IN THE

Supreme Court of the United States

NOS. 2, 3 AND 4, ORIGINAL.

OCTOBER TERM, 1940.

STATES OF WISCONSIN, MINNESOTA, OHIO and PENNSYLVANIA, *Complainants*, *vs.* STATE OF ILLINOIS and THE SANITARY DISTRICT OF CHICAGO, *Defendants.*	No. 2 Original.
STATE OF MICHIGAN, *Complainant*, *vs.* STATE OF ILLINOIS and THE SANITARY DISTRICT OF CHICAGO, et al., *Defendants.*	No. 3 Original.
STATE OF NEW YORK, *Complainant*, *vs.* STATE OF ILLINOIS and THE SANITARY DISTRICT OF CHICAGO, et al., *Defendants.*	No. 4 Original.

JOINT ABSTRACT OF RECORD.

VOLUME II.

EXHIBITS.

Filed April 30, 1941.

THE GUNTHORP-WARREN PRINTING COMPANY, 210 WEST JACKSON, CHICAGO

INDEX.

Mohlman Exhibits

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PREFACE.

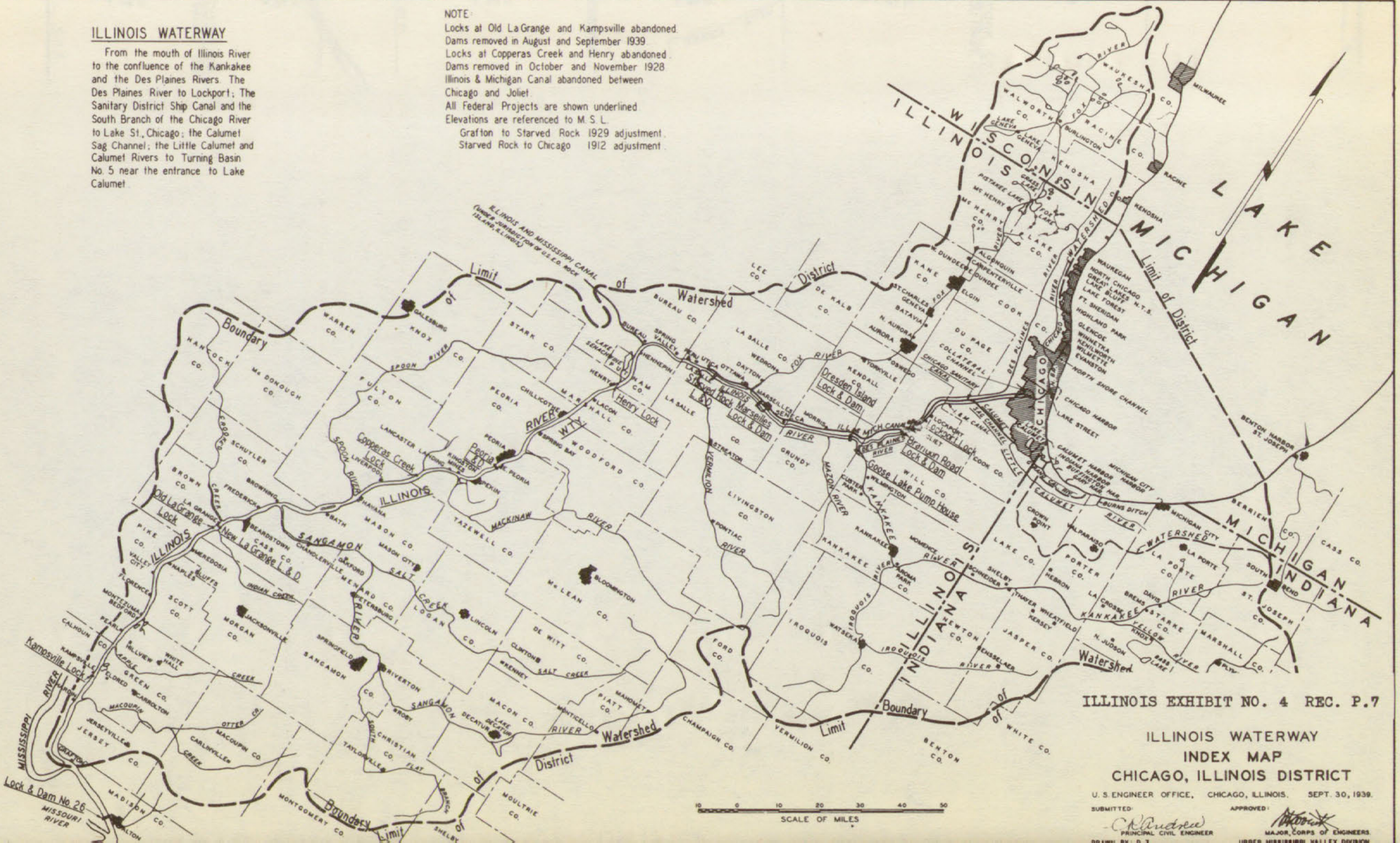
The petitioner and respondents have endeavored to set out, for the convenience of the Court, such portions of the exhibits in these causes deemed material for

due consideration of the Court of the issues raised by the petition of the State of Illinois and the return of the opposing Great Lake States. It is agreed, however, that either party may, in oral argument or in briefs, refer to any other exhibits appearing in the record and not contained herein.

ILLINOIS WATERWAY

From the mouth of Illinois River to the confluence of the Kankakee and the Des Plaines Rivers. The Des Plaines River to Lockport; The Sanitary District Ship Canal and the South Branch of the Chicago River to Lake St., Chicago; the Calumet Sag Channel; the Little Calumet and Calumet Rivers to Turning Basin No. 5 near the entrance to Lake Calumet.

NOTE:
Locks at Old La Grange and Kampsville abandoned. Dams removed in August and September 1939.
Locks at Copperas Creek and Henry abandoned. Dams removed in October and November 1928.
Illinois & Michigan Canal abandoned between Chicago and Joliet.
All Federal Projects are shown underlined.
Elevations are referenced to M. S. L.
Grafton to Starved Rock 1929 adjustment.
Starved Rock to Chicago 1912 adjustment.



ILLINOIS EXHIBIT NO. 4 REC. P.7

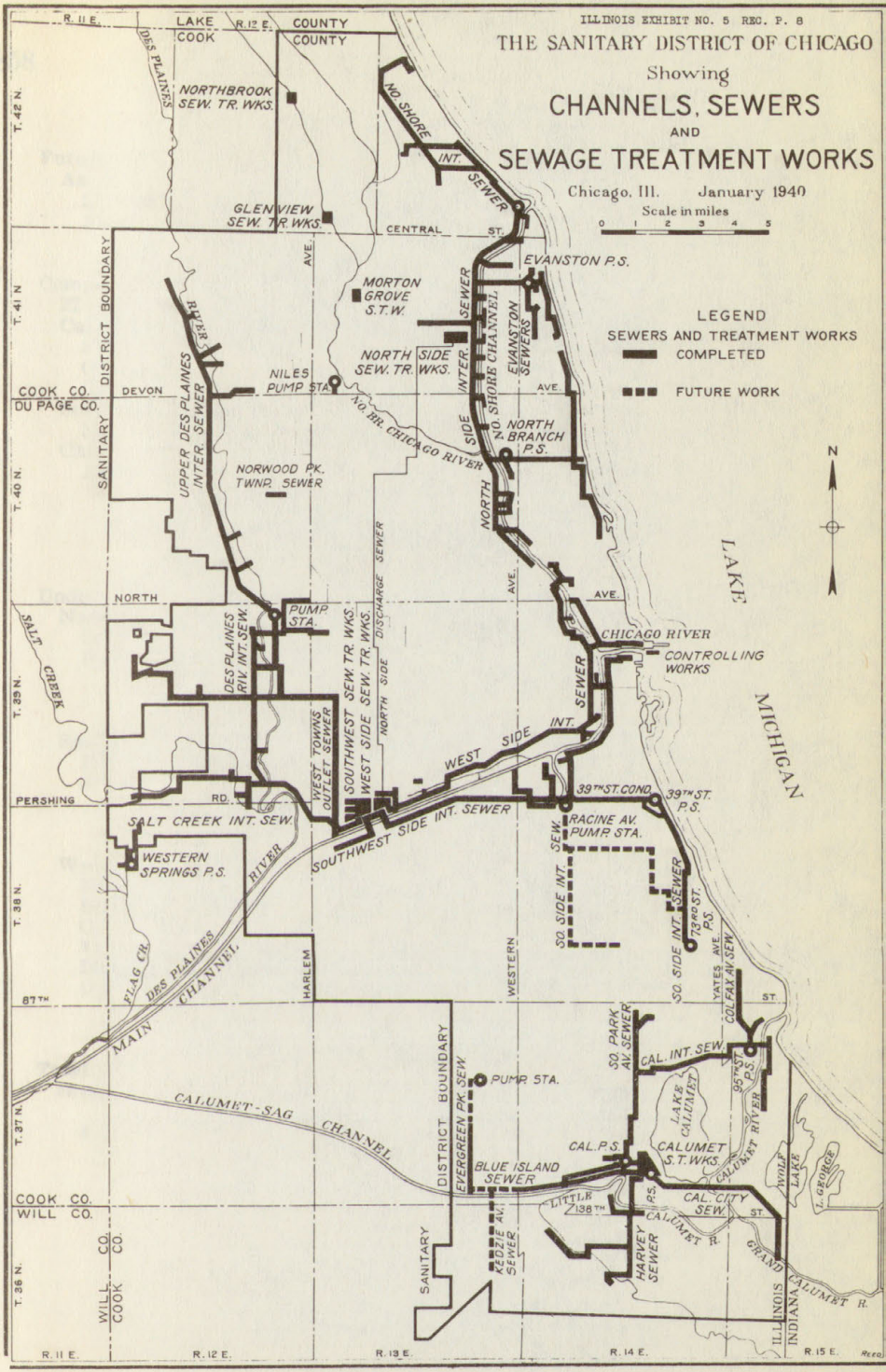
ILLINOIS WATERWAY
INDEX MAP
CHICAGO, ILLINOIS DISTRICT

U. S. ENGINEER OFFICE, CHICAGO, ILLINOIS. SEPT. 30, 1939.

SUBMITTED: PRINCIPAL CIVIL ENGINEER

APPROVED: MAJOR, CORPS OF ENGINEERS. UPPER MISSISSIPPI VALLEY DIVISION

DRAWN BY: P. J.


ILLINOIS EXHIBIT NO. 5 REC. P. 8
THE SANITARY DISTRICT OF CHICAGO
Showing
CHANNELS, SEWERS
AND
SEWAGE TREATMENT WORKS
Chicago, Ill. January 1940
Scale in miles
0 1 2 3 4 5
LEGEND
SEWERS AND TREATMENT WORKS
COMPLETED
FUTURE WORK
LAKE COUNTY
COOK COUNTY
NORTHBROOK SEW. TR. WKS.
GLENVIEW SEW. TR. WKS.
NO. SHORE INT. SEWER
CENTRAL ST.
EVANSTON P.S.
MORTON GROVE S.T.W.
EVANSTON SEWERS
NORTH SIDE SEW. TR. WKS.
NILES PUMP STA.
NO. BR. CHICAGO RIVER
NORTH SIDE INTER. SEWER
NORTH SHORE CHANNEL
NORTH BRANCH P.S.
NORWOOD PK. TWNP. SEWER
UPPER DES PLAINES INTER. SEWER
DES PLAINES RIVER
DISTRICT BOUNDARY
SANITARY
COOK CO.
DU PAGE CO.
DEVON AVE.
NORTH AVE.
PUMP STA.
DES PLAINES RIV. INT. SEW.
SALT CREEK
SOUTHWEST SEW. TR. WKS.
WEST SIDE SEW. TR. WKS.
NORTH SIDE DISCHARGE SEWER
WEST TOWNS OUTLET SEWER
WEST SIDE INT. SEWER
CHICAGO RIVER CONTROLLING WORKS
LAKE MICHIGAN
39TH ST. COND.
39TH ST. P.S.
PERSHING RD.
SALT CREEK INT. SEW.
WESTERN SPRINGS P.S.
SOUTHWEST SIDE INT. SEWER
RACINE AV. PUMP STA.
SO. SIDE INT. SEWER
73RD ST. P.S.
YATES AVE. SEW.
COLFAX AV. SEW.
87TH ST.
DES PLAINES RIVER MAIN CHANNEL
FLAG CR.
HARLEM
WESTERN
SO. PARK AV. SEWER
CAL. INT. SEW.
95TH ST. P.S.
CALUMET-SAG CHANNEL
DISTRICT BOUNDARY
EVERGREEN PK. SEW.
PUMP STA.
CAL. P.S.
CALUMET S.T. WKS.
CALUMET RIVER
LAKE CALUMET
BLUE ISLAND SEWER
LITTLE 138TH P.S.
CAL. CITY SEW.
CALUMET R.
WOLF LAKE
E. GEORGE
GRAND CALUMET R.
COOK CO.
WILL CO.
KEDZIE AV. SEWER
HARVEY SEWER
ILLINOIS
INDIANA
R. 11 E.
R. 12 E.
R. 13 E.
R. 14 E.
R. 15 E.
T. 42 N.
T. 41 N.
T. 40 N.
T. 39 N.
T. 38 N.
T. 37 N.
T. 36 N.
N

3858 STATE OF ILLINOIS EXHIBIT No. 10-D.

THE SANITARY DISTRICT OF CHICAGO.

Future Construction Program:		
As of June 1, 1940:		
27 existing contracts		$ 912,192
Future contracts		12,056,900
Total		$12,969,092
Completed June 1, 1940 to January 14, 1941:		
27 existing contracts above	$ 912,192	
Calumet Project—		
Sludge concentration tanks	27,000	
Oil storage tanks	25,000	
Cal-Beverly drop connection	17,000	
Southwest Side Project—		
Norwood Park sewer	31,000	
Chicago River Control Works—		
Addition to breakwater	200,000	
Total completed:		
Total future, as of January 14, 1941		1,212,192
		$11,756,900
Under contract:		
North Side Project—		
Golf and Glenview sewers	$ 200,000	
Emerson Street sewer	66,000	
	$ 266,000	
Southwest Side Project—		
Racine Avenue Pump. Sta. Pumps	$ 100,000	
Sewer controls, Salt Creek, etc.	23,000	
	$ 123,000	
West-Southwest Treatment Plant—		
Blowers	$ 544,000	
Boiler units	703,000	
Conveyor tunnels	75,000	
Vapor heaters	413,000	
Dust precipitators	258,000	
Office addition to sludge disposal building	10,000	
	$2,003,000	
Total under contract (some of which has been earned)		$ 2,392,000
Future contracts		$ 9,364,900

THE SANITARY DISTRICT OF CHICAGO.

Future Contracts, as of January 14, 1941:		
Calumet Project—		
Additional sludge handling equipment	$ 250,000	
Preliminary settling tanks	100,000	
Stony Island Avenue sewers	260,000	$ 610,000
North Side Project—		
North Side sewer siphons		103,000
Southwest Side Project—		
Racine Ave. Pump. Sta., roads, grounds, etc. WPA		100,000
West-Southwest Treatment Plant—		
Final settling tanks, Bat. A & B	$1,059,700**	
Sludge concentration tanks	160,800**	
Aeration tanks, Battery C	1,714,600	
Final tanks, Battery C	1,256,200	
Conduits, tunnels, etc	682,600	
Substructure, blower plant	200,000**	
Substructure, sludge handling plant	450,000**	
Blower plant, remainder	452,800	
Sludge handling plant, remainder	1,679,400	
Roads, grounds, etc	90,600	
Fertilizer plant	440,000*	
Screenings, scum & grit removal, etc	365,200	
Total		8,551,900
		$ 9,364,900

* To be advertised for bids January 24, 1941.
** $1,870,500 to be let before March 31, 1941.

3860 STATE OF ILLINOIS EXHIBIT No. 10-F.

FUTURE CONSTRUCTION PROGRAM—AS OF JANUARY 14, 1941.

	As of June 1, 1940 Ex. 10-A, B, C	As of January 14, 1941 Under Contract	Future
Calumet Project:			
Additional sludge handling equipment	$ 250,000		$ 250,000
Preliminary settling tanks	100,000		100,000
Sludge concentration tanks WPA	27,000	$ 27,000*	
Oil storage tanks WPA	25,000	25,000*	
Cal-Beverly drop connection WPA	17,000	17,000*	
Stony Island Ave. sewer	260,000		260,000
	$ 679,000	$ 69,000	$ 610,000
North Side Project:			
North Side sewer siphons	$ 103,000		$ 103,000
Golf and Glenview sewers	200,000	$ 200,000	
Emerson St. sewer, etc. WPA	66,000	66,000	
	$ 369,000	$ 266,000	$ 103,000
Southwest Side Project:			
Racine Ave. P. S., 2 pumps	$ 100,000	$ 100,000	
Racine Ave. P. S., roads, grounds, WPA	100,000		$ 100,000
Norwood Park sewer WPA	31,000	31,000*	
Sewer controls, Salt Creek & DesPl. WPA	23,000	23,000	
	$ 254,000	$ 154,000	$ 100,000
West-Southwest Treatment Plant:			
Final tanks, Bat. A. & B	$ 1,059,700		$1,059,700**
Aeration tanks, Battery C	1,714,600		1,714,600
Final tanks, Battery C	1,256,200		1,256,200
Conduits, tunnels, etc.	757,600	$ 75,000	682,600
Sludge concentration tanks	160,800		160,800**
Blower Plant:			
Blowers	280,000	544,000	200,000**
Substructure	200,000		452,800
Remainder	716,800		
Sludge Handling Plant:			
Equipment	590,000	703,000	450,000**
Substructure	450,000		1,679,400
Remainder	2,473,400	681,000	90,600
Roads, grounds, etc.	90,600		440,000**
Fertilizer plant	440,000		
Screenings, scum & grit removal, etc.	365,200		365,200
	$10,554,900	$2,003,000	$8,551,900
Chicago River Controlling Works:			
Addition to breakwater enclosure	$ 200,000	$ 200,000*	
Total	$12,056,900	$2,692,000	$9,364,900

* Work completed.
** Work to be let in near future.

