

REPORT OF THE INTERIM COMMITTEE  
COMMITTEE APPOINTED UNDER HOUSE  
FILE #1438 OF THE SESSION OF 1925,  
AND SAID COMMITTEE BEING CONTIN-  
UED IN THE 1927 SESSION.

To the members of the Legislature of the Session of 1929:

The undersigned members of the above named committee in accordance with House File No. 1428 of the Legislative session of 1925, and by motion to continue said committee on the 17th day of the 1927 session, hereby submit our report.

GENERAL

After your committee had made its report to the members of the 1927 Legislature, and having been authorized by motion of the House to continue its work for the next two years, they proceeded to exercise its duties, by holding meetings at intervals during said period. The members of the committee made frequent trips to various points along the Mississippi River from the lake region and south as far as Dubuque, Iowa, and further continued its investigation by boat down the Mississippi River, and in addition thereto by working with the United States Public Health Service, through its Sanitary Engineer, H. R. Crohurst, which department was in charge of the general investigation of the pollution of the Mississippi River, and worked in connection with the Health Boards of the States of Minnesota and Wisconsin, and the Cities of Minneapolis and St. Paul, and this report is based upon the investigation of your committee, together with that of the United States Public Health Department and the Health Department of the State of Minnesota.

STATE BOARD OF HEALTH

The opinion of the State Board of Health is as follows:

1. The pollution of the Mississippi River above and immediately below the Twin City lock and dam has reached such a degree that a definite public health hazard exists; and
2. A condition of public nuisance has been created; and
3. Fish life is being seriously depleted.

The Board further concludes that this condition of the river has impaired its use for recreational purposes, has depreciated property values in the residential sections adjacent to the river, and in addition the loss of commercial fishing industry has been serious.

The health board further states that the above condition should be corrected and that to do it, it will be necessary to collect and subject to treatment a very large part of the sewage and industrial waste from the metropolitan area of Minneapolis and St. Paul, as well as that from South St. Paul, Newport and other populated areas adjacent to these cities. And it is the opinion of the Health Board that following the completion of the Hastings Dam, in 1931, the unsanitary conditions now existing during low water stages through the metropolitan area will be greatly aggravated. This dam will create a pool in the river for approximately one mile above Hastings to the Twin City lock and dam, a distance of about thirty miles, and further states, that the section of the Mississippi River from St. Anthony Falls to and below the southerly limits of St. Paul, should receive immediate consideration. The first step should be to abate the local and general nuisance condition along the river fronts of Minneapolis and St. Paul, and to

prevent their re-occurrence. This may be accomplished by conducting the sewage through intercepting sewers to settling tanks for preliminary sedimentation. Such treatment would remove much of the suspended solids and would prevent sludge deposit and scum accumulations.

Unless this is done there will be deposited along the river front in St. Paul during the high water navigation stage a considerable amount of sludge, which will be exposed during the low water stage in winter should the gates at the Hastings dam be opened. Likewise, unless sedimentation for removing the settleable portion of the suspended matter of the sewage is provided, the channels above the Twin City Lock and Dam will be filled with sludge and silt.

#### METROPOLITAN DRAINAGE COMMISSION.

During the session of 1927 your committee made its report of the work done up to that time, covering its investigation for nearly two years. A chemical and bacteriological examination for a period of about six months, showed conditions of the water in the Mississippi River in the summer and fall of 1926 to be in such state of pollution as to be a menace to the health of the inhabitants of the community. The Cities of St. Paul and Minneapolis having taken an active interest in this investigation realizing that the sewage disposal of the two cities has polluted the water to such an extent that it is necessary that something be done in the matter of sewage treatment and building of intercepting sewers and a sewage disposal plant, therefore requested the Legislature to pass a bill authorizing them to expend money for the purpose of making a general survey of the sewerage system in this area and for the purpose of making a study of the subject of sewage treatment and sewage disposal, and the construction of a sewage disposal plant. A bill was introduced in the Legislature which was passed and enacted into law, being known as Chapter 181 of the General Laws of 1927, entitled: "An Act creating the Metropolitan Drainage Commission to study the subject of sewage disposal of any cities of the first class located in the natural water course, which in whole or in part flows through or adjacent to two or more of such cities, and in which sewage from such city or cities is disposed."

