STATE OF ILLINOIS

DEPARTMENT OF REGISTRATION AND EDUCATION

DIVISION OF THE

STATE WATER SURVEY

A. M. BUSWELL, Chief

BULLETIN NO. 20

COMPARISON OF CHEMICAL AND BACTERIOLOGICAL EXAMINATIONS MADE ON THE ILLINOIS RIVER DURING A SEASON OF LOW AND A SEASON OF HIGH WATER -1923-1924

By R. E. GREENFIELD

A PRELIMINARY NOTICE OF A SURVEY OF THE SOURCES OF POLLUTION OF THE STREAMS OF ILLINOIS

By G. A. WEINHOLD, R. E. GREENFIELD with A. M. BUSWELL

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STATE OF ILLINOIS.

DEPARTMENT OF REGISTRATION AND EDUCATION.

A. M. Shelton, Director.

LETTER OF TRANSMITTAL.

STATE OF ILLINOIS,
DEPARTMENT OF REGISTRATION AND EDUCATION,
STATE WATER SURVEY DIVISION.

URBANA, ILLINOIS, December 27, 1924.

A. M. Shelton, Chairman, and Members of the Board of Natural Resources and Conservation Advisors :

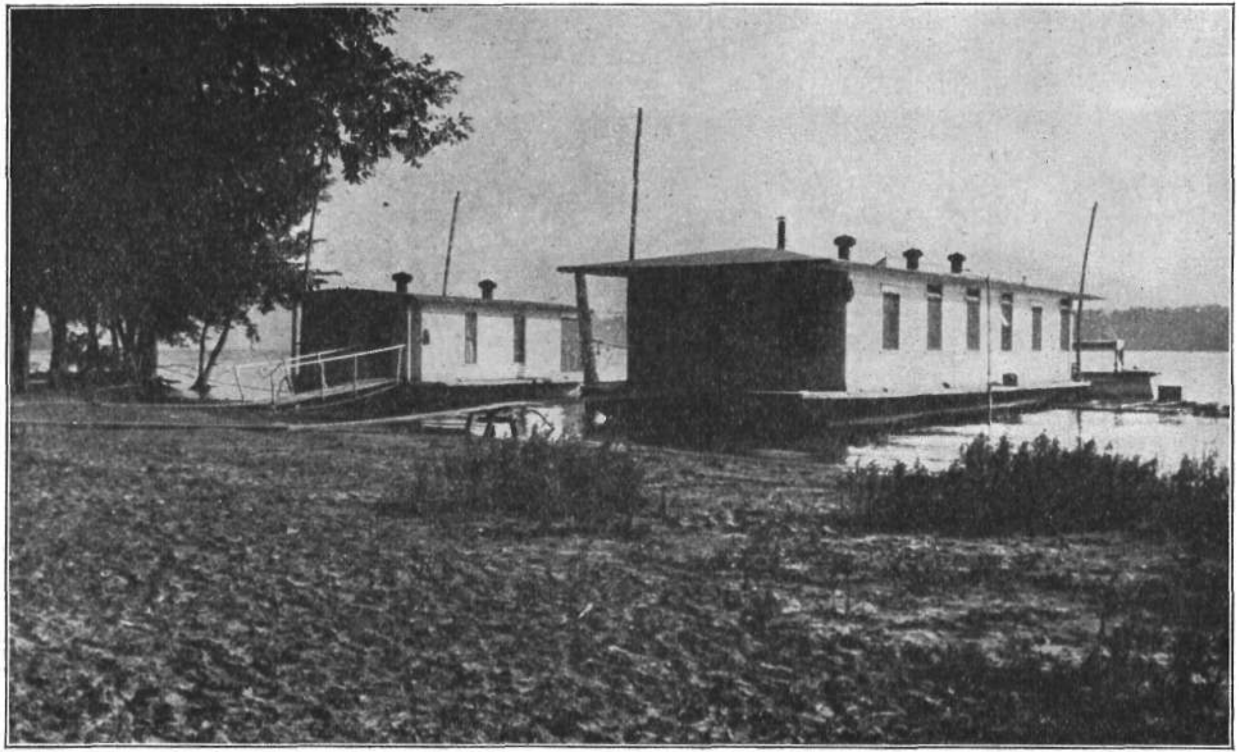
GENTLEMEN: Herewith I submit two reports concerning the general question of stream pollution in the State of Illinois and recommend that they be published together as Bulletin No. 20.

Since the Directors' report includes a statement of the general activities of all Divisions, it has seemed advisable to discontinue the publication of an annual report of this Division and to prepare instead summaries of our various investigations as they are completed. This policy was adopted with the publication of Bulletin 18 in May of 1922 and has been followed since that date.

Attention should be called to the fact that this is the first publication of Illinois River Studies by the State Water Survey. The results of previous studies have been published by the Natural History Survey. The amount of chemical and bacteriological work has been increased to such an extent, however, that it seems advisable to publish them in separate reports rather than to hold up these results until the laborious work of classifying biological collections can be completed.

Respectfully submitted,

A. M. BUSWELL, *Chief.*



House Boat Laboratory and Boat Equipment used in Illinois River Investigation as it Appeared in Summer of 1923.

COMPARISON OF CHEMICAL AND BACTERIOLOGICAL EXAMINATIONS MADE ON THE ILLINOIS RIVER DURING A SEASON OF LOW AND A SEASON OF HIGH WATER.

By R. E. Greenfield.

INTRODUCTION.

A chemical and biological survey of the Illinois River has been carried on by the Illinois Natural History Survey with the co-operation of the State Water Survey for over twenty-five years. Beginning in 1923, the State Water Survey at the request of the Natural History Survey has taken more direct charge of the work. For the most part the change has resulted in only minor changes in the character of the work being carried out.

The major part of the field work is done during the four summer months of June, July, August, and September. During this time the house boat laboratory equipment now located at Peoria is made use of.

This equipment consists of a large sixty foot house boat laboratory, a smaller auxiliary house boat, a thirty-six foot motor launch, a smaller nineteen foot three horsepower motor boat, and skiffs. The large house boat contains an office room, a larger laboratory, and another smaller room used for storage and for incubators. This boat is wired for electric current, making it possible to connect with power lines on shore furnishing current for lights and incubators. In 1923 the laboratory was equipped with apparatus sufficient to allow the proper collection and preservation of such biological specimens as were desired and the determining of dissolved oxygen and biological oxygen demand. In 1924 apparatus was added to take care of bacteriological examinations of both water and mud. The smaller house boat was used in 1923 as a place for storage and in 1924 as living quarters for a part of the crew. The launch equipment is sufficient to allow collections over a considerable section of the river. A somewhat faster boat to allow collection over a greater distance without undue loss of working time would at times be desirable.

The crew in 1923 consisted of Dr. R. E. Greenfield and Mr. A. L. Sotier from the State Water Survey Division, Mr. D. H. Thompson from the Natural History Survey Division, and a boatman who had had considerable experience on the river. In 1924 the crew was the same excepting that Mr. Harold Eigenbrodt took the place of Mr. Thompson and in addition an undergraduate student assistant was employed during the month of August and the first part of September. All of the crew with the exception of the boatman and the last named assistant lived on the boats.

Because of the sharp contrast between the climatic and hydrographic conditions during the summer of 1923 and those in the summer of 1924 it was thought worth while to make a preliminary report on certain of the chemical and bacteriological studies made during this period. Much of the other material collected, especially the biological, is not yet ready for publication since it is of such nature that considerable time is required to properly work it over, classify the results, and draw the proper conclusions. At this time no attempt will be made to compare the figures reported with earlier published results. Later it is proposed to prepare an additional paper making such comparisons and including considerable as yet unpublished material collected in former years. During these two seasons most of the collections have been made in the section of the river from Chillicothe to Kingston, 181.5 to 146 miles from Grafton according to the U. S. Engineers 1905 survey of the Illinois and Des Plaines River[1]. It was judged from earlier results that this section would yield information of the most interest from the pollution standpoint. Less intensive samplings were made from La Salle to Chillicothe and from Kingston to Beardstown.

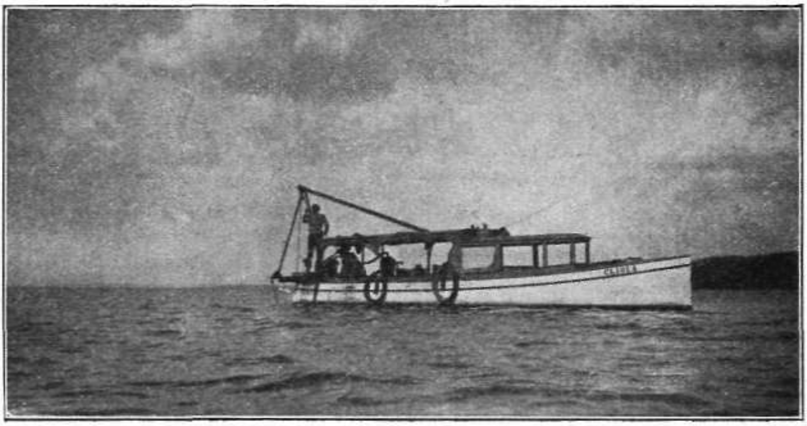
A description of the hydrographical features of this part of the river is to be found in Richardson's 1921 report[2].

A comparison of the graph of the Peoria river gauge readings for the summers of 1923 and 1924 is sufficient to emphasize the

[1] Report of U. S. Eng. Survey for a deep waterway. House Document No. 263, 59th Congress, First Session Wash. 1905.

[2] The Small Bottom and Shore Fauna of the middle and lower Illinois river and the connecting lakes. Robert E. Richardson, Natural History Survey Bull. XIII, Art. XV.

difference between the two seasons. These graphs are to be found in Figures I and II. In 1923 the season was relatively dry. The river did not even experience a high spring stage and was low on June 1st. It continued to fall reaching its lowest stage about the end of July. From then on it rose gradually with no abrupt changes at any time. At the same time the temperature was quite high causing high water temperatures throughout the summer (see Table I). The gauge readings in the summer of 1924 on the other hand showed that the spring raise was quite large, falling by the first of June to a stage nearly the same as the stage reached on June 1, 1923. Shortly



Launch Used in Illinois River Work. A Bottom Mud Sample is Being Taken.

after this the river rose rapidly reaching a maximum near the end of June, then falling almost as rapidly, reaching a minimum near the end of July followed by a very rapid raise which resulted in a maximum on the 21st of August which was one of the highest, if not the highest, stage ever recorded in a summer month. Following this maximum the stage fell off, at first rapidly and then slowly, the fall readings being low. Due to the excessive amount of water, cloudy weather, and a comparatively low temperature, the river temperature remained relatively low throughout the summer (see Table II).

COMPARISON OF DISSOLVED OXYGEN DETERMINATIONS.

A study of the dissolved oxygen of a polluted stream gives more information concerning the pollution of the stream than any other single chemical determination. Such determinations were made on the Illinois river during both of the summers under discussion in fairly large numbers. Dissolved oxygen was determined according to Standard Methods of Water Analysis, American Public Health Association[3] using the Rideal-Stewart modification of the Winkler method. Titrations were made in the field, it being unusual for a single sample to stand more than four hours before the final titration was made. Samples were taken at selected stations along the river. At any given station samples were obtained from several points across the stream or lake, in the narrow parts of the river usually at points one-fourth, one-half and three-fourths way across the stream, in wider parts more points were located at a station. At each point top and bottom collections were made, the top samples being about twelve inches from the surface and the bottom being from twelve to twenty-four inches from the bottom. Over very muddy bottoms precautions were taken against stirring up the mud in such a way as to allow it to get into the bottle. Collections were made with a special collecting device already described in this bulletin[5].

In Figures 1 and 2 the results of the channel collections are shown graphically. These same results are given in Tables I and II. Only channel collections are given at this time as they are the most influenced by introduced pollution. In the figures, time in days, is plotted along the horizontal or X axis. The first strip of the graph shows the gauge readings in feet on the U. S. Weather Bureau, Peoria gauge. The rest of the graph is divided in ten additional strips each one representing a different section of the river from Chillicothe to Kingston. The solid black vertical column, represents in parts per million the dissolved oxygens found in the bottom channel collections. The open column extending above the black represents additional oxygen found in channel surface collections. A column the full height of the strip would represent ten parts per million of dissolved oxygen. An open circle on the line indicates that a collection was made but no oxygen was found.

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[3] Standard Methods for the Analysis of Water and Sewage. Am. Pub Health Assoc. 1923.

[4] A new Sampler for Dissolved Oxygen. R. E. Greenfield and P. L. Mickle, State Water Survey Division Bull. 16, 197.

An examination of the 1923 data shows that at Chillicothe and for a few miles below low or zero oxygen was encountered throughout the summer. During the hotter parts of the summer, that is, the latter part of July and the first part of August these low oxygens extended down to the Mossville section, mile 171 to 173. The seeming exception of the Spring Bay section, mile 173 to 175 is explained, we believe, by the broad expanse of shallow water found on both sides of the channel at this station. In such shallow quiet water the production of oxygen by photosynthesis is both rapid and extensive. Any cross currents due to wind, etc., would make the obtaining of fair channel samples uncertain under such conditions. It is noticeable that in the section from the bridges at Peoria, mile 162 to Mossville, mile 172, that the occurrence of much higher oxygen in the top samples than in the bottom is frequent. This section of the river is broad and quiet being part of the portion known as Lake Peoria. The production of oxygen by photosynthesis is rapid under such conditions and mixing is at a minimum. In the narrower portions of the river below Peoria mixing is more perfect and photosynthesis is probably not as extensive so that this difference between top and bottom is much less noticeable. In the warmer part of July and August the effect of sewage from Peoria and Pekin is noticeable in producing a lowering of the dissolved oxygen content. These lower figures do not approach at any time those found above Mossville.

