between the mouth of the river and Henderson are shown on Table 5 which is appended. The data on abundance of fish are insufficient to allow comparison with other fishing waters but are indicative of a relatively low population. Game fish made up a small part of the total sample (6.9 per cent between the mouth and Shakopee, and 16.9 percent between Shakopee and Henderson).

The Minnesota River between the mouth and Henderson is lightly fished compared to other fishing waters in Minnesota. A few fishermen contacted near Shakopee in 1958, indicated general satisfaction with fishing success at that time. In 1963 the local State Game Warden observed some reduction in fishing between Shakopee and Henderson which was attributed locally to a reaction to oil pollution in the spring of 1963. In some winters game fish are rescued by seining by state crews from backwater lakes in the Mendota area when dissolved oxygen levels drop.

There are no Division of Game and Fish wildlife management or public hunting areas along the Minnesota River below Henderson. One public access is presently being acquired near State Highway 65 in Bloomington. Waterfowl use the Minnesota River and flood-plain lakes during migration, although to a lesser extent than they do the Mississippi River and its backwaters downstream. Some ducks nest along the Minnesota River. Waterfowl hunter use of flood-plain lakes below Shakopee is quite extensive and several areas are controlled by hunting clubs. Most flood-plain lakes are not affected by the river except at times of unusually high flow. Muskrats are common along the Minnesota River and other fur-bearers are present. Trapping is done between Henderson and the mouth of the river.

## Future Uses

The Mississippi River between the Rum River and the St. Croix River is at present little used by fishermen compared to the Navigation Pools downstream. In general the Mississippi River is fished less intensively than many other fishing waters in the state at the present time. It is probable, however, that the Mississippi River both between the Rum River and the St. Croix River and in the pools downstream will be used more by fishermen in the future and values related to fishing will increase if stream conditions are suitable for fish life.

Present water quality standards adopted for the Mississippi River between the Rum River and Lock and Dam No.2 promise to prevent further deterioration and may result in some improvement of conditions for fish in the river above Lock and Dam No. 2, particularly if flow patterns remain about the same. However, present and foreseeable conditions under the existing standards do not insure a sustained population of rough fish or game fish of good quality in all parts of Pool 2 and do not justify significant fisheries or game management work on the Mississippi River between St. Paul and Lock and Dam No. 2. To properly manage for fish, dissolved oxygen content should not be less than 5 ppm (parts per million) for more than 8 hours in any 24 hour period, and at no time less than 3 ppm.[5/] ([5/] Aquatic life water quality criteria, first progress report. Aquatic Life Advisory Committee of the Ohio River Valley Water Sanitation Commission, Sewage and Industrial Wastes, Vol. 27, No. 3, May, 1955.)

The St. Croix River below Taylors Falls and the Minnesota River below Henderson probably will also be used more in the future by fishermen and will increase in values related to fishing if stream conditions are suitable for fish.

In the lightly fished Minnesota River, both pollution abatement and other improvement of the stream is desirable.

It is probable that game management activities will be expanded and be intensified along the sections of the Mississippi River, Minnesota River and St. Croix River under consideration. It is probable also, that waterfowl hunter use of portions of these areas will be heavier in the future and that trapping of furbearers will continue.

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Table 1.- Common species of fish in the Mississippi River between the Rum River and Chippewa River 1/

| Species | Rum River to Camden | St. Anthony Upper Pool | Pool 1 | Pool 2 | Pool 3 | Pool 4 & 4A | Pool 5 |
|---|---|---|---|---|---|---|---|
| | | P = Present | | | | | |
| Game Species | | | | | | | |
| Walleye | P | No specific information | No specific information | P | P | P | P |
| Sauger | | | | P | P | P | P |
| Northern pike | P | | | P | P | P | P |
| Black crappie | P | | | P | P | P | P |
| White crappie | | | | | P | P | P |
| Largemouth bass | | | | P | | P | |
| Smallmouth bass | P | | | | | P | P |
| Rock bass | P | | | P | | P | P |
| White bass | | | | | P | P | P |
| Bluegill | P | | | P | P | P | P |
| Channel catfish | | | | P | P | P | P |
| Shovelnose sturgeon | | | | | | P | P |
| Fathead catfish | | | | | P | P | |
| Green sunfish | | | | P | | | |
| Pumpkinseed sunfish | P | | | | | | |
| Rough fish | | | | | | | |
| Carp | P | | | P | P | P | P |
| Sheepshead | | | | P | P | P | P |
| Brown bullhead | | | | | | P | P |
| Bigmouth buffalo | P | | | P | P | P | |
| Northern carpsucker | | | | | P | P | P |
| Northern redhorse | P | | | P | P | P | P |
| Longnose gar | | | | | P | P | |
| Shortnose gar | | | | P | P | P | |
| Bowfin | | | | P | | P | |
| Mooneye | | | | P | P | P | |
| Gizzard shad | | | | P | P | P | |
| Common sucker | P | | | P | P | P | |
| Spotted sucker | | | | | | P | P |
| Yellow bullhead | P | | | | | | P |
| Black bullhead | P | | | | | P | |
| Golden shiner | | | | | P | P | |
| Yellow perch | | | | P | | P | P |
| River sucker | | | | P | | | |

1/ This list indicates those species known to be present through fisheries surveys and fisherman reports. It is not a complete list of species.

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Table 2.- Mean numbers and weights of fish per set lift in the upper navigation pools of the Mississippi River in 1956

| Waters | Game Fish per set | | | | Rough Fish per set | | | |
|---|---|---|---|---|---|---|---|---|
| | Number | | Pounds | | Number | | Pounds | |
| | Gill net | Trap net | Gill net | Trap net | Gill net | Trap net | Gill net | Trap net |
| Rum River to Camden | No comparable data | | | | | | | |
| Upper St. Anthony Pool | No comparable data | | | | | | | |
| Pool 1 | No comparable data | | | | | | | |
| Pool 2 (Spring Lake) | 1.7 | 1.3 | 1.9 | 0.5 | 21.0 | 4.3 | 9.1 | 4.1 |
| Pool 3 | 4.0 | 8.6 | 4.1 | 7.6 | 6.2 | 21.7 | 5.8 | 54.8 |
| Pool 4 (includes part of Lake Pepin)* | 31.7 | 19.3 | 19.9 | 14.8 | 12.6 | 3.0 | 8.7 | 9.3 |
| Pool 4A (includes part of Lake Pepin)* | 26.8 | 14.8 | 13.8 | 9.0 | 7.2 | 10.3 | 9.5 | 36.0 |
| Pool 5 | 2.7 | 3.5 | 2.6 | 5.1 | 2.8 | 5.3 | 5.4 | 20.6 |

* In 1956 only. In subsequent years Pool 4A designated Lake Pepin and Pool 4 the areas above and below Lake Pepin in Navigation Pool 4.

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Table 3.- Commercial fish catch in the upper navigation pools of the Mississippi River by licensed fishermen, Minnesota and Wisconsin combined

| Year | Pool No. Acres * | 2 (11,811) | 3 (17,950) | 4 (13,820) | 4A (25,000) | 5 (12,580) |
|---|---|---|---|---|---|---|
| 1962 | | 331,587 | 46,035 | 467,628 | 1,402,451 | 178,004 |
| 1961 | | 344,345 | 104,180 | 358,508 | 1,378,206 | 218,768 |
| 1960 | | 326,524 | 118,812 | 450,617 | 1,178,273 | 163,349 |
| 1959 | | 322,025 | 21,160 | 419,165 | 1,553,024 | 121,459 |
| 1958 | | none | 16,763 | 554,923 | 1,763,898 | 95,410 |
| Mean | | 331,618** | 65,710 | 450,168 | 1,455,170 | 155,398 |
| Average pounds per acre per year | | 28.0 | 3.4 | 32.6 | 58.2 | 12.1 |

* Corps of Engineers data.
** 4-year average, no fishing done in Pool 2 in 1958.

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Table 4.- Common species of fish in the St. Croix River below Taylors Falls 1/

| Game Fish | Rough Fish |
|---|---|
| Lake Sturgeon | Gar (short nose and long nose) |
| Northern pike | Gizzard shad |
| Channel catfish | Mooneys |
| Flathead catfish | Carp |
| Rock bass | Quillback |
| White bass | Blue sucker |
| Smallmouth bass | Bigmouth buffalo |
| Black crappie | Northern redhorse |
| Sauger | Sheepshead |
| Walleye | |

1/ This list indicates those species known to be present through fisheries surveys and fisherman reports. It is not a complete list of species.

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Table 5.- Common species of fish in the Minnesota River between the mouth of the river and Henderson 1/

| Game Fish | Rough Fish |
|---|---|
| Sauger | Carp |
| White bass | Gizzard shad |
| Northern pike | Sheepshead |
| White crappie | Northern redhorse |
| Flathead catfish | Carp sucker |
| Black crappie | Bigmouth buffalofish |
| Walleye | Quillback |
| Largemouth bass | Shortnose gar |
| Channel catfish | Silver redhorse |
| Smallmouth bass | Common sucker |
| | Dogfish |
| | Hog sucker |
| | Smallmouth buffalofish |

1/ This list indicates those species known to be present through fisheries surveys and fisherman reports. It is not a complete list of species.

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MINNESOTA DEPARTMENT OF CONSERVATION

DIVISION OF GAME AND FISH

# Waterfowl Mortality Caused by Oil Pollution of the Minnesota and Mississippi Rivers in 1963

## INTRODUCTION

Following breakup of ice on the Minnesota and Mississippi Rivers in late March and early April, 1963, many waterfowl, especially ducks, were killed by oil on the surface of the water. Other birds were harmed when their feathers became coated with varying amounts of oil. Waterfowl losses occurred on approximately 60 miles of the Mississippi River from the mouth of the Minnesota River downstream to Lake Pepin. The major loss, however, occurred in three areas: (1) Spring Lake in Navigation Pool No. 2 above Hastings, Minnesota, (2) North and Sturgeon Lakes in Navigation Pool No. 3 below Hastings and (3) the headwaters of Lake Pepin including Mud Lake on the Wisconsin side of the main channel.

The oil responsible for the waterfowl and other wildlife damage and mortality came from two sources: (1) the Honeymead Products Company Plant at Mankato, Minnesota from which it was estimated 1 - 1 1/2 million gallons of soy-bean oil escaped to the Blue Earth River on January 23, 1963, and (2) the Richards Oil Company at Savage, Minnesota where an estimated one million gallons of petroleum oil described as a "low viscosity cutting oil" escaped to the Minnesota River and adjacent marshland sometime in December, 1962. 1/ ( 1/ Estimates of quantities of oil are from the Section of Water Pollution Control, Minnesota, Department of Health.)

The purpose of this report is to summarize principal activities of the Division of Game and Fish, Minnesota Department of Conservation and to set forth the character and extent of waterfowl and other wildlife losses attributed to oil pollution of the Mississippi and Minnesota Rivers in March and April, 1963.