This bill gave the Metropolitan Drainage Commission full power to study the subject of sewage disposal and treatment, to make surveys and to collect data relating to the methods which might be used in disposing of such sewage or of treating the same so as to protect such water course from pollution, as well as any other water course or bodies of water lying within the drainage area of which such cities are a part. Such Commission had the power and authority to employ engineers, sanitary experts, and such other skilled or technically trained persons as it deem advisable, had power and authority to employ necessary clerical and office assistants, and to incur such other expenses as may be necessary to carry out its work.

Under the bill the expenses of carrying on the work of the Metropolitan Drainage Commission was prorated between the Cities of St. Paul and Minneapolis.

As your committee was appointed for the purpose of investigating the pollution of the Mississippi River and the interstate waters, and as the Metropolitan Drainage Commission was created for the purpose of making a general survey of the sewerage system of the large cities abutting the Mississippi River and interstate waters, and for the purpose of making a study of the sewage disposal problem, and the work of this committee and of the Drainage Commission being of a different nature, yet so closely allied and dovetailing in with the existing condition, your committee has kept constantly in touch with the Metropolitan Drainage Com-

mission and is quite familiar with the work that the Drainage Commission has performed in the past two years, and as the Commission has prepared a comprehensive report of their work, your committee has not found it advisable in attempting to make any report of the findings of the Metropolitan Drainage Commission, as a printed copy of their report can be obtained by applying at their office, 2694 University Avenue, St. Paul, Minnesota.

INVESTIGATION OF THE POLLUTION OF THE  
MISSISSIPPI RIVER IN THE VICINITY OF  
MINNEAPOLIS AND ST. PAUL AS MADE BY THE  
UNITED STATES PUBLIC HEALTH SERVICE.

The United States Public Health Service, under the direction of E. R. Crohurst made an investigation covering a period of fifteen months from June 1926 to August 1927, having maintained a laboratory at the University of Minnesota to make its chemical and bacteriological examinations. Samples were gathered from fourteen different stations along the Mississippi River, starting at Camden Bridge in Minneapolis and going south along the Mississippi as far as Winona, Minnesota, a distance of 137 miles. Samples from these stations were received five days each week during the biggest part of the investigation, and along towards the end of the investigation some of the stations had to be abandoned on account of the lack of funds.

A total of 2823 samples were collected and analyzed from regular sampling stations on the main stream and tributaries, and about 70 special samples were collected from the stockyard sewer outlets in South St. Paul in February of 1927 in an endeavor to ascertain the strength of the industrial waste being discharged into this section of the Mississippi River.

SOURCE OF POLLUTION.

From the estimates of population, and total sewered population, as of January 1, 1927, it appears that on the Mississippi River above Minneapolis the total population was 447,007, of which 82 per cent was classed as rural and 18 per cent as urban. The largest community on the river above Minneapolis, St. Cloud, with an estimated population of 19,669, is located 72 miles above the Camden Avenue Bridge. Within the metropolitan area of the Twin Cities there was an estimated total population of 739,920, of which 96 per cent was urban and 4 per cent rural in character. On the Minnesota River watershed, above the metropolitan area, the total estimated population was 465,659, of which 85 per cent was rural. On the main stream and tributaries below the metropolitan area the population is mostly rural in composition. Thus, above the outlet of Lake Pepin there was a total estimated population on the watershed of 1,924,680, of which 911,846 was urban and 1,021,834 rural. Classifying this population by three zones above the outlet of the lake, the following populations are within the selected areas.

	Total estimated popula- tion	Per cent	Rural popula- tion	Per cent	Urban popula- tion	Per cent
Above metro- politan area	910,666	47	761,180	75	149,486	16
Within metro- politan area	739,920	39	31,110	3	708,810	78
Below metro- politan area	274,094	14	220,544	22	53,550	6
Totals	1,924,680	100	1,012,834	100	911,846	100

Of the total population above the outlet of Lake Pepin, 53 per cent was classed as rural and 47 per cent as urban, but, 78 per cent of all the population classed as urban was within the metropolitan area of the Twin Cities, while of the remainder 16 per cent was above and only 6 per cent below, this area.