The oxygen content of the water from the same stations in 1924 is in marked contrast with that of 1923. In the first place, oxygen to some extent was found at all times at all stations and while variations were found at times, these are not for the most part of a geographical nature except that as in 1923 there was a notable excess of top oxygen over bottom in samples collected in the quieter part of the lake. It is true that the effect of pollution is still noticeable at Chillicothe, since taken as a whole, the results are all lower there than those found between Mossville and Peoria Narrows, but the marked variation in oxygen to be noted in this season's results is related more to the stage of the river than to the geographical position of the station. When the river was rising rapidly and was muddy from mud carried into it by the small swollen tributaries the oxygen content was lowered at all points. Note the periods from June 20 to 30 and August 10 to 20. When the river was high but

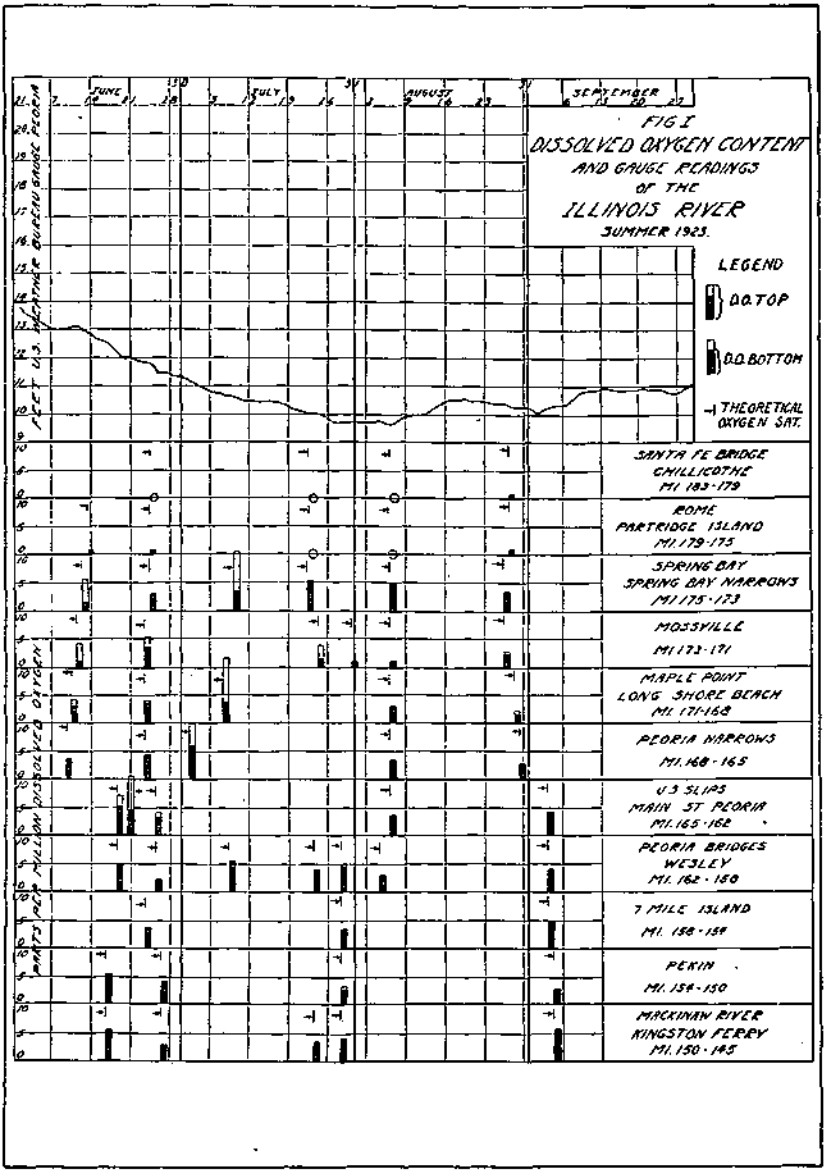

Fig. I.—Dissolve Oxygen Content and Gauge Readings of the Illinois River Summer 1923.

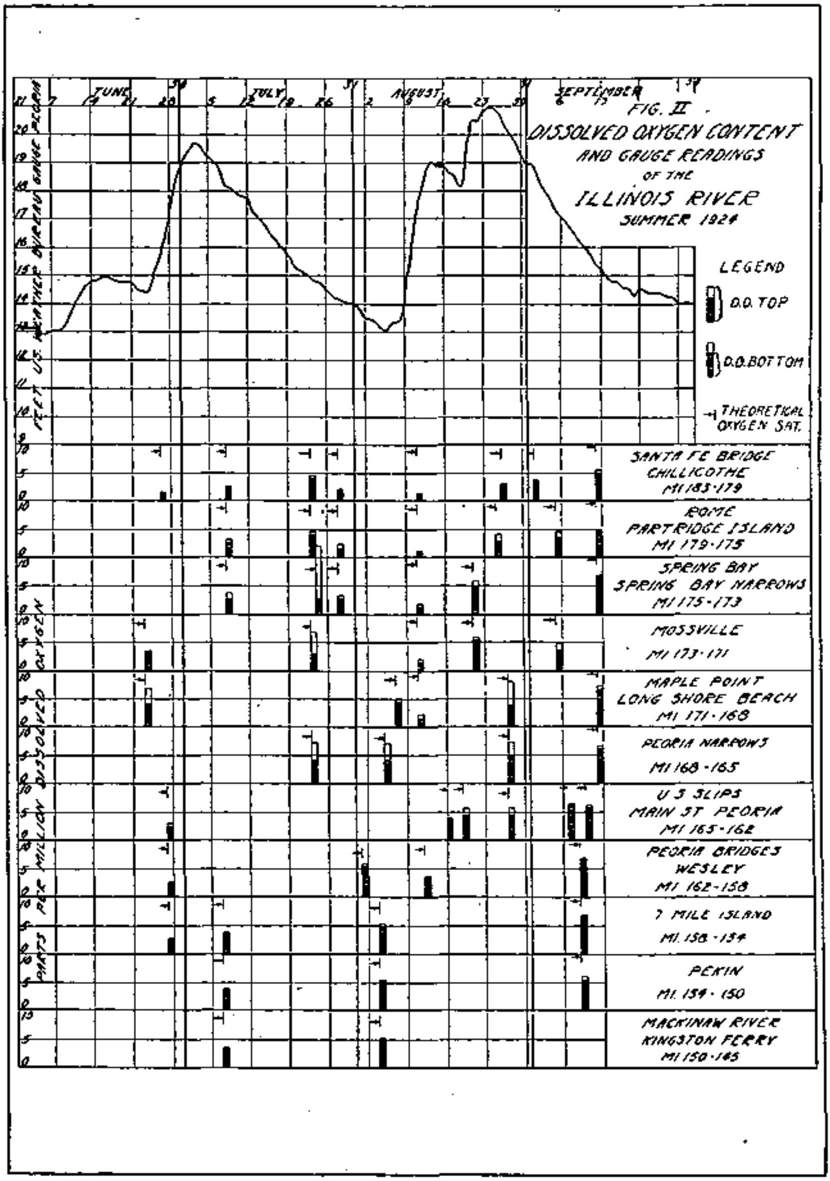

Fig. II.—Dissolve Oxygen Content and Gauge Readings of the Illinois River Summer 1924.

falling and had become clear by sedimentation, the oxygen figures were high and photosynthesis was noticeable. Note the period July 10 to 30 and September 1 to 12. For a short time when the river was at its lowest stage on about August 5 a geographical variation that is low at Chillicothe and higher farther south similar to but not as marked as that noticed in summer of 1923 is apparent. It is to be remarked, however, that this minimum stage is two and one-half feet above the minimum encountered in 1923.

The results of tests made over longer stretches of the river from La Salle to Chillicothe and from Kingston to Beardstown are given in Tables III and IV. In the main, the differences noted in these results are similar to those already examined. The results of 1924, while showing a marked decrease as we pass up the river, in the main show some oxygen even as far north as La Salle. A condition greatly different than that existing in the previous summer when no oxygen was found even as far south as Chillicothe which is sixty miles south of La Salle.

Summary of the Dissolved Oxygen Studies.—As a summary of the dissolved oxygen results it is apparent that in a summer such as 1923, characterized by a continued low stage of the river and high temperature, the dissolved oxygen content varied from low to high as we pass down the river, the variation depending primarily on the extent of destruction of introduced pollution, and that during such a summer the pollution introduced is sufficient to cause a complete disappearance of oxygen as far south as Chillicothe and even a little farther during portions of the summer. In a summer such as 1924 characterized by a high and extremely variable stage of the river while the effect of pollution is noticeable, in order to make an intelligible interpretation of the results consideration must be given to the fact that the large amount of water available for dilution prevents the production of septic or anaerobic condition as far down as before. In fact, at La Salle, we did not encounter such low oxygen results as we had at Chillicothe the summer before. In addition, it must be taken into consideration that during rapid rises when the river is quite muddy the oxygen content will be uniformly low. This is probably due both to absorption of oxygen by mud and to the prevention of photosynthesis by rendering the water turbid and by carrying the organisms away in the rapid current. The lowering of the oxygen content by excessive amounts of mud has been previously noted in one of the Natural History Survey Bulletins[5].

COMPARISON OF BIOLOGICAL OXYGEN DEMAND DETERMINATIONS.

Samples for biological oxygen demand determinations were collected at ten selected stations between Chillicothe and Kingston. Stations were so located as to include in the Lake Peoria portion one sample at each of the two narrows and one sample at each of the three widest portions of the lake. In the narrow portion of the river from Peoria to Kingston the stations were located about five miles apart. Only one sample was collected at a station. This was taken as near the center of the channel as could be estimated. The 1923 samples were collected by forcing the bottle a few inches to a foot below the surface and allowing it to fill. In 1924 samples were collected by lowering the bottle one-half the depth of the river. This change was made because it was felt that a sample collected one-half way down would be more nearly an average sample. It is possible that this would result in the biological oxygen demands for 1924 being somewhat lower than they would have been according to the 1923 methods, as there is often more algae and growing organic matter near the surface. Biological oxygen demand was determined by either making dilutions of the river water with aerated distilled water which had been stored at least two weeks or by simply aerating the river water followed in both cases by incubation in completely filled glass stoppered bottles. These bottles were sealed by completely immersing in small aquaria filled with water. These aquaria, with contained bottles, were incubated in a converted ice-box-incubator at twenty degrees Centigrade, plus or minus one degree, for five days. Initial and final dissolved oxygen was determined by the Rideal-Stewart modification of the Winkler method. The difference between these two determinations when calculated to parts per million of oxygen in the original volume of river water constitutes' the biological oxygen demand figures recorded. The results are shown graphically in Figure 3 and Figure 4, also in Tables V and VI. The biological oxygen demand figures for 1923 show a gradual decrease in all stations from spring to fall. This decrease is at times erratic and

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[5] Chemical and Biological Investigation of the Illinois River Mid-summer of 1911. Ill. State Lab. of Nat. Hist.
A preliminary statement made to the American Fisheries Soc. St. Louis, October 3, 1911. Pub. 1911.

TABLE V.—BIOLOGICAL OXYGEN DEMAND FIGURES.
ILLINOIS RIVER. SUMMER 1923.

CHANNEL SAMPLES.

Station	July 2	July 24	Aug. 6	Aug. 20	Sept. 4
Santa Fe Bridge (Mi. 181.5)..	35.0†	5.7	3.98	4.2	1.1
Rome (Mi. 178).............	31.0	5.9	4.66	3.2	2.1
Spring Bay Narrows (Mi. 173)	9.0	8.6	4.86	3.10	4.3
Maple Point (Mi. 170.5)......	.....	6.5	4.06	2.0	2.4
Peoria Narrows (Mi. 166)....	4.5	5.8	3.66	3.2	2.6
U. S. Slips Station (Mi. 164)..	5.1	4.1	3.54	5.4	3.2
McKinley Bridge (Mi. 162)...	13.0	5.4	3.46	5.0	3.5
Seven M.le Island (Mi. 157)..	7.6	4.6	4.00	8.5	1.5
Pekin (Mi. 153).............	7.4	4.1	4.16	9.8	3.5
Kingston Ferry (Mi. 146).....	.....	4.5	5.66	11.6	9.5

TABLE VI.—BIOLOGICAL OXYGEN DEMAND FIGURES.
ILLINOIS RIVER. SUMMER 1924.

CHANNEL SAMPLES.

Station	July 1	July 11	July 28	Aug. 6	Aug. 14
Santa Fe Bridge (Mi. 181.5)..	.....	3.4	3.9	3.1	2.1
Rome (Mi. 178)...............	1.6	2.6	1.4	1.9	1.4
Spring Bay (Mi. 174).........	1.2	2.6	1.6	....	0.0
Maple Point (Mi. 170.5).......	.....	3.0	2.3	....	0.0
Peoria Narrows (Mi. 166).....	.....	4.0	2.6	3.2	2.1

Station	July 2	July 15	July 31	Aug. 18
U. S. Slips Station (Mi. 164)...........	2.2	....	3.5	3.3
P. P. & U. Bridge (Mi. 161)............	3.8	3.2	2.5	3.7
Seven Mile Island (Mi. 157)............	2.8	4.6	3.1	3.6
Pekin (Mi. 153).......................	1.8	4.4	3.5	3.7
Kingston Ferry (Mi. 146)..............	.....	4.4	2.3	....

is on the whole quite small. Geographically the results at Chillicothe are usually highest as may be seen from Figure 3, decreasing to about a minimum at Peoria Narrows just above the city of Peoria proper, and increasing somewhat due to the sewage of Peoria and Pekin below this point. The 1924 results are much more erratic in nature and are on the whole much lower than the 1923 results. They seem to be, as were the dissolved oxygen determinations, quite closely related to the stage of the river. On a rising stage and a muddy stream the biological oxygen demand figures were lowest. It is not easy to understand why a muddy or rising stream would have a low biological oxygen demand as compared to a clear and falling stream. The explanation may be that the part of the mud which is not inert is oxidized by the oxygen of the stream rapidly and is not subject to further oxidation on longer standing. The fact that the dissolved oxygen of the stream is always lower under such con-

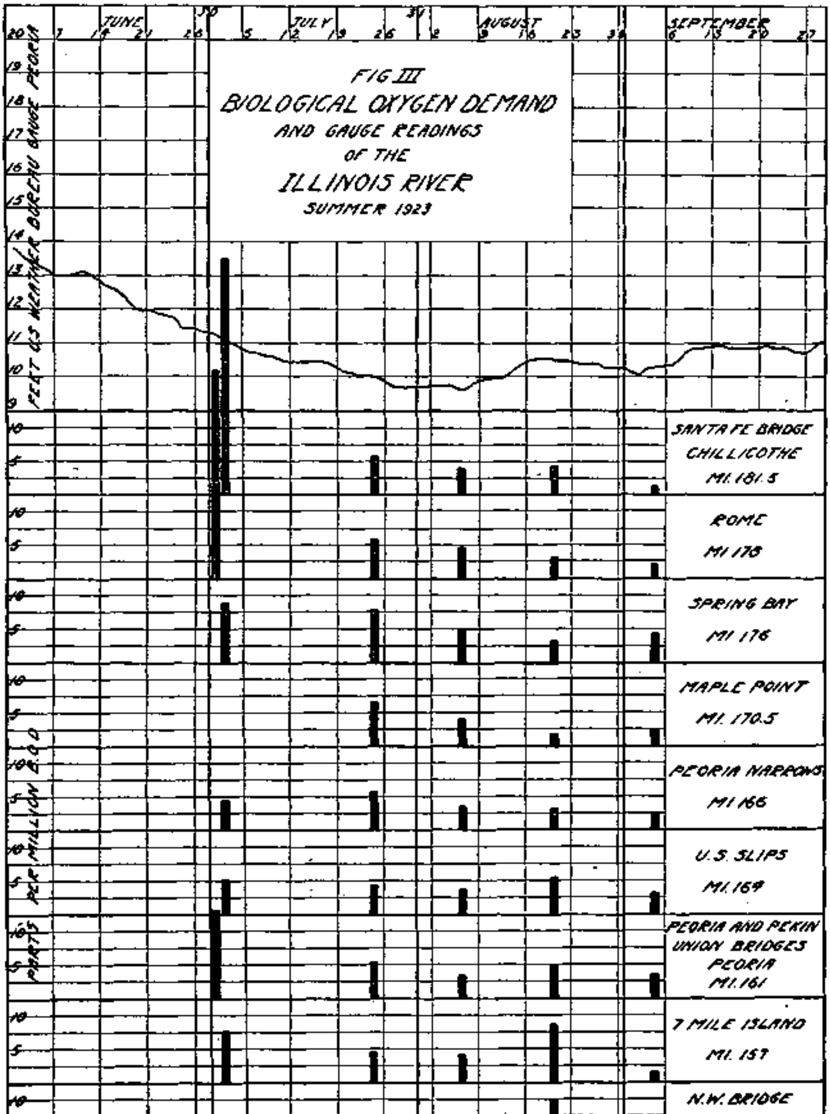


Fig. III.—Biological Oxygen Demand and Gauge Readings of the Illinois River, Summer 1923.