3631 ILLINOIS EXHIBIT No. 11A.

FLOW IN MAIN DRAINAGE CHANNEL.

Yearly Averages 1930-1940.

Year	Total Flow from Main Channel at Lockport C.F.S.	Inflow from Des-Plaines River C.F.S.	Domestic Pumpage Chicago Metropolitan Area C.F.S.	Net Diversion from Lake Michigan C.F.S.
1930 6 mo. (Jan. to June)..	8500	0	1680	6820
1930 6 mo. (July to Dec.)..	8216	0	1719	6497
1931	8180	0	1680	6500
1932	8100	2	1650	6450
1933	8005	45	1690	6270
1934	8125	0	1692	6433
1935	8093	7	1602	6484
1936	6607	33	1712	4862
1937	6677	23	1665	4989
1938	6648	45	1604	4999
1939	3132	13	1620	1499
1940*	3319	49	1589	1681

* Includes 10-day test flow period.

95 STATE OF ILLINOIS EXHIBIT No. 16.

REPORT ON
ADDITIONS TO
SOUTHWEST SEWAGE TREATMENT WORKS
AND SUPPLEMENTAL TREATMENT FOR
WEST SIDE SEWAGE TREATMENT WORKS
April 16, 1940.

96 April 16, 1940.

Mr. William H. Trinkaus,
Chief Engineer,
The Sanitary District of Chicago,
Office.

DEAR SIR:

At your request, we are presenting herewith a brief report covering the necessary work required to complete the Southwest Sewage Treatment Works and to supplement the present West Side Works by addi-

tional treatment. Necessarily, this involves consideration of these two plants as a whole. Consequently the estimates have been based on a combined total flow of 900 m.g.d. and the assumption that flows up to 150 per cent of average will be intercepted, but only 115 per cent of the average will be given complete treatment.

FLOWS:

The present sewage flows to the respective treatment plants are somewhat less than originally estimated in 1934. The future flows will depend on population growth, the extent of metering, and the rate at which meters are installed. For present conditions (1940), the flow is estimated as follows:

97

Tributary Area	Sewage Flow in M. G. D.	
	Avg.	Max. (150% Avg.)
West Side	400	600
Salt Creek	62	93
Southwest	394	591
Total	856	1,284

Seasonal Variations in the average monthly flow may occur approximately 87 to 117 per cent of the average month, judging from the West Side record.

PUMPING CAPACITY:

The installed rated pumping capacity at the two works is as follows:

Works	Units			Total M.G.D.
	Number	Capacity C.F.S.	Capacity M.G.D.	
West Side	2	100	65	130
	5	200	129	645
Southwest	4	300	194	775
Grand Total				1,550

The present hydraulic capacity of the West Side Works does not exceed 700 m.g.d.

EFFECT OF METERING:

The population on the West-Southwest area may grow moderately, but the flow may tend to decrease somewhat, should universal metering occur. Consequently, 900 m.g.d. seems a reasonable figure to adopt, for the average flow to the combined plants, with 484 m.g.d. apportioned to the West Side-Salt Creek area, and 416 m.g.d. to the Southwest.

98 For the present, it is proposed to provide complete treatment for only 115 per cent of the average flow, and to care for flows between 115 and 150 per cent of average by settling only in the existing Imhoff tanks. Later on, when the flows are more exactly known, and the rate of metering is indicated, consideration can be given to the expansion of capacity to 150 per cent, if need be.

These studies of treatment for the combined West-Southwest sewage are therefore based on the following flows:

Average for complete treatment	900 m.g.d.
Maximum for complete treatment	1035 m.g.d.
Maximum intercepted	1350 m.g.d.
Settling only	315 m.g.d.

POPULATION:

Population estimates are based on the 1930 estimates of the Sanitary District. However, in 1937, some estimates prepared by the Chicago Regional Plan Commission indicated a total population of the Sanitary District for 1940 about 90 per cent of the 1930 estimate. However, these two estimates indicate, over the next twenty years, a possible growth in the Sanitary District as a whole ranging for 25 to 33⅓ per

cent of the 1940 population. The 1940 census will shed some light on the probable trend.

STRENGTH OF SEWAGE:

As yet, complete analyses of the Southwest sewage are not available. It should prove stronger than the West Side, both in B.O.D. and suspended solids, because of the Packingtown wastes. There will also be greater hourly fluctuations through the 24 hours of the day, as well as throughout the week.

99 For the purpose of design, the following averages were used:

Source	Parts Per Million	
	Susp. Solids	5-Day B.O.D.
West Side, raw sewage.....	120	95
West Side, Imhoff effluent.....	60	57
Southwest, raw sewage.....	170	145

SOLID LOAD:

The solids arriving at the West-Southwest Works are estimated to total 1,301,000 lbs. per day in 1940, and 1,626,000 lb. in 1960. Included in these figures are the North Side and the Packinghouse solids, which should be handled at the Southwest Works.

SLUDGE CAPACITY OF IMHOFF TANKS AND DRYING BEDS:

The existing Imhoff tanks have a total sludge digestion volumes as follows:

Battery	Sludge Digestion Cu. Ft.
A	3,091,000
B	3,091,000
C	4,350,000
Total.....	10,532,000

The filtering area of the sludge beds totals 1,190,240 square feet.

In all the schemes for which estimates were prepared, this sludge digestion volume would probably be adequate, including chemical treatment and filtration through fine grained filters. The existing drying beds are inadequate, except for plain sedimentation.

100 EXPERIMENTAL WORK:

From 1936 to 1939, various procedures were studied to determine their value for supplementing the West Side Works. Included were:

(a) Activated sludge process-short period aeration.

(b) Chemical precipitation.

(c) Filtration on fine grain filters.

(d) Aeration with iron salts.

(e) High-rate trickling filters, single stage-Halvorson type.

(f) High-rate trickling filters, two-stage bio-filter Jenks type.

The results of these tests have been analyzed, and applied in the consideration of various alternative procedures of varying efficiency, as measured by the quality of effluent.

ESTIMATES:

Detailed estimates were made on two schemes for the activated sludge process; chemical precipitation; and the filtration by fine grained filters of plain settled effluent and chemical precipitation effluent. Scrutiny of the remaining procedures eliminated aeration with iron salts and high-rate trickling filters of both types, as too expensive for the results obtained.

On the alternatives estimated in detail, the first cost, operating cost, and total annual cost (including interest and depreciation) were determined for com-

parison. Filtration on fine grain filters was eliminated at this stage because of the high cost, for the relatively small benefit gained.

101 STANDARD OF EFFLUENT REQUIRED:

In the choice of procedure, the degree of effluent required hinges on the conditions to be maintained in the Illinois Waterway. In the testimony given in the socalled Lake level case, the tentative standard set by various witnesses would seem to require at least 3 parts per million of dissolved oxygen in the Des Plaines and Illinois Rivers. The maintenance of freedom from odor in the absence of sludge banks requires the presence of some dissolved oxygen. The margin of safety between complete de-oxygenation and the presence of appreciable dissolved oxygen cannot be estimated in operation so closely as to make it possible to adjust the dilution so that 1 or 2 parts per million of dissolved oxygen will always be present. To maintain a factor of safety in preventing nuisance, a minimum of 3 parts per million is required. This may also serve to maintain fish life, although many authorities now recommend somewhat higher figures, such as 5 parts per million, because as low as 3 parts per million presents practically no factor of safety for fish life.

CONTINGENCIES OUTSIDE CONTROL OF THE SANITARY DISTRICT:

In studying the problem of maintaining the Illinois waterway in a suitable condition, a number of unknown factors, or contingencies, appear which are beyond the control of the Sanitary District, such as—

(a) The development of water power will practically stop all reaeration of dams. Such reaeration is of value in the self-purification of the Waterway. The utilization of the power at Brandon Road and Dresden

Island would materially affect the condition of the Waterway above Marseilles Dam.

102 (b) The effect of an ice sheet on reaeration is as yet undetermined. The earlier data indicated that in severe winters considerably more flow may be required than in normal summer conditions. Recent data is somewhat at variance. However, extreme winters occur but seldom.

(c) The diversion allotted may be changed. The possibility of any further reduction in diversion appears remote.

(d) The growth of population and industry within the area of the Sanitary District.

(e) The requirements laid down for stream conditions by authorities having jurisdiction thereover. At present the power of regulation rests in the State of Illinois. In the near future, judging from legislation now proposed in Congress, control may be given also to a Federal authority.

(f) The general trend of regulation seems to point toward more vigorous standards for the sanitary condition of waterways than was the case ten or twenty years ago.

DIVERSION:

The allowed diversion is an annual average flow of 1,500 c.f.s. To budget the flow over the year means that for at least six months a diversion of 800 c.f.s. may be in use. In general, this reduces the amount of flow from Lake Michigan during the warmer months of the year, at a time when the dissolved oxygen content of the lake water is lowest.

COURT REQUIREMENTS:

In the hearings before the Special Master, Hon. Charles E. Hughes, the Sanitary District indicated that it expected to install works which would provide an over-all efficiency of 85 per cent or better, on an

annual average basis. In the opinion of the Supreme Court (April 14, 1930), Justice Holmes states:

103 "The Master estimates that with efficient operation the proposed treatment should reach an average of 85 per cent purification and probably will be 90 per cent or more."

OXYGEN BALANCE:

In a study of the oxygen balance in the Upper Illinois Waterway based on a diversion of 800 C.F.S. (such as may occur for at least 6 months per year), with 500 m.g.d. passing through the Southwest Works and receiving activated sludge treatment, it appears that a treatment greater than 82 per cent is required as an overall for the 400 m.g.d. passing through the West Side Works, and that supplemental treatment for the Imhoff tank effluent, making an overall purification of 90 per cent or better is required at the West Side, to maintain 3 parts per million of dissolved oxygen.

SEASONAL EFFECT:

There is also a seasonal effect of importance from two angles—first, the amount of dissolved oxygen which can be introduced into the canal system by the diversion from Lake Michigan, and, second, the temperature of the lake water and effluents and mixtures thereof, in so far as temperature affects the rate of satisfaction of B.O.D.

The temperature of Lake Michigan may vary from 32 deg. Fahr. in winter to 72 deg. Fahr. in summer, with corresponding content of dissolved oxygen at saturation, varying from 8.8 to 14.6 parts per million.

The rate of satisfaction of B.O.D. is slower at lower temperatures and thus permits a longer time of flow, and consequently greater effect of reaeration.

104 Aside from the effect of an ice sheet over the water-

way, the above seasonal occurrences would point to the need of the greatest reduction in B.O.D. during the summer months. Again, this corresponds, in general with the periods of lower diversions.

LIMITS OF CHOICE:

The promises to the Supreme Court and its understanding of the program proposed, together with the physical limitations on the problem in the Illinois Waterway, clearly point to the need of ability in the supplemental treatment of the effluent of the West Side Works to produce a high-grade effluent such as only an activated sludge plant can deliver.

For such purpose, chemical precipitation as a supplement to the Imhoff tank treatment does not go far enough. An estimate of the residual B.O.D. would indicate—

5-DAY B.O.D. IN EFFLUENT.

Treatment	5-Day B.O.D. p.p.m.
Imhoff	57
Imhoff plus chemical precipitation	36
Activated Sludge	10

To meet the critical seasonal periods and the future contingencies, a process is required to supplement the Imhoff effluent which will deliver an effluent containing only 10 p.p.m. B.O.D.

105 The percentage reduction for the combined West-Southwest Works with the following combinations is estimated as follows:

	Per Cent Reduction	
Treatment—West-Southwest	Susp. Solids	5-Day B.O.D.
Activated Sludge—Imhoff Tanks	76.7	73.7
Activated Sludge—Chemical Ppn.	81.9	81.7
Activated Sludge—All Plants	91.5	91.6

QUESTION OF POLICY:

The question of policy concerned rests on the fact that to satisfy the Court and complaining municipalities along the Illinois Waterway, the Sanitary District must act. The time for experiment or delay has passed, if financing can be arranged. Consequently, there is no opportunity for a tryout of the Southwest activated sludge works with the West Side Imhoff Works left as they are now, to test accomplishment. Whatever is done must be adequate, with certainty.

In the choice of plant types, the development of a uniform type of plant along activated sludge lines seems better from an operating standpoint than to introduce another and third type of plant for sewage treatment into the works at the Stickney site.

ADVANTAGE OF ACTIVATED SLUDGE:

There is another advantage in the choice of activated sludge for supplementing the West Side Imhoff plant, namely, the possibility of some revenue from the sale of heat-dried activated sludge. Such a supplemental plant may produce around 29,000 tons of dried sludge annually suitable for sale as fertilizer ma-
106 terial. If that portion produced in eight months of the year (19,500 tons) is sold, nets the Sanitary District a return of $4.00 per ton, a substantial revenue would be obtained ($78,000). No such possibility is inherent in any other alternative now available.

OPERATING COST CONTINGENCIES:

Apparently the contingency of fluctuating labor costs affects all alternatives. However, the added labor cost for the 400 m.g.d. from the West Side will be $39,000 greater for chemical precipitation than for activated sludge treatment.

For the activated sludge treatment, the other main

items of cost are for coal and ferric chloride, totaling $126,000, whereas for the chemical treatment, the cost of chemicals is estimated at $331,000, or $205,000 more than in the activated sludge alternative.

Thus on the main items of operating cost the extent of fluctuation may be much greater on the chemical treatment than for activated sludge.

COSTS COMPARED:

From the foregoing, it is clear that the comparison narrows down to two quite different schemes of different accomplishment, for supplementing the West Side Imhoff tanks, namely: Activated Sludge as against Chemical Precipitation. The plans proposed for both alternatives include the increase in the capacity of the Southwest Works to 500 m.g.d. on an activated sludge basis.

107 The first costs on a complete basis are given in the following table:

FIRST COST.

Procedure for Addition to West Side	Extension SW Works to 500 m.g.d.	Extension West Side to 400 m.g.d.	Total for 900 m.g.d.
Activated Sludge	$3,879,800	$5,869,000	$9,749,700
Chemical Precipitation	3,879,800	1,300,500	5,180,300

If a comparison be made on the basis of adding sufficient activated sludge treatment to produce a 5-day B.O.D. discharge equivalent to that derived from treating 400 m.g.d. by chemical treatment, a capacity for treatment of only 180 m.g.d. by activated sludge would be needed, with the following results:

FIRST COST.

Extension West Side	m.g.d.	Cost
Chemical Treatment	400	$1,300,500
Activated Sludge	180	3,662,000

This would materially reduce the annual cost of activated sludge, were a lowered degree of treatment satisfactory for the extension to the West Side Works.

108 The total annual costs of the two schemes are practically the same.

Procedure for Addition to West Side	Extension SW Works to 500 m.g.d.	Extension West Side to 400 m.g.d.	Total for 900 m.g.d.
Activated Sludge	$ 579,400	$ 569,200	$1,148,600
Chemical Precipitation	579,400	555,800	1,135,200

In these figures no credit is shown for the sale of heat-dried sludge for fertilizer. Whatever net income is obtained would reduce the cost of the activated sludge. The possible revenue from the sale of sludge from the West Side activated sludge treatment may exceed $78,000.

If the cost of the activated sludge extension for the West Side be corrected to a plant producing the same 5-day B.O.D. as the chemical precipitation, we have:

Procedure for Addition to West Side	Extension SW Works to 500 m.g.d.	Extension West Side	Total
Activated Sludge	$579,400	$320,600	$ 900,000*
Chemical Praecipitation	579,400	555,800	1,135,200**

* For 680 m.g.d.
** For 900 m.g.d.

In these figures, no credit is shown for the sale of heat-dried sludge as fertilizer.

109 Advantage in Financing:

In the present status of financing for the Sanitary District, there appears to be an advantage in keeping down operating costs and thus reducing the corporate tax levy. The higher construction cost under present conditions can be financed at a low interest rate, thus stabilizing that part of the fixed charges for the life of the bonds on a low basis.

RECOMMENDATIONS:

From the standpoint of utilizing the existing West Side Works to the fullest extent, and also from the standpoint of financing, we recommend that for the immediate future the extensions of the Southwest Works be designed to provide a complete plant which will handle an average flow of 500 m.g.d., with a maximum around 600 m.g.d. In such plant, the necessary dewatering, heat-drying, and incinerating equipment should be installed to provide, in addition, for all the excess activated sludge from the North Side Works, as well as from the supplemental activated sludge plant to be installed on the effluent of the West Side Imhoff tanks.

Following thereafter, the necessary additional activated sludge plant should be designed and built to treat the effluent of the West Side Imhoff tanks, on the basis that the effluent will be mixed with the Southwest Side sewage and the mixture treated in a consolidated South-west-West activated sludge plant.

Respectfully submitted:

F. W. MOHLMAN,
Director of Laboratories.

L. M. JOHNSON,
Engineer of Maintenance and Operation.

WM. A. DUNDAS,
Engineer of Mechanical Design.

L. C. WHITTEMORE,
Engineer of Treatment Plant Design.

LANGDON PEARSE,
Sanitary Engineer.