## MOVEMENT AND APPEARANCE OF THE OIL

The petroleum oil escaped to the Minnesota River near Savage from a marsh which was flooded with oil when storage facilities failed at the Richards Oil Company. Oil from this source was noted at the Black Dog Plant of the Northern States Power Company 4 to 5 miles below Savage on December 23, 1963. Some oil from this source probably flowed to the river at times during January and February, 1963, and a substantial amount evidently entered the river during the period of spring runoff. A large quantity of oil, apparently petroleum oil, was evident on the Minnesota River in early and mid-March but it should be noted that later the petroleum oil could not be distinguished by field observation from light slicks of soybean oil. Analyses of seven oil samples from the Mississippi River on several dates by the Minnesota Department of Health showed petroleum oil present in only one instance after March 25 suggesting that by this date much of petroleum oil had moved downstream ahead of the soybean oil or had otherwise dissipated. (Appendix A)

Soybean oil reached the Minnesota River via a short stretch of the Blue Earth River when storage facilities of the Honeymead Products Company plant failed in January 1963 during a period of very cold weather. The soybean oil apparently moved very little until breakup of ice in the Minnesota River in late March, but then it flowed rapidly downstream. This oil is of a very heavy consistency at temperatures below freezing. At the time of aerial observation of oil and census of waterfowl on March 26, heavy orange-red slicks of soybean oil were seen in the main channel at Lock and Dam No. 2, on the Mississippi River at Hastings.

Oil entered Spring Lake in Pool No. 2, the area of heaviest waterfowl damage, when the ice went out on March 28 and moved downstream into the upper end of Lake Pepin when ice went out on this lake, about April 2. Personnel of the Corps of Engineers, U.S. Army, reported the largest amount of oil went through Lock and Dam No. 3 about 12 miles above Lake Pepin on April 2. Members of a tow barge crew reported oil on Lake Pepin in the vicinity of Maiden Rock on April 3 and localized accumulations of oil were seen at this time and later by Division of Game and Fish personnel on the bottom and along shore in the vicinity of Bay City and Frontenac. Traces of oil were seen by Game and Fish personnel at Lake City approximately midway on Lake Pepin but apparently no significant amount of oil reached the outlet of Lake Pepin.

The character of soybean oil on and in the water changed with time. The thick orange-colored slicks which were first observed changed to pliable greyish and somewhat rubbery floating masses. These masses were stringy, rope-like or somewhat rounded. In a few places a sticky layer of similar color was deposited on the bottom. As oil moved downstream from the sources it lodged in small shoreline indentations, accumulated on beaches, and coated debris and shoreline vegetation. Soybean oil was most evident, since it left a varnish-like crust on beaches, debris and vegetation. Only limited areas of bottom were apparently covered with soybean oil, most notably in Lake Pepin in the vicinity of Bay City and Frontenac. Light oil slicks were observed to form around some of the floating consolidated oil masses apparently when the outer shell or membrane of the mass was ruptured. Light iridescent slicks of sufficient size to cause concern for waterfowl were still present on backwater lakes of the river near Lock and Dam No. 3 on April 11, but no significant waterfowl damage was observed after about April 2. The peak of waterfowl damage in the areas of major loss occurred within a day or two after ice went out.

## WATERFOWL RESCUE OPERATION

Movement of soybean oil down the Minnesota River and into the Mississippi River was reported by State Game Wardens the forenoon of March 26. Aerial survey on March 26 by a Division Biologist and Game Manager team and by Game Wardens revealed approximately 3,000 ducks on the Mississippi River between St. Paul and the head of Lake Pepin but no significant number of ducks on the Minnesota River. None of the ducks seen on this date appeared to be affected by oil. Observation by boat on March 27 revealed no waterfowl affected by oil in the main channel and ice-free backwaters in Pool No. 2. Spring Lake, the principal water area in Pool No. 2, was ice covered on March 27. On March 28 the ice went out of Spring Lake and in Spring Lake on this date the first report of oil-soaked ducks was investigated and confirmed by a Division Waterfowl Biologist who found 4 live and 9 dead ducks. On March 30, 150 live and 24 dead oil-soaked ducks were collected on Spring Lake and on North Lake a few miles below Hastings. On the following day, 518 live birds were rescued in these areas. Intensive rescue operations were initiated on April 1 and continued through April 5 when only a few affected live ducks were still being found. A few 2-man crews were kept in the area to April 12 and thereafter to April 30 the affected areas were watched by Division personnel stationed in the area.

Information on the scope of the rescue operations was obtained from a questionnaire sent to all known participants (Appendix B). In terms of man-power the rescue operation involved 88 State Game and Fish employees, 15 U. S. Fish and Wildlife Service employees and 6 other persons who worked an aggregate 438 man days. Equipment use totalled 47 flights of aircraft, 220 use-days for boats and motors and 37 use-days for trucks. Estimated cost to the Division of Game and Fish was approximately $19,000. Rescue work in addition to the above was carried out by the Minnesota National Guard and private individuals not reached by the questionnaire.

Most of the live oil-soaked ducks were cleaned at Carlos Avery Game Farm of the Division of Game and Fish but many were also cleaned at the Como Park Zoo in St. Paul and at the private residence of George Serbesku at Spring Lake. Cleaning agents and procedures used included several household detergents; the product Amway, manufactured by the Amway Company; and Triton X-100, a Rohm and Haas Company product.

The latter was worked into the feathers by hand, followed by washing the bird after 2 to 3 minutes with a solution containing 1 tablespoon trisodium phosphate and 1 tablespoon of Calgon per gallon of water. The bird was then rinsed in clean water. None of the materials or procedures tried resulted in easy efficient removal of oil. On many of the birds the oil had set to a paint-like consistency. Many of the birds were given an eyedropper of glucose (corn syrup) after rescue to offset shock.

Four hundred and sixty-six or 34 percent of the washed ducks were alive in pens on July 1 and of this number approximately 350 flew free before October 1 after moulting in July and August. The remaining birds flew free prior to freeze-up on about November 30. Detailed information on care given and factors related to survival of rescued ducks can be obtained from the Game Research Unit, Section of Research and Planning, Division of Game and Fish.

The effectiveness of several recommended emulsifiers and dispersants and of diatomaceous earth for removal of oil from the water surface was investigated. Before using emulsifiers or dispersants, however, it was necessary to determine their toxicity to fish, especially since most were proprietary products whose exact chemical composition was unknown.

The four products which appeared most promising and on which preliminary bioassays to determine toxicity to fish were run are listed below together with the toxicity data obtained:

| Products | Test Solution | Tlm | Time |
|---|---|---|---|
| Wyandotte ULC (Wyandotte Chemical Co.) | Full strength, 23 percent active ingredient | 75/ ppm | 24 hours |
| Franks Formula (T. J. Frank Co., Mpls.) | 1 ounce per gallon | 100/ ppm | 24 hours |
| Triton X-100 (Rhom -Haas Co.) | 25 percent solution | 100/ ppm | 24 hours |
| Gamlin Spill Remover | 25 percent solution | 50/ ppm | 17 hours |

The Tlm (median tolerance limit) is the concentration at which 50 percent of the test fish were killed in the time indicated.

Field trials on oil slicks were made with Wyandotte ULC and Franks Formula. Because of immediate availability, Franks Formula was chosen for initial use at rates of 30 and 60 pounds per acre on light and heavy slicks, respectively.

Wyandotte ULC appeared equally safe and effective at an initial application rate of approximately 20 gallons per acre.

The use of diatomaceous earth, suggested by representatives of the U. S. Public Health Service, was also explored. Laboratory work by the Minnesota Department of Health indicated about one pound of diatomaceous earth would be needed to remove four pounds of pure soybean oil (Appendix A). Limited field trials indicated several applications at a rate of possibly 200 to 300 pounds per acre might be required to remove a moderately heavy oil slick.

The limited experiences with emulsifiers, dispersants and diatomaceous earth as described above suggested their use would be most practical in relatively small areas of perhaps 100 acres or less. Also, possible adjustment of the suggested initial application rates should be considered in the course of practical use.

Related to duck rescue, also, were the efforts of the Minnesota National Guard to mechanically remove oil and divert oil from backwater areas where waterfowl were most likely to concentrate.

## EVALUATION OF WATERFOWL LOSSES

The number of live oil-soaked ducks rescued was 1,369 and the number of dead birds collected in the field and placed in cold storage was 1,842. Many dead birds were seen but were not collected while live birds could still be found. The ratio of live ducks rescued to dead ducks seen, based on the questionnaire completed by individuals in the field on the rescue operation was 1:2.96 (Appendix B). If this ratio is used, recognizing there is duplication of counts in both categories since undoubtedly some birds were seen and reported by more than one person, the estimated number of dead ducks on the river including the dead ducks collected is calculated at approximately 4,000. Including the live birds affected but rescued it would appear that a total of approximately 5,300 birds were affected or killed by oil. However, since ducks heavily covered with oil tended to crawl into dense cover where they were hard to find and some ducks exposed to oil may have flown several miles before being overcome, the total number of ducks lost is probably substantially greater than the calculated loss of about 4,800 (5,300 minus 466 survivors).

Composition of the duck kill was determined by examination of 2,745 dead birds which had been placed in cold storage and which were later examined by Waterfowl Biologists. These were the birds collected dead and those which died after rescue. The numbers of birds by species found in this examination are summarized on the following page (see also Appendix C).

| Species | Number |
|---|---|
| Lesser scaup duck | 1,800 |
| Ringnecked duck | 447 |
| Coots and grebes | 268 |
| Goldeneye duck | 70 |
| Wood duck | 35 |
| Bufflehead duck | 28 |
| Puddleducks, other than wood ducks | 14 |
| Mergansers | 37 |
| Other | 46 |
| Total | 2,745 |

Each waterfowl lost represents a real monetary value. Based on data compiled by the U.S. Fish and Wildlife Service for 1960, the national average expenditure per duck in the waterfowl hunter's bag for that year was $12.00.2/ ( 2/ Data obtained from the 1960 National Survey of Fishing and Hunting and the Waterfowl Status Report, 1961.) In 1962 the State of Illinois placed a value of $5.00 per bird on ducks killed by water pollution.3/ ( 3/ Personal communication May 6, 1963 from William J. Harth, Superintendent, Division of Fisheries, Illinois Department of Conservation.) It is felt that a value of not less than $5.00 per bird should be placed on the waterfowl killed on the Mississippi River in Minnesota in 1963. This value is considered to be the basic intrinsic worth of the bird and unrelated to costs of rescue and maintenance of the birds afterwards.

## OTHER WILDLIFE LOSSES

Mammals and other animals were reported as seen dead (Appendix F) in the following numbers: 26 beaver, 177 muskrats and about 50 "others" (includes cow, dog, gulls, herons, kingfisher, pigeons, pig, skunk, squirrel, turtles, blackbirds and songbirds). It seems likely that many of the animals in this "other" category died from causes unrelated to oil and the counts of beaver and muskrat are probably high since many of these animals were probably seen and reported by more than one person.

Fish were apparently directly affected very little by the oil spills. Of approximately 7,000 dead fish reported seen, 247 were listed as recently dead and most of these were carp. Winterkill is common in shallow backwater areas of the river and it was the opinion of persons on rescue work experienced with fish kills that the dead fish seen most probably died from causes other than oil pollution.

Bottom fauna of value as fish food may have been temporarily affected to some extent in localized areas but it is doubtful that any significant or permanent loss occurred.