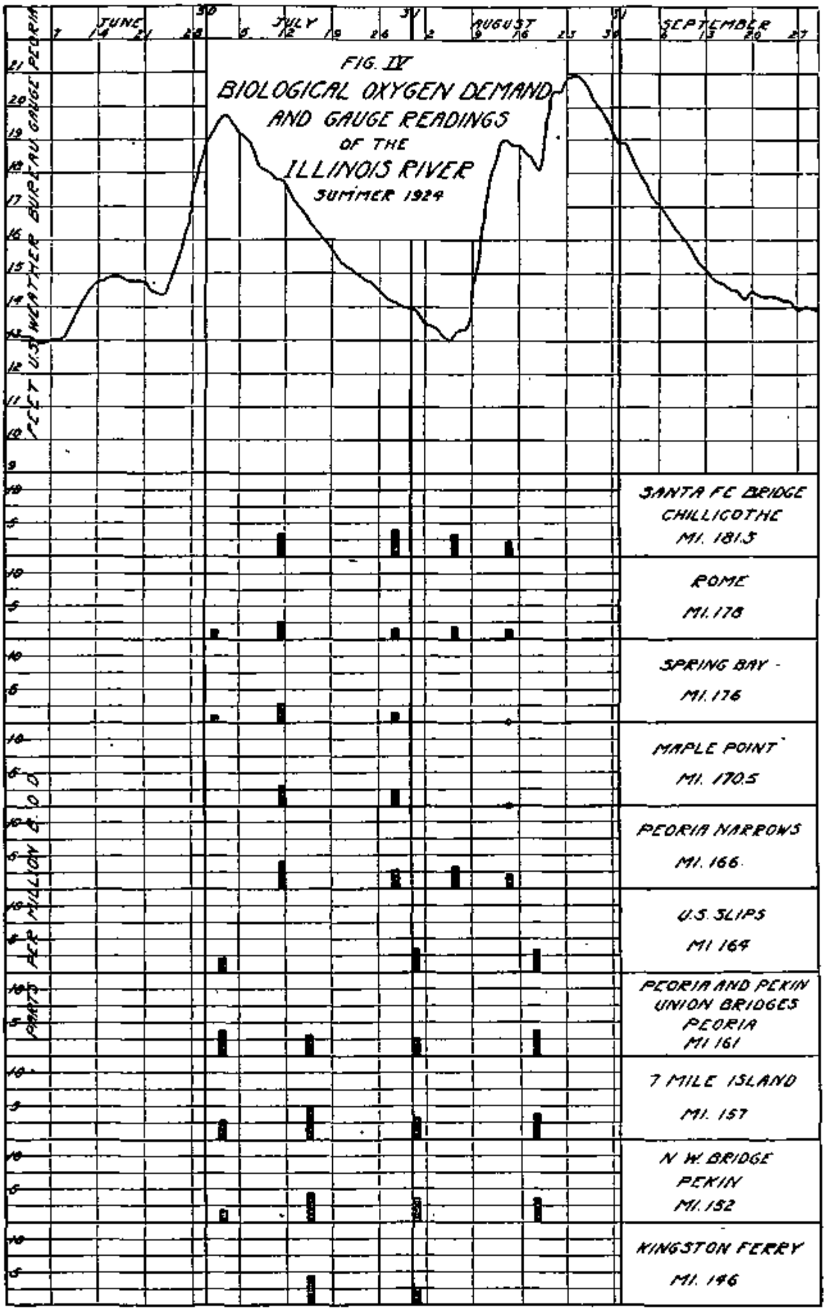


Fig. IV.—Biological Oxygen Demand and Gauge Readings of the Illinois River, Summer 1924.

ditions would tend to support this explanation. The increase at lower stages may be due to a decrease in dilution making the effect of the sewage more apparent, or to the presence of living organisms which furnish oxidizable matter only after their death which would take place to a considerable extent in the bottles.

Summary of Biological Oxygen Demand Results.—To summarize, it would seem from the Figures 3 and 4 that in the year of low water the biological oxygen demand changes with the degree of destruction of sewage reaching its lowest figure just above Peoria. Some previous data obtained by this laboratory and also some of the data obtained by the U. S. Public Health Service[6] do not entirely support this conclusion. This will be discussed in a later paper. In the year of high water in 1924, the average biological oxygen demand was lower due presumably to the greater dilution. Such variations as were noted seem to be due to the condition of the river as affected by its stage rather more than by the sewage pollution which had been introduced.

Bacterial Studies of the Water.—In the summer of 1923 some bacteriological samples were collected at the same stations and at the same time as those collected for the biological oxygen demand determinations. Since the boat laboratory was not at that time equipped to make the bacterial tests, the samples were shipped to Urbana packed in ice. The time of shipment varied from twenty-four hours to forty-eight hours. The results of the total count on agar at 37½°C were surprisingly low, much lower than those obtained by the U. S. Public Health Service[6] in the two similar years of 1921 and 1922. Since it is well known that the bacterial content of highly polluted waters often changes markedly upon shipment it was concluded that these unusually low results obtained during 1923 were not correct. For this reason the data obtained will not be given. In the main they showed, however, higher counts at Chillicothe decreasing to a minimum at Peoria Narrows and increasing sharply below Peoria and. Pekin. These changes are at least qualitatively such as would be expected from earlier work.

In 1924 arrangements were made to do the bacterial plating on the boat laboratory in order to minimize the change due to

[6] Private Communications of Eng. in charge of U. S. Pub. Health Service. Illinois River Investigations to Dr. S. A. Forbes, Chief, Nat. Hist. Survey.

shipment. By such an arrangement the samples were always plated within six hours after collection.

The samples were collected at the same stations and at the same time as the samples collected for biological oxygen demand. Six ounce bottles which were capped with oil cloth and sterilized in an autoclave at fifteen pounds steam pressure for fifteen minutes were used. The method of sampling was to make one quick dip about six inches below the surface, the direction of the dip being against the current of the stream. In this way the possibility of contamination by washings from the hand was obviated. The samples were kept on ice during the interval before plating.

Counts were made on nutrient agar at 37½°C for twenty-four hours, duplicate plates of each dilution being made. The count reported was the average of the two plates of the most favorable dilution. B.coli presumptive tests were made planting two tubes of each dilution. The figures reported are the reciprocals of the highest dilution fermenting. While this procedure may not result in the most probable B.coli content, it is essentially that recommended by the Standard Methods of Water Analysis, and will probably suffice for the purposes of this paper. If only one tube of the higher dilution fermented, one-half of the reciprocal is given. A few of the presumptive tests were partially confirmed on eosin methylene blue agar, all the tests tried gave one hunderd per cent confirmation. Difco's dessicated media was used throughout the work.

Due to the pressure of other work, aggravated to a considerable extent by the unusual seasonal conditions which handicapped the work, only a comparatively small number of samples were obtained. Prom these we have selected examples which seem to be typical of the condition for this summer.

On the whole the bacteriological results this year were much lower than those from previous years. This was undoubtedly due to the high water experienced throughout the summer. During periods of highest water the counts were lowest providing the river was not muddy at the time from freshets occurring locally.

On July 11 and 15 the following results were obtained. At this time the river was moderately high but was falling and clear.

	Agar Count	B. coli Presumptive
July 11—		
Santa Fe Bridge (Mi. 181.5)	**850**	**10**
Rome (Mi. 178)	**250**	**5**
Spring Bay Narrows (Mi. 173)	**150**	**5**
Maple Point (Mi. 170.5)	**300**	**1**
Peoria Narrows (Mi. 166)	**370**	**5**
July 15—		
Peoria & Pekin Union Bridge, Peoria (Mi. 161)	**3,400**	**1**
Seven Mile Island (Mi. 157)	**3,700**	**5**
Lower Bridge, Pekin (Mi. 152)	**3,400**	**10**
Kingston (Mi. 146)	**12,000**	**100**

July 28 and 31 when the river had fallen almost four feet reaching its lowest stage for the summer although still practically four feet above the lowest for the summer of 1923, the following results were obtained from the same stations.

	Agar Count	B. coli Presumptive
July 28—		
Santa Fe Bridge (Mi. 181.5)	.....	.....
Rome (Mi. 178)	**350**	**50**
Spring Bay (Mi. 173)	**500**	**5**
Maple Point (Mi. 170.5)	**370**	**5**
Peoria Narrows (Mi. 166)	.....	.....
July 31—		
Peoria & Pekin Union Bridge (Mi. 161)	**8,000**	**50**
Seven Mile Island (Mi. 157)	**32,000**	**50**
Pekin (Lower Bridge) (Mi. 152)	**40,000**	**100**
Kingston (Mi. 166)	**180,000**	**100**

It is notable that with the lower stage of the river the effect of pollution at Peoria and Pekin become more noticeable.

The results obtained August 8 are interesting as they show the effect of freshets bringing in mud from tributaries. A very heavy rain fell early in the morning delaying the start of the collection trip. Collections made from the U. S. Slip Station at Peoria and the Peoria and Pekin Union Bridge gave counts of 4000. At this point there are no tributaries and the water was not much muddier than it was normally. At Seven Mile Island, six miles below the Pekin and Peoria Union Bridge, the river was decidedly muddy due to the action of a creek between these two points. At this point a count of 120,000 was obtained. It is true that normally there seems to be an increase between these two points due seemingly to the effect of the incubation period on the sewage of Peoria. This increase was never at any other time as large as the one under discussion and ordinarily did not appear during high water. It would seem, therefore, that this large increase was due to mud. At Pekin, about four miles farther down, the water was much less muddy, this was not due so much to sedimentation in the four mile stretch but due to the fact that we got to Pekin a little before the muddiest water flowing in at Seven Mile Island had reached there. A count of 90,000 was obtained at Pekin. Since the stage of the water during these collections was high, counts somewhat below those given in the first tabulation above were to be expected had it not been for the unusual muddiness of the river.

On September 3 a trip was made to LaSalle. The stage of the river at the time was high but had been falling for ten days. The water was, therefore, quite clear. As would be anticipated, low results were obtained. Figures were as follows:

	Agar Count	B. coli Presumptive
LaSalle (Mi. 223)	3,000	1,000
N. Y. Central Bridge near DePue (Mi. 214)	3.000	50
Hennepin (Mi. 207)	2,200	10
Henry (Mi. 196)	350	10
Chillicothe (Mi. 181.5)	400	10
Peoria Narrows (Mi. 166)	450	5

It is to be seen from these results that the high dilution of this summer has been instrumental in producing a low bacterial content in the river. If due consideration be taken of the effect of rapid changes in stage the effect of the sewage from Chicago can be noted to about Chillicothe and a notable increase can be noted due to the sewage of Peoria and Pekin below these points.

General Summary and Conclusions.—From the results obtained during the past two summers it is to be concluded that during a normal summer of low water, such as was experienced in 1923 the chemical tests, such as the determination of dissolved oxygen and biological oxygen demand, and the bacteriological tests, will vary geographically in such a way as to indicate that they are chiefly dependent upon the amount of pollution introduced into the stream and the extent to which the polluting material has been destroyed. During such a summer the amount of pollution introduced in the head waters of the Illinois river is such as to render the river practically anaerobic during certain seasons of the year as far south as Chillicothe, 146 miles from Lake Michigan and about 18 miles above Peoria. Such a condition of course would make impossible the existence of fish or other forms of higher aquatic life in these portions of the river. This conclusion is confirmed by observation of the fishing activities. A comparatively short distance below this point, at Peoria Narrows, the river, as judged by these tests, reaches its highest state of self purification. At this point the river in some respects approaches the condition of a normal Illinois stream. Below this point the effect of the wastes from Peoria and Pekin is noticeable, although at no point studied did conditions approach those encountered above Chillicothe. The existence of, at least, the rougher fish below Peoria and Pekin would tend to confirm these conclusions. When the results from the biological collections are tabulated more information oh this point will be available.

The results obtained during a summer of high water accompanied by considerable fluctuation of stage must be interpreted rather more carefully. The major variations noted are seemingly caused more by the material carried in by the freshet water than by the introduced pollution. In addition the large amount of dilution water aiding in the destruction of the polluting wastes makes the general condition of the portion of the river studied much better than that of the previous year. If the results for the two summers are compared, station by station, the conclusion is arrived at that the condition of self purification advances more rapidly on the up stream points during the season of high water. If the results of 1924 are carefully examined by themselves the conclusion is again arrived at that the point of most advanced self purification is again only a short distance above Peoria although the differences between the stations in this particular section are not as sharp and clear cut as they were during the former year.

TABLE I—DISSOLVED OXYGEN CONTENT. TEMPERATURE AND PER CENT OXYGEN SATURATION OP THE ILLINOIS RIVER. SUMMER 1923.

CHANNEL SAMPLES CHILLICOTHE-KINGSTON FERRY.