H. P. RAMEY,
Assistant Chief Engineer.

112 STATE OF ILLINOIS EXHIBIT No. 17.

FEDERAL EMERGENCY ADMINISTRATION
OF PUBLIC WORKS.

May 3, 1940.

Mr. Joshua D'Esposito,
Resident Projects Engineer.

DEAR MR. D'ESPOSITO:

Pursuant to your call the Board of Review met in your office May 1-3 with all members present.

The Board had before it—

1. The completed summary of the investigations made by the Sanitary District to determine the most effective method of giving secondary treatment to the West Side Sewage

2. The letter transmitting this report, signed by L. C. Whittemore, Engineer of Treatment Plant Design

3. A review of the report dated April 16, 1940, signed by

F. W. Mohlman
Director of Laboratories
L. M. Johnson
Engineer of Maintenance & Operation
Wm. A. Dundas
Engineer of Mechanical Design
113 L. C. Whittemore
Engineer of Treatment Plant Design
Langdon Pearse
Sanitary Engineer
H. P. Ramey
Assistant Chief Engineer

4. An Independent review of the report prepared by U. F. Turpin, Assistant Projects Engineer.

The Board has given careful consideration to these

studies and is in general accord with the conclusion that the best method of supplementing the treatment now given to the West Side sewage lies in an enlargement of the Southwest activated sludge plant in the manner contemplated by Scheme A-2.

While the Board agrees with the Engineers of the Sanitary District as to the *method* of treatment, it is not satisfied that the additional treatment capacity proposed in Scheme A-2 will all be necessary to secure reasonably satisfactory conditions in the river below Lockport.

The Whittemore report is a very comprehensive one, but it is based on a number of assumptions, that though close enough for purposes of comparison, should be checked or verified as far as possible before
114 definitely embarking on a construction program estimated to cost $10,000,000. Whittemore, in his letter of transmittal, points to one of these assumptions as follows:

"it cannot be too strongly emphasized that more data should be secured on plant performance under the conditions of operation which will eventually prevail, before final designs for extensions are prepared."

In the report, proposed treatment plant capacity is based on an estimated sewage flow (West and Southwest combined) of 900 M.G.D. This assumption can be checked by gauging the actual flow and at the same time the assumed characteristics of the sewage can be verified by sampling.

When the results of the 1940 census become available they will throw much light on population trends and permit more intelligent planning for the future than is now possible.

A water filtration plant is in course of construction to serve the Southwest area and it is reasonable to assume that eventually the supply of filtered water

will be metered. When this is done, the volume of sewage from this area should be greatly reduced.

At the request of the State of Illinois, the United
115 States Supreme Court has reopened the question as to what constitutes a reasonable diversion of water from Lake Michigan. If, as a result of this investigation, the present authorized diversion should be altered even though for a temporary period of three years, it would be wise to study the effect of such an increase before fixing the treatment capacity of the combined West-Southwest plant.

For the reasons just stated, the Board considers it highly desirable to prosecute the work outlined in Scheme A-2 in two stages—

1. Increasing the capacity of the Southwest Plant from 400 to 500 M.G.D., a task that will require two working seasons, and

2. Re-appraising the requirements as they will then exist before undertaking the second stage. Such a re-appraisal may show that part of the proposed expenditure of $10,000,000 is unnecessary.

The Board realizes that time may be saved by adopting Scheme A-2 in its entirety at this time, but the advantages from an engineering standpoint, of the two-stage plan seem to far outweigh any loss of time.

The Board invites attention to the many difficulties
116 that have been encountered in putting the 400 M.G.D. activated sludge plant in commission and to the probability of encountering others in stepping up plant capacity to 500 M.G.D.

A further increase in plant capacity to 800 M.G.D. (or even to 900 M.G.D.) is indicated by the studies, but the experience gained under the two-stage plan will, in the opinion of the Board, be extremely valuable.

In recommending a two-stage plan of construction, the Board does not have in mind a rigid adherence to the line of demarcation between the 500 M.G.D. plant and the proposed 900 M.G.D. plant as set up by the Sanitary District. On the contrary, it recommends that the extensions of the buildings to house additional pump, blower and sludge dewatering equipment be made of the dimensions called for by Scheme A-2. To apply the two-stage program to such features would be economically unsound. For similar reasons it may be advisable to include in the first stage of the program 16 additional final tanks even though only 8 are estimated as necessary for the 500 M.G.D. plant.

Control Works Chicago River.

At the request of the Chief Engineer of the Sanitary District the Board examined several plans under-
117 consideration for stopping the leakage through the basin walls that form part of the control works at the mouth of the Chicago River.

In its opinion, the intrusion method does not give sufficient promise of success as to warrant further experimentation.

As between the plans calling for a clay blanket protected by rip rap and the plan calling for a steel sheet pile diaphragm, the Board recommends the latter. It notes, however, that the proposed diaphraghm is not anchored to the concrete cap of the crib. Further consideration of this feature is recommended.

Very truly yours,

Daniel W. Mead,
C. W. Kutz,
W. B. Storey,
Members of Board of Review.

118 STATE OF ILLINOIS EXHIBIT No. 18.

FEDERAL EMERGENCY ADMINISTRATION
OF PUBLIC WORKS

Office of
Resident Projects Engineer — Suite 300-302
Resident Projects Auditor — 910 S. Michigan Ave.
For Sanitary District of Chicago — Chicago, Illinois

May 3, 1940.

Mr. Ross A. Woodhull, President,
Board of Trustees,
The Sanitary District of Chicago,
910 South Michigan Avenue,
Chicago, Illinois.

DEAR MR. WOODHULL:

I transmit herewith copy of report to me by the Engineering Board of Review dated May 3, 1940, covering the problem of the enlargement of the existing Southwest Sewage Treatment Plant together with the additions necessary thereto for the secondary treatment of the West Side sewage, also a recommendation of the Board as to the best method of solving the problem of water inflow from the lake at the mouth of the river.

I concur in the recommendations of the Board, and shall advise the Public Works Administration in Washington to that effect.

Very truly yours,

JOSHUA D'ESPOSITO.

170 STATE OF ILLINOIS EXHIBIT No. 23.

THE SANITARY DISTRICT OF CHICAGO
SOUTHWEST SEWAGE TREATMENT WORKS
FLOW, B.O.D., D.O. AND SUSPENDED SOLIDS

Month 1939	Flow M. G. D.	5-day B. O. D. Raw Sewage	5-day B. O. D. Effluent	5-day B. O. D. Per Cent Reduction	Diss. Oxyg. Final Settling Tanks	Diss. Oxyg. Outfall	Susp. Solids Raw Sewage	Susp. Solids Effluent	Susp. Solids Per Cent Reduction
January									
February									
March									
April									
May .....(1)	41								
June .....(2)	160								
July	216	59	12	79.6			96	12	87.5
August	216	60	12	80.0			78	15	80.8
September	313	96	17	82.3		5.4	123	15	87.8
October	313	133	22	83.5		5.8	175	23	87.0
November	326	141	11	92.2		7.8	169	15	91.1
December	307	144	17	88.2		8.4	191	14	92.7
(3)	236								
Average ....(4)	282	106	15	85.8		6.8	139	16	88.5

(1) Preliminary settling only.
(2) Started aeration, part of flow, June 9th.
(3) Average May 1st to December 31st.
(4) Average July 1st to December 31st.

3642 STATE OF ILLINOIS EXHIBIT No. 27-A.

THE SANITARY DISTRICT OF CHICAGO
NORTH SIDE SEWAGE TREATMENT WORKS
SUMMARY OF RESULTS OF OPERATION
1929-1940

Year	Flow M.G.D.	5-Day B.O.D. Susp. Solids p.p.m.	Per Cent Reduction B.O.D.	Susp. Solids
1929	58.8	5.6	14	95	92.5
1930	139.4	8.5	16	92	89.1
1931	196.0	8	14	92.8	91.0
1932	200.3	9.7	12	91.7	91.3
1933	199.4	13.1	14	88.3	89.2
1934	193.5	14.1	14	89.4	90.5
1935	199.4	10.1	13	91.0	90.2
1936	204.6	8.5	14	92.2	89.8
1937	204.8	9.2	12	91.5	91.5
1938	200.1	8.6	10	92.2	93.0
1939	202.5	7.7	11	93.5	92.4
1940	188.2	7.0	11	94.6	92.4

3644 STATE OF ILLINOIS EXHIBIT No. 28-A.

THE SANITARY DISTRICT OF CHICAGO
CALUMET SEWAGE TREATMENT WORKS
SUMMARY OF RESULTS OF OPERATION
1936-1940

Year	Flow M.G.D.	5-Day B.O.D. p.p.m.	Susp. Solids p.p.m.	Per Cent Reduction B.O.D.	Susp. Solids
1936	62.7	16	23	83.5	86.9
1937	65.4	13	15	86.3	90.1
1938	61.8	14	13	83.1	90.2
1939	71.6	12	12	87.0	90.6
1940	67.2	10	12	90.7	90.1

3646 STATE OF ILLINOIS EXHIBIT No. 29-A.

THE SANITARY DISTRICT OF CHICAGO
WEST SIDE SEWAGE TREATMENT WORKS
SUMMARY OF RESULTS OF OPERATION
1931-1940

Year	Flow M.G.D.	5-Day B.O.D. p.p.m.	Susp. Solids p.p.m.	Per Cent Reduction B.O.D.	Susp. Solids
1931	85.1	56	69	56.0	58.4
1932	125.7	59.2	60	42.0	51.2
1933	135.2	66.7	57	42	57.5
1934	128.4	65.6	56	47.5	61.4
(a) 1935	135.2	43.2	48	54.5	61.1
1936	197.6	49.3	57	49.2	52.9
1937	275.6	57	67	40.7	40.2
1938	305.7	50	55	47.4	54.5
1939	237.8	50	57	53.7	63.0
1940	361.5	64	75	50.0	58.0

NOTE:
(a) Battery C placed in service April 29, 1935.

251 STATE OF ILLINOIS EXHIBIT No. 31.

TABLE I.

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER
DISSOLVED OXYGEN AND OXYGEN DEMANDS

Station: Locks, Mouth of Chicago River

Dates: 1939-1940

Date Month		Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand, 20°C., p.p.m. 5 days
Nov.	1939	8	11.9	3
Dec.	"	5	12.9	1.8
Jan.	1940	2	14.1	1.7
Feb.	"	2	13.3	1.8
Mch.	"	3	13.3	1.4
Apr.	"	7	12.0	1.2
May	"	11	10.5	1.3
June	"	16	9.9	1.3
July	"		9.6	1.3
Aug.	"		8.7	0.9

253 STATE OF ILLINOIS EXHIBIT No. 32.

TABLE II.

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER
DISSOLVED OXYGEN AND OXYGEN DEMANDS

Station: Damen Avenue Dates: Jan. 1938-May, 1940

Date Month	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand, 20°C., p.p.m. 5 days
Jan. 1938	2	11.2	8.2
Feb.	—	—	—
Mch.	—	—	—
Apr.	12	9.4	9.7
May	15	8.6	10.7
June	17	6.9	10.5
July	21	5.1	8.0
Aug.	22	5.5	6.8
Sept.	19	5.7	7.9
Oct.	15	5.5	12.0
Nov.	8	8.3	13.5
Dec.	5	10.1	13.5
Jan. 1939	5	7.5	17.1
Feb.	4	8.5	20.6
Mch.	7	5.9	23.3
Apr.	19	1.5	36.3
May	16	0.5	55.1
June	19	2.0	21
July	22	0.2	25
Aug.	23	0.0	33
Sept.	21	0.1	32
Oct.	17	1.2	24
Nov.	11	5.2	22.4
Dec.	10	8.6	13.1
Jan. 1940	4	9.5	16.5
Feb.	5	7.5	19.3
Mch.	5	8.0	21.0
Apr.	9	6.2	13.9
May	14	3.6	11.6
June	18	1.6	8.0
July		3.7	5.6
Aug.		3.3	4.2

255 STATE OF ILLINOIS EXHIBIT No. 33.

TABLE III.

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER
DISSOLVED OXYGEN AND OXYGEN DEMANDS

Station: Summit Dates: Jan. 1938-May, 1940

Date Month	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand, 20°C., p.p.m. 5 days
Jan. 1938	2	9.8	26.8
Feb.	4	9.3	24.9
Mch.	6	8.2	23.4
Apr.	10	6.6	20.7
May	13	3.2	18.0
June	17	1.4	14.6
July	22	0.6	15.2
Aug.	22	1.1	13.5
Sept.	20	1.3	12.8
Oct.	17	0.8	18.0
Nov.	10	5.1	22.6
Dec.	4	8.7	25.0
Jan. 1939	6	2.4	40.3
Feb.	6	3.9	38.8
Mch.	8	1.9	37.1
Apr.	11	0.0	47.9
May	17	0.0	66.9
June	20	0.2	48.
July	23	0.0	37.
Aug.	25	0.0	33.
Sept.	23	0.0	35.
Oct.	19	0.1	36.
Nov.	19	0.4	26.5
Dec.	15	3.3	25.
Jan. 1940	10	4.4	26.
Feb.	—	2.8	33.
Mch.	—	4.3	32.
Apr.	10	1.7	28.
May	14	0.4	30.
June	20	0.0	42.
July		0.1	24.
Aug.		0.2	23.

257 STATE OF ILLINOIS EXHIBIT No. 34.

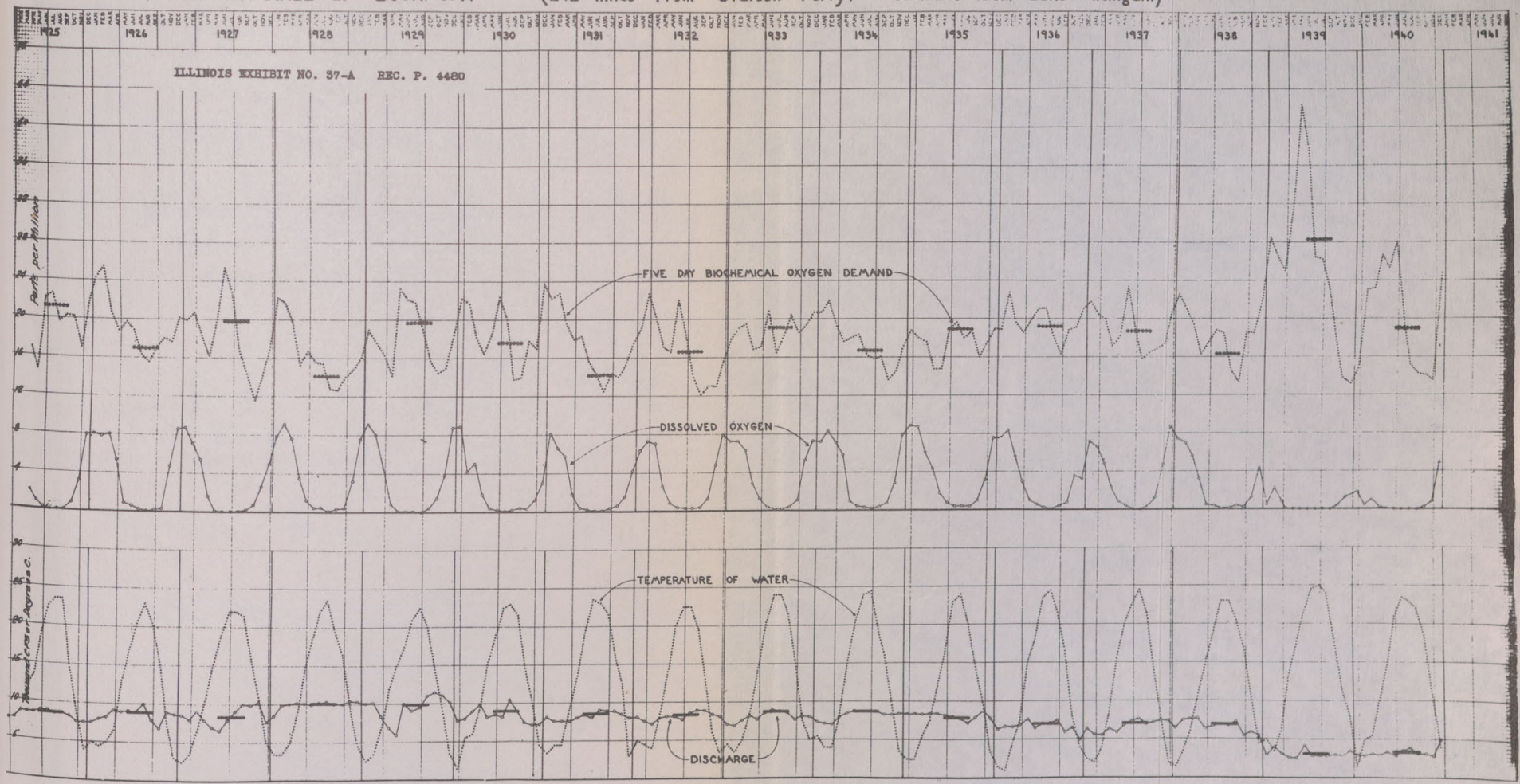
TABLE IV.