This conclusion is substantiated by reports on samples collected by U. S. Public Health Service Personnel[4/] ([4/] Progress Report to Colonel Leon H. Hagen, Assistant Adjutant General, Minnesota Department of Military Affairs dated April 30, 1963 from Mr. F. E. DeMartini, Chief, Technical Advisory and Investigations Section, Technical Services Branch, DWSPC, U. S. Public Health Service, Cincinnati.) and by data collected from six stations in the Red Wing-Lake Pepin area by the Section of Research and Planning, Division of Game and Fish after oil contamination in 1963 (Appendix D).

/S/ BERNARD R. JONES

Bernard R. Jones, Supervisor
Biological Services Unit
Section of Research and Planning

/S/ ROBERT L. JESSEN

Robert L. Jessen, Research Biologist
Game Research Unit
Section of Research and Planning

/S/ MILO CASEY

Milo Casey, Regional Game Manager
Section of Game

Approved:

/S/ JOHN B. MOYLE

John B. Moyle, Supervisor

Section of Research and Planning

/S/ DAVID B. VESALL

David B. Vesall, Supervisor

Section of Game

October 31, 1963

* * * *

Appendix A

MINNESOTA DEPARTMENT OF HEALTH

Division of Environmental Sanitation

Section of Engineering Laboratories

LABORATORY STUDIES OF OIL

RECOVERED FROM SAVAGE AND MANKATO SPILLS

Nineteen oil samples have been collected and characterized in this study. The results are summarized in the attached table.

Initially samples were extracted with chloroform. The chloroform and aqueous phases were separated and the chloroform phase filtered through medium porosity paper. Part of the chloroform solution was treated with activated carbon, and both parts were placed on a steam bath to evaporate the chloroform. Infra-red studies were made of the oil residue.

This treatment was satisfactory for soybean oil, but the petroleum oil under investigation had volatile aromatic constituents which were mostly removed during treatment. The use of irtran--2 windows makes it possible to handle wet samples in the infra-red apparatus and the procedure finally used in preparing samples was simply that of drawing off as dry a portion as possible after the sample had been allowed to stand for several hours. This procedure could be expected to eliminate losses of volatile constituents in the laboratory, but the samples containing petroleum oil were still low in aromatics. Apparently these materials tend to disappear rapidly, possibly by evaporation, from the spilled material.

Oil samples were mechanically removed from the ducks collected in this study and analyzed directly without treatment.

At times, the oil which normally floated on the surface of the river tended to sink. One such sample of oil from the bottom of Lake Pepin (number 6283) was examined and found to be soybean oil. In boiling water, the oil again started to float on the surface, releasing a considerable quantity of sand and dirt as well as water-soaked twigs and leaves. The tendency to sinkapparently resulted from the entrapment of this heavy material in the oily mass.

The use of a finely divided material such as diatomaceous earth, which would not readily separate from the oil, had been suggested as a means of causing the oil to sink to the bottom and remain there until decomposed. Laboratory experiments indicated that for pure soybean oil one pound of diatomaceous earth would be required for every four pounds of oil. Less diatomaceous earth would probably be needed in actual use since the oil would already have entrapped some fine clay, etc. The stability of the mixture with time is still being tested.

A BOD (5-day biochemical oxygen demand) study was made of material collected from the beach at Wacouta, Minnesota, in Upper Lake Pepin on April 17. The sample was prepared for the BOD test by macerating 6.4 grams of the solid material with 240 ml. (milliliters) of water in a Waring blender. The resulting mixture was then diluted with BOD dilution water in BOD bottles, seeded with river water, and incubated for 5 days at 20°C.

Dilutions which provided useful oxygen depletion data, and the oxygen measurements obtained, were as follows:

| Sample Concentration in Laboratory Bottle (mg/l) | Oxygen Depletion (mg/l) | mg of Oxygen consumed per mg of sample |
|---|---|---|
| 52 | 4.3 | 0.08 |
| 26 | 2.7 | 0.10 |
| 10.4 | 1.4 | 0.13 |
| 5.2 | 1.0 | 0.19 |

The increase in the BOD with greater dilution appears to be attributable to the low solubility of the material. The results indicate a relatively low BOD for organic material. It would not under conditions in the stream or lake exert an oxygen demand as great as obtained in the laboratory, since the sample was thoroughly macerated and mixed before the analysis. The material normally occurs in the river in large pieces and would not expose much surface area to bacterial activity.

It appears that oily material typical of the sample analyzed would not have sufficient oxygen demand to significantly affect the oxygen resources of the river.

SAMPLES COLLECTED AND ANALYZED IN OIL SPILL STUDY

| LABORATORY NUMBER | FIELD NUMBER | DATE COLLECTED | LOCATION | SAMPLING POINT AND SOURCE OF SAMPLE | RESULTS SOYBEAN | PETROLEUM |
|---|---|---|---|---|---|---|
| 6391 | 1 | 3/28/63 | Spring Lake | Oil scraped from ducks | 100% | — |
| 6392 | 2 | 3/28/63 | Spring Lake | Oil scraped from ducks | 80%-90% | 10%-20% |
| 6393 | 3 | 3/28/63 | Spring Lake | Oil scraped from ducks | 90% or more | 10% or less |
| 6394 | 1 | 3/30/63 | Sturgeon Lake | Oil scraped from ducks | 100% | — |
| 6395 | 2 | 3/30/63 | Sturgeon Lake | Oil scraped from ducks | 100% | — |
| 6396 | 3 | 3/30/63 | Sturgeon Lake | Oil scraped from ducks | 100% | — |
| 6397 | 1 | 4/1/63 | Mississippi R. near Red Wing | Oil scraped from ducks | 100% | — |
| 6398 | 2 | 4/1/63 | Mississippi R. near Red Wing | Oil scraped from ducks | 100% | — |
| 6399 | 3 | 4/1/63 | Mississippi R. near Red Wing | Oil scraped from ducks | 100% | — |

Note: All samples from ducks were collected by Minnesota Department of Conservation personnel.

SAMPLES COLLECTED AND ANALYSED IN OIL SPILL STUDY

| LABORATORY NUMBER | FIELD NUMBER | DATE COLLECTED | LOCATION | SAMPLING POINT AND SOURCE OF SAMPLE | RESULTS SOYBEAN | PETROLEUM |
|---|---|---|---|---|---|---|
| 6061 | A | 3/25/63 | Newport | 1495 Cedar Lane, Newport, Mississippi R. | — | 100% |
| 6062 | B | 3/25/63 | Newport | End of 12th St. at Mississippi R. | — | 100% |
| 6089 | D | 3/27/63 | Savage | Port Richards, Richards Oil Co., from diked area. | — | 100% |
| 6128 | E | 3/28/63 | Hastings | At Hastings dam, Mississippi R. | 100% | — |
| 6129 | F | 3/28/63 | Shakopee | Bridge off Highway 169, Minnesota R. | 100% | — |
| 6130 | G | 3/28/63 | Rapidan | 2 miles east of Rapidan, below junction of LeSueur R. and drainage from Honeymead dump area. | 100% | — |
| 6169 | 1 | 4/1/63 | Dakota County | Southeast part of Spring Lake, from shore of island near main channel. | 100% | — |
| 6179 | 2 | 4/1/63 | Pine Bend | From main channel of Mississippi R. opposite N.W. Coop. Mills. | 100% | — |
| 6171 | 3 | 4/1/63 | Pine Bend | From shore oil deposit 1 block south of N.W. Coop. Mills. | 40% | 60% |
| 6283 | 24 | 4/4/63 | Bay City, Wisc. | Oil that settled on bottom of Lake Pepin. | 100% | — |

MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF GAME AND FISH
390 Centennial Building
St. Paul 1, Minnesota

Appendix B

April 8, 1963

OFFICE MEMORANDUM

TO: Departmental personnel and others who aided in the duck rescue operation

FROM: Gordon Wollan, Director, Minnesota Division of Game and Fish

SUBJECT: Duck Rescue Operation

Because of financial considerations and use of Federal Aid personnel on the duck rescue operation we will have to prepare shortly a report on all phases of the duck rescue. The attached questionnaire has been prepared to gather the information needed. Please fill out one of the attached sheets giving information on your part in the rescue operation. Date and fill in one column for each day you were on this job. Please return the filled-out questionnaire to me as soon as possible.

Indicate whether dead fish seen (if any) were fresh or had been dead for some time. If you used a dog in searching for ducks, indicate under "Notes". Also include under "Notes" any special observations or ideas that may be helpful in future emergencies of this kind. If more space is needed use back of sheet.

Since the same sheet is going out to all persons concerned, some of the information requested may not be applicable to you. We do not have a record of all volunteers who helped on the job. If you know of such, please have each one fill one of the additional attached sheets.

Thank you for your help in this emergency.

/s/ Gordon Wollan

# REPORT ON DUCK RESCUE OPERATION

| NAME: | ADDRESS: | | TITLE (if state employee): | |
|---|---|---|---|---|
| | DATE | | | |
| DATA: | Month Day 1963 | Month Day 1963 | Month Day 1963 | Month Day 1963 |
| Kind of work done | | | | |
| Area or place of work | | | | |
| Number of hours worked | | | | |
| Estimated number of live ducks rescued | | | | |
| Estimated number of dead ducks seen during search | | | | |
| Estimated number of dead fish seen during search | | | | |
| Dead mammals and birds other than ducks seen - SPECIFY KIND AND NUMBER | | | | |
| Equipment used | | | | |
| Extent of oil in area worked (heavy, light slick, patches or none) | | | | |
| Notes | | | | |

RETURN TO: Director, Division of Game and Fish, 390 Centennial Building, St. Paul 1, Minnesota

Tabulation of Data from Questionnaires

Returned by Persons in Duck Rescue and

Related Jobs, March 15 through April 25, 1963

In all, 109 questionnaires were returned. Because of variation in filling out the forms some judgment is involved in the tabulation of the data. The totals -- except for number of people involved, man-days worked and hours worked -- are probably too high since the ducks reported rescued or the dead ducks and other animals reported seen may have been seen and reported by more than one individual. Also, in some cases, only approximate numbers are given on these sheets. Activities of the National Guard are not included.

1. Personnel reporting - number of persons

| | |
|---|---|
| State personnel | 88 |
| Federal personnel | 15 |
| Others | 6 |
| Total | 109 |

2. Breakdown of state personnel reporting

| | |
|---|---|
| Game wardens | 30 |
| Biologists | 19 |
| Fisheries personnel | 9 |
| Game personnel | 30 |
| Total | 88 |

3. Kind of work done - man-days or portions thereof

| | |
|---|---|
| Duck rescue in the field | 178 |
| Other work including washing of ducks, field supervision, travel from home stations, office details, field inspection for oil, use of emulsifiers, construction of oil barriers, and not specified | 260 |
| Total | 438 |

Most of the work was done during the period April 1 through April 6 inclusive.

4. Areas of work - man-days or portions thereof

| | | |
|---|---|---|
| Spring Lake and vicinity, including North and Sturgeon Lakes | | 189 |
| Carlos Avery | | 36 |
| Other, including Minnesota and Mississippi Rivers | | 213 |
| | Total | 438 |

5. Hours worked and reported

| | | |
|---|---|---|
| State employees | | 3,475 |
| Federal employees | | 431 |
| Other | | 44 |
| | Total | 3,950 |

6. Ducks rescued and seen (including coots and grebes)

| | |
|---|---|
| Live ducks reported rescued | 2,704 |
| Dead ducks reported seen | 8,003 |
| Ratio of rescued ducks to dead ducks | 1:2.96 |

Note - there is undoubtedly duplication of counts in both categories.