Station	Date	Top Samples			Bottom Samples		
		Dissolved Oxygen Parts per Million	Temp.	% Sat. O_2	Dissolved Oxygen Parts per Million	Temp.	% Sat. O_2
Santa Fe Bridge (Mi. 181.5)	June 26	0	27.0	0	0	27.0	0
" " " " "	July 24	0	27.5	0	0	27.5	0
" " " " "	Aug. 7	0	27.0	0	0	27.0	0
" " " " "	Aug. 29	0.4	22.2	4	0.6	22.4	7
Rome (Mi. 178)	June 15	.95	22.6	10	.6	22.2	7
" " "	June 26	0.6	27.5	7	0.8	27.2	10
" " "	July 24	0.0	28.0	0	0.0	28.0	0
" " "	Aug. 7	0.0	....	0	0.0	....	0
" " "	Aug. 29	0.8	22.4	9	0.8	22.4	9
Spring Bay (Mi. 174)	June 14	5.75	25.9	69	1.4	22.0	16
" " " "	June 26	3.0	27.1	38	2.8	27.1	35
" " " "	July 24	1.7	28.0	21	5.1	27.5	64
" " " "	Aug. 8	0.7	....	8	4.8	....	55
" " " "	Aug. 28	2.8	22.5	32	3.5	22.5	40
Spring Bay Narrows (Mi. 173)	July 11	10.2	29.5	131	3.2	27.8	40
Mossville Station (Mi. 172)	June 13	4.1	22.4	47	1.05	20.5	11
" " " "	June 25	5.4	28.2	69	3.4	28.0	43
" " " "	July 26	3.7	26.2	46	1.3	26.0	16
" " " "	Aug. 7	...	....	..	1.1	....	12
" " " "	Aug. 8	1.3	....	15	1.3	....	15
" " " "	Aug. 28	2.8	21.8	32	2.3	21.5	26
Maple Point (Mi. 170.5)	July 9	11.4	30.0	145	3.3	28.0	42
" " " "	Aug. 8	2.8	....	35	2.6	....	30
" " " "	Aug. 30	2.1	23.0	15	1.7	23.0	20

Long Shore Beach (Mi. 169)	June 12	4.3	20.0	47	2.9	19.5	31
" " " " "	June 25	4.1	28.0	52	3.6	28.0	46
Al Fresco (Mi. 167.8)	June 11	3.6	20.4	40	3.6	19.8	40
" " " "	July 3	10.0	25.2	119	6.0	23.4	69
Peoria Narrows (Mi. 166)	June 25	4.3	28.5	55	4.1	28.2	52
" " " "	Aug. 8	3.5	....	41	3.4	....	39
" " " "	Aug. 31	2.6	23.0	31	2.9	23.0	33
U. S. Slips Station (Mi. 164)	June 22	10.4	30.0	137	4.35	27.8	55
" " " " " "	Aug. 8	3.7	....	41	3.3	....	38
" " " " " "	Sept. 5	4.3	24.4	51	4.3	24.0	51
Main Street, Peoria (Mi. 162.5)	June 20	7.2	26.2	88	5.2	25.6	65
" " " " "	June 27	3.9	27.5	49	3.1	27.0	39
McKinley Bridge (Mi. 162)	June 20	4.7	25.5	56	4.6	25.2	55
" " " "	June 27	2.3	28.0	29	2.3	27.0	28
" " " "	July 25	4.0	26.8	50	4.0	26.8	50
" " " "	July 30	4.5	25.2	55	4.8	25.2	59
" " " "	Sept. 5	4.1	25.2	50	4.2	25.2	51
P. P. & U. Bridge (Mi. 161)	Aug. 7	3.0	28.0	38	3.0	28.0	38
Wesley (Mi. 159.5)	July 10	5.5	28.8	71	5.2	28.5	67
Seven Mile Island (Mi. 157)	July 25	3.7	27.0	46	3.5	27.0	45
" " " " "	July 30	3.3	25.0	40	3.2	25.0	39
" " " " "	Sept. 5	4.1	25.0	50	4.9	25.0	60
Pekin (Mi. 153)	June 18	5.3	24.2	64	5.2	23.0	61
" " "	June 28	4.0	24.5	49	3.9	24.5	48
" " "	July 30	3.3	25.7	41	2.5	25.7	31
" " "	Sept. 6	2.8	24.8	34	2.7	24.4	33
Mackinaw (Mi. 150.5)	June 18	5.5	24.8	67	5.3	24.8	65
" " "	July 25	3.5	27.5	45	3.5	27.5	45
" " "	Sept. 6	3.0	25.0	37	5.7	25.0	71

TABLE II—DISSOLVED OXYGEN CONTENT. TEMPERATURE AND PER CENT OXYGEN SATURATION OP THE ILLINOIS RIVER. SUMMER 1924.

CHANNEL SAMPLES ONLY.

Station	Date	Top Samples: Dissolved Oxygen Parts per Million	Top Samples: Temp.	Top Samples: % Sat. O_2	Bottom Samples: Dissolved Oxygen Parts per Million	Bottom Samples: Temp.	Bottom Samples: % Sat. O_2
Santa Fe Bridge (Mi. 181.5)	June 26	1.5	24.4	18	1.4	24.4	16
" " " " "	July 8	2.6	22.8	30	2.5	22.8	29
" " " " "	July 23	4.4	26.0	54	4.1	25.8	50
" " " " "	July 28	2.1	25.8	25	2.2	25.8	28
" " " " "	Aug. 11	1.3	22.0	15	1.3	22.0	15
" " " " "	Aug. 26	3.0	24.4	36	3.0	24.1	35
" " " " "	Sept. 1	3.5	24.5	42	3.3	24.9	40
" " " " "	Sept. 12	5.3	17.0	55	4.7	17.0	48
Rome (Mi. 178)	July 8	3.1	23.0	35	2.4	22.8	28
" " "	July 23	4.6	26.0	56	3.8	25.5	46
" " "	July 28	2.2	26.0	27	1.5	25.8	18
" " "	Aug. 11	1.1	23.0	12	1.0	22.5	11
" " "	Sept. 5	4.2	21.5	47	3.4	21.5	39
" " "	Sept. 12	4.4	17.0	45	4.6	17.5	47
Spring Bay (Mi. 174)	July 8	3.6	23.2	42	2.5	22.8	29
" " " "	July 23	12.0	27.5	151	2.7	25.5	32
" " " "	July 28	3.1	26.0	38	2.6	25.6	31
" " " "	Aug. 12	1.6	20.5	17	1.2	21.5	13
" " " "	Aug. 21	5.8	24.0	68	4.7	23.0	55
Spring Bay Narrows (Mi. 173)	Sept. 12	6.2	18.0	65	6.4	17.5	66
Mossville Station (Mi. 172)	June 23	3.5	24.2	44	3.3	24.0	39
" " " "	July 23	6.9	27.0	86	2.8	25.5	34
" " " "	Aug. 12	2.0	22.0	23	1.4	21.5	15
" " " "	Aug. 21	5.7	23.0	66	5.3	22.5	60
" " " "	Sept. 5	4.9	21.5	55	3.6	21.0	40

Maple Point (Mi. 170.5)	June 23	6.8	25.0	81	4.0	24.0	47
" " " "	Aug. 12	2.3	22.0	26	1.4	21.5	16
Long Shore Beach (Mi. 169)	Aug. 7	4.9	26.0	60	4.2	26.0	51
" " " " "	Aug. 27	7.8	25.0	93	3.5	24.0	41
" " " " "	Sept. 12	7.1	19.0	76	6.4	17.5	66
Al Fresco (Mi. 167.8)	July 23	7.2	26.4	88	4.1	25.5	50
" " " "	Aug. 5	7.1	27.0	88	4.0	27.0	50
Peoria Narrows (Mi. 166)	Aug. 27	7.4	25.5	88	4.8	24.5	58
" " " "	Sept. 12	6.4	18.0	67	6.0	18.0	62
U. S. Slips Station (Mi. 164)	June 27	2.9	24.0	34	2.4	24.0	24
" " " " " "	Aug. 28	5.8	25.5	69	4.4	25.5	53
" " " " " "	Sept. 9	6.4	18.8	68	6.4	19.5	69
" " " " " "	Sept. 12	6.2	18.5	65	5.8	18.0	61
Main Street, Peoria (Mi. 162.5)	Aug. 16	3.8	22.0	43	3.5	22.0	40
" " " " "	Aug. 19	5.5	21.0	61	4.3	21.0	48
P. P. & U. Bridge (Mi. 161)	Sept. 9	6.9	19.4	74	6.9	19.4	74
Wesley (Mi. 159.5)	June 27	2.7	24.8	32	2.5	24.5	30
" " "	Aug. 1	5.9	28.5	75	5.7	28.5	73
" " "	Aug. 12	3.7	25.5	45	3.7	25.5	45
Seven Mile Island (Mi. 157)	June 27	2.8	24.6	33	2.8	24.6	33
" " " " "	July 7	3.9	22.8	45	3.9	22.8	45
" " " " "	Aug. 4	5.2	26.0	64	4.9	26.0	61
" " " " "	Sept. 9	6.9	19.0	74	6.9	19.0	74
Pekin (Mi. 153)	Aug. 4	5.4	26.5	68	5.4	26.5	68
N. W. Bridge, Pekin (Mi. 152)	July 7	3.6	23.0	42	3.4	23.0	40
" " " " " "	Sept. 9	6.0	18.0	62	5.4	18.0	56
Mackinaw (Mi. 150.5)	July 7	3.4	23.0	40	3.3	22.8	39
Kingston Ferry (Mi. 146)	Aug. 4	5.1	27.0	63	5.1	27.0	63

TABLE III.—DISSOLVED OXYGEN CONTENT. TEMPERATURE AND PER CENT OXYGEN SATURATION OF THE ILLINOIS RIVER. SUMMER 1923.

CHANNEL SAMPLES LASAIXE-CHIXLICOTHE.

KINGSTON FERRY-BEABDSTOWN.

Station	Date	Top Samples			Bottom Samples		
		Dissolved Oxygen Parts per Million	Temp.	% Sat. O_2	Dissolved Oxygen Parts per Million	Temp.	% Sat. O_2
First bridge above La Salle (Mi. 224½)...	Aug. 15	0.0	24.5	0	0.0	24.8	0
La Salle (Mi. 223)........................	July 5	0.4	22.8	5	0.3	22.5	4
" " " "	Aug. 15	0.0	25.0	0	0.0	24.5	0
Peru (Mi. 222)........................	Aug. 15	1.7	25.5	20	1.5	25.0	18
Spring Valley (Mi. 218)..................	July 5	0.0	23.5	0	0.0	23.0	0
" " " "	Aug. 15	1.7	25.5	20	1.6	25.5	19
Hennepin Canal (Mi. 210)................	Aug. 14	0.0	27.0	0	0.0	26.0	0
Hennepin (Mi. 207)......................	July 5	0.0	22.8	0	0.0	22.8	0
" " "	Aug. 14	0.0	27.0	0	0.0	26.8	0
Henry above the dam (Mi. 196).........	July 5	0.7	23.5	8	0.5	23.2	6
" " " " " "	Aug. 15	0.4	26.4	5	0.2	26.0	2
Henry below the dam (Mi. 196)...........	July 5	0.0	23.8	0	0.0	23.5	0
" " " " " "	Aug. 15	0.7	26.5	9	1.3	26.2	16
Lacon (Mi. 189).........................	July 5	4.3	25.0	51	1.2	23.0	13
" " "	Aug. 16	0.8	24.4	9	0.3	24.0	4
Lancaster (Mi. 146)......................	July 18	3.3	28.0	41	2.8	27.5	35
Spring Lake Canal (Mi. 142).............	Aug. 22	2.0	23.5	23	2.0	23.2	23
Copperas Creek Dam, below dam (Mi. 137)	July 18	1.7	26.8	21	1.5	26.8	19
" " " " " " "	Aug. 22	2.7	23.8	32	2.8	23.8	23

Copperas Creek Dam, above dam (Mi. 137)	July 18	2.3	36.5	28	2.0	27.5	25
" " " " " " "	Aug. 22	1.6	23.5	19	1.0	23.2	11
Liverpool (Mi. 128)	Aug. 22	2.6	24.0	30	0.0	24.0	0
Quiver Beach (Mi. 122)	Aug. 22	2.3	23.8	27	1.0	24.0	12
Havana (Mi. 120)	July 18	1.3	26.8	16	1.1	26.8	14
Matanza Beach (Mi. 114½)	July 17	2.0	29.0	26	1.9	29.0	24
" " " "	Aug. 23	2.3	23.0	26	2.3	23.0	26
Foot of Grand Island (Mi. 107)	Aug. 23	2.7	23.2	31	2.3	23.0	26
Mouth of Sangamon River (Mi. 98)	Aug. 23	2.9	23.2	33	2.7	23.0	31
Beardstown (Mi. 88)	Aug. 23	2.3	24.0	27	2.4	23.5	28

TABLE IV.—DISSOLVED OXYGEN CONTENT. TEMPERATURE AND PER CENT OXYGEN SATURATION OP THE ILLINOIS RIVER. SUMMER 1924.

CHANNEL SAMPLES LASALLE-CHILLTMICOTHE.

KINGSTON FERRY-BEARDSTOWN.

Station	Date	Top Samples: Dissolved Oxygen Parts per Million	Top Samples: Temp.	Top Samples: % Sat. O_2	Bottom Samples: Dissolved Oxygen Parts per Million	Bottom Samples: Temp.	Bottom Samples: % Sat. O_2
La Salle (Mi. 223)	Sept. 2	3.4	21.0	38	3.4	21.0	38
Peru (Mi. 222)	June 16	3.4	20.0	37	3.5	20.0	37
Spring Valley (Mi. 218)	June 16	3.0	20.0	33	3.0	20.0	33
N. Y. Cen. R. R. Bridge, near DePue (Mi. 214)	June 16	2.5	20.0	27	2.6	20.0	28
" " " " " " " " " "	July 10	2.0	22.5	23	1.7	22.5	20
" " " " " " " " " "	Sept. 2	2.9	22.0	33	2.9	22.0	33
Hennepin (Mi. 207)	June 16	1.7	20.5	18	1.5	21.2	17
" " "	July 25	1.3	25.0	15	0.9	24.8	11
" " "	Sept. 2	2.2	22.	24	2.0	22.0	24
Henry (Mi. 196) (above dam)	June 16	2.6	20.1	28	2.4	20.7	26
Henry (Mi. 196) (below dam)	June 16	1.5	20.8	17	2.0	20.0	22
Henry (Mi. 196)	July 9	4.0	....	45	4.1	....	46
" " "	July 10	4.7	22.5	53	4.9	22.5	56
" " "	July 25	3.0	25.0	36	2.7	25.0	32
" " "	Sept. 2	4.2	22.0	47	4.6	22.0	52
Lacon (Mi. 189)	June 16	4.5	21.0	50	2.5	20.8	30
" " "	July 9	4.0	....	45	3.7	....	41
" " "	Sept. 1	4.5	24.5	53	4.1	24.5	48
Babbs Slough (Mi. 184)	June 26	1.0	24.2	12	1.1	24.0	13
" " " "	July 23	5.4	26.0	66	4.2	25.5	52
" " " "	Aug. 26	3.8	24.5	46	2.7	23.8	44

Spring Lake Canal (Mi. 142)	July 17	4.9	24.4	58	4.5	24.4	53
Copperas Creek (Mi. 137)	July 17	5.0	24.5	59	4.9	24.5	58
Liverpool (Mi. 128)	July 17	5.2	24.8	62	5.1	24.6	61
Havana (Mi. 120)	July 17	4.9	24.0	58	4.7	25.0	45
Bath (Mi. 111)	July 18	4.4	24.0	52	4.3	24.0	51
Hickory Island (Mi. 100)	July 18	4.4	24.0	52	4.0	24.0	48
Beardstown (Mi. 88)	July 18	4.4	24.5	53	4.1	24.5	49
Head of Bar Island (Mi. 86)	July 18	4.5	24.0	54	4.7	24.8	56

A PRELIMINARY NOTICE OF A SURVEY OF THE SOURCES OF POLLUTION OF THE STREAMS OF ILLINOIS.