The estimate of the population equivalent to the industrial wastes reaching the river, and the total sewered population (actual sewered population and industrial waste equivalents) above the various sampling stations on the main stream and tributaries. Sewered populations have been compiled from communications sent to the communities on the watershed having a population of about 700 or greater. Sewered population estimates do not include the sewered population of public or private institutions, the population of which may be quite large at certain points on the watershed. The industrial waste equivalents have been estimated from sampling at the stockyard outlets, at South St. Paul, from observations of the strength of paper mill and canning wastes, by the Wisconsin State Board of Health, and from creamery wastes, by assuming an equivalent sewered population for an average creamery and applying this figure where creameries have been reported on the watershed. With the exception of the large packing industries, located at and in the vicinity of South St. Paul, there have been reported, as scattered over the watershed, 66 creameries, 18 canning plants, 4 poultry dressing establishments, 4 small slaughter houses and 7 paper mills. This information can in no way be considered complete.

Of the actual estimated population connected with sewerage systems, 75 per cent is within the metropolitan area, and of the industrial waste equivalents, 65 per cent is in the metropolitan area. Of the total equivalent sewered population above Minneapolis, 3,090 is located on the river, within the first 50-mile zone, and 68,810 within the 50 to 100 mile zone, above the city. The sewered population on the river below the metropolitan area is so distributed that it seems to have very little effect on the river, except locally, immediately below sewer outlets where sludge deposits may occur.

In the metropolitan district there are a total of 37 sewer outlets, of various sizes, discharging into the river above the lock and dam. Of this total, 26 are Minneapolis outlets, located on both sides of the river, and 11 are from the St. Paul sewerage system discharging on the east bank. Below the dam, in the vicinity of the mouth of the Minnesota River, are 10 institutional outlets, including those from the Soldiers Home, Veterans Hospital and Fort Snelling. Below the mouth of the Minnesota River there are 25 outlets, on both sides of the river in St. Paul, and 11, including the stockyards sewers, in the vicinity of South St. Paul. There are therefore, a total of about 63 sewers of various sizes discharging untreated sewage and industrial waste into that portion of the Mississippi River between the Camden Avenue bridge, in Minneapolis, and Inver Grove, just below South St. Paul.

From the best data obtainable, at the time of the investigation, the following estimates of total equivalent sewered populations have been compiled for the metropolitan district.

Minneapolis above the lock and dam . . . . .	380,490
St. Paul and vicinity . . . . .	205,200
South St. Paul and vicinity . . . . .	305,100
Total . . . . .	890,790

The discharge of sewage into the pool formed by the lock and dam at Minneapolis has resulted in the deposition of considerable sewage material and other matter on the bottom and along the sides. Estimates of the depth of accumulated deposits, since the dam was constructed in 1914, have varied from 8 to 11 feet. A further complication of the sewage disposal problem, of the Twin Cities and Vicinity, is foreseen with the construction of the proposed second dam at Hastings. A pool similar to the one already in existence at Minneapolis will be created, into which the

25 sewers from St. Paul and the 11 outlets from South St. Paul will discharge, with the formation of sludge deposits in their vicinity.

PHYSICAL CONDITIONS  
DURING THE PERIOD OF  
THE INVESTIGATION.

The general appearance of the Mississippi River through the Twin Cities, and as far downstream as Hastings, during the months of June, July and August, 1926, was that of a heavily polluted and overloaded stream. Its appearance, above the metropolitan area of the Twin Cities, near the Minneapolis Water Works intake, was that of a normal surface stream, but in the 10 miles between the Camden Avenue Bridge and the Twin City lock and dam, its condition was completely altered. In the pool behind the dam, septic conditions were vigorous throughout the summer, the surface of the water was broken by rising gas bubbles, from the fermentation of the sludge on the bottom and sides of the pool, and the surface was often covered with films of "sewage sleek" from the sewer outlets on both sides of the river. The water of the pool was usually dark in color and there was much evidence of sewage pollution by the character of the materials caught on the screens at the power house and floating in the quiescent water near the head of the lock. Odors were noticeable at times, on the parkways bordering the river, but these usually occurred in the vicinity of the larger sewer outlets from which the odors were probably derived.

In connection with the production of odors, it is interesting to note that the river banks through Minneapolis and St. Paul are composed of sandstone or limestone. The sewerage system is constructed above the river, near the surface of the stone formation, and is usually discharged through a drop manhole into a tunnel extending back from the river bank. In the process of falling from the higher to the lower elevation, in some instances many feet, much gas seems to be liberated, from the sewage, which causes noticeable odors in the vicinity of the down shafts and at the end of tunnels at the river bank.