7. Dead fish seen

| | | |
|---|---|---|
| Total reported | about | 7,000 |
| Reported as "fresh dead" | | 247 |

Note - personnel experienced with fish kills nearly all reported the fish seen were carp and were fish that had been dead for some time -- probably winterkills in backwaters.

8. Reports of other dead animals seen

| | | |
|---|---|---|
| Beaver | | 26 |
| Muskrats | | 175 |
| Others | about | 50 |

Others include: crow, dog, gulls, herons, kingfisher, parakeets, pig, pigeons, skunks, squirrel, turtles, blackbirds, and songbirds.

Note - Counts of these animals are very doubtful, since many of these animals were probably seen more than once. There was, for example, a beaver at the landing at Spring Lake that was seen by many persons. There are always some dead animals that can be found in the river whether there is pollution or not, especially after ice break-up in spring. Most of these animals were reported for the period March 30 - April 15, inclusive.

9. Equipment-use days, or parts thereof, reported

| | |
|---|---|
| Airplane | 47 |
| Boat and motor | 220 |
| Truck | 37 |

John B. Moyle, Supervisor

Section of Research & Planning

Division of Game and Fish

5/27/63

MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF GAME AND FISH
Section of Research and Planning
Game Research Unit

Appendix C

Summary of Dead Birds Examined and X-Rayed Following Oil Pollution Die-off on the Mississippi River

ANATINAE

| Species | Sex | Amount of oil on birds 1/ | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5a | 5b | 5c | Total |
| Mallard | Male | 3 | | | | 1 | | | 4 |
| Mallard | Female | 2 | | | | | | | 2 |
| Black Duck | Male | 1 | | | | | | | 1 |
| Green-Winged Teal | Male | 1 | | | | | | | 1 |
| Blue-Winged Teal | Male | 1 | | | | | 1 | | 2 |
| Baldpate | Male | 2 | | | | | | | 2 |
| Shoveller | Male | 1 | | | | | | | 1 |
| Shoveller | Female | 1 | | | | | | | 1 |
| Wood Duck | Male | 12 | | | | 2 | 3 | | 17 |
| Wood Duck | Female | 14 | 1 | | | 2 | 1 | | 18 |
| | | 38 | 1 | | | 5 | 5 | | 49 |

AYTHYINAE & ERISMATURINAE

| Species | Sex | 1 | 2 | 3 | 4 | 5a | 5b | 5c | Total |
|---|---|---|---|---|---|---|---|---|---|
| Redhead | Male | 1 | | | | | 1 | | 2 |
| Redhead | Female | 5 | | | | 1 | | | 6 |
| Ring-necked Duck | Male | 248 | 8 | 3 | | 21 | 8 | | 288 |
| Ring-necked Duck | Female | 143 | 4 | | | 8 | 4 | | 159 |
| Canvasback | Male | 1 | | | | 2 | | | 3 |
| Çanvasback | Female | 1 | | | | 1 | | | 2 |
| Greater Scaup | Male | 9 | | | | 2 | 1 | | 12 |
| Greater Scaup | Female | 5 | | | | | 1 | | 6 |
| Lesser Scaup | Male | 861 | 28 | 5 | | 213 | 176 | 19 | 1,302 |
| Lesser Scaup | Female | 308 | 10 | 1 | | 85 | 87 | 7 | 498 |
| American Golden-eye | Male | 35 | 1 | | | 2 | 1 | | 39 |
| American Golden-eye | Female | 27 | | | | 1 | 3 | | 31 |
| Bufflehead | Male | 8 | | | | 7 | 1 | | 16 |
| Bufflehead | Female | 11 | | | | 1 | | | 12 |
| Ruddy Duck | Male | 3 | | | | | | | 3 |
| Ruddy Duck | Female | 6 | | 1 | | | | | 7 |
| | | 1,672 | 51 | 10 | | 344 | 283 | 26 | 2,386 |
| Ring-necked or Scaup | | 2 | | | | | | | 2 |
| | | 1,674 | 51 | 10 | | 344 | 283 | 26 | 2,388 |

1/ - 1. Feathers completely matted
2. Feathers 51 - 99% matted
3. Feathers 25 - 50% matted
4. Feathers 5 - 25% matted
5. Washed bird.
   a. Over 50% of feathers still matted
   b. 5 - 50% of feathers still matted
   c. Less than 5% of feathers still matted

## Merginae, Coot, Grebes and Miscellaneous Species

| Species | Sex | 1 | 2 | 3 | 4 | 5a | 5b | 5c | Total |
|---|---|---|---|---|---|---|---|---|---|
| Hooded Merganser | Male | 2 | | | | 1 | | | 3 |
| Hooded Merganser | Female | 2 | | | | | | | 2 |
| American Merganser | Male | 7 | | | | | 1 | | 8 |
| American Merganser | Female | 1 | | | | | | | 1 |
| Redbreasted Merganser | Male | 17 | | | | | | | 17 |
| Redbreasted Merganser | Female | 4 | 1 | | | | 1 | | 6 |
| | | 33 | 1 | | | 1 | 2 | | 37 |
| Coot | - | 141 | 7 | 2 | | 51 | 20 | 4 | 225 |
| Eared Grebe | - | | | | | | 1 | | 1 |
| Pied-billed Grebe | - | 24 | 1 | | | 7 | 9 | 1 | 42 |
| | | 24 | 1 | | | 7 | 10 | 1 | 43 |

### Miscellaneous

| Species | Sex | 1 | Total |
|---|---|---|---|
| Cormorant (tagged) | - | 1 | 1 |
| Ring-billed Gull (tagged) | - | 1 | 1 |
| Herring Gull | - | 2 | 2 |
| Yellowlegs (tagged) | - | 1 | 1 |
| Great Blue Heron | - | 1 | 1 |

\+ Muskrats

7 Pigeons, 3 Blackbirds and 1 crow discarded

### Grand Totals

| | 1 | 2 | 3 | 4 | 5a | 5b | 5c | Total |
|---|---|---|---|---|---|---|---|---|
| Anatinae | 38 | 1 | | | 5 | 5 | | 49 |
| Aythyinae | 1,674 | 51 | 10 | | 344 | 283 | 26 | 2,388 |
| Merginae | 33 | 1 | | | 1 | 2 | | 37 |
| Coot | 141 | 7 | 2 | | 51 | 20 | 4 | 225 |
| Grebes | 24 | 1 | | | 7 | 10 | 1 | 43 |
| Miscellaneous -- Banded | 3 | | | | | | | 3 |
| | 1,913 | 61 | 12 | | 408 | 320 | 31 | 2,745 |

Appendix D

MINNESOTA DEPARTMENT OF CONSERVATION

DIVISION OF GAME AND FISH

SECTION OF RESEARCH AND PLANNING

Bottom Fauna Data

Mississippi River, Lock and Dam No. 3 to below Lake Pepin

Location of Stations 1/

Station 1 - Located in the channel south of Island No. 2[illegible] (Diamond Island) at approximately mile 79[illegible] and approximately 4 miles upstream from Red Wing, Minnesota.

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1/ River miles, island numbers and names of backwater areas are taken from Charts No. 50, 51 and 52 of Navigation Charts, Middle and Upper Mississippi River. Cairo, Illinois to Minneapolis, Minnesota, Corps of Engineers, U. S. Army, January, 1956.

Station 2 - Located in a back channel at the outlet of Lower Lake at approximately mile 787 3/4 and approximately 0.6 mile north of the main channel; approximately 3 miles below Red Wing, Minnesota.

Station 3 - Located in Goose Bay at approximately mile 788 1/2 and approximately 1.3 miles north of the main channel; approximately 2 1/2 miles below Red Wing, Minnesota.

Station 4 - Located off the upstream end of the island at the entrance of the Mississippi River into Lake Pepin at approximately mile 785 1/2.

Station 5 - Located in Lake Pepin off Minnesota Highway Department Roadside Park approximately at mile 776.

Station 6 - Located in a bay (Steamboat Bay) approximately 0.5 mile north of the main channel at approximately mile 764 1/4 immediately below Lake Pepin.

MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF GAME AND FISH
SECTION OF RESEARCH AND PLANNING

Bottom Fauna Data 1/
Mississippi River, Lock and Dam No. 3 to below
Lake Pepin, 1963

| Organisms | Number of Organisms per Square Yard 2/ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Station | 1 | | 2 | | 3 | | 4 | | 5 | 6 |
| Date Collected | 7/22 | 9/10 | 7/18 | 9/11 | 7/22 | 9/11 | 7/23 | 9/10 | 9/9 | 9/9 |
| Dredge Hauls | 16 | 16 | 16 | 16 | 16 | 8 | 8 | 8 | 10 | 8 |
| Ephemeroptera (mayflies) | | | | | | | | | | |
| Hexagenia naiads | 2 | - | - | - | - | - | - | 5 | - | 5 |
| Caeninae naiads | 7 | - | 7 | - | 9 | - | 54 | 5 | - | 77 |
| Tricoptera (stoneflies) | | | | | | | | | | |
| Leptoceridae larvae | 20 | - | 5 | 2 | - | - | 14 | - | - | - |
| Psychomyiidae larvae | - | - | 18 | 2 | - | - | 9 | - | - | - |
| Diptera (two-winged flies) | | | | | | | | | | |
| Chironomidae larvae | 1112 | 182 | 329 | 68 | 1620 | 126 | 662 | 104 | 32 | 572 |
| Chironomidae pupae | 14 | 2 | 11 | - | 16 | - | 59 | 5 | 7 | 7 |
| Cerotopogonidae larvae | - | - | 2 | 2 | 140 | 167 | - | - | - | 5 |
| Chaoborus larvae | 11 | 5 | 2 | 2 | 180 | 23 | 9 | - | - | - |
| Unidentified sp. | - | - | 2 | - | 11 | - | - | - | - | 5 |
| Coleoptera (beetles) | | | | | | | | | | |
| Elmidae larvae | 2 | 38 | - | - | 2 | - | - | - | - | 5 |
| Crustacea | | | | | | | | | | |
| Hyalella sp. | - | 5 | - | 2 | - | - | - | - | 104 | - |
| Oligochaeta (aquatic earthworms) | 1847 | 290 | 1235 | 1051 | 122 | 266 | 41 | 2129 | 22 | 441 |
| Hirudinea (leeches) | - | - | 7 | - | - | - | - | - | - | 18 |
| Mollusca (clams and snails) | | | | | | | | | | |
| Sphaeridae | 20 | - | 2 | 2 | - | - | . | 5 | - | - |

1/ Field and laboratory work by the Fish and Wildlife Surveys Unit, Section of Research and Planning.
2/ Based on eight to sixteen samples collected with a 6-inch x 6-inch Ekman dredge.

MR. SMITH: Are there any other State Departments represented here that would like to make a statement?

(No response.)

MR. SMITH: If not, we will go to other official agencies.

The first one we would like to call on would be the Twin City Metropolitan Planning Commission. They have indicated that a statement would be made.