By G. A. Weinhold, R. E. Greenfield, with A. M. Buswell.

INTRODUCTION.

It is well recognized that the increase of the pollution of our natural streams and water courses constitutes a serious menace to one of our valuable natural resources. Even a most superficial examination of the condition of our streams is sufficient to show that their usefulness, for many purposes, has been greatly decreased. This increase in pollution of the streams affects alike the community, industry, or individual seeking an increased water supply; the vacationist seeking a suitable resort or picnic grounds, the sportsman who is desirous of testing his angling skill, or the commercial fisherman or clam digger whose livelihood depends upon the proper growth of fish and shell. "While only a superficial examination is necessary to convince one of the seriousness of this question, collected and definite statistics as to the nature and extent of wastes being introduced into the streams of Illinois, are for the most part lacking. Without such data it is difficult or impossible to determine the relative seriousness of the situation in the various streams or to lay out a reasonable and coherent plan for the alleviation or remedy of existing conditions. Because of this lack of definite figures the State Water Survey Division has recently begun to collect and tabulate information on the wastes introduced into the streams of the state. These wastes have been considered under the heading of Domestic Sewage and Industrial Wastes.

Domestic Sewage.—Information on the domestic sewage load of the various streams is more readily available than that on the industrial waste. Lists of incorporated places having sewer systems and sewage disposal plants have been prepared. Information in these lists has been collected from a variety of sources, the principle ones being:

Records of the State Water Survey Division.

Yisits by the personnel of the State Water Survey Division.

Lists of plans examined by the State Board of Health furnished by the Division of the Sanitary Engineering of the State Board of Health.

Notices, announcements of bids, articles and contractors' notes found in the various engineering magazines.

A few personal letters and interviews.

No general questionnaires have as yet been used in this part of the work. It is fully realized that much of the material in these tabulations is still incomplete or in error. Corrections are being made constantly as new information is obtained. If there are any corrections that can be furnished by the readers of this article it will be greatly appreciated. The complete list follows. It has been divided into three parts:

1. Communities having sewerage systems but dumping the unpurified sewage into a water course. No. 136.
2. Communities having sewerage. system and which treat the sewage in some sort of a sedimentation tank. No. 72.
3. Communities having sewerage systems and treating the sewage with some device in addition to sedimentation. No. 57.

The population of each incorporated place is given as taken from the 1920 census. For the most part the actual population served by the sewers in any given place will be somewhat less than the total population. It is intended to correct this population figure to show the actual population served, as soon as the necessary data can be obtained. In the present list in the cases of a few towns where the sewer system is known to be quite incomplete this fact is noted.

GROUP I.—SEWERAGE SYSTEMS IN ILLINOIS DUMPING UNPURIFIED SEWAGE IN STREAMS. TOTAL 136.

	Town	Population	Year	
1	Abingdon	2,721	1914	Sewerage system discharges into tributary of Spoon River.
2	Algonquin	693	1915	Sewerage system—Fox River.
3	Altamont	1,352	1917	Sewerage system—Coon Creek. Brockett Creek private septic tanks.
4	Alton	24,682	1914	Sewerage system—Mississippi River.
5	Assumption	1,852	1917	Sewerage system—Big George Creek.
6	Astoria	1,340	1914	Limited system — extension proposed.
7	Aurora	36,397	1917	Sewerage system.
8	Averyville	3,815	1917	Sewerage system—Illinois River.
9	Beardstown	7,111	1914	Sewerage system—Illinois River.

	Town	Population	Year	
10	Belvidere	7,804	1914	Sanitary sewerage system into Kishwaukee River.
11	Bement	1,663	1917	Sewerage system.
12	Benld	3,316	1922	Combined sewerage system.
13	Bloomington	28,725	1917	Sewerage system. Proposed Bloomington Sanitary District defeated by election twice. Bond issue defeated.
14	Batavia	4,395	1917	Sewerage system.
15	Bradley	2,128	1914	Sewerage system—Kankakee River.
16	Byron	855	1914	Sewerage system—Rock River.
17	Carbondale	6,267	1922	Sewerage system—small creek. R. A. Rollo Murphysboro proposed extensions.
18	Cairo	15,203	1917	Sewerage system.
19	Carlinville	5,212	1917	Sewerage system.
20	Carlyle	2,027	1911	Northern half town sanitary sewers into Kishwaukee River.
21	Carmi	2,667	1917	Sewerage system.
22	Casey	2,187	1911	Combined system sewerage—Embarrass River.
23	Cedar Point	686	1913	Combined system sewerage—Cedar Creek.
24	Charleston	6,615	1912	Combined system sewerage small creek to Embarrass River.
	Chicago Sanitary District			Estimated 4,000,000 combined domestic and industrial waste load.
25	Coal City	1,744	1917	Sewerage system.
26	Clinton	5,898	1912	Combined system sewerage.
27	Colfax	916	1913	Proposed combined system sewerage discharged into Mackinaw River which is dry in summer.
28	Crescent City	310	1915	Combined sewerage system. Into ditch said never to go dry.
29	Danville	33,776	1914	Separates plan sewerage. Thirty miles pipes. Into Vermilion River.
30	Dixon	8,191	1914	Combined system into" Rock River.
31	DesPlaines	3,451	1915	Combined system into DesPlaines River.
32	East Alton	1,669	1922	Sanitary Sewer System 6.9 miles. Sheppard & Morgan, Edwardsville, Engr.
33	East Peoria	2,214	1914	Sewerage system—Illinois River.
34	East St. Louis	66,767	1913	76.6 miles combined plan sewerage system. Mississippi River and Cahokia Creek.

	Town	Population	Year	
35	Edwardsville	5,336	1914	Sewerage system combined plan. Three systems all into Cahokia Creek. Fourth system dry weather, three small septic tanks.
36	Effingham	4,043	1915	Sewerage system combined plan. Too small and in poor condition. Water backs up at times of flood. Discharged into small creek which discharges to Salt Creek, thence to Little Wabash (2 miles). Nuisance in small creek.
37	Evanston	37,234	1912	73.9 miles combined plan. Five outlets to Lake Michigan.
38	Elmwood	1,242	1917	Sewerage system.
39	Farmer City	1,678	1912	One-fifth town sewered. Into Salt Creek.
40	Freeport	19,669	1912	Separate plan sewerage system. Into Pecantonic River.
41	Galena	4,742	1913	Sewerage into Galena River.
42	Galesburg	23,834	1914	Combined sewerage—Cedar Fork. Highly polluted—Herring & Fuller, Alvord & Shields, Eng.
43	Gillespie	4,063	1917	Combined sewerage plan into Bear Creek which is dry in summer. One mile pipe.
44	Granite City	14,757	1915	Sewerage system into Cabaret Slough of Mississippi River.
45	Greenup	1,230	1917	Sewerage system.
46	Greenview	755	1917	Sewerage system.
47	Hamilton	1,698	1912	Separate plan. Hamilton Slough of Mississippi River.
48	Harrisburg	7,125	1914	Combined system into Middle Forks of Saline River. Inadequate.
49	Havana	3,614	1915	Completely sewered into Illinois River.
50	Hinsdale	4,042	1917	Sewerage system.
51	Hinckley	665	....	
52	Jacksonville	15,713	1917	Three systems of combined sewers into small creeks. 1919—proposed sanitary district.
53	Joliet	38,442	1914	Mostly combined plan sewerage into DesPlaines River.
54	Kankakee	16,753	1912	Twenty-seven miles separate plan sewerage system into Kankakee River.
55	Kincaid	1,453	1914	Five miles separate type. Into gulley near South Fork of Sangamon River.
56	Kenilworth	1,188	1911	4.7 miles combined plan sewers into Lake Michigan.

	Town	Population	Year	
57	Knoxville	1,708	1917	No sewerage system. Fifteen private sewage disposal plants built by Russell Sewage Disposal Co.; discharge into very small streams.
58	Ladd	2,040	1913	2½ miles combined system. Into ravine, to Spring Creek. Have had complaints.
59.	Lawrenceville	5,080	1912	Three sewerage districts. Into Embarrass River.
60	LaSalle	13,050	1911	Combined system to I and M. Canal. Septic tank proposed.
61	Lemont	2,322	1917	Drains to Illinois River.
62	Lexington	1,301	1917	Sewerage system.
63	Lincoln	11,882	1912	No adequate disposal. Sewerage system into small creeks which are dry in summer.
64	Litchfield	2,684	1915	Combined sewerage system. Few houses connected. Into West Fork of Shoal Creek.
65	Lockport	2,684	1915	Nine miles combined plan sewers into DesPlaines River.
66	Lyons	2,564	1915	Sewerage system into DesPlaines River.
67	Madison	4,996	....	
68	Marengo	1,758	1914	4.3 miles sewers. Into Kishwaukee River. W. S. Shields, Engineer.
69	Marseilles	3,391	1915	7.1 miles combined plan sewerage system. Into Illinois River.
70	Marshall	2,222	1914	Combined plan. Three outlets to a tributary of Little Wabash.
71	Mattoon	13,522	1914	Twenty-five miles sewers when proposed are complete. One-half town now sewered into Kickapoo Creek.
72	Melrose Park	7,147	1912	Combined sewerage system into DesPlaines River. Complaints by Riverside.
73	Metropolis	5,055	1915	One-half town sewered. Into Ohio River.
74	Milford	1,466	1917	Sewerage system.
75	Minonk	2.109	1914	Two systems. Discharged into ditch causing nuisance and complaints.
76	Minooka	314	1913	Sanitary system sewers proposed to discharge into DuPage River.
77	Moline	30,734	1913	57.7 miles sewers on separate plan small part through Imhoff and chlorinated before discharged into Mississippi River.
78	Morrison	3,000	1914	Combined system. Six outfalls into Rock Creek.

	Town	Population	Year	
79	Mound City	2,756	1922	Sewerage system, combined five miles. Price & McCormick, Des Moines, Iowa, Engr.
SO	Morris	4,505	1922	7.6 miles combined sewerage system. Consoer Eng. Co., Chicago., Engineers.
81	Monticello	2,280	1917	Sewerage system.
82	Mt. Vernon	9,815	1917	Sewerage system.
83	Mt. Carmel	7,456	1917	Sewerage system.
84	Mt. Carroll	1,806	1917	Sewerage system.
85	Murphysboro	10,703	1917	Sewerage system.
86	Niles Center	763	1918	Three miles sewers into Chicago Drainage Canal. Harry Emerson, Chicago, Engr.
87	Normal	5,143	1912	Sewerage system. Sugar Creek.
88	Oglesby	4,135	1913	Sanitary sewers. Vermilion River.
89	Onarga	1,302	1913	Proposed combined sewerage sys tern Spring Creek. Spring Creek to Kankakee River.
90	Oregon	2,227	1914	Four miles sewers combined plan. Rock River.
91	Ottawa	10,816	1917	
92	New Athens	1,406	1922	5.8 miles sanitary sewers. Stanley Krebs, Belleville, Engr.
93	Niles	1,258	1922	2.8 miles combined plan sewers system, Consoer Eng. Co., Chicago, Engr.
94	Park Ridge	3,383	1922	Combined sewerage system. Des Plaines River.
95	Pekin	10,000	....	Sewerage system, Illinois River.
96	Peoria	66,000	....	Sewerage system, Illinois River.
97	Peru	8,869	1913	Combined sewerage system, Illinois River.
98	Petersburg	2,432	1913	About ten miles sewerage system, Sangamon River; A. B. Alexander, Decatur, Engr.
99	Plainfield	1,147	1912	3.85 combined plan. DuPage River. H. D. Hallett, Aurora, Engineer.
100	Paxton	3,033	1917	Sewerage system.
101	Quincy	35,918	1917	Sewerage system.
102	Riverdale	1,166	1915	1.6 miles combined sewerage system. Little Calumet River.
103	River Forest	4,358	1917	Sewerage system.
104	Rockdale	2,532	1915	Combined plan. Illinois-Michigan Canal.
105	Riverside	2,532	1914	Combined sewerage system Des Plaines River.
106	Rockford	65,651	1917	Sewerage system into Rock River.
107	Rock Island	35,177	1915	General sewerage system. Mississippi River.

	Town	Population	Year	
108	St. Anne	1,067	1915	3.4 miles sewers; Little Beaver Creek; R. D. Gregg,' Kankakee, Ill.
109	St. Elmo	1,337	1917	Sewerage system.
110	Savanna	5,237	1915	Five miles sanitary sewers Mississippi River.
111	Schiller Park	390	1922	Combined sewer system. 2.6 miles. Consoer Eng. Co., Chicago.
112	Shelbyville	3,568	1913	Eleven miles sewers. Robinson Creek to Okaw River. System in very poor condition.
113	Silvis	2,541	1913	Sanitary sewers—Rock River. H. G. Paddock, Moline, Ill.
114	Springfield	59,183	1913	General system empties into Spring Creek to Illinois River.
115	Spring Valley	6,493	1914	Combined system serving two-thirds the population. Spring Creek to Illinois River.
116	South Beloit	1,436	1922	Combined sewer system. 14.3 miles.
117	Sterling	8,182	1917	Combined plan. Rock River.
118	Streator	14,779	1917	Combined plan. Into Coal Run Creek to Vermilion. Tank 1910.
119	Rock Fal's	2,927	1917	Combined plan. Rock River.
120	Sycamore	3,602	1913	Eight miles combined plan. Into Kishwaukee River.
121	Taylorville	5,806	1913	Complete sewerage. South Fork of Sangamon River.
122	Tuscola	2,564	1914	Proposed sewerage system.
123	Vandalia	3,316	....	
124	Virginia	1,501	1913	Sewerage system.
125	Warsaw	2,031	1912	Proposed 6% miles on separate plan. Mississippi River.
126	Washington	1,643	1912	One-fifth sewered. Small creek dry in summer.
127	Watseka	2,817	1912	Incomplete system. Iroquois River and Sugar Creek.
128	Waukegan	19,226	1912	Forty miles sewers. Lake Michigan.
129	West Dundee	1,594	1915	Sewerage system.
130	Western Springs..	1,258	1915	Sewerage system. Salt Creek to Des Plaines River.
131	West Hammond..	7,492	1914	Complete sanitary sewers. Calumet River.
132	Wilmette	1,384	1914	Fifteen miles sewers. Lake Michigan.
133	Wilmington	1,384	1912	Proposed 4.23 miles semi-combined Kankakee River.
134	Yorkville	441	1914	Proposed sewerage to Fox River. 3800 feet.
135	Zion City	5,580	1917	Sewerage system.