In the summer of 1926, very little diluting water was supplied by the Minnesota River, and the polluted condition of the Mississippi River was noticeable through St. Paul, South St. Paul to Hastings. In this section of the river, deposition of sewage material from the sewer outlets at St. Paul and the stockyards sewers at South St. Paul, had taken place behind the wing dams and in the backwater pools, alongside the main channel, due to decreased volume and velocity of flow. Septic conditions were observed in the river as far downstream as Hastings.

Below Hastings and the confluence of the St. Croix River, there was a noticeable improvement in the condition of the water, until at the outlet of Lake Pepin the condition of the river seemed to be as good or better than when it entered the metropolitan district of the Twin Cities.

With the increase in stream flow and decreases in water temperatures, beginning about the first of September, 1926, the condition of the upper river throughout its entire length improved. Indications of septic action behind the dam in Minneapolis and in the portion of the river between the dam and Hastings, disappeared, and there was evidence that considerable quantities of the deposited sludge or sewage solids had been cleaned out from behind the wing dams and in the backwater pools in the section of the main channel through St. Paul to Hastings.

In the latter part of November, the river became frozen over and there was an ice cover on it, with water temperatures of 0 degrees Centigrade, until about the middle of March 1927. Following the spring run-off of April and May, with about 15,900 and 11,100 second feet average monthly flows at the Falls of St. Anthony, the quantity of water gradually diminished to an average of 4,100 second feet in August. During the spring run-off, probably additional deposits in the river were swept away in the section of the river below the Twin City Lock and Dam, but it seems doubtful if this increased flow had much effect on deposits behind the dam at Minneapolis.

Inspection of the pool behind the lock and dam, during the summer of 1927, indicated that septic action again started about June 10th, in the vicinity of the large 38th Street sewer outlet. It is very probable that the temperature of the river water in the vicinity of this outlet and over the sludge deposits known to exist along the bank below it, was somewhat higher than in the remainder of the pool, so that the septic conditions started early at this point. By the end of June septic action was in evidence over the entire area of water surface behind the lock and dam, and this action continued until the close of the investigation on the last of August. When septic conditions were first observed in the vicinity of the 38th Street sewer outlet, the stream flow had decreased to about 6,000 second feet and the water temperature increased to about 21 degrees Centigrade. At the end of the 1926 dry period, septic conditions in the basin disappeared when the stream flow had increased to about 5,000 second feet and the water temperatures had decreased to 18 degrees Centigrade.

During 1927, conditions in the river through St. Paul down to Hastings, appeared much better than in 1926, but at times toward the end of summer, sample collectors reported objectional conditions in the vicinity of the Robert Street bridge and at the bridge across the river at Inver Grove below the sewer outlets of the packing houses.

#### RESULTS OF CHEMICAL AND BACTERIOLOGICAL DETERMINATIONS.

With the extremely low stream flows in June, July and August, 1926, (averaging about 2,000 second feet) at the Falls of St. Anthony, the dissolved oxygen carried by the Mississippi River, as it entered the metropolitan district, was practically depleted in passing through the pool created by the lock and dam, and remained depleted through St. Paul, South St. Paul and as far downstream as Hastings, or to a point just above the confluence of the St. Croix River. During the three summer months the monthly average dissolved oxygen carried by the river at the Camden Avenue bridge, Minneapolis, varied from 6.13 to 8.05 parts per million, or from 71 to 85 per cent saturation. For the same months, the average dissolved oxygen had been reduced at the lock and dam to from 0.43 to 0.74 parts per million, or to from 5 to 8 per cent saturation. Although the Minnesota River carried an average of from 4.8 to 5.7 parts per million of dissolved oxygen during these months, the flow estimated at the mouth (June 332, July 148 and August 265 second feet) was insufficient to produce little, if any, effect on the oxygen conditions in the main stream through St. Paul and below, so that the average monthly dissolved oxygen at Hastings had still further decreased to between 0.16 and 0.39 parts per million, or from 2 to 4.5 per cent saturation. Below Hastings, due to the inflow of the St. Croix River carrying an average of from 7.1 to 8.2 parts per million, dissolved oxygen, and the Cannon River from 7.1 to 8.5 parts per million and in addition to the absence of any large amounts of pollution, the condition of the river showed a marked improvement between Hastings and Red Wing, the monthly average dissolved oxygen at Red Wing being slightly in excess of 2 parts per million (25 per cent saturation) and at Read's Landing, the outlet of Lake Pepin, the average monthly dissolved oxygen had increased to 5.4 to 5.8 parts per million (61 to 76 per cent saturation). The period of depleted oxygen in the upper portion of the river was coincident of course with the septic condition of the sludge deposits on the bottom from Minneapolis to Hastings.