DR. HARGRAVES: Have you a copy of it?

MR. SMITH: I don't recall having received a copy of the statement. They were here yesterday.

MR. WILSON: Mr. Edmund, the former chairman, was here this morning. Of course, I don't think he represents them now.

MR. SMITH: The next would be the Lower Minnesota Watershed District.

Is Mr. Westerberg present?

(No response.)

MR. SMITH: I have one copy of material which was left. This is the statement of Kenneth W. Westerberg, Secretary, Lower Minnesota River Watershed District, Savage, Minnesota.

DR. HARGRAVES: How many pages is it?

MR. SMITH: Two pages.

DR. HARGRAVES: I will read it:

STATEMENT OF KENNETH W. WESTERBERG, SECRETARY, LOWER MINNESOTA RIVER WATERSHED DISTRICT, SAVAGE, MINNESOTA, PRESENTED BY DR. HARGRAVES

DR. HARGRAVES: "Gentlemen:

"My name is Kenneth W. Westerberg. I am the Secretary of the Lower Minnesota River Watershed District, a political subdivision organized and existing under the laws of the State of Minnesota. Watershed districts created pursuant to Minnesota law are special use districts empowered to manage and regulate water use within their boundaries. The Lower Minnesota River Watershed District includes the lands abutting on the Minnesota River from its junction with the Mississippi River to a point upstream just above the City of Chaska, Minnesota. The District includes parts of the Counties of Ramsey, Scott, Dakota, Hennepin and Carver Counties. Watershed districts may be established for any or all of the following conservation purposes:

"1. Control or alleviation of damage by flood "waters;

"2. Improvement of stream channels for drainage, navigation, and any other public purpose;

"3. Reclaiming or filling wet and overflowed lands;

"4. Providing water supply for irrigation;

"5. Regulating the flow of streams and conserving the waters thereof;

"6. Diverting or changing watercourses in whole or in part;

"7. Providing for sanitation and public health and regulating the use of streams, ditches, or watercourses for the purpose of disposing of waste;

"9. Repair, improve, relocate, modify, consolidate, and abandon, in whole or in part, drainage systems within a watershed district.

"10. Imposition of preventive or remedial measures for the control or alleviation of land and soil erosion and siltation of watercourses or bodies of water affected thereby;

"11. Regulating improvements by riparian landowners of the beds, banks, and shores of lakes, streams, and marshes by permit or otherwise in order to preserve the same for beneficial use."

I don't know that anybody argues with the soil conservation program. I don't know whether this needs to be completed or not. If it could be accepted?

MR. STEIN: We would be delighted to accept it, without objection.

DR. HARGRAVES: What about Wisconsin?

MR. WISNIEWSKI: All right.

MR. STEIN: As if read.

DR. HARGRAVES: I might say it looks as though it goes on and discusses their powers, and says the watershed district is carrying out the purposes for which it was established. I will at least save my voice a bit.

(The rest of the prepared statement of Mr. Westerberg is as follows:

A principal purpose of the Lower Minnesota River Watershed District involves improvement of the river channel for navigation purposes. The Board of Managers is presently engaged in a cooperative project with the United States Corps of Army Engineers for the dredging and improvement of the Minnesota River Channel from its junction with the Mississippi River to Mile 14.7, which is just above the City of Savage, Minnesota. While the principal project under way involves deepening of the river channel for navigation purposes, the Board of Managers is concerned with improving and maintaining water quality which will allow for recreational and other uses in the stream. The Board of Managers has the power to make surveys and utilize other surveys and data to develop projects to accomplish the purposes for which the District is organized. The District is empowered to cooperate and contract with the State of Minnesota or subdivisions thereof, or Federal agencies in carrying out projects authorized by the Watershed Act.

The District has recently directed its engineer to inventory water resources within the District, particularly the extent to which groundwater is discharging into the Minnesota River Valley and the extent, if any, of recharge of the groundwater from the surface waters of the Minnesota River. A general inventory of the types of water users in the District will also be made by the engineer. Within the boundaries of the District are many public lakes that are located off of the main channel of the River which are desirable habitat presently for various forms of wildlife. Fluctuations of the water levels of these areas and methods of protecting the habitat of wildlife species using these areas will be studied by the District engineer.

The Watershed District, in carrying out the purposes for which it was established, is undertaking this inventory of water needs and uses within its area, and requests that it be kept advised concerning the results of the survey of pollution of the Mississippi River being carried out by the United States Public Health Service.)

* * *

MR. SMITH: I would like to call next on the Metropolitan Mosquito Control District representative.

STATEMENT OF A. W. BUZICKY, DIRECTOR,

METROPOLITAN MOSQUITO CONTROL DISTRICT

MR. BUZICKY: I am A. W. Buzicky, representing the Metropolitan Mosquito Control Commission, and I am Director.

The Commission does not have any comments to make and to insert into the record as of this time.

MR. STEIN: Thank you.

MR. SMITH: Next would be the Chairman of the Water Pollution Control Advisory Committee, Mr. Tischler.

STATEMENT OF JOHN F. TISCHLER, CHAIRMAN, MINNESOTA WATER POLLUTION CONTROL ADVISORY COMMITTEE

MR. TISCHLER: Chairman Stein, conferees:

I am John F. Tischler, Chairman of the Minnesota Water Pollution Control Advisory Committee.

Our 16-member committee was appointed by the Governor under the provisions of Chapter 20, Minnesota Statutes, 1961.

I think I probably have the shortest statement on record here. We are an advisory committee. No one has to take our advice. We act as a sort of prod on the Minnesota Water Pollution Commission, not because we don't believe the individual members are sincere, not because we believe the Commission as a whole is not doing everything it can do with the facilities it has on hand, but, rather, to give them a little someone to pass the buck to.

We put the heat on them; they put the heat on the industries and the municipalities, and if they kick back, they can say, "Well, the Advisory Committee is after us."

We believe that the Mississippi River from the outlet of the Minneapolis-St. Paul Sewage Plant to Hastings, Minnesota, is polluted to a point where it endangers fish and wildlife, and is a menace to health and the recreational and esthetic values of the river.

We urge that there be but a single standard of purity for the waters of the Mississippi.

We urge that the same standard of pollution abatement be insisted upon for all parts of the Mississippi River as are sought in other sections of the State of Minnesota.

We suggest that the Minneapolis-St. Paul Sanitary District disposal plant be so improved and enlarged so that it may put into effect much more efficient treatment facilities, which will meet the future needs for the protection of health, recreation and industrial growth of the area.

Mr. Chairman, I am also Secretary of the Minnesota Conservation Federation, an affiliate of the National Wildlife Federation, and we were invited here to make a statement as well.

MR. STEIN: That would be fine.

MR. TISCHLER: The Minnesota Conservation Federation, an affiliate of the National Wildlife Federation, is made up of 160 sportsmen's and conservation clubs throughout the State, with a membership in excess of 25,000.

We took a leading part in securing passage of the Munger Water Pollution Act in 1961, and the Rosenmeier Pollution Bill in 1963, as well as the Ashbach Bill.

We are aware of the heavy pollutional load in the Mississippi River between the Minneapolis-St. Paul sewage treatment plant and Hastings, and we urge the up-grading of that sewage treatment plant to maintain standards as high as those in other parts of the State.

There is one thing which hasn't been touched upon in this conference, which is talked about throughout the State, and that is making draw-downs of the headwater lakes of the Mississippi River System to act as a dilutant for the pollution load in the Mississippi, and also to provide water for industrial cooling purposes in the Twin City area.

The Minnesota Conservation Federation is opposed to any draw-downs of those headwater lakes.

Thank you.

MR. STEIN: Thank you, sir.

I might point out here that the Congress has spoken on that, and the Federal law is specific on that.

I think Colonel Harding, when he was here, may have mentioned that. In the Federal Water Pollution Control

Act Amendments of 1961, it was provided that storage capacity could be made available in Federal impoundments or reservoirs for water pollution control purposes.

However, this could not -- and, I repeat, could not -- and cannot be used as a substitute for adequate treatment at the source.

In the administration of that Act, it has been decided that this, at least, means secondary treatment at the source. So no water will be made available from Uncle Sam, I don't think, until this is done.

There are certain situations, though, and this is why the Act was passed, where even providing the best reasonable treatment, there may be periods where dilution water is necessary, because in some streams where you get something drying up or a very low spot and the stream dries up and gets various puddles or pools, you may wipe out the aquatic life, and even if the water comes back it will take you another year before you can get that back to normal again. Sometimes it will take longer.

Sometimes this cycle repeats itself over and over again, so you always have a depleted stream.

If, during these low streams, you can maintain a reasonable minimum condition so that when more water comes in the ecology of the stream won't be too badly disrupted, we may have achieved something.

MR. TISCHLER: Our position was that we were opposed to draw-downs in lieu of proper treatment facilities.

MR. STEIN: Thank you.

MR. WILSON: Mr. Chairman, might I ask Mr. Tischler to stay just a minute, because I want to ask him a question or two?

MR. STEIN: Surely.

MR. WILSON: But before I do that, I would like to comment on this particular point of the Mississippi River draw-downs, which have long been a subject of controversy in this State.

At the hearings that were held by the Commission in the summer of 1962, on the adoption of the Mississippi River standards that Dr. Hargraves told about, the Corps of Engineers presented a statement.

Colonel Harding and two of his engineers are here present, and if they have anything to add to what I am about to say, I think that it would be appropriate to hear them at this time.

Those big reservoirs at the headwaters of the Mississippi were created by Act of Congress many years ago in aid of navigation, so that in the days before the 9-foot channel dam was constructed, water could be let down to raise the water level for navigation and watering purposes

J. F. Tischler

at and below the Twin Cities.

In those days, the principal navigation was the towing of logs and lumber, and before that, of course, there had been some passenger traffic; but the need for that use of the river was very largely diminished when the 9-foot channel dam system was constructed.

Since then, under Acts of Congress, the Secretary of Defense -- I believe it used to be the War Department -- has a certain measure of discretion to use that water for other public purposes, but the Corps of Engineers, representing the Secretary, has recognized that there is a very marked controversy between conflicting interests in Minnesota, namely, the interests that are represented by the conservation organizations that Mr. Tischler is spokesman for, and all the resort groups and property owners living around those big lakes, and the downstream people around the Twin Cities who want more of that water for water supply, sewage dilution, and what not.

Now, as I recall the position of the Corps of Engineers, it was that they were not going to attempt to make any decision between those conflicting interests in Minnesota, and that probably the ultimate decision as to which of those interests should be recognized in the use of this water would be up to the Minnesota Legislature.

That is still an open question.

Now, if Colonel Harding or any of his assistants would like to make a comment on that, I suggest that they be given an opportunity to.

However, I just want to add, before we keep Mr. Tischler standing there any more -- I just want to ask him this:

Calling his attention to the fact that the Commission for some time past, in view of the fact that the terms of the original members of your Advisory Committee had expired, was trying to have vacancies filled and trying to have your Advisory Committee have an official meeting. I just wanted to ask you if that has been done yet. Has the Governor filled the vacancies, or have you had an official meeting lately, or what?

By what group was this statement that you presented here this morning, framed?

MR. TISCHLER: We had an official meeting last Friday. The terms have not been filled, the expired terms, and I might add we sought the legislative appropriation to cover expenses of our group in the last session, and we didn't get that either.