GROUP II.—SEWERAGE SYSTEMS IN ILLINOIS INCLUDING TREATMENT WITH SOME SORT OP SETTLING TANKS.
TOTAL 72.

	Town	Population	Year	
1	Amboy	1,944	1922	Two Alvord type tanks 8x16x17. Total settling capacity 18,600 gal. Sludge capacity 75 cu. yds.
2	Anna	3,019	1922	Two septic tanks (1912) 63x12x6. Total capacity 33,530 gal. Sludge capacity 97 cu. yds. Taylor & Woltman, Bloomington, Engrs.
3	Anna State Hospital		1913	Septic tank. A nuisance.
4	Area	420	1917	3.4 miles sewers. Imhoff tank. Effluent to ditch to Des Plaines River, W. A. Studer, Libertyville.
5	Arthur	998	1922	6.36 miles sanitary sewers. Holbrook, Warren & Van Praag, Decatur. Ill., Engrs.
6	Atlanta	1,173	1913	Septic tank.
7	Belleville	24,823	1913	Three septic tanks—dry weather flow only is passed through. Other times directly into Richland Creek. Tanks 60'x30'xll', 54'x21'xl5' and 54'x21'xl5'. 1915 pollution damage suit.
8	Benton	7,201	1914	Emscher tank.
9	Canton	10,928	1914	Dry weather flow through septic tanks 70'x60'x6', 40'x30'x6', then into Big Creek. Odors in summer have caused complaints.
10	Carrollton	2,020	1915	Through septic tank into Macoupin Creek.
11	Carthage	2,129	1912	A tank 40'x80'x5'4" deep is cut by dividing walls into thirty-two compartments 10 ft. square. (Russell system sewage disposal). Discharge into small creek off Crooked Creek.
12	Carey	463	1922	Septic tank and Imhoff tank.
13	Centralia	12,491	1914	Two septic tanks (125'xl9'x5'), (120'xl4'x7').
14	Collinsville	9,753	1907	Sewage discharged into small creek.
15	DuQuoin	7,285	1914	Circular septic tank 40' diameter 10'—66,000 gal. capacity, discharge into open ditch of small water-shed.
16	DePue	2,552	1914-15	Tanks.
17	Eldorado	5,004	1914	Septic tank.
18	Elgin	27,454	1914	Proposed. Intercepting sewer to Fox River.
19	Edwardsville	5,336	1921	Tanks.

	Town	Population	Year	
20	Findlay	882	1917	Four sedimentation tanks of Emscher Eng. News type with screen and grit chambers and sludge bed for each tank. Based on two hour retention in dry weather flow. 3,000,000 gallons flow gives three hour retention period.
21	Flora	3,558	1917	Separate sewerage system. The sanitary sewage through a tank of 100,000 gallons capacity into Seminary Creek. The tank is divided into two chambers and one used at a time. Each chamber divided into four parts by three baffle walls.
22	Geneseo	3 375	....	Tanks.
23	Geneva	2,803	1914	Sewerage system into Fox River. Proposed two story tank to give 1.6 hrs. retention of 200,000 gal. flow per day and storage for nine months sludge. W. S. Shields, Chicago, Engrs.
24	Georgetown	3,061	1914	Combined system sewers with 4,000.000 gallons per day capacity. A septic tank 57.600 gallons capacity gives seven hours retention on 200.000 gals. Branch of Little Vermilion which goes dry in summer.
25	Gibson City	2,234	1917	
.26	Grayslake	736	1915	Proposed Imhoff tank.
27	Herrin	10,986	1915	Proposed separate system sewerage through septic tank to small stream to Big Muddy River.
28	Hillsboro	5,074	1923	Septic tank.
29	Hoopeston	5,451	1916	Eleven miles of sewers. Septic tank of two parts each 81xl2'x7½' deep. Total capacity 109,200 gallons. Gives 8 hr. retention on 350,000 gal. per day flow. Discharge with drainage ditch to North Fork of Vermilion.
30	Jerseyville	3,839	1914	Sanitary sewers to Macoupin and Otter Creek. Septic tank hut not used.
31	Kewanee	16,026	1913	Septic tank of two parts each 8'x37'x5⅓' deep. Total capacity 24,000 gallons. Effluent into small creek is putrescible and causes complaints in summer time.

	Town	Population	Year	
32	Lake Bluff	819	1922	One Imhoff tank 46'x23'x28' with settling capacity 46,700 gallons and sludge capacity of 150 cu. yds. One contact tank 11'x7'x6' capacity 3,900 gallons. Not in use. Pearse, Greeley & Hanson, Engrs.
33	Lake Zurich	316	....	Septic tank.
34	Libertyville	2,125	....	Eighty-five per cent of town connected to sewerage system. Two septic tanks, each 56'x8'x6½' located 1700 ft. from Des Plaines River.
35	Macomb	6,714	1914	Thirteen miles sewers. Settling tank 15'x50'x5½' deep, giving retention of two hours. Sludge dumped into same ravine as effluent after heavy rains. Effluent to Jordan Creek which has no dry weather flow.
36	Manteno	758	1914	Septic tank 15'x20'x7' for small area. Effluent to small stream. Proposed new sewerage system for town.
37	Marion	9,582	1916	Septic tank; Frank Payne, Engr.
38	McHenry	1,146	1922	Two Alvord type tanks—total settling capacity of 17,000 gal. and sludge capacity of 73 cu. yds. Dimensions 9x18x11. Alvord & Burdick, Engrs.
39	McLeansboro	1927	1912	Sanitary sewers for half town. Septic tank. Effluent to small stream.
40	Momence	2,218	1914	Combined system divided, one to serve north side, one the south side. To Kankakee River, north side sewage passing through settling basin 23'x50'.
41	Monmouth	8,116	1912	Combined system sewers seventy-five per cent of town into branch Cedar Creek. Dry weather flow through a septic tank 7'x40'x75'.
42	Morton Grove	1,079	1914	Imhoff.
43	Mt. Morris	1,250	1913	Septic tank for Mt. Morris school.
44	Mt. Olive	3,503	1922	5.8 miles sewer extension. Two Imhoff tanks total capacity 37,000 gals and 500 cu. yds. sludge capacity. Each 48'x33'x29'. Holbrook, Warren & Van Praag.
45	Naperville	3,830	1915	Eleven miles sewers. Septic tanks with inlet chamber and two settling chambers each 12'6"x36'x7'6". total capacity 50,600. Based on 350,000 gal. flow gives retention 3½ hours. Into a ditch near DuPage River.

	Town	Population	Year	
46	Neoga	1,149	1920	Septic tank.
47	Nokomis	3,465	1920	Septic and Imhoff tanks.
48	Newton	2,083	....	Tank.
49	Oblong	1,547	1915	2.2 miles sewers. Septic tank 10'x60'; effluent into a dry ravine. G. W. Low, Olney, Engr.
50	Palatine	1,210	1914	Combined system, screens, grit chambers, Imhoff tanks.
51	Palestine	1,803	1914	Sec. G. Imhoff.
52	Paris	7,985	1912	Sanitary sewer serve seventy-five per cent with outlet into ditch near Sugar Creek. Flows through septic tanks of two compartments each 7'xl0"x42'4"x7' deep. Total 17,500 gallons.
53	Pinckneyville	2,649	1919	Septic tank.
54	Pontiac	6,664	1921	Tank.
55	Peotone	1,090	1914	Tanks.
56	Rankin	944	1914	Proposed 3.8 miles sewers into a small creek. Septic tank for dry weather flow only 30'xl4'x8' deep, capacity 25,000 gallons a day, giving nine hour retention.
57	Rantoul	1,551	1917	Chanute Field. Tank of two compartments handles 60,000 gallons a day. Effluent to Upper Salt Fork.
58	Robinson	3,375	1914	Separate plan sewerage. Through septic tank, S4'xl6'x9', 90,000 gallons capacity and into ditch along LaMotte Creek.
59	Rochelle	3,310	1914	Seven miles sanitary sewers. Through septic tank of two compartments each 10'x4"x60'4"x7' deep with capacity 66,000 gallon (total). Based on 180,000 gallons flow a day gives 8¾ hour retention. Effluent to Kyte Creek.
60	Roseville	952	1916	Proposed 4½ miles sanitary sewers and sedimentation tank. A. T. Miltby, Chicago, Engr.
61	Royalton	2,043	1922	8.3 miles sanitary sewers and septic tank 44x22x10 with capacity 30,000 gallons and 25 cu. yds. sludge. Pierce & McCormack, Des Moines, Iowa.
62	Saint Charles	4,099	1915	14.3 miles sewers. Two story settling tank 60'x25'xl8', 20,000 gallons settling capacity and 20,000 gal. sludge compartment capacity. Effluent to Fox River. W. S. Shields, Chicago.

	Town	Population	Year	
63	Salem	3,457	1917	Twelve miles sewers. Two' Imhoff tanks sedimentation chamber 33½'x8'x6' deep or 24,000 gal. capacity. Sludge digestion chamber below of 10,630 cu. ft. capacity or fourteen months storage. Sewage flow 300,000 gal. per day gives two hour retention. Effluent to Crooked Creek. Sludge bed 92'x60'.
64	Sheridan	476	1922	2.9 miles sanitary sewers, one septic tank 26,200 gal. capacity and 465 cu. yd. sludge capacity. Dimensions 36'x20'xl0'. Marr-Green & Co., Chicago, Engrs.
65	Toluca	2,503	....	Tank.
66	Wenona	1,203	1915	Proposed system and septic tank.
67	West Frankfort	8,47S	1917	Tanks.
68	Wheaton	4,137	1917	Storm and sanitary sewers. Septic tank. Effluent to Spring Brook.
69	White Hall	2,954	1913	Sanitary sewerage. Septic tank. Effluent to tributary of Apple Creek.
70	Winnetka	6,694	1912	Thirty-one miles sewers combined and separate Cameron septic tank 50'x20'x8' deep for part discharged in Skokie Creek. Rest to Lake Michigan untreated.
71	Wyoming	1,376	1915	Two miles sewers. Tank 14'x24'x4' deep. Effluent to ditch along Spoon Creek.
72	Zeigler	2,338	1922	8.5 miles sanitary sewers. Two septic tanks each 40'x40'x10'. Total capacity 79,000 gallons and 220 cu. yds. sludge. E. A. Cox, West Frankfort.

GROUP III. SEWERAGE SYSTEMS IN ILLINOIS INCLUDING TREATMENT WITH SETTLING TANKS PLUS SOMETHING IN ADDITION. TOTAL 57.

	Town	Population	Year	
1	Aledo	2,231	1912	Complete sanitary sewerage. No stream near by so treat by sedimentation in two story tanks followed by passage through percolating filters. Under superintendent of water works. Not well attended. SettLng tank 61'x9"xl8', settling chamber proper 15'x50'x8', capacity 5,625 gallons. Retention period one hour assuming sixty gallons flow daily per capita. Three filter units capacity 4,000,000 gallons a day—drained by broken tile. Effluent 200 ft. to creek. Sludge beds (1915) 30'x30'x3 ft., cinder 6", sand with tile underdrain. Not used.
2	Antioch	775	....	Tanks.
3	Arlington Heights.	2,250	1915	Grit chamber, settling . tanks ot 42,000 gallons capacity, dosing chamber 7,700 gallons per dose, six intermittent sand filters total 57 acres.
4	Arlington Village..	2S4	1912	Tank and sand filter.
5	Ashton	882	1915	Proposed septic tank and sand filter.
6	Barrington	1,743	1914	Screen and grit chambers, Imhoff tank dosing chamber with automatic dosing devices, four sand filters total .385 acres. Imhoff has two sedimentation chambers 20'x 5½'x5' and sludge chamber 7,720 gallons capacity in charge of town marshal.
7	Bushnell	2,716	....	Tanks.
8	Cambridge	1,335	1919	Discharge into creek along Rock River. Two story settling tank dosing chamber two unit sand filter and sludge bed. Filters not cared for and out of commission.
9	Chicago Heights. ..	19,653	1917	Two compartment septic tank and contact bed. Recently rebuilt.
10	Christopher	3,830	1922	Secondary sedimentation tank and three trickling filter units each 48x46x6 or total. .158 acres. Caldwell Engr. Co., Jacksonville, Ill.
11	Crete	945	1915	Proposed tank and filters. Drainage into Goose Creek which is too small to handle sewage.
12	Crystal Lake	2,249	1910	Tanks.

	Town	Population	Year	
13	Cuba	1,484	1915	Proposed but not all approved. Six miles approximately of sewers, into branch of Big Creek, then to Spoon River to Illinois River. Plant. Valve chamber 5'x3½'x4' deep. Two primary sedimentation tanks 45'x7' deep and 10' and. 6' wide respectively with capacity 23,500 gallons and 14,200 gallons. Based on 200,000 flow gives 4½ hours retention. Secondary sedimentation tank 4½'x 17'x7' deep. Roughing filter—Bed of coke 2½' deep by 8' wide in direction flow and 17' weir and 10" pipe to creek.
14	DeKalb	7,871	1915	16.4 miles sewers. Kishwaukee River plant. To handle 400.000 gallons flow day. Concrete grit chamber 40'x6'x6', settling tank 60' long—two units 20' wide by 6' deep or 54,000 gallons capacity each unit. Settling period three hours. Two dosing chambers 20'x30'x2.5', dose 11.250 gallons time. Trickling filter 160x70 area. 23 acre 6'9" crushed stone and gravel sludge basin 50'x60". C. D. Hill, Chicago, Engr.
15	Downers Grove ...	3,543	1915 1922	Treatment plant (1905) included septic tank—60'x18'x8' capacity 64,000 gal. giving five hour retention. Dosing chamber 10' square, six sand filters changed in 1910 to crushed rock filters total area .25 acres. Have received no attention and are usually clogged. Effluent to small creek. St. Joseph Creek.
16	Dwight	2,255	1914	6.1 miles "sewers. Filters, 6" coarse cinders underlain 8" drain tile 125'x20' at bottom—125'x40' at top —2500 sq. ft. filtering surface. Dry weather flow is 170,000 gallons a day. Filter must operate at 3,000,000 gallons per day. Effluent into Gooseberry Creek gives bad odors at times. (1922) sewers outlet extension 0.22 miles and new Imhoff tank 45'x23'x24' with capacity of 32 300 gal. and 131 cu. ft. sludge. Consoer Engr. Co., Chicago, Eng. Sludge beds.
17	Earlville	1,012	1914	Imhoff tanks and percolating filters.
18	Elmhurst	4,594	1922	Imhoff tanks and sand filters.