During the summer of 1926, the water entering the metropolitan district had a monthly average, 37-degree Centigrade agar count in 24 hours, varying from 950 for August to 2,900 per cubic centimeter in June. At the lock and dam the average monthly agar count had increased to from 300,000 to 650,000 per cubic centimeter. Through St. Paul the average decreased slightly, but reached a maximum at Hastings, ranging from 750,000 to 1,200,000 per cubic centimeter. On some days the agar count at Hastings reached three million per cubic centimeter. The B. coli content varied from an average of 1 to 4 per cubic centimeter, above Minneapolis, to from 1,600 to 2,000 per centimeter at the lock and dam, showed a slight decrease through St. Paul and reached monthly averages of from 3,200 to 10,000 per cubic centimeter, at Hastings.

Below Hastings both the bacterial count at 37 degrees and the B. coli estimates showed a decrease, with monthly averages of 33,000 to 53,000 per cubic centimeter, for the 37-degree count, and 100 to 200 coli per cubic centimeter at Red Wing, which had still further decreased to a 37-degree count of 7,400 to 18,000 per cubic centimeter and a coli content of from 1 to 3 per cent cubic centimeter at Reed's Landing, the outlet of Lake Pepin.

With the decrease in water temperature, in September and October, and the increase in the average monthly runoff, to 6,000 and 6,572 second feet at the Falls of St. Anthony, septic conditions in the pool and in the river through St. Paul disappeared and the river was in a much improved condition. The water entering the metropolitan district carried a monthly average of dissolved oxygen of between 8.0 to 9.2 parts per million (about 81 per cent saturation) with an average of from 5.3 to 7.9 parts per million (54 to 69 per cent saturation) remaining at the lock and dam. Through St. Paul the monthly average dissolved oxygen was from between 5.0 to 8.5 parts per million with 6.4 to 9.2 parts per million present at Hastings.

During the months of September, October and into November, until the ice cover formed on the river, there was a regular increase at all stations in the average dissolved oxygen with the decrease in water temperatures toward freezing.

Throughout the entire period of ice cover on the river, which lasted from about the middle of November to the middle of March, there was a regular decrease in the dissolved oxygen content of the water at all stations, and the longer the cover remained in place, the lower the dissolved oxygen became. In spite of the fact that 0 degrees Centigrade, the winter temperature of the water, the dissolved oxygen should have reached a maximum (about 14.6 p.p.m.), actually by February the dissolved oxygen at the various sampling stations had reached the amounts indicated in the following table.

Station number	Month of February.		Month of March.	
	Dissolved oxygen p.p.m.	Per cent saturation	Dissolved oxygen p.p.m.	Per cent saturation
1	5.68	39	10.63	75
3	5.87	40	11.00	78
5	5.77	39	10.66	75
6	5.65	39	10.26	72
7	4.46	31	9.02	66
9	7.71	53	8.63	62
11	2.48	17	4.91	35
14	10.21	70	10.17	74

#### REOCCURRENCE OF CONDITIONS OF 1926-1927.

In the fall of 1926, septic conditions in the pool behind the lock and dam disappeared when the stream flow through the pool had reached approximately 5,000 second feet. At this time the water temperature had fallen at the outlet of the pool to 18 degrees Centigrade. In the summer of 1927, septic conditions again became general throughout the pool when the stream flow had decreased to about 6,000 second feet and the water temperatures had risen to 21 degrees Centigrade. Indications are, that the critical flow in the river through Minneapolis lies somewhere between five and six thousand second feet for the present sewage loading.

Average monthly stream flows of 5,000 second feet or less, through the pool behind the lock and dam, have occurred during the summer months in the past 28 years.

Out of the last 28 years, there have been 11 for which measurements are available, when at least during two consecutive summer months the average monthly flow has been below 5,000 second feet. During each of the last 6 years (1922-1927) the average monthly summer flow has been less than 5,000 second feet, for periods of two months each, while prior to this last extensive period of low summer flows, the interval between has varied from 2 to 8 years. With increased sewage loading of the river, due to increase in population and extensions of the sewerage system, together with possible industrial developments and increase in industrial wastes, the time interval of periods of objectionable conditions in the Mississippi River behind the lock and dam will be continually shortened and the duration of each period lengthened.