MR. WILSON: The money has been provided lately, though, has it not?

MR. TISCHLER: Not as far as I know. Meeting expense is provided by your Commission out of your contingent fund.

MR. WILSON: Then, as we understood it, this statement that you have presented is the consensus of the original Committee?

MR. TISCHLER: At a meeting held last Friday, yes.

MR. WILSON: Thank you.

MR. STEIN: Do you have any questions?

MR. WISNIEWSKI: Mr. Tischler, are all the head-water lakes that you referred to in your statement the same bodies of water that Mr. Wilson has referred to as regulating reservoirs on this river?

MR. TISCHLER: Yes.

MR. WISNIEWSKI: Thank you.

MR. TISCHLER: There is one -- I hate to run on like this. There has been one factor in regard to these headwater lakes. When these dams were established, and so on, we had a large number of potholes and marshes and sloughs, small lakes along the course of the river which, through the year, acted as feeders to the volume of water going down the Mississippi.

Many of those lakes -- many of them were

Government subsidy -- have since been drained. Our reservoirs are lost, so now we are depending practically upon the headwaters to provide a flow of water to the river.

MR. STEIN: Thank you, sir.

DR. HARGRAVES: I would like to make one further comment, and then we will call on the next person.

The State of Minnesota Water Pollution Control Commission adopted a definite statement of policy on December 21, 1962, and it is referred to in the back of my statement this morning. It wasn't read. It relates to the fact that the Commission believes that flow augmentation should not be used at any time as a substitute for operation of sewage or industrial waste treatment works at maximum capacity, or for any other method of controlling waste at the source, and so on; so we are on record, and this is referred to in our report.

MR. STEIN: Thank you.

Colonel Harding, do you want to add anything or not?

COLONEL HARDING: I would like to make one brief comment.

I did mention during my presentation yesterday that we are conducting a study on the operation of the headwater reservoirs. This was partially initiated as a result of certain resolutions passed by the Minnesota State Legislature a few years ago, indicating that they felt the States should have a greater role in the operation of these reservoirs than they have at present.

As a result, we have been working on this study for two or three years. It is scheduled to be completed during the first fiscal year of 1965. One of the objectives of the study is to determine whether the mode of operation of the reservoirs, as presently prescribed by the Secretary of the Army, is to be changed.

In working up this study, we have taken the operating data under our operations plan, and we have taken the State's suggested operations plan. We have fed this in the machine down in Omaha, and we, at the present time, have received these results and are in the process of analyzing them.

However, as has been pointed out, we have many onflicting interests. We have the people up in the lakes who want the water to remain level. We have the people in the Twin Cities area who recognize that they are going to have increased water supply requirements. We have our pollution control requirements which have been emphasized in this meeting, so that to come up with an answer that is going to satisfy all these divergent interests, I think it is apparent to everybody, is most difficult, but we are working on it.

MR. STEIN: Thank you, Colonel.

Thank you, Mr. Tischler.

Mr. Smith?

MR. SMITH: The next group we have are the municipal or community sewage sources, and we start with the upper end of the Mississippi River under consideration by this conference, and the first municipality would be Anoka.

Is there anyone here representing Anoka?

If not, I would like Mr. Thimsen to read a paragraph into the record describing the treatment facilities which are in operation.

STATEMENT OF DONALD J. THIMSEN, MINNESOTA DEPARTMENT OF HEALTH, SECTION ON WATER POLLUTION

MR. THIMSEN: The Anoka sewage treatment plant was constructed in 1956 and is a secondary plant consisting of a grit chamber, primary settling tank, high rate trickling filters, final settling tanks, chlorination contact tank, and separate sludge digestion tanks. The sewage treatment plant is designed to treat sewage and waste flowing at the rate of 1.44 mgd with a 5-day BOD of 300 mg/1 to produce an effluent BOD of approximately 75 mg/1.

DR. HARGRAVES: I might say for the sake of the group and for the recorder, that you have all of these, and Mr. Thimsen can show you where he is reading from; but we are going to call on him for many of these, so that we are on record as to what our communities are doing.

MR. SMITH: The next one in order would be the North Suburban Sanitary Sewer District, and they have a statement to make.

MR. TAUTGES: We have a paper and we also have a statement in addition, which we would like to put into the record as if it were read in.

MR. STEIN: Without objection, that will be done.

STATEMENT OF TOM TAUTGES, VICE-CHAIRMAN OF THE BOARD OF TRUSTEES OF THE NORTH SUBURBAN SANITARY SEWER DISTRICT

MR. TAUTGES: My name is Tom Tautges and I am a member of the Spring Lake Park Village Council. I am also Vice-Chairman of the Board of Trustees of the North Suburban Sanitary Sewer District, a district comprising some 50,000 acres of land and representing 71,000 residents.

I have been instructed by the Board to submit a position paper. Accordingly, I will keep my remarks brief and, to sum up the position of the Board of Trustees, I welcome our out-of-State conferees and the representatives of the Department of Health, Education, and Welfare.

We welcome especially the opportunities for fresh and uncommitted points of view.

More than anything else we ask for objectivity because we know the conferees appointed by the Minnesota Water Pollution Control Commission are committed in advance to the proposition that all of the sewage in the metropolitan area be collected and transported at great expense to a single treatment plant, thereby abandoning the Hastings Pool for purposes other than sewage disposal and resulting in an unacceptable level of downstream pollution.

In a report of the staff of the Minneapolis-St. Paul Sanitary District, which is a major source of pollution in this area, they set forth the following goals:

1. "Protection of water supplies and reduction of health hazards to a minimum.

2. Elimination of nuisance conditions resulting from inadequate sewage disposal.

3. Restoration and preservation, to the greatest extent practicable, of the recreational use of watercourses."

We support these objectives. However, during the past two years the Minnesota Water Pollution Control Commission has missed a golden opportunity to achieve these goals. They missed it by setting their sights too low when they established standards for the Hastings Pool. Under these standards, no fish propagation can take place in the Hastings Pool and recreational activities in that portion of the river are generally discouraged. The Hastings Pool represents Zone 3 in the classification and standards adopted by the Commission.

As we understand the purpose of this conference, it is to improve river water conditions from those we now have and from those we can foresee on the basis of these recently adopted standards.

Several factors enter into the consideration of the water pollution control program for any metropolitan area. This one has its own peculiar conditions.

First of all, the Mississippi River and its tributaries within this metropolitan area represent the water courses available for assimilating liquid wastes from this area. The total flow of water available for this purpose can be small because of our location near the headwaters of these rivers. For this reason any consideration of the pollution problem in the Hastings Pool and the waters downstream must take into account upriver sewage disposal practices that would affect both the volume of wastes dischanged to the Hastings Pool and the quality of the river water entering the pool.

Since there is a limited amount of water flowing through this metropolitan area, we must use it wisely. It is common practice in other metropolitan areas to divide the sewage flow so as to introduce treated effluent at various points in the water course. In this manner they take advantage of the maximum assimilative capacity of the waters.

This logical use is exactly the position of the North Suburban Sanitary Sewer District. Scientific studies have proven it is impossible to maintain what have been considered adequate river conditions during low river flows by discharging all of the treated waste effluent into the same zone of the Mississippi River, if conventional methods of sewage disposal are to be employed.

We are nevertheless convinced that the volume and flow of the rivers is adequate to properly assimilate the treated wastes from the greater metropolitan area, if our State Water Pollution Control Commission would insist upon uniformly high degrees of sewage treatment and if the treated wastes are divided and enter the rivers at various points. This accomplishes the purpose of reducing the enormous volume of waste projected to be introduced only to the Hastings Pool when it is known that the pool is unable to assimilate such a pollutional load.

The present policy of the Minnesota Water Pollution Control Commission provides for concentration of the entire pollutional load into one portion of the Mississippi River. This imposes unacceptable water condition on our neighbors downstream both in Wisconsin and Minnesota.

We plead with the Public Health Service and their scientists to give us the background and data from which acceptable water quality standards can be developed. This will permit planning for sewage works construction that will result in safe, rational, and economical sewage disposal for our district and for any other region of this greater metropolitan area.

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STATEMENT OF THE NORTH SUBURBAN SANITARY SEWER DISTRICT TO BE PRESENTED AT THE CONFERENCE ON WATER POLLUTION CONTROL

PRESENT STANDARDS

In a staff report to the Board of Trustees of the Minneapolis-St. Paul Sanitary District dated January 22, 1962, the staff of that District stated that:

"The principal objectives which must be achieved in providing an adequate solution to the sewage problem in the metropolitan area may be stated as follows:

1. Protection of water supplies and reduction of health hazards to a minimum.

2. Elimination of nuisance conditions resulting from inadequate sewage disposal.

3. Restoration and preservation, to the greatest extent practicable, of the recreational use of watercourses."

The Board of Trustees of the North Suburban Sanitary Sewer District supports these objectives. An analysis of the river standards endorsed by this same staff and enacted by the State Water Pollution Control Commission, however, will reveal a question of intent to limit the application of these objectives to the waters passing through but not downstream from the Twin Cities. To such limited application we object strongly.

In 1962 the State Water Pollution Control Commission held a series of hearings relative to the adoption of river standards from the Rum River to the Hastings dam. Three sets of standards were adopted for three separate segments or zones of the river. The standards applying to the three zones differed from zone to zone, primarily from the standpoint of dissolved oxygen content to be maintained in the river water; with a minimum of 4.0 parts per million dissolved oxygen required in the stretch above St. Anthony Falls (Zone I) under the same river flow condition which would have permitted dissolved oxygen depletion in the stretch influenced by wastes from the Twin Cities sewage treatment facilities at Pig's Eye (Zone III). Another set of river flow conditions demanding 5.0 parts per million dissolved oxygen above St. Anthony Falls (Zone I) required only approximately 2.0 parts per million dissolved oxygen downstream from Pig's Eye (Zone III).

The standards further provided that whether or not the dissolved oxygen standards and other water quality conditions could be met, no new sewage treatment plant effluent, regardless of degree of treatment can be discharged to the Mississippi River or its tributaries between the mouth of the Rum River and the Pig's Eye facility (Zones I and II). The standards provide no machinery to eliminate the more than 60 raw sewage overflows from the Minneapolis and St. Paul sewer system in that same stretch of river. Nor does adequate machinery now exist in the Minnesota Department of Health to police the utilization of the Minneapolis and St. Paul sewer systems to prevent an increase of raw sewage discharge from those overflow points as a result of continual over-utilization and overselling of nonexisting "excess capacity" in those sewer systems.

These standards were adopted by the State Water Pollution Control Commission in 1963. It is the position of the Board of Trustees of the North Suburban Sanitary Sewer District that the standards now in effect impose unreasonable restrictions upon the use of the Mississippi

River passing through the Twin Cities while neglecting an opportunity to upgrade river conditions below the Pig's Eye plant. The standards applicable to the portion of the river downstream from the Pig's Eye plant are no higher and in the cases of at least two provisions they are lower than the standards in effect, but not legally adopted prior to 1963.

It is the position of this Board that the river standards should be high throughout the area. The fact that the Pig's Eye plant is within and not downstream from the Twin Cities Metropolitan Area is a fundamental factor in support of uniform standards throughout most of the stretch of the river in question.