	Town	Population	Year	
19	Fairfield	2,754	1917 1915	Sanitary sewers and disposal plant. Effluent into Johnson Creek which has no dry weather flow. Sewage flow 150.000 to 200,000 gallons per day. Inlet chamber 5'x3½'x4' deep, 2 septic tanks 10'x45'x7', 23,600 gals.; 6'x45'x7', 14,180 gals. Retention 2.8 hour, 1.8 hour; retention together 4.6 hour. Coke filter 17'x8'x3' deep—poor strainer, easy clogged outlet chamber.
20	Farmington	2,631	1914	Tanks.
21	Sheridan		1912	Two hydrolytic tanks—16'x65'x11' giving retention period of five hour using one tank, of ten hours using both. The sludge deposits go to sludge digestion tank 16'x40'x5½'. Two settling tanks 18' diameter 6' deep give retention of one or two hours. Sprinkling filters—113'x79' x7' with forty sprinkling nozzles. Filter material broken stone. Sedimentation and sand sludge drying beds. Three of latter each 18'x40', 400,000 gallons flow per day treated.
22	Galva	2,974	1912	Sanitary sewers—two systems, one north and one south part of town. South plant sedimentation tank 10'x30'x9', 43,875 gallons per day with eight hours retention. Trickling filter—two units 14'x34' or .022 acre with 5½' cinders as filter material. Filtration rate 2,000,000 gallons per acre per day. Filters in poor condition. Grit chamber 4'xl0'x6'6" 1922. Plans for plant for southwest district. 1911 North plant. 1911. 'Grit chamber 2'6"x 3'3"x3'7", two story tank—4'x21 in settling part or 2,200 gallons. Sludge part: 2' deep, 5,460 gallons capacity. Dosing apparatus. Trickling filter 21'x45' or .022 acre; filter material broken tile 7'6" deep. Sludge bed.
23	Genoa	1,228	1915	Screens. Grit chamber—180 gallons capacity. Emscher settling tank two compartments 75,000 gallons each 50' square cross section 20' long. Sludge part 20 cu. yds. capacity. Sludge bed 40'x25' or 1,000 sq. ft. Sand and gravel 15" deep and tile. Effluent into Kishwaukee River.

	Town	Population	Year	
24	Glencoe	3,381	1911	Sanitary sewerage system. Bast side—Cameron septic tank. Four primary and secondary filters. Effluent to Lake Michigan. West side —Two tanks 50'x20'. Effluent to ditch to North Chicago River.
25	Glen Ellyn	2,851	1914	Screen and grit chamber 4'x15'x5'. Two sedimentation tanks 48,690 gallons and 94,990 gallons. 11½ hour retention. Dosing chamber—8.290 gallons at time. Four trickling filters 33'x80'x5½' deep or .243 acre. Sludge bed.
26	Glenview	760	1916	Tank and contact bed.
27	Greenville	3,091	1915	Septic tank of two compartments each 41'x15'x6'4" with 29,000 gallons capacity. .2 acre gravel pit to filter settled sewage. 75,000 gallons flow per day giving nine hours retention. 375,000 gallons per acre per day on filter.
28	Harvard	3 294	1914	7.6 miles sewers on separate plan. Inlet chamber 6'x3'x4' deep. Septic tank—two compartments 12'x60'x9' 6" deep. Capacity each 51,400 gallons. Aerating ana dosing chamber. Aeration obtained by falling and splashing into dosing chamber. Latter 24'x15'x1.63' deep. One dose 4,600 gallons or once every sixty-five minutes. Six filter beds each 50'x75' or 375 sq. ft. total .52 acre. 24" sand and 12" gravel. Rate 18,500 gallons per acre per day. 100,000 gallons per day treated. Sludge goes to lagoon next septic tank. Effluent to Kishwaukee River. Plant in good condition.
29	Highland	2,902	1913	Proposed sewerage system and treatment.
30	Highland Park	6,167	1922	Seven separate sewerage districts. Sewage treatment plant for Deerfield Ave. District. Imhoff tank—42x22x27' capacity, 33,300 gallons and 111 cu. yds. sludge. Secondary sedimentation 19x17 (radial) 7,600 gallons and 6.7 cu. yds. sludge capacity. Sprinkling filter 50x59 or .068 acres. Park Ave. District (5 districts). Two Imhoff tanks 50x 26x24 total capacity 90,000 gallons and 533 cu. yds. sludge. Contact tank 18'x18'x9' of 10,000 gallons capacity. Pearse, Greeley and Hansen, Engineers.

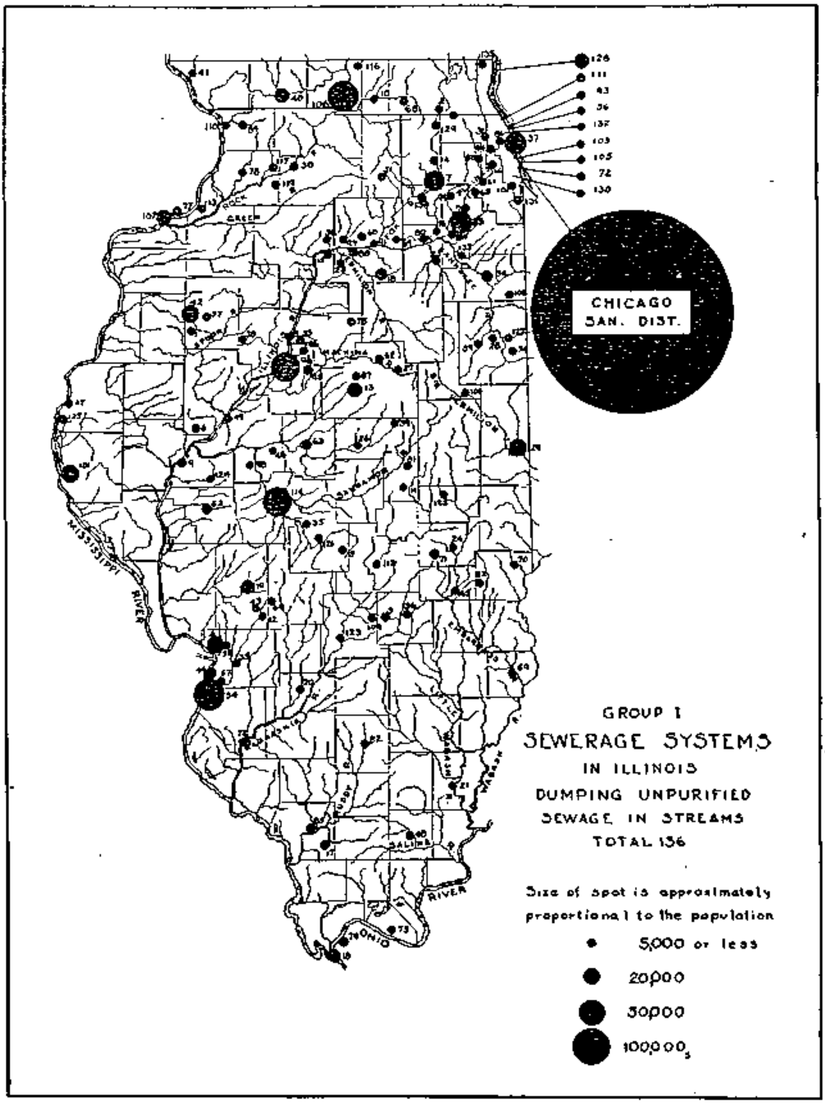
	Town	Population	Year	
31	Highwood	1,446	1922	Imhoff 62x22x31—capacity 66,700 gallons and 222 cu. yds. sludge. Secondary sedimentation — 19x17 (radial) 16,100 gallons capacity and 24 cu. yds. sludge. Sprinkling filter 75x74 area. 127 acres. Pearse, Greeley & Hansen.
32	Johnston City	7,137	1922	Imhoff—39x20x23—capacity 27,200 gallons and 143 cu. yd. sludge. Two sprinkling filters 60x124 total area .171 acres." D. B. Wilson, Marion.
33	LaGrange	6,525	1915	Combined system sewerage. Septic tanks. Sprinkling filter 190'xS3'x6' deep. Broken stone. Area .344 acres. Poor condition. Built for 5,000 population. Effluent to Salt Creek to Des Plaines.
34	LaGrange Park	1,684	1912	Tank and percolating filter.
35	L'ake Forest	3,657	1913	Septic tanks and intermittent filters for portion sewage. Effluent to Lake Michigan.
36	LeRoy	1,6S0	1916	G. tank and sand filter.
37	Lewistown	2,279	1914	Separate system; septic tank, two units 60'xl0'x8', total capacity- 54,-000 gals. Grit chamber 2'x2'—660 gallons capacity. Effluent to Speedway Creek. C. W. Brown, Engr.
38	Lombard	1,331	....	Imhaff tanks and sand filters.
39	Matteson	4S5	1914	Proposed sewerage system and treatment plant.
40	Mendota	3,934	1914	Three-fourth town sewered—7.64 miles. Four intermittent sand filters each 75'x300', total two acres, 20" sand—seven rows 5" tile. Small grit chamber. Septic tank to be built. Sewage is led on alternate beds each week one at a time. Filter rate 570,000 gal. per acre per day. 8.2 miles sewers proposed. Effluent into Mendota Creek.
41	Moline	30,734	1921	Part screens.
		5,000	1913	Part contact beds.
42	Morton Grove	....	....	In Sanitary District, Chicago, Ill.
43	Mounds	2,661	1915	3.4 miles sewers. Septic tank, 70'x20'xl0'—capacity 105,000. gallons. 200,000 gallons flow a day gives twelve hour retention. Filter 83'x53'. Filter material 5" broken stone and 8" cinders. Not cared for. Effluent to slough of Ohio River.

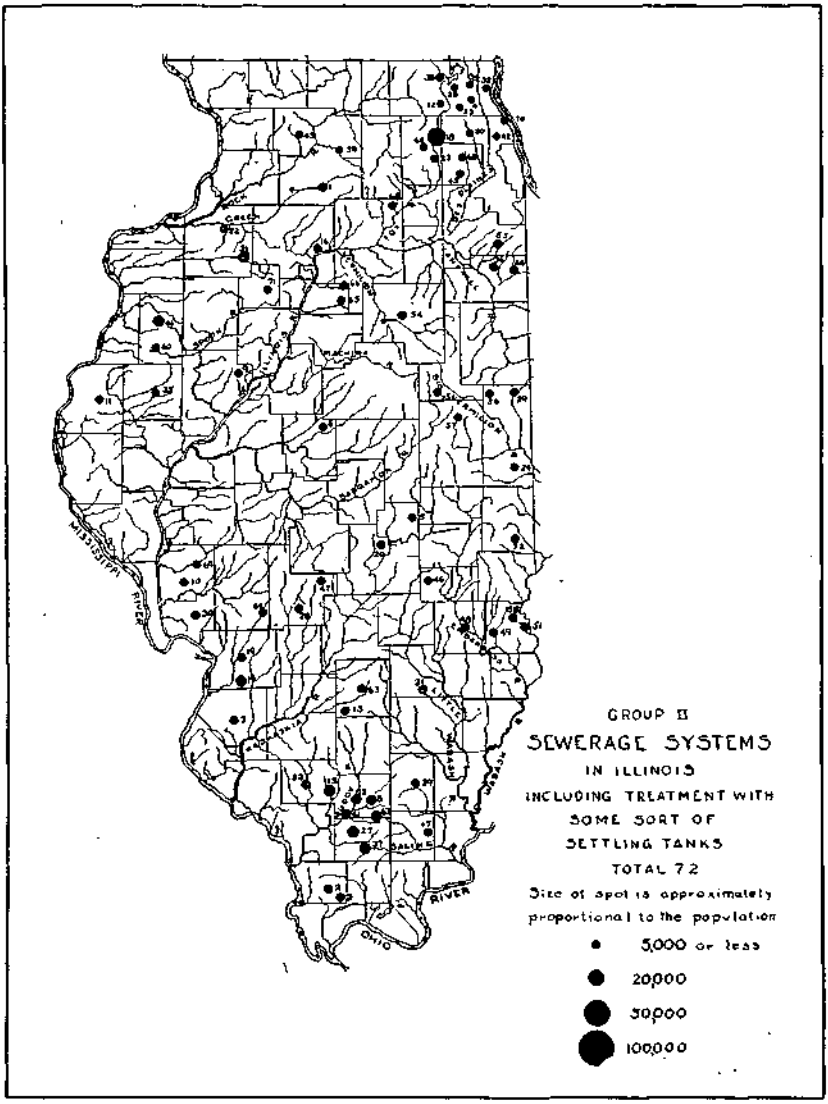
	Town	Population	Year	
44	North.Chicago	5,839	1913	Septic tanks and percolating filters.
45	Olney	4,491	1914	Two Imhoff tanks; two dosing chambers, 14,500 gallons capacity. Eight intermittent filters .11 acre x 8 =.88 acres. Filter load 568,000 gal. per acre per day. Sludge bed—100 days sludge in digestion chamber. 500,000 gallons flow a day, retention 1¾ hours. W. S. Shields.
46	Palestine	1,803	1918	Imhoff tanks and sand filters.
47	Pana	6,122	1915	Plant. Grit chamber, trickling filter, dosing chamber, 2nd settling tanks, sludge beds, Sell & Kohler, Pana, Ill.
48	Piano	1,473	1915	Separate system sewerage. Septic tank—two units each 60'x9½'x¾'—inlet. 60'x9½'x7¼'—outlet, total capacity 51,200 gallons. Based on 75,000 gallons flow retention five hour one unit. Sprinkling filters. Effluent Big Rock River to Fox River. H. D. Hallett, Aurora.
49	Polo	1,867	1907	Tank and contact bed abandoned.
50	Princeton	4,126	1914	Fifteen miles sewers. Complete. Septic tanks — 55'x20'xl2'—100,000 gal. capacity; four compartments, one of which can be cleaned while others are being operated. 350,000 gallons flow day gives retention seven hours. Trickling filter. 45x 45x8 or .046 acres. Filter material broken stone and tile. Filter load 7,600,000 gal. per acre per day equivalent to population of 90,000 people.
51	Sandwich	2,409	1914	Sanitary sewerage system 100,000 gallons flow per day. Two—two story settling tanks each 66,000 gallons. Sludge chamber 62 cu. yds. Dosing chambers 25'xl2'9"x2' deep, 4,780 gallons per dose or doses (42) a day. .7 per filter. Six sand filters. 75'x50'. Total .516 acres. Filter sand 27" deep load 390,000 gal. per acre per day pop. load 3,900, sludge bed 20'x30.
52	Sparta	3,340	1916	Proposed separate system. Septic tank and filters. Marys River tributary.
53	Toulon	1,235	....	Tank and percolating filter.