If for any reason a change in the regulation of the summer flow of the river should be made, resulting in decreased run-off through Minneapolis, periods of objectionable conditions from the discharge of sewage may be more frequent in the future than they have been in the past.

#### DILUTION RATIOS NECESSARY.

At various meetings of the Interim Committee and of the Sanitary and Drainage Commissions of the Twin Cities, the question of the dilution ratio (ratio of diluting water to sewage) in the river through Minneapolis and St. Paul has been touched upon. Figures varying from 3 to 8 second feet, per 1,000 of sewered population, have been suggested as sufficient to dilute, without nuisance, the sewage of the Twin Cities. On the above basis and using the estimated sewered population above the dam as 380,500, flows in the river of from 1,150 to 3,050 second feet have been considered as sufficient for the disposal of sewage entering the section of the river above the dam. These dilution ratios are usually applicable where there is rapid flow in the receiving stream, where the mixing of the sewage and diluting water is thorough, and where the bed of the receiving stream is free from sludge deposits or other organic materials. In places, behind the lock and dam, deposition of sludge is said to have occurred to depths of 8 to 11 feet. It is believed that these sludge deposits have a very great influence on the water of the river and make necessary dilution ratios much in excess of those ordinarily required.

Using the dissolved oxygen and biochemical oxygen demand results, after correction for river temperature, between Stations Nos. 1 and 3, it is possible to estimate the difference in the oxygen balance in the stream between these two points. In June, 1926, the dissolved oxygen and 5-day biochemical oxygen demand at Station No. 1 was 8.05 and 1.50 parts per million, respectively. At Station No. 3, the dissolved oxygen had decreased to 0.74 parts per million and the 5-day oxygen demand had increased to 5.84 parts per million. The average temperature during June at Station No. 1 was 18.3 degrees Centigrade, and at Station No. 3, 19.4\* C., while the average flow of the river through the pool behind the lock and dam was 2,458 second feet. Correcting the 5-day biochemical oxygen demand for temperature, there was an increase in oxygen demand between Stations Nos. 1 and 3 of 4.34 parts per million. At the same time there was a decrease in the dissolved oxygen of the water of 7.31 parts per million between these same stations. Based on the average monthly flow, at the dam, there was an average daily loss in dissolved oxygen equivalent to 97,000 pounds, and the water leaving the dam contained substances requiring, during the next 5 days, an additional 56,000 pounds of oxygen daily, a total change in balance of 153,000 pounds. In a similar manner the change in oxygen ~~xxxx~~ balance of the stream in passing from Station No. 1 to No. 3 has been computed for each month during the investigation.



## SUMMARY AND CONCLUSIONS.

In this report are presented data collected during the investigation of the pollution of the Mississippi River through the Metropolitan area of the Twin Cities and its effect on the boundary waters between Minnesota and Wisconsin.

The study was made possible by the co-operation between the States of Minnesota and Wisconsin, the Cities of Minneapolis and St. Paul, and the United States Public Health Service.

The data assembled during the investigation consisted of total population estimates, estimates of sewered population and of population equivalent to industrial wastes, methods of sewage treatment, stream flow records, and results of chemical and bacteriological analyses of river water taken during the 15 months June 1926 to August 1927.

The total estimated population on the watershed above Winona, as of Jan. 1, 1927, was 1,924,680. Above the Twin Cities, 16 per cent of the population (149,486) was urban in character, while below the Cities, 20 per cent (123,697) fell within this classification. In the metropolitan district the urban population was 96 per cent (708,810) of the estimated population.

The total equivalent sewered population (actual sewered population plus population equivalent to industrial wastes) above the Twin Cities was 219,880, of which 3,090 was in the 50-mile zone and 68,810 in the 50 to 100 mile zone above Minneapolis.

Of the total equivalent population of 890,790 in the metropolitan area, approximately 380,490 was above the dam, 205,200 below the dam through St. Paul, and 305,100 in the vicinity of South St. Paul. Below the metropolitan area the equivalent sewered population was 302,285.

Of the total equivalent sewered population above Winona, 60 per cent was along the 36 miles of river through the Twin Cities, and the sewage was discharged into the river without treatment through approximately 83 outlets.

The sewage from about 4 per cent of the equivalent sewered population on the entire watershed received some form of treatment.