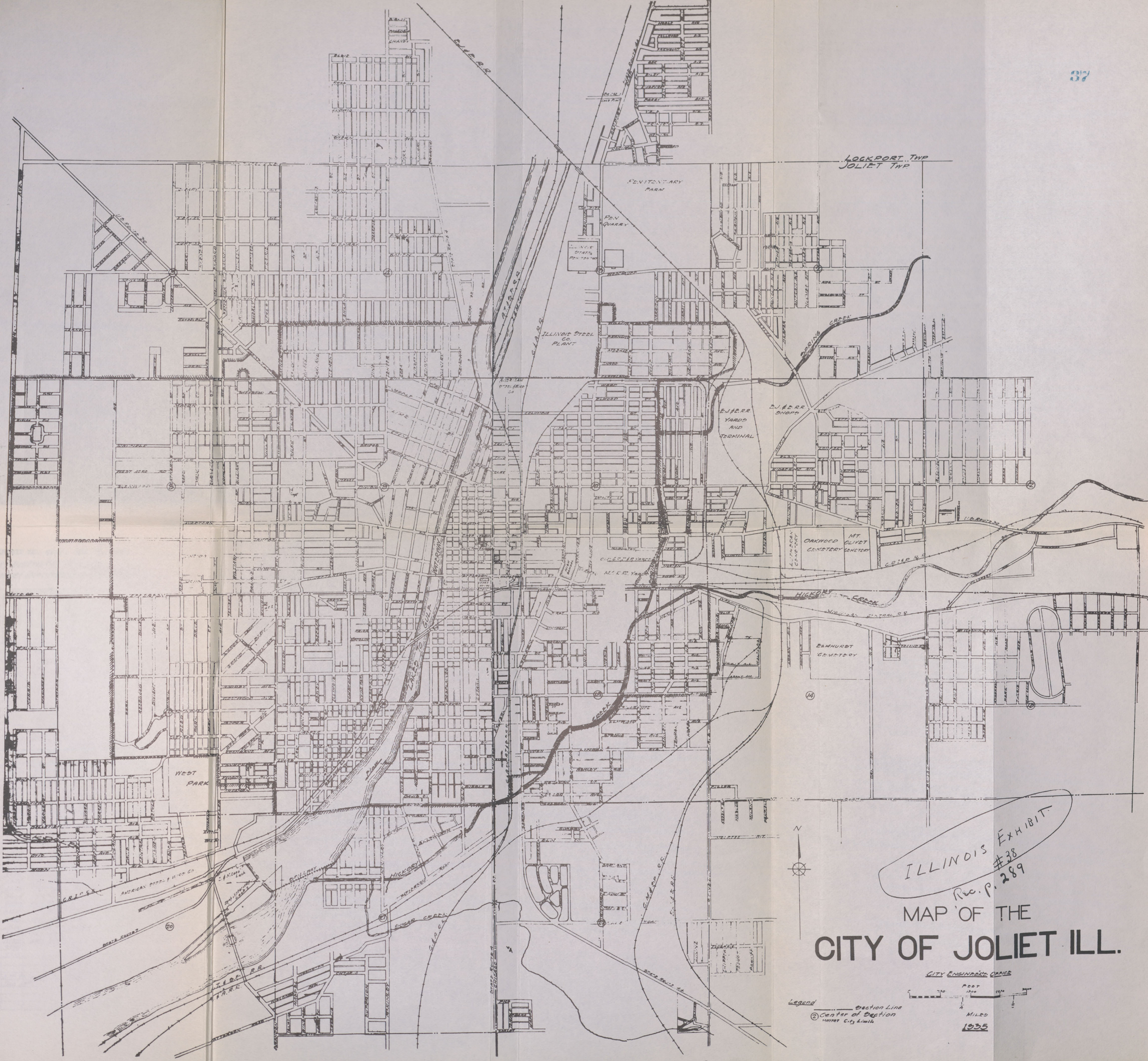
THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER
DISSOLVED OXYGEN AND OXYGEN DEMANDS

Station: Lockport Dates: Jan. 1938-May 1940

Date Month			Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand, 20°C., p.p.m. 5 days
Jan.	1938	6408	1.5	7.4	22.6
Feb.		7422	3.5	7.0	21.0
Mch.		7607	6.0	5.6	19.4
Apr.		7686	10.5	3.2	16.3
May		6311	15.0	0.5	17.6
June		6701	19.0	0.3	18.8
July		6814	23.0	0.1	18.5
Aug.		6740	23.0	0.1	14.6
Sept.		7247	20.5	0.3	13.4
Oct.		5512	17.0	0.2	18.6
Nov.		5861	10.5	1.2	18.5
Dec.		5469	4.5	4.3	21.8
Jan.	1939	2911	5.0	0.5	28.5
Feb.		3989	3.5	2.2	26.6
Mch.		3200	6.5	0.8	25.0
Apr.		2718	13.5	0.1	31.4
May		2623	17.5	0.0	42.3
June		4227	21.5	0.0	37.8
July		2880	24.5	0.0	26.5
Aug.		2902	25.0	0.0	26.2
Sept.		2826	24.0	0.0	23.0
Oct.		3022	18.0	0.0	18.1
Nov.		2820	11.5	0.4	13.8
Dec.		3469	8.0	1.3	13.2
Jan.	1940	2949	1.5	1.8	14.8
Feb.		2802	5.0	0.4	23.0
Mch.		3167	5.5	1.0	23.2
Apr.		3026	10.0	0.2	26.6
May		3344	14.5	0.1	25.3
June			21.0	0.0	27.9
July				.0	18.7
Aug.				0.1	15.2

MAIN CHANNEL at LOCKPORT (292 miles from Grafton Ferry: 35 miles from Lake Michigan.)




LOCKPORT TWP
JOLIET TWP
E.J.&E.R.R.
A.T.&S.F.R.R.
C.I.&W.R.R.
PENITENTIARY FARM
P.B.V. QUARRY
ILLINOIS STATE PENITENTIARY
ILLINOIS STEEL CO. PLANT
SPRING CREEK
E.J.&E.R.R. YARDS AND TERMINAL
E.J.&E.R.R. SHOPS
OAKWOOD CEMETERY
MT. OLIVET CEMETERY
U.S. ROUTE 30
HICKORY CREEK
EAMHURST CEMETERY
LAKE TO GULF WATERWAY
DIVERSION CANAL
WEST PARK
AMERICAN STEEL & WIRE CO.
HICKORY CREEK
STATE ROUTE 7
STATE ROUTE 53
C.R.I.&P. R.R.
I.&M.R.R.
M.C.R.R.
N
ILLINOIS EXHIBIT #38
Rec. P. 289
MAP OF THE
CITY OF JOLIET ILL.
CITY ENGINEERS OFFICE
FEET
MILES
1935
Legend
Section Line
Center of Section
Present City Limits

ILLINOIS EXHIBIT NO. 40-A REC. P. 3672.

Sanitary District of Chicago
Main Channel Discharge at Lockport

M & O Division
Hydraulic Control Section

Year	Month	Planned Flow: Average Monthly as of Jan. 1	Planned Flow: Average Monthly as revised Monthly	Planned Flow: Storm Reserve	Planned Flow: Average Dry Weather	Actual Flow: Average Monthly	Actual Flow: Storm Run-off	Actual Flow: Average Dry Weather	Precipitation U. of C.
		1	2	3	4	5	6	7	8
		cfs	cfs	cfs	cfs	cfs	cfs	cfs	Inches
1938	Jan.				6300	6408	208	6200	2.02
	Feb.				6780	7422	522	6900	2.11
	Mar.				7300	7607	307	7300	3.51
	April				7250	7686	286	7400	2.20
	May				6350	6311	311	6000	3.98
	June				6050	6701	701	6000	6.78
	July				6050	6814	714	6100	3.90
	Aug.				6050	6740	640	6100	2.12
	Sept				6130	7247	1147	6100	5.29
	Oct.				5750	5512	112	5400	0.77
	Nov.				5915	5861	61	5800	0.95
	Dec.				5425	5469	269	5200	1.18
	Average		6649		6279	6648	440	6208	
	Total								34.81
1939	Jan.		3200	400	2800	2911	138	2773	2.22
	Feb.		2800	400	2400	3989	1559	2430	1.98
	Mar.		2800	400	2400	3200	724	2476	2.96
	April	2800	2800	400	2400	2718	301	2417	3.22
	May	2800	2800	460	2340	2623	360	2263	3.66
	June	3500	3600	400	3200	4227	992	3235	5.13
	July	3500	3200	400	2800	2880	118	2762	2.74
	Aug.	3500	3200	600	2600	2902	50	2852	1.47
	Sept.	3000	3100	400	2700	2826	12	2814	0.49
	Oct.	2900	3100	400	2700	3022	172	2850	1.79
	Nov.	2800	2900	300	2600	2820	0	2820	0.95
	Dec.	2700	3500	300	3200	3469	0	3469	0.90
	Average	3135	3133	405	2678	3132	369	2763	
	Total								27.51
1940	Jan.	3100	3100	300	2800	2949	191	2758	1.25
	Feb.	2900	2900	300	2600	2802	273	2529	0.89
	Mar.	2900	2900	300	2600	3167	284	2883	2.41
	April	3075	3075	400	2675	3026	429	2597	3.17
	May	3000	3000	400	2600	3344	322	3022	5.16
	June	3200	3200	400	2800	2876	130	2746	1.31
	July	3675	3675	375	3300	3609	179	3430	1.29
	Aug.	3700	3700	200	3500	3923	246	3677	3.95
	Sept.	3300	3300	300	3000	3125	10	3115	0.31
	Oct.	2900	3000	200	2800	3186	188	2998	3.26
	Nov.	2900	2850	250	2600	2824	90	2734	2.36
*	Dec.	2850	2715	150	2565	2618	142	2476	1.30
*	Average	3125	3131	302	2829	3138	209	2929	
P	Dec.					9990			0.08
Δ	Average					3319			
	Total								26.74

* Except period Noon of Dec 2nd to noon of Dec 12th
P Noon of Dec 2nd to noon of Dec 12th
Δ Year

ILLINOIS EXHIBIT No. 43 REC. P. 1431

Sanitary District of Chicago

Main Channel Half-Hour Discharge at Lockport
On the 15th day of each Month of year

M&O Division
Hydraulic Control Section

Year 1939.

Time	Jan. CFS	Feb. CFS	Mar. CFS	Apr. CFS	May CFS	June CFS	July CFS	Aug. CFS	Sept. CFS	Oct. CFS	Nov. CFS	Dec. CFS
A.M. 12 MN	3271	5695	7805	3774	2650	3573	3495	3986	3385	3176	3706	6075
30	3271	5693	7821	3759	2852	3563	3215	3604	3233	3046	5138	4494
1	3266	5698	7831	3752	(	5201	3215	3599	)	"	3543	4511
30	3276	(	7856	4052		3600	3210	(		3046	3513	4566
2	(		7847	4037		3590	3210	)	3233	2971	3497	6101
30	)	)	7838	"	)	3600	3205		3212	(	3562	4528
3		5698	7853	4037	2852	3585	3205	3599	3212	)	3569	4548
30	(	5708	7854	5069	2847	3599	4856	3529	3228	2971	5208	6103
4	3276	7325	7879	3469	(	3578	3227	"	3216	4604	3602	4511
30	3286	5758	7870	3069		4985	3227	3529	3216	3023	3579	4480
5	3261	5718	7891	1867		2789	2399	3524	3206	3003	5213	6072
30	)	5708	6529	1887		2799	2139	2391	3272	2328	3602	4461
6		5698	6026	1877		2804	2134	2021	2386	3715	3138	4490
30	3261	5700	6046	1877	2847	2779	2134	2011	2094	2092	1857	3898
7	2240	5695	5990	1882	2842	2784	2139	3723	2089	2122	1847	2148
30	1895	"	5986	1882	2822	2772	2139	2048	2099	2090	1852	2148
8	1883	5695	5953	1858	2597	2764	2149	2043	2089	3696	1852	2143
30	1883	5682	5977	1835	1880	2754	2154	2048	2094	2102	1857	2162
9	1898	(	7434	1906	1885	2749	2139	2043	2091	2092	1837	2167
30	1898	)	6040	1855	(	2749	2159	"	2091	2091	1907	2167
10	1893		6015	1855		4404	2121	2043	2086	3707	1837	2157
30	(	5682	5611	1840		2762	2121	2110	2091	2107	"	2162
11	)	4717	4424	1850	)	4414	2136	2039	2091	2099	1837	2162
30	1893	4360	4402	1845	1885	2770	2153	2034	2086	2094	3462	2167
12 N	1888	4391	4362	"	1880	2749	3823	3693	2086	2099	1859	2152
P.M. 30	1889	4380	4357	1845	(	2734	2141	2024	3751	2104	1864	2151
1	(	4365	4357	3502	)	2820	2126	3706	2091	2104	1859	(
30	)	)	4387	1872	1880	2739	2126	2028	2086	2099	1869	)
2			4382	1867	1875	4392	2131	2083	2086	2104	1869	
30		4365	4382	1857	"	2766	3844	3706	2113	2099	1858	)
3	(	2767	4412	1872	1875	2766	2129	2048	2096	2099	1847	2151
30	1889	2254	4412	1868	1880	2786	2121	2063	2081	2104	1852	2146
4	1884	(	4382	1909	(	2781	2146	2053	2086	)	3490	2161
30	1884	)	4452	3502	)	2781	2141	"	2071	)	1869	2161
5	2219		4425	1850	1880	2818	3838	2053	2066	2104	3433	3858
30	3249	2254	4410	1835	1881	2803	2138	2042	2066	2939	3888	4377
6	3254	2604	4400	1840	1881	2798	2153	3688	2084	3241	3988	4361
30	3259	2639	4386	1855	1861	2798	2168	2058	3751	3246	3973	4268
7	3254	2634	4386	2632	3545	2778	2168	2048	2183	3246	3968	4258
30	(	3988	4361	2887	1900	2774	2148	2115	3436	3171	3958	3926
8	)	4395	4391	3092	1886	2781	2141	2048	3892	3166	3968	3911
30		4405	4376	3082	2715	2761	2131	3781	5625	3166	3896	3921
9	3254	4415	4421	3097	4622	3368	3200	4381	3900	3181	3837	3921
30	3259	"	4421	3017	2985	3568	3400	4381	3980	3111	5444	3911
10	4852	4415	4401	4740	2920	3563	3283	4276	5496	3111	3859	5456
30	3266	4365	4401	3334	2805	3573	4950	4276	3607	3175	3844	3907
11	3261	"	4396	3352	2805	3578	4920	4406	3277	3111	5329	3896
30	3276	4365	4391	4994	4362	3568	3317	3879	3629	3111	3824	3974
12 MN												
Mean	2711	4652	5587	2681	2459	3204	2728	2891	2871	2734	3131	3537
Max.	4852	7325	7891	5069	4622	5201	4950	4381	5625	4604	5444	6103
Min.	1883	2254	4357	1835	1861	2734	2121	2011	2066	2090	1837	2143

Sanitary District of Chicago

Main Channel Half-Hour Discharge at Lockport
On the 15th day of each Month of year

M & O Division
Hydraulic Control Section

Year 1940.

Time	Jan. CFS.	Feb. CFS	Mar. CFS	Apr. CFS	May CFS	June CFS	July CFS	Aug. CFS	Sept. CFS	Oct. CFS	Nov. CFS	Dec. CFS
A.M. 12 MN	5445	2779	2951	4198	5363	3198	4067					
30	5465	2604	2743	2578	5052	7923	3915					
1	5460	(	2738	2593	5082	7903	3775					
30	5609	(	2728	S	5092	4503	3835					
2	6082	)	2703	2593	5072	7940	3835					
30	6093	2604	2713	2513	6582	7953	3830					
3	5948	2539	4343	2511	5005	7978	3840					
30	5939	(	2713	2501	5012	7948	S					
4	5800	(	2718	2501	5045	2933	3840					
30	5319	(	S	2411	4997	2728	3850					
5	5065	(	2718	3747	7898	2168	3103					
30	4986	)	2100	2158	2178	3808	2853					
6	4981	2539	1905	2158	2178	2174	2853					
30	4976	2049	1880	2153	2184	2183	2848					
7	7658	3520	1872	2153	2193	2168	2884					
30	1879	1891	1872	2143	2183	2153	2871					
8	1854	1894	1877	2133	3803	2146	2867					
30	1859	1886	1868	2148	2182	2150	4495					
9	S	1886	1873	(	2172	S	2884					
30	1859	1891	1878	)	2191	2150	2882					
10	1849	1890	1878	(	S	2146	4485					
30	1854	1890	1881	2148	2191	2161	2879					
11	1866	1875	)	2141	2201	7156	(					
30	1866	1875	)	2121	2206	2156	(					
12 N	1871	1872	)	2126	2179	3797	2879					
P.M. 30	(	1872	(	2121	2169	2178	2945					
1	(	1877	1881	1706	216H	2754	2879					
30	(	1872	1863	2108	2179	2188	2880					
2	1871	(	1868	1726	2179	2178	2850					
30	1866	S	1873	3742	2174	2244	2857					
3	1848	1872	(	2147	2175	2178	2853					
30	1858	1882	(	2122	3810	S	2848					
4	3486	3518	(	2127	2180	2178	2858					
30	1869	1904	(	2119	3845	2167	2853					
5	3177	1889	(	2114	2175	2155	S					
30	7178	1872	)	2114	2182	3823	2853					
6	6584	3093	1873	2142	2196	2173	2858					
30	6323	3363	4386	2115	3815	2173	S					
7	6323	3343	4367	4926	2179	2158	2858					
30	6354	3208	4302	3100	2177	3835	2853					
8	6370	(	4187	2981	2186	3794	2863					
30	7921	(	4192	2983	5841	2458	4520					
9	6314	(	S	4580	5252	3405	5041					
30	6224	3208	4192	3000	5263	3405	5453					
10	6224	3063	4202	2985	5284	3106	5173					
30	7744	3056	4195	2865	508H	S	4981					
11	6119	3056	4045	2773	4966	3106	4975					
30	6164	2856	5615	2773	4968	3096	4866					
12 MN												
Mean	4287	2462	2680	2545	341H	2670	3458					
Max.	7921	3520	5615	4926	6582	4503	5453					
Min.	1879	1872	1863	1706	216H	2146	2848					