In order to fully examine the implications of the standards in question, it is necessary to examine first the river characteristics and the existing or committed uses of the river. Secondly, it is necessary to examine the effects of river quality standards upon the costs of construction and operation of sewerage facilities.

## RIVER CHARACTERISTICS AND RIVER WATER USES

Zone I of the Mississippi River, as described in the standards adopted in 1963, extends from the mouth of the Rum River to St. Anthony Falls. Although the water stored behind the St. Anthony Falls dam would submerge the inlet gallery of the Minneapolis water treatment plant at any flow condition in the river, hydraulic engineering studies show that confinement of the river within a narrow channel and the curvature of the alignment of the river prevent recirculation of the water within the portion of the river influenced by that dam.

The Minneapolis water intake is the only water intake of concern from the standpoint of the discharge of effluent from proposed sewage treatment facilities into waters of this zone.

The areas bordering the river upstream are within the boundaries of incorporated municipalities outside the corporate boundaries of Minneapolis. These areas are primarily residential in nature. The area bordering the river directly across the river from the Minneapolis water intake and the areas on both sides of the river between the water intake and the south boundary of Zone I are industrial in nature.

Prior to the adoption of the standards, the Federal Government had, in fact, expended approximately $35,000,000 to construct locks through the St. Anthony Falls structures and to develop a navigation channel for industrial barge traffic to serve river front industrial sites within Zone I up to a point approximately one mile downstream from the Minneapolis water intake.

All of Zone I has been classified for public water supply purposes. The area upstream from the Minneapolis water intake is committed to development which is compatible with such classification. However, the portion of Zone I lying within the confines of the afore-described Upper Harbor Navigation Improvement Project is committed by present usage and by expenditure of public funds to development which is not compatible with such classification.

To this extent it is the conviction of this Board that the State Water Pollution Control Commission has improperly classified the portion of Zone I downstream from the Minneapolis water intake, and specifically that portion located within the Upper Harbor Improvement, and that the standards associated with that classification are not consistent with the proper classification of those waters.

An examination of the standards themselves as they apply to Zone I will show further inconsistencies.

Section 3 (g) provides that "The discharge of treated sewage effluent, industrial waste, or other wastes shall be restricted so that at any water supply intake the maximum limits for chemicals in the waters shall be such that after Class IV treatment has been provided as specified in Section 2 (Public Health Bulletin No. 296), the concentrations recommended in the U. S. Public Health Service Drinking Water Standards, 1962, will not be exceeded in the drinking water.---"

This is an entirely realistic water quality standard which would appear to reflect the proper nature of water quality standards when viewed with the knowledge of the resources immediately available to this specific standard-setting agency.

Conflicting with that provision, however, is Section 3(b), which provides that "no treated sewage effluent shall be discharged into the waters from any source originating after the taking effect hereof, including, without limitation, discharges from watercraft."

Section 3(b) is not a water quality standard at all, but is a river use prohibition. This provision is an engineering decision without the benefit of hydraulic engineering study. The effect of this arbitrary decision is that regardless of any other factors which would ordinarily apply to such a situation, the provisions set forth in the remainder of Section 3 cannot be met if treated sewage effluent is discharged to any portion of Zone I. The test as to whether or not any constituent of that effluent can reach a water supply intake in concentrations exceeding the limits set forth in Section 3 (g) is, by that so-called "standard," entirely foreclosed; yet this is the test to which any proposal for discharging sewage effluent to those waters should be subjected.

A further inconsistency in the entire set of standards is the variation in dissolved oxygen levels to be maintained in the various zones of the river under specific river flow conditions. The 5.0 part-per-million dissolved oxygen content established for Zone I cannot be justified from the standpoint of the classification assigned to that zone. At the same time, the dissolved oxygen levels assigned to the Zone III standards are not appreciably higher than those which have been in effect on a somewhat informal basis for approximately thirty years. Those low dissolved oxygen levels which will actually permit oxygen depletion under low instantaneous flow conditions amount to abandonment of that zone for many recognized river uses.

In view of the extensive open water areas of Zone III that are readily accessible for recreational purposes as compared to the relatively confined and inaccessible water areas in both Zones I and II, the standards now applicable throughout the classified section of the river are inconsistent with the best recreational utilization of the river.

ECONOMIC CONSIDERATIONS

Finally, in consideration of the purposes of river classification and standards is the question of the impact of economic factors of sewage treatment and disposal.

In 1960 the Minneapolis-St. Paul Sanitary District published a report covering a five-year study of the expansion of sewage works in the Minneapolis-St. Paul Metropolitan Area. Among the proposed solutions to the sewage problem, the report described regional sewage treatment facilities as providing a satisfactory and reasonable solution to the problem. The report suggested further that the disadvantages to such regional facilities involved emotional objections to plant sites.

Engineering studies conducted by the North Suburban Sanitary Sewer District show significant cost savings associated with a regional sewage treatment plant for this District. Those studies show that such a regional facility can produce an effluent of satisfactory quality to conform to all of the scientific and technical provisions of the present standards, except the provision that prohibits such a facility.

Of the several engineering plans offered in the report, the staff of the Minneapolis-St. Paul Sanitary District and the Executive Officer of the Minnesota Department of Health promoted the plant which involved the discharge of all of the treated sewage effluent from this metropolitan area into what later became designated as Zone III of the Mississippi River.

Two factors were utilized in an unsuccessful attempt to support this plan from the standpoint of overall economics. One factor involved the anticipation of a set of river standards that would permit a relatively low level of sewage treatment in sewage treatment plants discharging to Zone III and at the same time would require a very high level of treatment at upstream plants and thus reflect an economic imbalance in favor of centralization of treatment.

Although such river standards did, in fact, evolve from the State Water Pollution Control Commission, the testimony presented during the hearings of those proposed standards left little question that such differential standards would still result in an economic imbalance in favor of a regional sewage treatment facility upriver. The incorporation of the provision prohibiting the discharge of treated sewage effluent into Zone I shows clearly that a preferred engineering solution, rather than the need for maintenance of satisfactory river water quality and economic considerations, motivated the State Water Pollution Control Commission in the establishment of these so-called "standards."

The other factor involved design on the basis of population projections and land-use data that were collected before local planning had progressed sufficiently to make such data reasonably valid. Again those data were unsuccessfully utilized to influence an economic imbalance in favor of centralization of treatment. The population projections made prior to 1960 were undermined by the 1960 Census data. The land-use projections have been invalidated to a very significant degree by local development which has taken place since the collection of the data utilized in the study. In this case the data were, without question, collected and utilized in good faith by the persons who prepared the report. The promoters of centralized treatment, however, continued to treat cost comparisons based upon these data as if their validity could not be questioned.

Also missing from the report covering the five-year study is the reflection of the advances made in sewage treatment technology in the past nine years, as those advances would affect construction and operation costs of new sewage treatment facilities. Thorough consideration of this, in addition to the two above factors, will show overwhelming economic advantages in favor of the approach involving regional sewage treatment facilities.

It follows then that the so-called "standards," which are intended to be river water quality standards, have been developed to dictate a specific engineering plan for sewage disposal for this metropolitan area. This was done even though the foundation for that plan has been severely undermined by development of the area since the original design criteria were collected and presented.

At this time there is no valid support for past statements by the staff of the Minneapolis-St. Paul Sanitary District or the City of Minneapolis, with reference to the comparison of costs between sewerage systems involving regional, as opposed to central (Pig's Eye), treatment facilities. The only study which has been used by those persons in the past for such a comparison has been invalidated by development of the area and by improvements in sewage treatment technology and the costs-of-treatment estimates were based upon anticipated river water quality standards, which, though now a reality, are being tested in the courts by this District and are sufficiently controversial to be a subject of this conference.

When the promoters of sewage treatment centralization finally concluded that such centralization could not be supported by objective and thorough economic study, they were successful in prevailing upon the Minnesota State Water Pollution Control Commission to use the river standards to prohibit any other approach.

## SUMMARY

The Board does not object to standards which will insure a high level of purity for waters that can enter the intake structures of water treatment facilities.

The portion of Zone I upstream from the head of the Upper Harbor navigation improvement is properly classified for those purposes, although the significance of a 5.0 part-per-million minimum dissolved oxygen level for waters so classified is not entirely clear. The projects of the North Suburban Sanitary Sewer District are designed to preserve the conditions which permit this classification.

The waters in all zones downstream from the head of the navigation improvement, however, are committed to similar uses, and these waters should all be included in the same classification. Standards applicable to those waters should be uniform.

The level at which those standards are established should depend to a considerable extent upon the level of water quality the Cities of Minneapolis and St. Paul, as represented by the Minneapolis-St. Paul Sanitary District, can be encouraged to maintain in the Mississippi River through those downstream metropolitan area communities contiguous to the Hastings Pool.

Until the political leaders of Minneapolis and St. Paul are convinced that they have no right to expect river conditions within their cities which differ in any way from the conditions they are willing to produce in the river passing through their downstream neighboring metropolitan area communities, the metropolitan sewage problem will remain a controversy.

The Pig's Eye Sewage Treatment Plant is within the Twin Cities Metropolitan Area, and the property bordering the portion of the Mississippi River that is influenced most by the effluent from that plant is also within this metropolitan area.

The concentration of the sewage load from the entire metropolitan area in the Hastings Pool serves no other purpose than to condemn the waters of that pool to a pollution load that those waters cannot adequately assimilate. The distribution of that pollutional load to take advantage of the assimilative capacity of the river within the metropolitan area, which is now either unused o. used to assimilate raw sewage discharges, will permit uniformly better river conditions throughout the metropolitan area, provided that a high degree of treatment is required at all sewage treatment facilities and provided that steps are taken to eliminate the raw sewage discharges.

If river water quality standards and treated sewage effluent standards are established to reflect a desired river water quality, rather than a desired engineering plan, water pollution control agencies will have fulfilled their responsibility and the basis for a solution to this sewage problem will then be available.

Thank you.

MR. STEIN: Are there any comments or questions from Wisconsin?

(No response.)

MR. STEIN: Minnesota?

MR. WILSON: Mr. Chairman, I do not think that this is an appropriate time to take the time of this gathering with any arguments about the merits or demerits of the proposals in this statement.

I simply wish to call attention to the present legal situation in that behalf.

The North Suburban Sanitary Sewer District first contested the authority of the Commission in a court proceeding, claiming that they were exempt, to a very large degree, by virtue of the terms of their enabling Act from the authority of the Water Pollution Control Commission.

That point was decided against them by the District Court of Ramsey County, and that decision has become final, so that it is now authoritatively determined that the North Suburban Sanitary Sewer District, like all other units of government that have anything to do with pollution control or sewage disposal, is now subject to the authority of the Commission.

There is also pending an appeal to the District Court of Anoka County, taken by the North Suburban Sanitary Sewer District, from the standards applicable to them which have just been described. That appeal has not yet been brought on for hearing.

I might say that in the course of the hearings that were held in 1962 by the Commission, all these points that have just been listed here were reviewed, and evidence was taken thereon, and is incorporated in the record, which will be submitted to the court upon this appeal. The final decision as to the reasonableness of the standards adopted by the Commission will be made by the District Court, and may subsequently be subject to review by the State Supreme

Court.