The Mississippi River, as it entered the Twin Cities, showed very little effect of the discharge of sewage and wastes into it from the communities above, and the amount of sewage which it received below the metropolitan district was so distributed as to have but little effect on the river, except perhaps locally, immediately below points of discharge. The great bulk of the contamination of the upper Mississippi River was therefore directly chargeable to the Twin Cities and Vicinity.

Stream flow data show that the summer flows of 1926 were extremely low through the metropolitan district and that the flows of the summer following, while again below the normal, were above those of the preceding summer. The fall and winter months had stream flows very nearly normal, but the spring flows of 1927 were well above normal.

Observations along the river and the results of the chemical and bacteriological examinations indicated that the river was heavily polluted through the metropolitan area of the Twin Cities. These conditions extended as far downstream as Hastings during the summer of 1926, but conditions through St. Paul in 1927, 1928 were somewhat improved. Below Hastings, improvement in the river was noticeable to Red Wing, and recovery apparent at the outlet of Lake Pepin.

The most objectionable conditions were in the pool behind the dam at Minneapolis, where septic conditions existed in the sludge deposits on the bottom, where gas ebullition was vigorous and where the surface was often covered with sewage sloop.

The low winter flows, with ice cover on the river, apparently prevented reaeration of the water at the surface, with the result that the effect of lowered dissolved oxygen conditions extended further downstream in the winter months to the outlet of Lake Pepin.

The appearance and disappearance of septic conditions in the pool at Minneapolis suggest a critical summer flow of between 5,000 and 6,000 second feet with present sewage loading. The high dilution ratio is probably due to the action of sewage sludge and other deposits in the pool.

The chemical data appear to indicate that there is an accumulation of sewage sludge and other materials, during the winter months when biological activities are restrained, which remains to exert its influence during the months of higher water temperatures. These conditions result in an excessive load during the months of summer flow when the stream is least capable of caring for it.

Past records of stream flow indicate that average monthly flows of 5,000 second feet or less during at least two successive summer months have occurred during 11 of the past 28 years. Two consecutive summer months of low flows have occurred during each of the past 6 years, with longest interval between of eight years from 1902 to 1910.

Estimates of time of flow, from the dam, indicate that water passing it with a comparatively high oxygen demand will leave the metropolitan district, under present channel conditions, without exerting its influence through St. Paul and South St. Paul.

Within a comparatively short time, however, a second pool will be created between the present dam and Hastings, by the construction of a dam three miles above that city. Present conditions in this section of the river will therefore be materially changed. A second pool, resulting in decrease in velocity, deposition of sewage materials and increase in time of passage through these communities and out of the metropolitan district, will result in conditions similar to those already existing through Minneapolis. Whereas the upper pool will be supplied with a normally aerated water entering its upper end, the second pool will receive water more or less depleted of oxygen from its passage through the pool above.

Increasing sewage loads in the existing pool at Minneapolis, with the probability that within a few years the sewage and industrial wastes from St. Paul and South St. Paul will enter a similar pool, will result in accumulations of sewage materials requiring such high dilution ratios, during the summer periods, that objectionable conditions through the Twin Cities will be of very frequent occurrence.

The United States Board of Health having recommended that steps be taken immediately to study the sewage treatment methods, applicable to the sewage of the Twin Cities, to relieve the excessive sewage loads accumulated in the river at Minneapolis, and to prepare for a similar condition of sewage loading which will occur south of St. Paul and at South St. Paul following the creation of the second pool by the construction of the Hastings dam, and in order to maintain the Mississippi River in a reasonably clean and inoffensive condition through and below these municipalities, and the recommendation having been accepted, and the Metropolitan Drainage Commission having been created and having submitted its report to the Cities of Minneapolis and St. Paul, and it further appearing to your committee that the condition is a matter for the metropolitan area to dispose of, your committee therefore makes no recommendation as to how the pollution should or ought to be taken care of, as it feels that the large cities contributing mostly to this pollution have felt the responsibility and are taking steps to eliminate this nuisance. Your committee further feels that the matter is a large one and that it will take some little time to dispose of it entirely.

We recommend the committee be continued, and that it co-operate with the large cities and the Metropolitan Drainage Commission in the furtherance of the elimination of the pollution from our waters.

Respectfully submitted.

*James A. Chas. Chas.*  
*Otto W. Kolshorn Ch.*  
*Joseph H. Masek*  
Secretary.

Adopted by the Senate  
FEB 14 1920  
Secretary of the Senate