3647 STATE OF ILLINOIS EXHIBIT No. 44-A.

THE SANITARY DISTRICT OF CHICAGO
NORTH SIDE SEWAGE TREATMENT WORKS
FLOW, B.O.D., D.O. AND SUSPENDED SOLIDS

1940

Month	Flow M.G.D.	5-Day B.O.D. Raw Sewage	5-Day B.O.D. Effluent	5-Day B.O.D. % Reduction	Diss. Oxygen Final Settling Tanks	Diss. Oxygen Outfall	Suspended Solids Raw Sewage	Suspended Solids Effluent	Suspended Solids % Reduction
Jan.	174	160	9.6	94.0	2.7	9.5	141	16	88.7
Feb.	181	143	8.2	94.3	1.6	9.3	147	13	91.2
Mar.	187	142	8.4	94.0	1.5	9.2	145	13	91.0
Apr.	189	136	8.4	93.8	2.1	9.1	145	12	91.7
May	220	108	7.2	93.3	1.8	8.5	144	10	93.0
June	193	110	6.7	93.9	1.7	7.9	146	10	93.2
July	195	112	5.6	95.0	1.4	7.6	147	8	94.6
Aug.	200	103	4.9	95.2	1.4	7.4	151	9	94.0
Sept.	181	119	4.4	96.3	1.2	7.5	124	7	94.4
Oct.	180	130	6.0	95.4	1.0	7.9	152	9	94.1
Nov.	177	145	6.5	95.5	1.0	8.4	142	12	91.5
Dec.	182	139	7.7	94.5	1.9	8.9	142	14	90.1
Average	188	129	7.0	94.6	1.6	8.4	144	11	92.4

3650 STATE OF ILLINOIS EXHIBIT No. 45-A.

THE SANITARY DISTRICT OF CHICAGO
CALUMET SEWAGE TREATMENT WORKS
FLOW, B.O.D., D.O. AND SUSPENDED SOLIDS

1940

Month	Flow M.G.D.	5-Day B.O.D. Raw Sewage	5-Day B.O.D. Effluent	5-Day B.O.D. % Reduction	Dissolved Oxygen Outfall Sewer	Suspended Solids Raw Sewage	Suspended Solids Effluent	Suspended Solids % Reduction
Jan.	67	125	10	92.0	8.4	121	14	88.4
Feb.	72	118	9	92.4	8.5	123	12	90.2
Mar.	62	106	9	91.5	8.7	123	13	89.4
Apr.	61	101	9	91.0	8.6	120	11	90.9
May	70	87	9	89.7	8.3	118	12	89.8
June	70	96	8	91.6	7.6	126	11	91.3
July	63	98	8	91.8	7.3	119	10	91.6
Aug.	66	98	9	90.8	7.2	128	10	92.2
Sept.	64	108	10	90.7	7.5	117	10	91.5
Oct.	66	104	12	88.5	7.5	120	15	88.4
Nov.	70	123	17	86.1	7.9	111	10	91.0
Dec.	76	115	11	90.4	8.4	120	12	90.0
Average	67	107	10	90.7	8.0	121	12	90.1

3652 STATE OF ILLINOIS EXHIBIT No. 46-A.

THE SANITARY DISTRICT OF CHICAGO
WEST SIDE SEWAGE TREATMENT WORKS
FLOW, B.O.D., D.O. AND SUSPENDED SOLIDS

1940

Month	Flow M.G.D.	5-Day B.O.D. Raw Sewage	5-Day B.O.D. Effluent	5-Day B.O.D. % Reduction	Dissolved Oxygen Outfall	Suspended Solids Raw Sewage	Suspended Solids Effluent	Suspended Solids % Reduction
Jan.	168	129	62	51.9		152	65	57.2
Feb.	187	118	67	43.2		141	72	48.9
Mar. (a)	348	132	74	44.0		178	85	52.2
Apr. (b)	394	137	75	45.2		171	85	50.2
May (c)	437	109	55	49.5		163	73	55.2
June (d)	391	133	64	51.9		217	74	61.3
July (e)	449	123	60	51.2		178	75	57.8
Aug. (f)	449	116	48	58.6		182	58	68.1
Sept. (g)	383	130	54	58.5	4.6	193	67	65.3
Oct. (h)	371	141	60	57.4	5.1	214	71	66.8
Nov. (i)	374	142	75	47.2	5.3	192	86	55.2
Dec. (j)	385	128	76	40.6	8.6	167	84	49.7
Average (k)	362	128	64	50.0	5.9	179	75	58.0

(a) Prel. sludge received from SW. Wks. 4 M.G.D., equivalent to 37 p.p.m. susp. solids.
(b) Prel. sludge received from SW. Wks. 4 M.G.D., equivalent to 38 p.p.m. susp. solids.
(c) Prel. sludge received from SW. Wks. 5 M.G.D., equivalent to 55 p.p.m. susp. solids.
(d) Prel. sludge received from SW. Wks. 6 M.G.D., equivalent to 79 p.p.m. susp. solids.
(e) Prel. sludge received from SW. Wks. 6 M.G.D., equivalent to 67 p.p.m. susp. solids.
(f) Prel. sludge received from SW. Wks. 6 M.G.D., equivalent to 65 p.p.m. susp. solids.
(g) Prel. sludge received from SW. Wks. 7 M.G.D., equivalent to 68 p.p.m. susp. solids.
(h) Prel. sludge received from SW. Wks. 7 M.G.D., equivalent to 69 p.p.m. susp. solids.
(i) Prel. sludge received from SW. Wks. 6 M.G.D., equivalent to 43 p.p.m. susp. solids.
(j) Prel. sludge received from SW. Wks. 5 M.G.D., equivalent to 34 p.p.m. susp. solids.
(k) Prel. sludge received from SW. Wks. 5 M.G.D., equivalent to 46 p.p.m. susp. solids.

3654 STATE OF ILLINOIS EXHIBIT No. 47-A.

THE SANITARY DISTRICT OF CHICAGO
SOUTHWEST SEWAGE TREATMENT WORKS
FLOW, B.O.D., D.O. AND SUSPENDED SOLIDS

1940

Month	Flow M.G.D.	5-Day B.O.D. Raw Sewage	5-Day B.O.D. Effluent	5-Day B.O.D. % Reduction	Dissolved Oxygen Outfall	Suspended Solids Raw Sewage	Suspended Solids Effluent	Suspended Solids % Reduction
January	287	151	13	91.3	8.6	217	15	93.1
February	267	142	10	93.0	8.3	194	14	92.8
March (a)	197	—	26	—	9.5		34	
April (b)	252	172	62	64.0	7.4	242	63	74.0
May (c)	310	142	58	59.1	6.0	203	62	69.4
June (d)	365	154	71	53.8	4.2	191	69	63.8
July (e)	287	151	44	70.8	4.2	187	43	77.0
Aug. (f)	340	134	52	61.1	5.1	188	56	70.2
Sept. (g)	358	141	45	68.1	5.1	170	45	73.5
Oct. (h)	361	152	53	65.1	5.6	220	58	73.6
Nov. (i)	374	188	73	61.2	6.4	215	79	63.3
Dec. (j)	358	193	102	47.1	8.5	211	105	50.2
Average (k)	313	156	51	67.3	6.6	203	54	73.4

(a) Complete Treatment on 161 M.G.D.
(b) Complete Treatment on 122 M.G.D.
(c) Complete Treatment on 142 M.G.D.
(d) Complete Treatment on 130 M.G.D.
(e) Complete Treatment on 168 M.G.D.
(f) Complete Treatment on 176 M.G.D.
(g) Complete Treatment on 236 M.G.D.
(h) Complete Treatment on 248 M.G.D.
(i) Complete Treatment on 222 M.G.D.
(j) Complete Treatment on 139 M.G.D.
(k) Complete Treatment on 192 M.G.D.

3674 STATE OF ILLINOIS EXHIBIT No. 62.

SANITARY DISTRICT OF CHICAGO
DIVERSION FROM LAKE MICHIGAN

Year	Month	Total Average Monthly 1 CFS	Des Plaines River Inflow 2 CFS	Total from Lake Michigan Watershed 3 CFS	Domestic Pumpage 4 CFS	Chicago and Calumet Rivers 5 CFS	Diversion from Lake Michigan 6 CFS	Precipitation U. of C. 7 Inches
1938—	Jan.	6408	20	6388	1589	520	4279	2.02
	Feb.	7422	63	7359	1554	789	5016	2.11
	Mar.	7607	25	7582	1534	868	5180	3.51
	April	7686	22	7664	1529	1006	5129	2.20
	May	6311	13	6298	1563	460	4275	3.98
	June	6701	28	6673	1649	1009	4015	6.78
	July	6814	305	6509	1761	776	3972	3.90
	Aug.	6740	11	6729	1808	501	4420	2.12
	Sept.	7247	25	7222	1683	1814	3725	5.29
	Oct.	5512	11	5501	1577	194	3730	0.77
	Nov.	5861	9	5852	1514	125	4213	0.95
	Dec.	5469	9	5460	1491	138	3831	1.18
	Average	6648	45	6603	1604	683	4316	
	Total							34.81
1939—	Jan.	2911	10	2901	1488	251	1162	2.22
	Feb.	3989	40	3949	1504	1829	616	1.98
	Mar.	3200	31	3169	1515	1250	404	2.96
	April	2718	23	2695	1689	868	138	3.22
	May	2623	18	2605	1532	906	167	3.66
	June	4227	16	4211	1669	1986	556	5.13
	July	2880	7	2873	1878	501	494	2.74
	Aug.	2902	3	2899	1801	397	701	1.47
	Sept.	2826	0	2826	1733	238	855	0.49
	Oct.	3022	4	3018	1619	197	1202	1.79
	Nov.	2820	4	2816	1518	131	1167	0.95
	Dec.	3469	4	3465	1487	116	1862	0.90
	Average	3132	13	3119	1620	722	777	
	Total							27.51
1940—	Jan.	2949	19	2930	1566	257	1107	1.25
	Feb.	2802	36	2760	1538	432	796	0.89
	Mar.	3167	68	3099	1521	582	996	2.41
	April	3026	66	2960	1523	292	1145	3.17
	May	3344	118	3220	1528	837	861	5.16
	June	2876	53	2823	1662	567	594	1.31
	July	3609	38	3571	1854	360	1357	1.29
	Aug.	3923	47	3876	1750	307	1819	3.95
	Sept.	3125	32	3093	1673	119	1301	0.31
	Oct.	3186	27	3159	1525	159	1475	3.26
	Nov.	2824	24	2800	1459	138	1203	2.36
	*Dec.	2618	68	2550	1448	304	798	1.30
	*Average	3138	49	3089	1592	363	1134	
	†Dec.	9990	41	9949	1501	225	8223	0.08
	‡Average	3319	49	3270	1589	363	1318	
	Total							26.74

* Except period Noon of Dec. 2nd to noon of Dec. 12th
† Noon of Dec. 2nd to noon of Dec. 12th
‡ Year

3677 STATE OF ILLINOIS EXHIBIT No. 63.

ANALYSES OF SAMPLES FROM MAIN CHANNEL AND ILLINOIS RIVER

AVERAGE MONTHLY RESULTS, SEPT.-DEC., 1940

(Complete Data in Record, Exhibits 31 to 36, and Page 1840)

1940

Station	Dissolved Oxygen P.P.M. Sept.	Oct.	Nov.	Dec.	5-day B.O.D. P.P.M. Sept.	Oct.	Nov.	Dec.	Temperature Deg. C Sept.	Oct.	Nov.	Dec.
Lake Michigan	8.8	9.8	11.9	14.1	0.9	1.0	1.5	1.6	18	15	8	3
Damen Ave.	4.2	4.9	7.9	11.4	3.5	4.5	4.4	3.9	19	15	7	3
Summit	0.3	0.5	3.2	7.5	21	22	30	29	21	18	10	5
Lockport	0.1	0.2	0.8	4.9	14.3	14.1	13.6	24.7	22	19	11	4
Marseilles	4.4	5.4	9.3	11.4	3.1	3.7	4.8	5.6	21	17	8	5
Chillicothe	6.8	7.3	10.4	12.2	4.7	4.8	3.9	4.2	21	16	7	3

1820 MOHLMANN EXHIBIT No. 1.

THE SANITARY DISTRICT OF CHICAGO (1)
ENGINEERING DEPARTMENT

Subject: Determination of Chlorine Demand—Main Channel

Computation: July 2 and 3, 1940.

Parts per Million

Time	July 2, 1940 Damen Ave.	Summit	July 3, 1940 Damen Ave.	Summit	Lockport
9:00 A.M.	2.1	5.0	2.0	4.5	3.7
9:30	1.6	5.0	2.0	4.5	3.7
10:00	1.6	4.5	2.3	4.0	3.7
10:30	1.3	4.5	2.3	3.5	3.7
11:00	1.6	5.5	2.0	4.0	5.0
11:30	1.8	5.0	2.0	4.0	5.0
12:00	1.6	4.0	2.3	4.5	5.0
12:30 P.M.	2.3	4.0	2.3	4.0	5.0
1:00	2.3	3.0	2.3	5.0	5.0
1:30	2.3	4.0	2.0	4.0	6.2
2:00	2.0	4.0	2.3	4.5	5.0
2:30	2.0	4.0	2.3		
3:00	2.3	4.0	2.3		
Average	1.9	4.4	2.2	4.2	4.6

2446 MOHLMAN EXHIBIT No. 8.

EDITORIAL.

OXYGEN DEMAND OF SLUDGE DEPOSITS.

The most objectionable feature of a grossly polluted stream is the presence of floating, gas-lifted sludge, foul in odor and nauseous in appearance. Abatement of stream pollution should always be directed first to the removal from sewage of the settleable solids, and second to the reduction of the B.O.D. of the clarified sewage. Although it is generally accepted that clarification accomplishes about 35 per cent reduction of B.O.D. and complete treatment 90 per cent, the actual benefit to the stream by clarification may greatly exceed 35 per cent, particularly in the early months of summer.

Stabilization of sewage sludge deposits on stream beds is accomplished at the expense of the dissolved oxygen of the supernatant water. The well-known accelerating effect of comparatively small increases in temperature on the rate of oxygen demand of sewage also applies to sludge, and when the water temperature reaches 15 to 20 degrees Centigrade in June, a sudden increase in the oxygen requirement of sludge deposits occurs. For a few weeks the sludge deposits may erupt violently and the river surface may be covered with a carpet of bubbling sludge. Later in the summer, the water temperature may reach 30 degrees Centrigrade, and as the temperature mounts, the sludge continues to putrefy, although not with the explosive violence associated with the onset of summer weather.

For a long time it has been known that the oxygen demand of freshly settled sewage sludge is far greater

than that of digested sludge, or of stream deposits several years old, but there have been comparatively few investigations of the rate of B.O.D. of sludge. In the past few years, however, attention has been directed toward this subject at a number of research laboratories in the United States. Results of investigations of B.O.D. of sludge and river mud have been reported by Rudolfs, Fair, Theriault and Baity, the latter in this issue (page 539). Studies have also been under way since 1935 in the laboratories of the Sanitary District of Chicago and undoubtedly similar work has been carried on elsewhere.

Dr. Baity's paper on the results of his work at Harvard in 1925 is very interesting, and he has studied more phases of the problem, at one time, than other investigators. He started with raw sewage sludge, with a high volatile content, and with very thin layers, ranging from .089 to 4.0 centimeters in depth. The experiments were carried on for only 36 days. As Dr. Baity states, it is recognized that this period was too short to establish many factors related to the long-time incubation required for the complete stabilization of sludge deposits of appreciable depth. The curve of oxygen in his Fig. 2 is ended with the statement "oxygen demand essentially satisfied," but it seems to the writer that this conclusion is subject to doubt, and if the tests had been continued, the oxygen demand might have continued indefinitely, and the total after a year or two might have been double the 36-day total.

Other studies, on somewhat different bases, and with deeper layers of sludge, have been continued to 400 days (Rudolfs) and 700 days (Sanitary District of Chicago). The results of Dr. Rudolfs' study are given in an abstract in this issue (page 636). A somewhat casual consideration of the results of both studies shows the following:

Days at 20 deg. C.	Mgm. 5-day B.O.D. per Gm. Volatile Solids	
	Rudolfs	San. Dist. Chi.
0	540	380
40	380	270
80	320	210
120	270	170
200	190	140
400	110	105
600	—	97
700	—	96

The rate after 40 days was approximately 70 per cent of the initial rate in both cases, while even after 400 days, the rate was still 20 to 28 per cent of the initial. During a summer period of about 120 days, the rate might therefore decrease to about half the initial. During the following winter the sludge would remain practically dormant, and through the following summer the rate would again decrease to about one-half of the initial rate of the second year. After this, the rate would apparently remain more or less constant for a number of years, at 100 mgm. 5-day B.O.D. per gm. of volatile solids. A number of well-digested sludges from the Illinois River have averaged around this value. The sludge beds studied by Rudolfs, in the Connecticut River have below Springfield, Massachusetts, also averaged approximately 100 mgm. per gm. volatile solids.

Dr. Baity gives a 10-day B.O.D. for the Brockton sludge of 244 mgm. per gm. volatile solids, equivalent to approximately 180 mgm. on a 5-day basis. This is lower than the values found by Rudolfs and the Sanitary District of Chicago for fresh sewage sludge, but higher than has been reported for sludge from river bottoms.