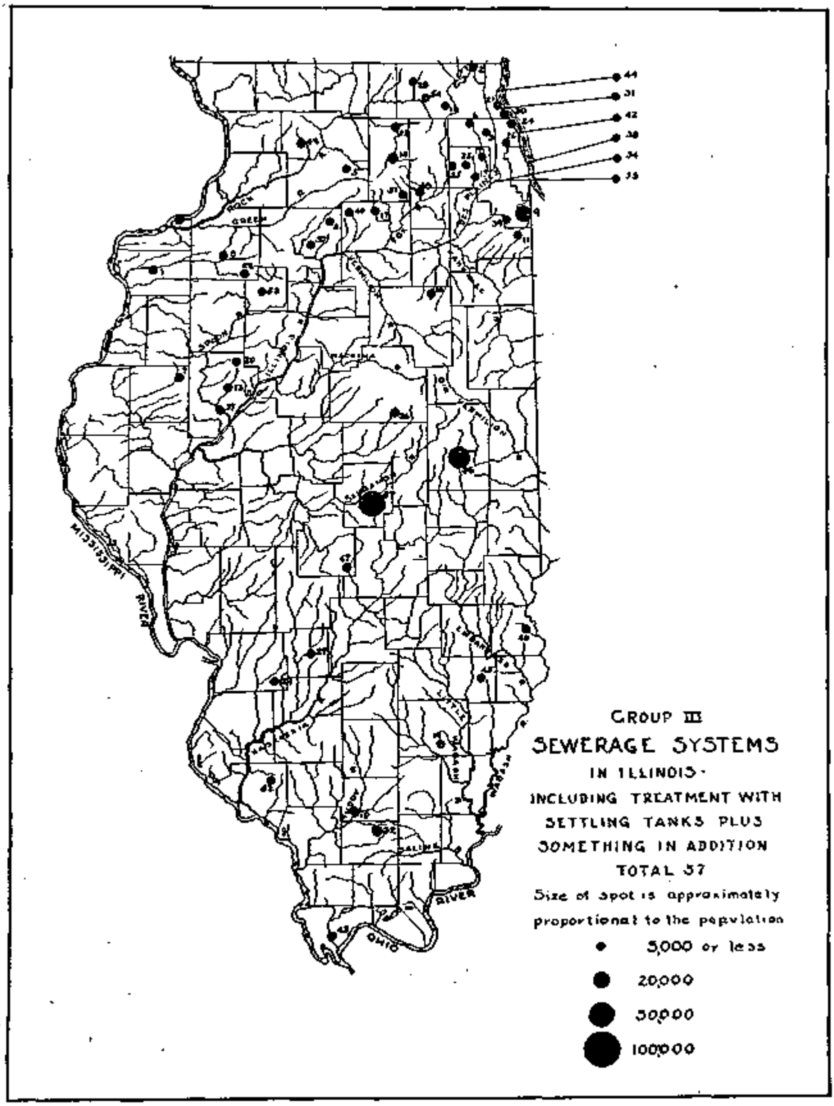
	Town	Population	Year	
54	Woodstock	5,523	1914	Twenty-two miles sewers. 1,300,000 + gallon per day flow capacity. Diverting chamber. Septic tank—two parts each 80'x14'x8'. Capacity 150,000 gallons retention ten hours. Dosing chamber 30'x20'. Two groups, four each, intermittent sand filters. 55x50—total .5 acre. 12" sand—12" gravel—12" stone. Load 736,000 gallons per acre per day. Population load 9,200.
55	West Chicago	2,594	191S	Imhoff tanks and sand filters.
56	Champaign-TJrbana.	26,117	1924	Imhoff tanks and sprinkling filters.
57	Decatur	43,818	1923	Imhoff tanks and sprinkling filters.

In order to show the geographical distribution of this sewage load a spot map has been prepared from each division of the list. The size of each spot has been made approximately proportional to the population of the place. The names of the towns have not been placed on the map since this would cause considerable crowding, but each spot on the maps has been numbered to correspond with the number found in the list of cities.

Examinations of these maps show that certain rivers in the State are receiving a large load of untreated or partially treated sewage, notably the upper Illinois and, to a considerable extent, the Rock River. Most of the tributaries of the Illinois River are not burdened to the extent that the main river itself is. In the northern part of the State, the Kankakee and Iroquois River do not carry sewage from an extremely large population nor does the Fox. Both of these are fairly good sized streams. The Sangamon is carrying the unpurified sewage of only one city of any considerable size, that is Springfield. In the south as far as sewage systems go the rivers are not heavily burdened. Some rather important industrial wastes, notably, those from mines and oil wells, constitute a menace, however, to many of these southern rivers. It is to be noted that there is not a single water course of any considerable size in the State which is not receiving at least some purified or partially purified sewage. It is also true that while there are a considerable number of towns purifying their waste by passing through some rather complete sewage disposal plant in a large per cent


CHICAGO SAN. DIST.
GROUP I
SEWERAGE SYSTEMS
IN ILLINOIS
DUMPING UNPURIFIED
SEWAGE IN STREAMS
TOTAL 136
Size of spot is approximately proportional to the population
5,000 or less
20,000
50,000
100,000
MISSISSIPPI RIVER
OHIO
RIVER


GROUP II
SEWERAGE SYSTEMS
IN ILLINOIS
INCLUDING TREATMENT WITH
SOME SORT OF
SETTLING TANKS
TOTAL 72
Size of spot is approximately
proportional to the population
5,000 or less
20,000
50,000
100,000
MISSISSIPPI RIVER
OHIO RIVER
WABASH


GROUP III
SEWERAGE SYSTEMS
IN ILLINOIS -
INCLUDING TREATMENT WITH
SETTLING TANKS PLUS
SOMETHING IN ADDITION
TOTAL 57
Size of spot is approximately
proportional to the population
5,000 or less
20,000
50,000
100,000
MISSISSIPPI RIVER
OHIO RIVER
WABASH

of the cases it has been found upon inspection that these plants are poorly kept up and doing little if any good.

Industrial Wastes.—The collection of information concerning industrial waste is much more difficult; there seems to be no general source of information which will suffice in this study. The U. S. Census Reports are too general and groups the State into too large divisions. Directories such as manufacturers' directories, city, telephone, and others are unreliable in that they usually give the main offices of the manufacturing company without indicating the existence or place of the factories which are actually producing the waste. Very complete information concerning mines, gas plants, oil wells, oil refineries, and other industries connected with mineral resources of the State is available in the publications and files of the State Geological Survey Division. For these industries material from this source was used exclusively, for other industries no considerable amount of information is available in the files of the various State departments. It was decided, therefore, that in the collection of this material that the State would be worked over county by county, that advantage would be taken as much as possible of visits made to various parts of the State by the personnel of the State Water Survey Division and that for the preliminary information a questionnaire would be used.

A copy of the letter and questionnaire used follows:

Copy of Letter Questionnaire.

DEAR SIB:

This Department is engaged in a study of the industries in the State with special reference to Water Resources. Such a study should be of great value to the community in indicating the lines of development desirable in the conservation of our natural resources.

We are enclosing with this letter a suggested list. Would you please indicate on this sheet the industries in your vicinity? If at the same time you could give us the name of firms engaged in such industries, the magnitude of the industry either as to amount of product produced or consumed, this information would he appreciated. If you do not have this information immediately at hand simply list on the blank the industries in your city.

Thanking you for any help you can give us along this line.

Very truly yours,

Copy of List of Industries Accompanying Above Letter.

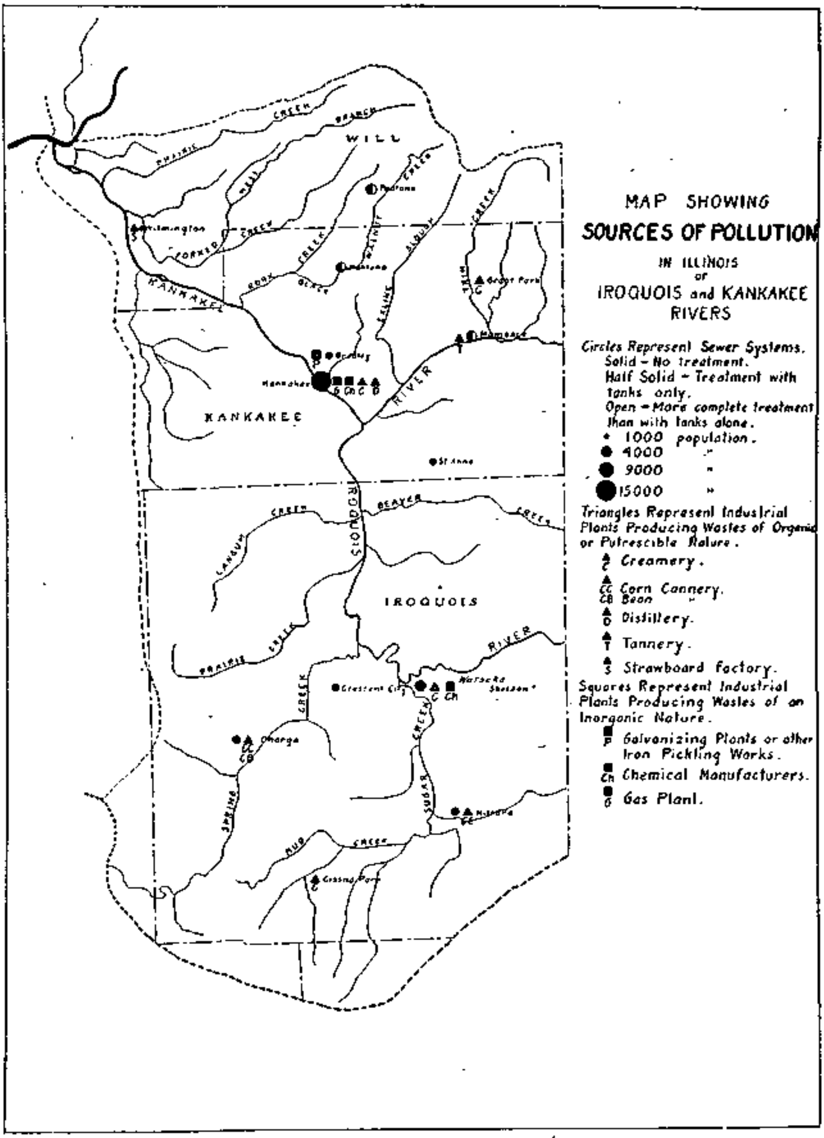
1. Strawboard factories.
2. Paper factories.
3. Corn product plants, i. e., producing cornstarch, corn oil, etc.
4. Packing plants and allied industries including at least the larger slaughter houses.
5. Tanneries or allied industries.
6. Canning factories, corn, peas, etc.
7. Laundries—Note: List only laundries in towns *not* having sewerage systems. Disregard all others.

S. Galvanizing or pickling plant or any factories which use acid to pickle iron such as wire works, bolt factories, porcelain iron factories, etc.

9. Dyeing works, i. e., dyeing goods.
10. Chemical manufacture. Please indicate nature of product produced.
11. Oil refineries.
12. Milk products, i. e., creameries producing butter, condensed milk or other milk products other than the ordinary handling of milk for domestic distribution.
13. Distilleries producing industrial alcohol, etc.
14. Any other industries using water in large quantities other than condensed water or for steam generation. Give product produced.

In the counties which have so far been circularized the returns from these questionnaires were very gratifying. Out of the three counties, Will, Kankakee and Iroquois, only approximately twelve questionnaires were not returned. Most of these were from relatively small communities where such industries do not exist.

The three counties, Will, Kankakee and Iroquois, were taken first because they included all of the Illinois portion of the Kankakee and Iroquois river water-shed, which is one of the least loaded water-sheds in the State from the pollution standpoint. Figure 4 shows geographically the industries producing waste on this water-shed. The relative size of each industry is not indicated, and, in fact, in a considerable number of cases it has not been obtained. The sources of domestic sewage are also shown on this map. It is to be seen from this map that while these streams are probably among those receiving the least pollution of any in the State there are quite a variety of factories contributing waste to them. In a majority of the cases these wastes are being produced and dumped into the stream without any form of purification. While such conditions may as yet have done no serious damage to these streams, it is no doubt time that some investigation be made of the proper carrying capacity of the streams and steps taken to prevent overloading in the future.


MAP SHOWING
SOURCES OF POLLUTION
IN ILLINOIS
OF
IROQUOIS and KANKAKEE
RIVERS
Circles Represent Sewer Systems.
Solid – No treatment.
Half Solid – Treatment with tanks only.
Open – More complete treatment than with tanks alone.
1000 population.
4000 "
9000 "
15000 "
Triangles Represent Industrial Plants Producing Wastes of Organic or Putrescible Nature.
C Creamery.
CC Corn Cannery.
CB Bean "
D Distillery.
T Tannery.
S Strawboard Factory.
Squares Represent Industrial Plants Producing Wastes of an Inorganic Nature.
P Galvanizing Plants or other Iron Pickling Works.
Ch Chemical Manufacturers.
G Gas Plant.
WILL
KANKAKEE
IROQUOIS
KANKAKEE
RIVER
IROQUOIS
RIVER
BEAVER
CREEK
SUGAR
CREEK
Wilmington
Kankakee
St Anne
Crescent City
Onarga

The State Water Survey Division proposes to continue with the collection of this information for the various water-sheds of the State. The principal effort will be made in collecting complete information, first, on streams as yet not overloaded where preventative measures are still possible, and afterwards on the more polluted water-sheds where the capacity of the streams for waste are already overtaxed and only remedial measures are possible.

SUMMARY.

The State Water Survey Division is engaged in the collection of information concerning the amount and extent of polluting wastes being introduced into the streams of the State. It is believed that the collection of such data should aid materially in planning the steps to be taken toward the conservation of the usefulness of these streams which constitute one of our important natural resources.

At the present time a preliminary list of the cities and towns of the State having sewerage systems with a statement as to the final disposition of the sewage has been prepared and is presented in this article. In addition a more detailed study has been made of the Kankakee and Iroquois river water-shed listing in addition to the cities producing sewage, the industries producing wastes known to be objectionable when introduced into the streams.

Maps have been prepared showing the geographical distribution of these wastes and their relation to the natural water courses.

The investigation is being continued with the intention of preparing such detailed maps of all of the water-sheds of the State.