That is the status of that matter at present. It may be quite some time yet before there will be a final judicial decision that will settle those questions.

MR. TAUTGES: Well, I think that this is all correct, but still the fact remains that we are trying to improve the conditions of the river, and I think that we have come up with a good way of improving the conditions of the river. I think it bears on this conference.

MR. WILSON: On that point, Mr. Chairman, as we have continually emphasized, every standard adopted by the Commission is subject to continuous review.

Whenever conditions change, and whenever evidence is submitted to the Commission that justifies the raising of the standards, it is always the policy of the Commission to set the standards just as high as possible, remembering that in order to withstand court attack, every standard has to be based on evidence, and it must be reasonable.

MR. STEIN: Does the North Suburban Sanitary Sewer District have a treatment plant that you maintain and operate?

MR. TAUTGES: No, sir, we don't. We presently have plans.

MR. STEIN: What happens to your waste now?

MR. TAUTGES: We use septic tanks and drain fields, and we do not have any central collection point for sewage.

MR. WILSON: They have under negotiation, if not consummated, a contract with the City of Minneapolis for the disposal of their sewage through the Twin Cities system. How long that will be effective remains to be seen, but, at any rate, that is the present proposal for disposal of the sewage from this district when they get their sewer system constructed.

MR. STEIN: I think, though, you must admit, Mr. Wilson -- at least to me this is a rather unique position for a polluter or a potential discharger to streams to say that the State regulatory agency's standards are too low and requirements are too low. I haven't heard that very frequently. I must say that.

MR. WILSON: Mr. Chairman, you must bear in mind that these standards were established for three successive zones of the river.

The standard for this upper zone was established as high as it is because of potential danger to the Minneapolis City water supply, which comes from the pool into which the North Suburban Sanitary Sewer District proposes to discharge the effluent from a proposed sewage treatment plant that has not been constructed.

MR. TAUTGES: It hasn't been --

MR. STEIN: Let him finish.

MR. WILSON: May I finish?

If this standard is sustained by the courts, then the North Suburban Sanitary Sewer District will not be able to go ahead with the construction of its sewage treatment plant.

Their proposal is that before too many years, the capacity of their now pending connection which will undoubtedly be made with the present Twin Cities system will be exceeded by population growths. They have projected a population that will run up to 100,000 or more in not too many years in that area, at which time they contemplate that this present arrangement, the capacity of it, will be exceeded, and then their proposal would be to construct a sewage treatment plant.

Now, I think this ought to be pointed out. If at that time, when this condition occurs or is foreseen eight or ten or fifteen years from now, whenever it is seen that the population development of that fast-growing area is in danger of overtaxing the capacity of this sewer connection, the question of reviewing that standard can immediately be brought before the Commission, and the Commission can then make a decision upon the then existing conditions. However, presently, this district is contesting the standards established by the Commission because it would preclude them from constructing their sewage treatment plant to outlet on the St. Anthony Falls Pool, which would be cheaper than the works necessary to make a permanent connection with the Twin Cities system.

Now, no one knows yet what is going to happen to that Twin Cities system until this comprehensive plan required by the Ashbach Bill is submitted to the Commission next fall.

It may be that that will include some proposal for the construction of parallel or enlarged or additional trunk line sewers that will take care of the increased sewage flow from this growing area.

No one knows that yet, but, at any rate, as I pointed out, the question of the reasonableness of these present standards is now in court, and it will depend upon the court proceedings.

MR. STEIN: Did you want to say something, sir?

MR. TAUTGES: There is one comment that I will add: That it is continually brought up that we will be endangering the Minneapolis water supply system, and I think there is no scientific basis that we would be endangering the Minneapolis supply.

We would put our effluent down a mile and a half from the Minneapolis water intake, and, incidentally, into the area of navigation which has been opened up by the opening of the new locks constructed at a cost of $35 million by the Federal Government.

There is no scientific proof that there would be any recirculation in this so-called pool and that we would be endangering the Minneapolis water supply. I think it is purely an emotional thing that has been brought up, and is continually brought up by these sources.

MR. STEIN: This is just for clarification of the record.

You said you were proposing to put your effluent down. I assume you mean downstream from --

MR. TAUTGES: Yes. We were going to build an outfall line from the plant.

MR. STEIN: Which will be a mile and a half below their water intake?

MR. TAUTGES: That is correct.

MR. STEIN: I just wanted to clarify that.

DR. HARGRAVES: And into the pool at St. Anthony.

MR. WILSON: Mr. Chairman, that is on a level slack-water pool.

I don't want to take the time to argue with the representative here about the merits of that proposal. All

I have to say is that under the law, the findings of the Commission on that point are prima facie reasonable and valid, and the argument that the gentleman has just made is one for the attorneys of that district to make to the court.

MR. TAUTGES: Well, since you raised it, I just wanted to give my answer to it.

MR. STEIN: Thank you.

MR. TAUTGES: Are there any more questions?

MR. STEIN: Thank you very much.

MR. TAUTGES: Thank you.

DR. HARGRAVES: I think the Commission has considerable sympathy for this group, and this is also a difference in philosophy as to the use of the stream, as to whether we should put effluent into sections that go through both cities. We are in hopes of cleaning it up as we are the Minnesota River, because of parks and other things that are along there.

Communities do change their opinion as to what is pollution and what is not, I think, depending upon the area that is involved.

We did spend all summer last year on this problem, and probably we now are prejudiced, but I am sure that we will try to give the North Suburban group the best that we can and still consider the rest of the State.

MR. STEIN: Dr. Hargraves, a colloquy like this is most indicative of a healthy program to clean up pollution. It is obvious that both parties here want to do what is best, or what they consider best, in getting clean water.

It is just a question of a difference, and this is one of the areas.

MR. WILSON: That is very true, Mr. Chairman. It is entirely probable, and this is one of the reasons why the Commission is heartily in accord with the effort being made by the Public Health Service to make this study. Although a great deal of time was spent by the Commission's engineers to the extent of the limit of their small staff in studying these conditions of the Mississippi River bearing on this problem, we know that they did not have the means to do all that the Public Health Service can do.

Although I am only attorney for the Commission, I am sure that I can speak for them when I say that they will welcome all the evidence that may be disclosed by the Public Health Service that bears on this issue, and will give it very thorough consideration.

MR. STEIN: All right.

Mr. Smith?

MR. SMITH: Next on our list is the City of

Minneapolis. Is the City Attorney or City Engineer here?

(No response.)

MR. SMITH: I have a printed statement which they left with us. There are ten copies.

MR. STEIN: Do you want this submitted for the record as if read?

MR. SMITH: For the record, certainly.

DR. HARGRAVES: If there is no objection.

MR. MUEGGE: As if read.

MR. STEIN: As if read.

(The statement presented by the City of Minneapolis is as follows:

CITY OF MINNEAPOLIS

Statement for Presentation at Federal and Interstate Conference on Pollution of Mississippi River at St. Paul, Minnesota
February 7, 1964

The Minneapolis City Council at its regular meeting of January 31, 1964, directed "Gordon Bodien and Arvid Falk" to attend the "Conference on Interstate Pollution of the Mississippi River, February 7, 1964, St. Paul," and that they be directed to prepare a statement outlining the general policy of the City of Minneapolis insofar as this problem of pollution is concerned with reference to the Mississippi River as it involves the City.

As the largest city on the Upper Mississippi River Watershed, the City of Minneapolis has long recognized and exercised its responsibility in the control and abatement of water pollution and the protection of the Metropolitan Area's water resources.

In 1933, as the culmination of an extensive investigation of the pollution of the Mississippi River, the City of Minneapolis joined with the City of Saint Paul as the major participants in the Minneapolis-Saint Paul Sanitary District. The accomplishments of the Sanitary District include the engineering and construction of a major system of interceptor sewers and treatment works which set the pattern of downstream pollution abatement and waste treatment practices. Beginning operation in 1938, the Sanitary District's primary sewage treatment plant has established an outstanding record of successful and efficient operation, effecting a significant improvement in the past downstream river conditions and maintaining reasonable levels of water quality.

In response to the surge of growth and development experienced in the Minneapolis-Saint Paul Metropolitan Area in the early 1950's, the Minneapolis-Saint Paul Sanitary District in 1956 embarked upon a costly and extensive study of the sewage works requirements of the metropolitan area. With the preliminary investigation essentially completed in June 1961, the District authorized a major expansion program to the existing Pig's Eye Lake Sewage Treatment Plant. This treatment plant expansion project, which has a total estimated cost of $23,000,000, is now under construction. It includes additional capacity for the growth and development of the two Central Cities as well as the contracted suburban communities which comprise a sewered area nearly double that of Minneapolis-Saint Paul proper. In addition, the new expanded treatment plant includes secondary treatment which will accomplish levels of treatment substantially higher than that presently attained.

Supplementing the program of the Sanitary District, the City of Minneapolis has instituted independent programs which have benefited long-range water pollution control objectives. The City's program of replacing the original combined sewer system with separate storm and sanitary sewers has substantially reduced overflow of untreated sewage to the river during times of rainfall and runoff. Over the years, approximately $14,000,000 has been expended on this storm water separation program. An accelerated program has been scheduled for the future years and these projects are being constructed as rapidly as financial resources permit.

The September 1960 report of the engineering consultants to the Sanitary District (Volume Three, page 12-4) shows that of the 27,710 acres of sewered area in the City of Minneapolis, 15,847 acres (or over 57%) was served by separate sanitary and storm sewers. Work completed since this report was made, together with projects now being built, will add approximately 2,800 acres served by separate sewers, increasing to over 67% the total area having completely separated sewers. The conversion of substantial areas of Minneapolis from a combined system to separate sewers for storm water and sanitary sewerage has made it possible for Minneapolis to convey through its system of trunk sewers and interceptors the sanitary sewage from surrounding suburban communities. At the present time there are twenty-seven suburbs and agencies that use or have made arrangements to use the Minneapolis sewer system.

In the spring of 1962 the State of Minnesota, through its Water Pollution Control Commission and State Board of Health, held formal hearings proposing "classification of the Mississippi River and its tributaries between the Rum River and the St. Croix River and for the establishment of Pollution Standards therefor." The City Council authorized introduction of a statement favoring the proposed classification. Standards proposed for the section between the Rum River and St. Anthony Falls are essential to protect the water supply of Minneapolis, St. Paul and the suburban areas presently being served by the Minneapolis and Saint Paul water plants. The standards proposed for the section between St. Anthony Falls and the Minneapolis-Saint Paul Sanitary District plant "will when adopted and enforced be of great benefit to the residents of the Metropolitan Area." This stand, by the City of Minneapolis, in favor of the classification and regulation of these two sections of the Mississippi River was taken with full knowledge and understanding of the obligations it was assuming.

In summary, the City of Minneapolis believes that its record of past accomplishments, its policy of continuing as rapidly as possible its storm sewer program, its cooperation with the State Legislature, the State Board of Health, and the Water Pollution Control Commission and suburban communities is a commendable one and indicates clearly its determination to improve the quality of the water in the river.

CITY OF MINNEAPOLIS

/s/ By Gordon E. Bodien,
City Engineer

/s/ By Arvid M. Falk
Assistant City Attorney)

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GPO 878-465