Notwithstanding these variations, which may be

ascribed to the effect of different techniques, the fact remains that a procedure is being developed and data are being accumulated that will enable us to evaluate the effect of sludge deposits in stream studies. Even with sewage treatment, sludge banks will be formed from storm-water discharge. With data based on the organic content of sludge, we can in time evaluate the influence of such deposits.

The influence of sludge in the lower reaches of the Illinois River has been discussed briefly by Wisely, who states on page 569 of this issue that in the stretch from Mile 162 to Havana (Mile 120), 50 per cent of the total oxygen demand was exerted by sludge deposits. The Board of Review of the Sanitary District of Chicago estimated that the sludge deposits in the upper Illinois River exerted an oxygen demand in summer that was equivalent to the total flow of sewage, thus doubling the load on the oxygen resources of the river.

The consensus of those who have studied the oxygen demand of sewage sludge seems to be that by far the greatest source of deoxygenation is caused by freshly settled sludge, deposited during the winter months and throughout the current summer. Such deposits, when allowed to pass through another winter, will show a greatly reduced rate of demand during the second summer. Dr. Imhoff once suggested to the writer that under some conditions it might be desirable to skim off the surface of lake bottoms early in the spring, in order to remove sludge deposited during the previous winter. Such vacuum cleaning has not been accomplished, so far as the writer knows, but there is a great deal of significance in this suggestion.

It is fortunate that so many investigators are studying the oxygen demand of sludge deposits, with refer-

ence to stream conditions, and our efforts to abate stream pollution will be on a sounder foundation when we have more information on this important subject.

F. W. M.

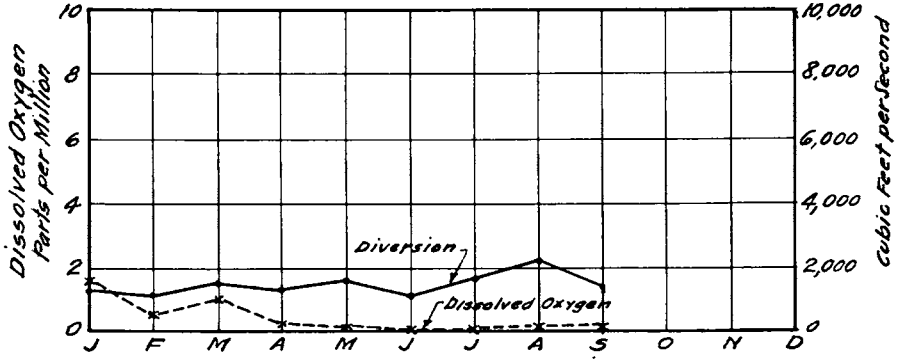
MOHLMAN EXHIBIT NO. 14-A, B, C, D REC. P. 3530

Basis for Estimating Additional Diversion Needed in Summer

Mohlman Exhibit 14a

CHART I

Average Results of Analyses and Flow Records at Lockport.



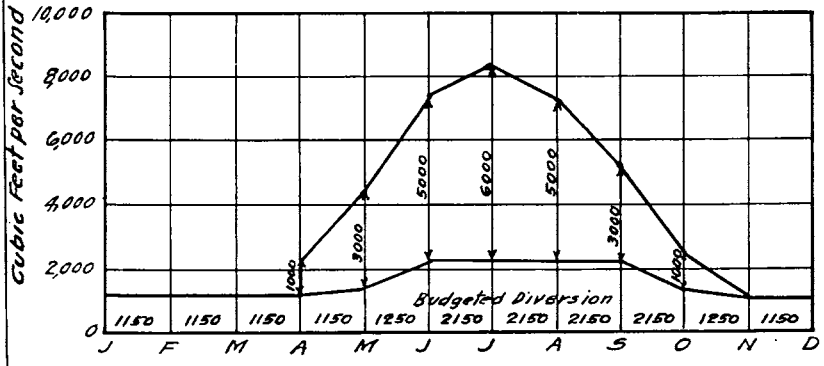
Year 1940

See Table I

CHART II

Proposed Increase of Diversion

(Actual Increase to be based on Analyses submitted to U.S. Engrs)



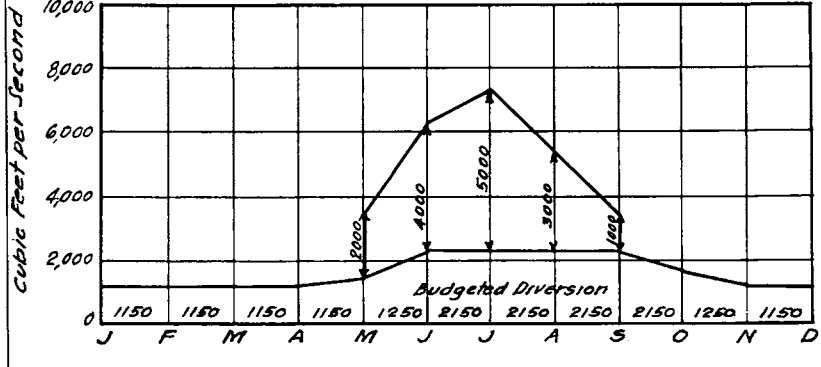
Year 1941

See Table II

CHART III

Proposed Increase of Diversion

(Actual Increase to be based on Analyses submitted to U.S. Engrs)



Year 1942

See Table III

Mohlman Exhibit 14b.

Table I.

Analyses at Lockport and Diversion, 1940.

Month 1940	Dissolved Oxygen P.P.M. Average	Diversion C.F.S. Average	Total Flow at Lockport C.F.S. Average
Jan.	1.8	1364	2949
Feb.	0.4	1228	2802
Mar.	1.0	1578	3167
Apr.	0.2	1437	3026
May	0.1	1698	3344
June	0.0	1161	2876
July	0.0	1717	3609
Aug.	0.1	2126	3923
Sept.	0.1	1420	3125
Oct.	0.2		
Nov.			
Dec.			

Mohlman Exhibit 14c.

Table II.

Proposed Increase of Diversion.

Actual Increase to Be Modified in Accordance with Results of Sanitary District Analyses Submitted to U. S. Engineers.

Year 1941.

Cubic Feet Per Second.

Month 1941	Budgeted Diversion (By H. P. Ramey)	Additional Diversion Proposed	Total Diversion	Total Flow at Lockport (At 1,650 C.F.S. Sewage)
Jan.	1,150	0	1,150	2,800
Feb.	1,150	0	1,150	2,800
Mar.	1,150	0	1,150	2,800
Apr.	1,150	1,000	2,150	3,800
May	1,250	3,000	4,250	5,900
June	2,150	5,000	7,150	8,800
July	2,150	6,000	8,150	9,800
Aug.	2,150	5,000	7,150	8,800
Sept.	2,150	3,000	5,150	6,800
Oct.	1,250	1,000	2,250	3,900
Nov.	1,150	0	1,150	2,800
Dec.	1,150	0	1,150	2,800
Total	18,000	24,000	42,000	61,800
Average for Year	1,500	2,000	3,500	5,150

Mohlman Exhibit 14d.

Table III.

Proposed Increase of Diversion.

Actual Increase to Be Modified in Accordance with Results of Sanitary District Analyses Submitted to U. S. Engineers.

Year 1942.

Cubic Feet Per Second.

Month 1941	Budgeted Diversion (By H. P. Ramey)	Additional Diversion Proposed	Total Diversion	Total Flow at Lockport (At 1,650 C.F.S. Sewage)
Jan.	1,150	0	1,150	2,800
Feb.	1,150	0	1,150	2,800
Mar.	1,150	0	1,150	2,800
Apr.	1,150	0	1,150	2,800
May	1,250	2,000	3,250	4,900
June	2,150	4,000	6,150	7,800
July	2,150	5,000	7,150	8,800
Aug.	2,150	3,000	5,150	6,800
Sept.	2,150	1,000	3,150	4,800
Oct.	1,250	0	1,250	2,900
Nov.	1,150	0	1,150	2,800
Dec.	1,150	0	1,150	2,800
Total	18,000	15,000	33,000	52,800
Average for Year	1,500	1,250	2,750	4,400

3535

Mohlman Exhibit 14-E.

Basis for Estimating Additional Diversion Needed in Summer for Ameliorating Conditions in Brandon Pool.

(By F. W. Mohlman.)

1. Table I and Chart I show results of analyses for dissolved oxygen, and flow of water at Lockport in 1940. The October results are available only through Oct. 20, 1940. The dissolved oxygen results have started to increase, with an average of 0.5 p.p.m. on Oct. 15th.

2. Table II and Chart II show the diversion in 1941 budgeted to provide as much dilution as possible in summer, plus an estimated additional diversion extending from April through October. The increase extends up to 6,000 c.f.s. in July, but the total proposed additions average only 2,000 cu. ft. per second on an annual basis which added to the authorized 1,500 c.f.s. gives a total annual average of 3,500.

It is impossible to estimate the exact amount of increased diversion that will be needed in the summers of 1941 and 1942, therefore, it is proposed that the increases be based on the results of the actual analyses made by the Sanitary District hourly, and now furnished to the U. S. Engineers in Chicago as monthly averages. The results could be transmitted daily, and as soon as the dissolved oxygen began to approach zero, next April, the diversion would be increased within the limits of suggested increases shown in the table and chart. The amount of additional diversion required would increase markedly in June, reaching a maximum in July, thereafter decreasing.

3. Table III and Chart III show suggested increases in diversion in the summer of 1942. The total increases shown average only 1,250 c.f.s. on an annual basis, which added to the 1,500 authorized gives a total annual average diversion of 2,750 c.f.s.

As a temporary working basis to avoid nuisance during 1941 and 1942, it is proposed that a minimum dissolved oxygen content of one part per million be maintained in Brandon Pool, as determined hourly at the outlet of the pool.

Actual chemical analyses, made in the summers of 1941 and 1942, will provide a much safer criterion for determining the increase of diversion needed for those years than estimates which can be made at the present time.

3596 MOHLMAN EXHIBIT No. 17.

SUMMARY AND CONCLUSIONS.

REPORT ON THE FLUSHING EXPERIMENT AUTHORIZED BY U. S. SUPREME COURT.

The flushing experiment authorized by the U. S. Supreme Court extended from noon on December 2, 1940 to noon on December 12, 1940. During the test the total flow at Lockport averaged 9,973 c.f.s. and the diversion (flow at Lockport less water pumpage in the Chicago area) 8,430 c.f.s. This was the maximum flow capacity of the Drainage Canal at the time of the test.

Samples were collected at fourteen stations, the most important being those at Cass St., Joliet, just above Brandon Pool, and at Brandon Bridge, just below Brandon Dam. A total of 8,970 analyses were made.

The suspended solids test shows the amount of sludge suspended in and carried along with the current. During the 10-day test a total of 84,010 tons of total suspended solids, on the dry basis, of which 27,067 tons were organic, were carried into Brandon Pool. During the same period a total of 21,123 tons of total suspended solids (dry basis), of which 7,512 were organic, were carried out of the Pool. The differences, 62,887 tons of total and 19,555 tons of organic solids, settled in the Pool. The amount that settled was 75 per cent of the total and 72 per cent of the organic solids. Therefore the test did not scour solids out of Brandon Pool, but resulted in deposition of large tonnages in the Pool. However, the solids washed out of the Pool were slightly higher in per cent of organic matter than those which entered, as the incoming total solids contained 32 per cent volatile matter and the outgoing solids contained 35.6 per cent.

The results of the determinations of biochemical oxygen demand showed a reduction of 52.8 per cent from Cass St. to Brandon Bridge. Therefore 47.2 per cent was carried out of the Pool. This indicates that putrescible organic matter was scoured out of the Pool to a greater extent than shown by the record of the total and volatile suspended solids.

Samples were collected and soundings made of the sludge on the bottom of Brandon Pool, before and after the test. Soundings indicated a fill of 2 to 2½ ft., equivalent to about one-half million cubic yards of wet sludge. Analyses showed that the sludge had a higher avidity for oxygen after the test than prior thereto. Therefore the potential ability of the sludge to create odors in the Pool has not been lessened. Throughout the winter the sludge lies dormant because the temperature is too low to generate the foul gases which produce odors.

The level of Brandon Pool at the Dam was lowered one-half foot to induce the flow of 10,000 c.f.s. A further lowering in the Pool level of about one foot on December 7 may have been the cause of a slight increase in the solids discharged from the Pool. However, even on this day 5,680 tons of suspended solids entered the Pool and only 2,861 tons were discharged.

The increased velocity in the Main Channel scoured out a surprisingly large tonnage of sludge. With cleaner bottom conditions in the Main Channel from Chicago to Lockport, it is probable that the oxygen demand at Lockport will be somewhat less than if the test had not been made. The results show that the concentrated 10-day effort carried out of the Main Channel about 245 times as much organic sludge as would normally be transported in one dry-weather winter day with 1,500 c.f.s. diversion, and 94 times as much organic sludge out of Brandon Pool.

During the test some 5,365 tests were made for dissolved oxygen. This indicator of purity was nearly zero at Lockport prior to the test, and increased gradually during the test to a maximum of 10.0 parts per million. The day after the test concluded, 10.7 p.p.m. was found, which quickly dropped to around 1.0 p.p.m. At the lower end of Brandon Pool the dissolved oxygen also increased to a maximum of 10.3 p.p.m. on the last day of the test, and thereafter dropped to an average of 0.9 p.p.m. on December 17. This rapid decrease, together with the observation of gas ebullition from the Pool when samples were collected on December 27, plus the fact of increased deposits of sludge of more putrescible character, leads to the conclusion that with the approach of warm weather, Brandon Pool will again become foul and odorous. The dissolved oxygen at Lockport will certainly drop to zero long before the summer of 1941 unless the diversion of water from Lake Michigan is increased progressively as the temperature of the water increases.

The more putrefactive sludge deposited in Brandon Pool during the test will begin to decompose in the early summer more intensively than the older sludge present at the bottom of the Pool before the test was made. The foul and odorous putrefaction will be concentrated in the Pool unless relieved by diversion of sufficient water from Lake Michigan to maintain at least 1.0 p.p.m. of dissolved oxygen in the water at the lower end of the Pool, as requested in the modified petition of the State of Illinois.

The effect of the test on the Illinois River was measured by samples and analyses at Marseilles, 45 miles below Lockport, and at Chillicothe, 112 miles below. The results showed only a very moderate increase of suspended solids and oxygen demand. The increase of suspended solids at Chillicothe was mostly clay or silt.

THE SANITARY DISTRICT OF CHICAGO.

REPORT ON THE FLUSHING EXPERIMENT AUTHORIZED BY U. S. SUPREME COURT.

DECEMBER 2-12, 1940.

By F. W. Mohlman,
Director of Laboratories.

The flushing experiment authorized by the U. S. Supreme Court started at 12 noon Monday, Dec. 2, 1940, and ended at 12 noon Thursday, Dec. 12, 1940. The average flows in the Main Channel and Des Plaines River, and the diversion from Lake Michigan, from noon to noon for several days before the test, for the ten days of the test, and for several days thereafter, were as follows:

DISCHARGE AND DIVERSION.

Date 1940 Noon to Noon	Cubic Feet per Second			
	Main Channel at Lockport	Metropolitan Pumpage	Diversion from Lake Michigan	Des Plaines River (Enters Below Lockport)
		Before Test		
Nov. 27-28	2,866	1,497	1,369	97
28-29	3,214	1,498	1,716	87
29-30	2,849	1,488	1,361	80
30- 1	2,994	1,432	1,562	75
Dec. 1- 2	2,708	1,450	1,258	70
		During Test		
Dec. 2- 3	10,770	1,539	9,231	75
3- 4	9,828	1,566	8,262	75
4- 5	10,246	1,554	8,692	70
5- 6	9,857	1,550	8,307	67
6- 7	9,645	1,557	8,088	65
7- 8	9,679	1,486	8,193	75
8- 9	9,949	1,498	8,451	98
9-10	9,843	1,565	8,278	112
10-11	9,819	1,553	8,266	127
11-12	10,090	1,551	8,539	155
		After Test		
Dec. 12-13	3,772	1,541	2,231	175
13-14	2,543	1,523	1,020	160
14-15	2,356	1,466	890	135
15-16	4,534	1,545	2,989	115
16-17	3,148	1,637	1,511	90

Note: Des Plaines River enters below Lockport, but above Cass St.

The flow at Cass Street (Joliet) and at Brandon Dam was the sum of the flows from the Main Channel and Des Plaines River.

Samples were collected and analyses made at practically all stations, from noon Nov. 27, 1940, until noon, Dec. 17, 1940. The most important stations were those at Cass St. and at Brandon Bridge, the latter being about a thousand feet downstream from Brandon Dam. Results of analyses at Cass St. showed the condition of the water just above Brandon Pool, and those at Brandon Bridge showed the condition just below the Pool. Samples at Lockport were collected from the Main Channel at the Ninth Street Bridge, some 8,800 feet above the Power House.

Upstream from Lockport, samples were collected in Chicago as follows:

Locks, Mouth of Chicago River
North Branch, Chicago Ave.
South Branch, Eighteenth St.
South Branch, Halsted St.
Main Channel, Damen Ave.
Main Channel, Kedzie St.
Main Channel, Summit

Downstream from Brandon Bridge, samples were collected from the Illinois River at Marseilles and Chillicothe. Nine special samples were collected daily, from Dec. 6 to 17, in Brandon Pool above the Dam, for determination only of dissolved oxygen.

The sampling schedule at the more important stations comprised collection of samples for suspended solids hourly; for dissolved oxygen hourly; for biochemical oxygen and turbidity every four hours. The total number of analyses made was approximately as follows:

Dissolved Oxygen	5,365
Suspended Solids	2,285
B.O.D.	727
Turbidity	573
Sludge Analyses	20
	8,970

Suspended Solids and Turbidity.

As the purpose of the test was to flush sludge out of the Main Channel and Brandon Pool by increasing the velocity, determinations of suspended solids, and especially volatile suspended solids, were of particular importance. Therefore hourly samples were collected at Lockport, Cass St., Brandon Bridge and Marseilles, and at less frequent intervals at Summit, Chillicothe and other stations.

Determinations of turbidity were made at intervals of four hours, or less often. The results are of little significance because the solids transported by the increased velocities were for the most part too coarse to be measured as turbidity, but their actual concentration was shown by the results of suspended solids determinations.

Suspended Solids.

Lockport, Cass St., Brandon Bridge. The results for 24-hour averages, in parts per million, are shown in Tables I, II, and III, and individual hourly results are plotted in Fig. 1 for Cass St. and Brandon Bridge.

Results in tons per 24 hours are shown in Tables IV, V, and VI.

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

PARTS PER MILLION

DISSOLVED OXYGEN AND OXYGEN DEMANDS
AND
SUSPENDED SOLIDS

Station Lockport Dates Nov. 27-Dec. 17, 1940

TABLE I.

Date	Hour	Discharge Sec. Ft.	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand 20° C., p.p.m. 5 Days	Susp. Solids Total	Susp. Solids Volatile
			Results Before Test				
	1 P.M.						
Nov. 27-28	12 Noon	2,866	7.0	1.2	14.8	16	8
28-29		3,214	6.6	0.7	16.4	19	8
29-30		2,849	6.7	0.5	16.8	17	11
30- 1		2,994	6.9	0.8	13.0	15	8
Dec. 1- 2		2,708	6.9	0.5	15.5	18	10
			Results During Test				
Dec. 2- 3		10,770	5.0	1.6	55	327	83
3- 4		9,828	3.5	5.6	59	491	168
4- 5		10,246	3.5	6.6	46	489	147
5- 6		9,857	2.5	8.0	35	319	116
6- 7		9,645	3.0	8.7	32	264	108
7- 8		9,679	3.0	9.2	27	193	65
8- 9		9,949	3.5	9.7	17.7	179	53
9-10		9,843	3.5	9.8	20	172	60
10-11		9,819	2.5	9.9	21	161	53
11-12		10,090	3.0	10.0	20	148	47
			Results After Test				
Dec. 12-13		3,772	2.5	10.7	12.5	48	17
13-14		2,543	2.0	10.2	12.7	19	6
14-15		2,356	2.5	7.9	15.1	17	8
15-16		4,534	3.0	3.1	22	39	20
16-17		3,148	2.5	2.6	18.0	23	13

Average 24-Hour Results

The Sanitary District of Chicago
Main Channel and Illinois River

Parts per Million

Dissolved Oxygen and Oxygen Demands

and

Suspended Solids

Station Cass St. Dates Nov. 27-Dec. 17, 1940

Table II.

Date	Hour	Discharge Sec. Ft.	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand 20° C., p.p.m. 5 Days	Susp. Solids Total	Susp. Solids Volatile
			Results Before Test				
	1 P.M.						
Nov. 27-28	12 Noon	2,963	5.7	1.9	13.0	—	—
28-29		3,301	5.5	0.6	22.0	—	—
29-30		2,929	6.5	0.6	17.3	21	12
30- 1		3,069	6.9	0.6	15.6	22	13
Dec. 1- 2		2,778	5.6	1.1	13.4	20	11
			Results During Test				
Dec. 2- 3		10,845	4.0	0.7	59	440	89
3- 4		9,903	2.0	4.3	61	504	184
4- 5		10,316	3.5	5.2	47	482	168
5- 6		9,924	3.0	6.8	34	379	138
6- 7		9,710	4.5	7.5	31	282	95
7- 8		9,754	4.0	8.4	26	216	74
8- 9		10,047	4.5	8.6	17.0	216	71
9-10		9,955	4.5	8.8	20	198	64
10-11		9,946	4.5	9.0	21	188	61
11-12		10,245	5.0	8.9	19.4	177	57
			Results After Test				
Dec. 12-13		3,947	4.5	9.7	12.4	63	25
13-14		2,703	4.0	10.0	9.2	30	13
14-15		2,491	4.5	8.6	14.8	28	14
15-16		4,649	4.5	3.9	18.8	46	24
16-17		3,238	4.5	2.3	18.5	30	16

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

PARTS PER MILLION

DISSOLVED OXYGEN AND OXYGEN DEMANDS

AND

SUSPENDED SOLIDS

Station Brandon Bridge Dates Nov. 27-Dec. 17, 1940

TABLE III.

Date	Hour	Discharge Sec. Ft.	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand 20° C., p.p.m. 5 Days	Susp. Solids Total	Susp. Solids Volatile
			Results Before Test				
	1 P.M.						
Nov. 27-28	12 Noon	2,963	5.9	9.4	8.8	19	12
28-29		3,301	5.9	8.5	11.8	18	11
29-30		2,929	6.5	8.4	15.3	14	10
30- 1		3,069	7.3	8.1	13.5	15	9
Dec. 1- 2		2,778	6.3	8.5	11.5	14	7
			Results During Test				
Dec. 2- 3		10,845	5.0	8.1	13.9	75	18
3- 4		9,903	2.5	10.3	14.5	65	23
4- 5		10,316	3.0	11.0	16.9	73	24
5- 6		9,924	3.5	11.4	15.4	91	37
6- 7		9,710	4.0	11.4	18.5	79	31
7- 8		9,754	4.0	11.5	22.4	109	37
8- 9		10,047	4.5	11.9	14.3	78	28
9-10		9,955	4.5	12.2	12.6	69	25
10-11		9,946	3.5	12.2	16.1	64	21
11-12		10,245	4.0	12.1	14.9	77	34
			Results After Test				
Dec. 12-13		3,947	4.0	12.2	12.0	31	13
13-14		2,703	3.5	12.7	9.2	21	6
14-15		2,491	3.5	12.0	12.1	23	10
15-16		4,649	4.5	9.9	17.9	36	19
16-17		3,238	4.5	8.8	18.7	48	20

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

TONS PER 24 HR.

DISSOLVED OXYGEN AND OXYGEN DEMANDS
AND
SUSPENDED SOLIDS

Station Lockport Dates Nov. 27-Dec. 17, 1940

TABLE IV.

Date	Discharge Sec. Ft.	Diss. Oxygen	Tons per 24 Hr. Oxygen Demand 20° C., p.p.m.	Suspended Solids		
			5 Days	Total	Volatile	
Results Before Test						
Nov. 27-28	2,866	9.2	114	124	62	
28-29	3,214	6.1	142	165	69	
29-30	2,849	3.8	130	132	85	
30- 1	2,994	6.5	105	121	65	
Dec. 1- 2	2,708	3.6	113	131	73	
Total	14,631	29.2	604	673	354	
Avg.	2,926	5.8	121	135	71	
Results During Test						
Dec. 2- 3	10,770	46.4	1,596	9,490	2,408	
3- 4	9,828	148.4	1,562	13,000	4,450	
4- 5	10,246	182.1	1,269	13,490	4,057	
5- 6	9,857	212.5	928	8,470	3,080	
6- 7	9,645	226.0	832	6,860	2,810	
7- 8	9,679	240.0	704	5,035	1,695	
8- 9	9,949	260.0	474	4,800	1,421	
9-10	9,843	260.0	531	4,565	1,592	
10-11	9,819	262.0	556	4,260	1,401	
11-12	10,090	272.0	544	4,020	1,276	
Total	99,726	2,109.4	8,996	73,990	24,190	
Avg.	9,973	211	900	7,400	2,420	
Results After Test						
Dec. 12-13	3,772	108.8	127	478	173	
13-14	2,543	70.0	87	130	41	
14-15	2,356	50.1	96	108	51	
15-16	4,534	37.9	269	476	244	(Rain)
16-17	3,148	22.0	153	195	110	
Total, 13-14, 14-15, 16-17	8,047	142.1	336	433	202	
Avg. 13-14, 14-15, 16-17	2,682	47.4	112	144	67	

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

TONS PER 24 HR.

DISSOLVED OXYGEN AND OXYGEN DEMANDS
SUSPENDED SOLIDS

Station Cass St. Dates Nov. 27-Dec. 17, 1940

TABLE V.

Date	Discharge Sec. Ft.	Diss. Oxygen	Tons per 24 Hr. Oxygen Demand 20° C., p.p.m. 5 Days	Suspended Solids Total	Suspended Solids Volatile	
Results Before Test						
Nov. 27-28	2,963	15.2	104	—	—	
28-29	3,301	5.3	195	—	—	
29-30	2,929	4.8	137	166	95	
30- 1	3,069	5.0	129	182	108	
Dec. 1- 2	2,778	8.2	100	150	82	
Total	15,040	38.5	665	498	285	
Avg.	3,008	7.7	133	166	95	
Results During Test						
Dec. 2- 3	10,845	20.5	1,724	12,850	2,600	
3- 4	9,903	115	1,612	13,450	4,910	
4- 5	10,316	144	1,306	13,400	4,670	
5- 6	9,924	182	910	10,145	3,690	
6- 7	9,710	197	813	7,400	2,410	
7- 8	9,754	221	683	5,680	1,945	
8- 9	10,047	233	460	5,850	1,920	
9-10	9,955	236	537	5,310	1,717	
10-11	9,946	241	563	5,040	1,635	
11-12	10,245	245	535	4,885	1,570	
Total	100,645	1,834.5	9,143	84,010	27,067	
Avg.	10,065	183	914	8,401	2,707	
Results After Test						
Dec. 12-13	3,947	103	132	670	266	
13-14	2,703	73	67	218	95	
14-15	2,491	57.7	99	188	94	
15-16	4,649	48.8	236	576	301	(Rain)
16-17	3,238	20.0	162	261	140	
Total, 13-14, 14-15, 16-17	8,432	150.7	328	667	329	
Avg. 13-14, 14-15, 16-17	2,810	50.2	109	222	110	

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

TONS PER 24 HR.

DISSOLVED OXYGEN AND OXYGEN DEMANDS

Station Brandon Bridge Dates Nov. 27-Dec. 17, 1940

TABLE VI.

Date	Discharge Sec. Ft.	Diss. Oxygen	Tons per 24 Hr. Oxygen Demand 20° C., p.p.m.	Suspended Solids		
			5 Days	Total	Volatile	
Results Before Test						
Nov. 27-28	2,963	75	70	152	96	
28-29	3,301	76	105	160	98	
29-30	2,929	66	121	110	79	
30- 1	3,069	67	112	124	74	
Dec. 1- 2	2,778	64	86	109	52	
Total	15,040	348	494	655	399	
Avg.	3,008	70	99	131	80	
Results During Test						
Dec. 2- 3	10,845	237	406	2,192	526	
3- 4	9,903	275	387	1,735	613	
4- 5	10,316	306	470	2,030	668	
5- 6	9,924	305	412	2,435	990	
6- 7	9,710	298	484	2,069	812	
7- 8	9,754	302	589	2,861	974	
8- 9	10,047	322	387	2,112	758	
9-10	9,955	327	338	1,850	670	
10-11	9,946	327	431	1,715	563	
11-12	10,245	334	412	2,124	938	
Total	100,645	3,033	4,316	21,123	7,512	
Avg.	10,065	304	432	2,112	751	
Results After Test						
Dec. 12-13	3,947	130	128	330	138	
13-14	2,703	93	67	153	44	
14-15	2,491	80	81	154	67	
15-16	4,649	124	225	457	238	(Rain)
16-17	3,238	77	163	419	175	
Total, 13-14, 14-15, 16-17	8,432	250	311	726	286	
Avg. 13-14, 14-15, 16-17	2,810	83	104	242	95	

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

PARTS PER MILLION

DISSOLVED OXYGEN AND OXYGEN DEMANDS
AND
SUSPENDED SOLIDS

Sation Marseilles Dates Nov. 27 to Dec. 17, 1940

TABLE IX.

Date	Hour	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand 20° C., p.p.m. 5 Days	Susp. Solids* Total	Susp. Solids* Volatile
		Results Before Test				
Nov. 27	1 A.M.-12 Mdn.	6	10.5	4.6	29	6
28		5	11.0	4.3	25	6
29		4	11.2	4.3	19	7
30		5	11.5	3.8	19	7
Dec. 1		5	11.7	4.6	17	5
		Results During Test				
Dec. 2		3	11.4	4.5	86	13
3		3	10.1	8.0	75	20
4		5	10.1	7.6	58	13
5		4	11.6	7.3	53	17
6		5	12.0	7.3	46	16
7		5	12.1	7.3	63	17
8		5	12.0	7.3	57	22
9		5	12.0	8.1	51	18
10		5	12.3	7.3	57	16
11		5	12.3	5.9	53	18
		Results After Test				
Dec. 12		5	12.2	8.5	39	15.
13		4	12.0	7.3	16	5
14		4	12.1	4.6	14	5
15		4	12.0		18	8
16		3	12.3		15	6

* 1 P.M. to 12 Noon.

AVERAGE 24-HOUR RESULTS

THE SANITARY DISTRICT OF CHICAGO
MAIN CHANNEL AND ILLINOIS RIVER

PARTS PER MILLION

DISSOLVED OXYGEN AND OXYGEN DEMANDS
AND
SUSPENDED SOLIDS

Station Chillicothe Dates Nov. 27 to Dec. 17, 1940

TABLE X.

Date	Hour	Temp. C°	Diss. Oxygen p.p.m.	Oxygen Demand 20° C. p.p.m. 5 Days	Suspended Solids Total	Volatile
		Results Before Test				
Nov. 27		4.1	11.9	5.1	—	—
28		3.4	11.9	3.9	25	7
29		3.3	12.1	3.7	32	9
30		3.5	12.0	3.0	23	6
Dec. 1		2.3	12.5	4.5	24	5
		Results During Test				
Dec. 2		2.3	12.6	3.7	26	6
3		0.6	12.9	4.7	34	7
4		1.4	12.7	5.2	73	12
5		1.7	12.8	6.4	59	11
6		2.5	12.2	6.0	49	9
7		3.8	11.5	6.5	61	12
8		3.4	12.1	5.0	52	11
9		3.7	11.8	7.1	47	9
10		3.7	11.7	6.6	55	13
11		3.5	11.6	5.8	39	10
		Results After Test				
Dec. 12		3.8	11.4	5.3	43	10
13		2.8	12.3	4.0	31	7
14		1.7	12.6	3.5	21	6
15		2.2	12.7	2.7	17	5
16		2.1	12.6	3.1	35	8

Dissolved Oxygen and Flow at Lockport

December, 1938, 1939 and 1940

Day	Dissolved Oxygen, P.P.M.			Flow, Cu. Ft. per Second		
Dec.	1938	1939	1940*	1938	1939	1940*
1	4.4	0.2	0.5	4,922	3,279	2,708
2	2.4	—	1.6	5,113	3,348	10,770
3	—	0.1	5.6	6,475	3,059	9,828
4	1.3	0.1	6.6	4,737	3,282	10,246
5	1.1	0.3	8.0	4,763	3,559	9,857
6	2.6	0.8	8.7	5,301	3,184	9,645
7	1.0	0.5	9.2	5,239	3,073	9,679
8	1.0	0.3	9.7	5,146	3,841	9,949
9	0.9	—	9.8	5,133	3,543	9,843
10	—	0.3	9.9	5,144	3,029	9,819
11	0.4	1.1	10.0	5,019	3,293	10,090
12	1.4	1.4	10.7	5,209	3,706	3,772
13	3.2	1.5	10.2	5,467	4,112	2,543
14	2.9	0.6	7.9	5,426	3,746	2,356
15	4.1	1.7	3.1	4,659	3,537	4,534
16	3.5	—	2.6	5,175	3,171	3,148
17	—	0.9	3.7	5,743	3,082	2,795
18	5.7	0.9	3.9	6,030	3,328	2,440
19	6.5	1.7	0.8	6,203	3,244	2,403
20	6.6	1.7	0.2	6,231	3,546	2,375
21	6.9	1.4	—	6,213	4,082	2,190
22	7.5	1.4	0.1	6,223	3,720	2,147
23	6.8	—	—	6,257	3,116	2,217
24	—	—	—	5,271	3,117	2,534
25	—	—	—	5,200	2,956	2,066
26	5.5	1.9	0.2	5,273	3,529	2,322
27	7.2	2.6	0.5	5,605	3,893	2,397
28	7.8	3.5	—	6,313	4,126	2,294
29	7.4	4.5	0.3	5,568	3,787	2,199
30	8.2	—	0.4	5,445	3,667	2,325
31	—	—	—	4,998	3,569	3,399
Avg.	4.3	1.3	4.9	5,469	3,469	4,996

* D.O. and flows from noon to noon through Dec. 16, thereafter midnight to midnight

TABLE XIX.

DIVERSION TEST
THE SANITARY DISTRICT OF CHICAGO
BIOCHEMICAL OXYGEN DEMAND

	Tons 5-day Period of Test	B.O.D. Per Day
Cass. St.	9,143	914
Brandon Bridge	4,316	432
Reduction	4,827	
Per Ct. Reduction	52.8	
Per Ct. Transported	47.2	

Summit, Mouth of River, North Branch, South Branch. Average results of B.O.D. determinations at Summit and upstream stations are shown in Tables XI to XVIII, inclusive. At Summit the sludge deposits were washed out fairly completely during the first five days of the test, and thereafter the B.O.D. dropped to a low average of 13 p.p.m., because of the increased dilution, whereas the B.O.D. had averaged from 30 to 40 p.p.m. prior to the test. At stations above Summit, also, the B.O.D. results were considerably lower during the test than prior thereto.

SLUDGE IN BRANDON POOL

Samples of sludge were collected from the bottom of Brandon Pool before and after the test. The first set of samples was collected on November 1, 1940, and the second set on December 27, 1940. The procedure for sampling sludge from the depths of an Imhoff tank was used, namely, a pitcher pump with a calibrated suction hose extending down into the liquid. The hose was lowered until sludge was encountered, then the pump was operated until the sludge ran uniform in consistency, and the sample was taken. The depth was recorded. Then the hose was lowered farther and

pumping continued until the sludge was quite dense and almost refused to flow, when another sample was collected.

During the first test, on November 1, 1940, the iron sounding disc used by the U. S. Engineer Corps was lowered until it came to rest, and the depth measured.

The record of the samplings and soundings is presented in Table XX. Samples were collected at McDonough St., in the center of the Pool opposite the U. S. Moorings, and at the north, center, and south ends of the Dam.

The results for November 1 show that in the Pool, thin sludge was encountered at about 18½ feet depth, thick sludge about 20 ft., and the sounding disc sank to 20½ ft. The thick sludge at 20 ft. depth in the sample at the center of the Dam contained 88.8 per cent moisture. This is a dense sludge in sewage works practice. The disc method of sounding is shown by these results to measure only the depth at which a dense, compact deposit is found, as the heavy disc sinks through the "flocculent active sludge deposits" referred to in the stipulation for the test. In the sample opposite the Moorings, the disc stopped at sludge with 93.7 per cent moisture, but at the south end of the Dam (left of Locks) it sank below 94 per cent moisture sludge, and at McDonough St. it came to rest at 87.3 per cent moisture sludge.

When sludge collections were made at the same stations on December 27, 1940, after the test ended, it was found that the sludge level had not changed at McDonough St., above the Pool in the narrower section, but at the Moorings the level had risen 2 to 2½ ft., at the center of the Dam, it had risen 1 to 1½ ft., and at the left of Locks (South End) it had risen 1½ ft., whereas it had fallen 2 ft. immediately north of the Dam.

Table XX.

The Sanitary District of Chicago

Samples of Sludge Collected from Brandon Pool

Location	November 1, 1940—Before Test			Dec. 27, 1940—After Test	
	Clear Water at—Depth	Sludge Samples at Depth	Depth Sounding by U. S. Engrs. Disc	Sludge Samples at—Depth	Remarks
McDonough St.	24½ Ft.	1. 25 Ft. 2. 25½ Ft.	25½ Ft.	1. 25 Ft. 2. 25½ Ft.	Thin Sludge Thick Sludge
North of Dam	15½ Ft.	1. 16 Ft. 2. 16½ Ft.	17 Ft.	1. 18 Ft. 2. 18½ Ft.	Thin Sludge Thick Sludge
Middle of Dam	18½ Ft.	1. 19 Ft. 2. 20 Ft.	20 Ft.	1. 18 Ft. 2. 18½ Ft.	Thin Sludge Thick Sludge
Left of Locks	18 Ft.	1. 18½ Ft. 2. 19 Ft.	19½ Ft.	1. 17 Ft. 2. 17½ Ft.	Thin Sludge Thick Sludge
U. S. Moorings	19½ Ft.	1. 20 Ft. 2. 21 Ft.	21 Ft.	1. 18 Ft. 2. 18½ Ft.	Thin Sludge Thick Sludge

Samples collected by means of pitcher pump and hose. Depths given are from surface of water.

Considerable gassing, large bubbles. Had trouble holding Tug Gilbert from swinging, due to steady northeast wind.

These results indicate that over most of the Pool the sludge level had risen about 2 ft., except for some scouring action at the north end of the Dam, possibly because of local currents induced at this spot.

This estimate of 2 ft. more sludge introduced into the Pool checks with the tonnage shown by the tests for suspended solids. Table VII shows 62,887 tons (dry weight) of suspended solids deposited in the Pool. The specific gravity of the sludge averaged 1.17 at 88.9 per cent moisture. One ton of sludge containing around 12 per cent solids occupies approximately one cubic yard of space. At 88 per cent moisture, 62,887 tons of dry solids would produce 524,000 tons or cubic yards of wet sludge. The area of the Pool below Mc-

Donough St. is 5,456,000 square feet. A deposit of 524,000 cubic yards would fill this area to a depth of 2.6 ft., or at a lower moisture content of 85 per cent, to 2.0 ft. Considerably more sounding and sampling would be necessary to give accurate data on the amount of sludge deposited in the Pool during the test, but present available data indicate a fill of about 2 to 2½ feet.

Results of determinations of B.O.D. of the sludge are presented in Tables XXI and XXII. A comparison of results before and after the test computed to B.O.D. of dry sludge, total and volatile, is shown in the last two columns of these tables. The results show an increased B.O.D. after the test for all stations except one. However, eight samples out of ten had an increased B.O.D. of the volatile organic matter after the test, as shown below:

B.O.D. PER GRAM OF VOLATILE SOLIDS.

	McDonough St.		North of Dam		Center of Dam		Left of Locks		U. S. Moorings	
Sample	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom	Top	Bottom
Before	142	114	245	212	280	170	246*	168	222	181
After	154	127	294	273	307	219	287*	197	176	158

* Corrections.

These results indicate that the sludge deposited in the Pool during the test was slightly more putrescible, and not so well stabilized as the surface sludge present in the Pool before the test was made.

Table XXI.

The Sanitary District of Chicago

Samples from Brandon Pool Before Flushing Experiment

November 1, 1940

Oxygen Demand of Sludge—Brandon Pool

Station and Depth (Ft.)	Moisture Per Cent (After Draining)	Solids		Volatile		B.O.D.			
		Per Cent	Gm. Dry	Per Cent	Gm. Dry	P.p.m.	Mg. Oxygen Used	Mg. Oxygen Per Gram Dry Sludge	Mg. Oxygen Per Gram Dry Volatile
McDonough St.									
25	92.4	7.6	0.76	26.6	0.20	2830	28.3	37.3	142
25.5	87.3	12.7	1.27	27.8	0.35	4000	40.0	31.5	114
North of Dam									
16	97.3	2.7	0.27	33.7	0.09	2200	22.0	81.5	245
16.5	95.1	4.9	0.49	33.3	0.16	3400	34.0	69.4	212
Middle of Dam									
19	98.5	1.5	0.15	34.4	0.05	1400	14.0	93.3	280
20	88.8	11.2	1.12	32.8	0.37	6300	63.0	56.2	170
Left of Locks									
18.5	96.0	4.0	0.40	33.2	0.13	3200	32.0	80.0	246
19	94.0	6.0	0.60	32.7	0.20	3350	33.5	55.8	168
U. S. Moorings									
20	95.0	5.0	0.50	34.5	0.18	4000	40.0	80.0	222
21	93.7	6.3	0.63	33.4	0.21	3800	38.0	60.4	181

Weight of Wet Sludge Used = 10 gms.

Table XXII.

The Sanitary District of Chicago

Samples from Brandon Pool After Flushing Experiment

December 27, 1940

Oxygen Demand of Sludge—Brandon Pool

Station and Depth (Ft.)	Moisture Per Cent (Sample as Received)	Solids		Volatile		B.O.D.			
		Per Cent	Gm. Dry	Per Cent	Gm. Dry	P.p.m.	Mg. Oxygen Used	Mg. Oxygen Per Gram Dry Sludge	Mg. Oxygen Per Gram Dry Volatile
McDonough St.									
25	98.2	1.8	0.36*	39.6	0.14*	2150	21.5	59.8	154
25.5	87.9	12.1	1.21	40.4	0.49	6250	62.5	51.6	127
North of Dam									
18	95.1	4.9	0.49	32.0	0.16	4700	47.0	96.0	294
18.5	92.3	7.7	0.77	31.8	0.25	6830	68.3	87.6	273
Middle of Dam									
18	97.4	2.6	0.26	34.5	0.09	2850	28.5	110.0	307
18.5	86.7	13.3	1.33	31.0	0.41	9000	90.0	67.6	219
Left of Locks									
17	96.6	3.4	0.34	34.9	0.12	3450	34.5	101.5	287
17.5	86.6	13.4	1.34	31.7	0.42	8300	83.0	62.0	197
U. S. Moorings									
18	94.7	5.3	0.53	33.0	0.17	3000	30.0	56.6	176
18.5	85.5	14.5	1.45	29.4	0.43	6800	68.0	46.9	158

Wt. of Wet Sludge = 10 gms.

* Wt. of Wet Sludge = 20 gms.

4015 MOHLMAN EXHIBIT No. 18.

THE SANITARY DISTRICT OF CHICAGO

REPORT ON

ANALYSES OF SAMPLES FROM MAIN CHANNEL

LOCKPORT AND SUMMIT

Month of January, 1938-1941

By F. W. MOHLMAN

Director of Laboratories

At the request of the Master, a report has been prepared on the results of analyses of samples from the Main Channel at Lockport and Summit for the years 1938 to 1941. The tabulations are attached hereto, marked, respectively—

Mohlman Exhibit 18a.	Dissolved Oxygen and B.O.D. at Lockport; January, 1938 and 1941.
Mohlman Exhibit 18b.	Total Discharge at Lockport; January, 1938-1941.
Mohlman Exhibit 18c.	Dissolved Oxygen and B.O.D. at Summit; January, 1938-1941.
Mohlman Exhibit 18d.	Dissolved Oxygen and B.O.D. at Lockport; January, 1938-1941.

4016 The following notes are explanatory of these four exhibits.

The actual conditions at *Lockport* in January, 1941, when compared with January, 1938 show that the dissolved oxygen was far less in 1941 than in 1938, with an average of 7.4 p.p.m. in 1938 and only 0.8 in 1941 (through January 21). The B.O.D. values were approximately the same, with an average of 21.2 p.p.m. in 1938 and 18.9 p.p.m. in 1941.

The great decrease in dissolved oxygen in 1941 was

largely due to the longer time of flow from Chicago to Lockport, with the discharge of 2,781 c.f.s. in 1941, as compared with 6,408 in 1938. In 1941, the time from Damen Avenue to Lockport was approximately four days, as compared with about two days in 1938. Therefore, in 1941, the dissolved oxygen was depleted down to an average of 0.8 p.p.m. in spite of the low temperature of the water. This dissolved oxygen content is almost as low as in 1939, but because of the increased operation of the Southwest Plant, the B.O.D. in 1941 (18.9 p.p.m.) was considerably less than in 1939 (28.5 p.p.m.).

The complete data through January 21, 1941, are shown in Mohlman Exhibits 18a, 18b, and 18d for Lockport and Exhibit 18c for Summit, attached hereto. The daily 1941 results are compared with daily results in January in 1938, 1939, and 1940.

The very low dissolved oxygen content in January, 1941 is cause for alarm, with reference to the conditions to be expected a few months hence, when the temperature of the water rises. So far in 1941, the
4017 C.O. results are lower than in 1940, and the B.O.D. is higher, indicating a worse condition in 1941 than in 1940. This is partly explainable by the slightly lower flow at Lockport in 1941 (2,781 c.f.s.) as compared with 2,949 c.f.s. in 1940. The low average in January, 1941 is due to the effort to conserve diversion this winter in preparation for the demands next summer.

The results given herein are actual, from the actual analyses of samples collected at the respective points. Although some of the sludge deposits in the Main Channel were moved down into the Brandon Road Pool during the 10-day tests with 10,000 c.f.s., with the flow reduced again to the low discharge prior to the test,

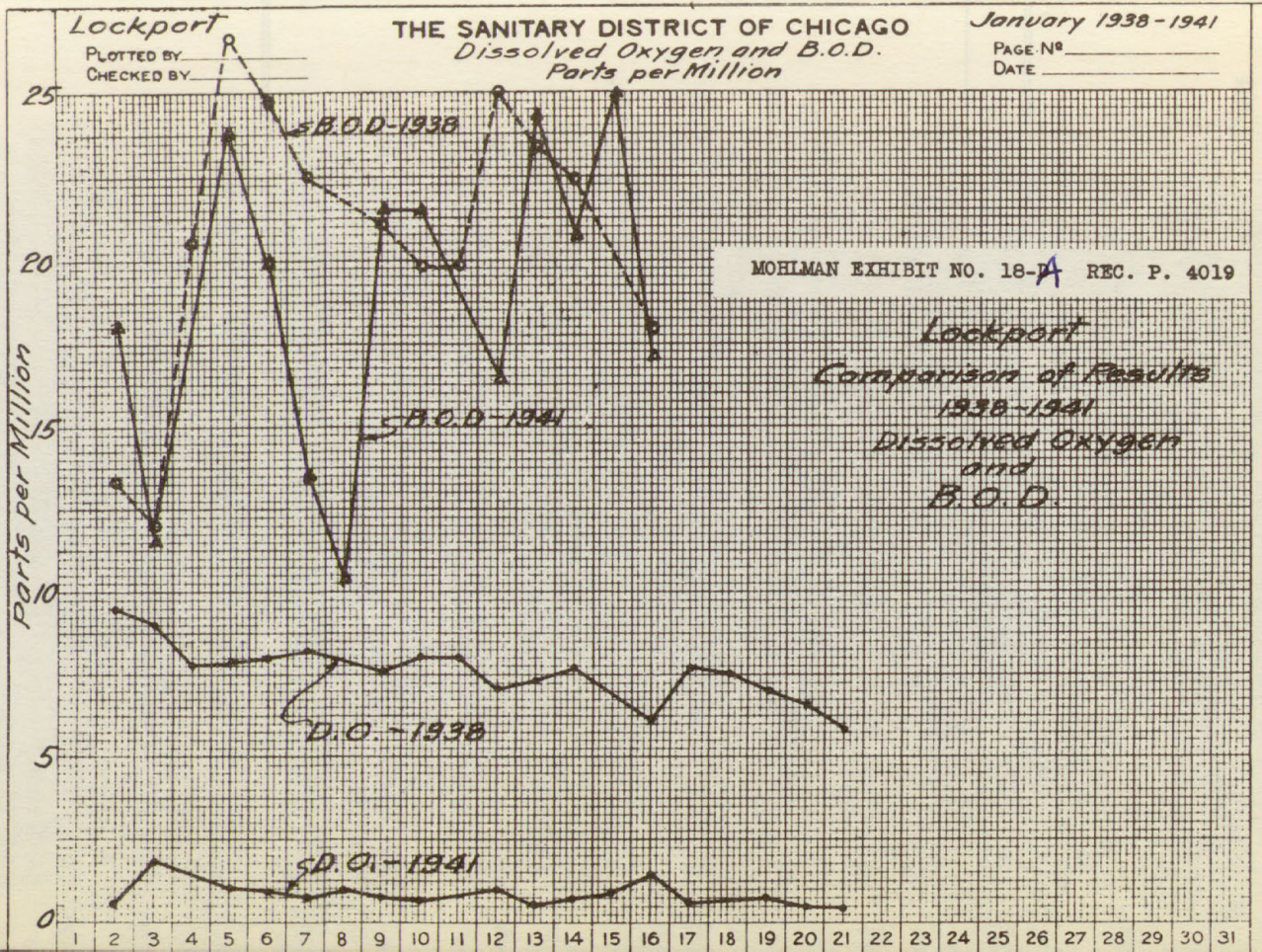
the conditions at Lockport are bad, in fact, the worst of any January on record, except 1939. If the conditions at Lockport are now worse than in January, 1940, Brandon Pool is certain to be worse, because of the sludge deposited therein during the flushing experiment. This disturbing result indicates that the only safe basis for determination of the amount of water needed in 1941 and 1942 to prevent nuisance at Lockport and in Brandon Pool is the "actual" analysis of the water.

The modified petition of the State of Illinois requests diversion based solely on results of analysis and specifies the maintenance of at least 1.0 part per million of dissolved oxygen in the water of Brandon Pool. In 1938, routine analyses were not made in Brandon Pool, but were made at Lockport, just above the Pool, with the dissolved oxygen and B.O.D. results as follows (Illinois Exhibit 34):

4018 ANALYSES AT LOCKPORT, MAIN CHANNEL
YEAR 1938

Month	Dissolved Oxygen P. P. M.	5-Day B. O. D. P. P. M.
January	7.4	22.6
February	7.0	21.0
March	5.6	19.4
April	3.2	16.3
May	0.5	17.6
June	0.3	18.8
July	0.1	18.5
August	0.1	14.6
September	0.3	13.4
October	0.2	18.6
November	1.2	18.5
December	4.3	21.8
Average	2.5	18.4

Occasional samples in Brandon Pool in the summer of 1938 showed from 0.2 to 1.5 p.p.m. dissolved oxygen, and usually around 1.0 p.p.m. Maintenance of a minimum of 1.0 p.p.m. in 1941 and 1942 would therefore result in conditions approximately the same as in 1938, but better than in 1938 or 1940. It is impossible at this time to compute the specific amount of diversion needed to maintain this standard.


Lockport
PLOTTED BY
CHECKED BY
THE SANITARY DISTRICT OF CHICAGO
Dissolved Oxygen and B.O.D.
Parts per Million
January 1938 - 1941
PAGE Nº
DATE
MOHLMAN EXHIBIT NO. 18-A REC. P. 4019
Lockport
Comparison of Results
1938 - 1941
Dissolved Oxygen
and
B.O.D.
B.O.D-1938
B.O.D-1941
D.O.-1938
D.O.-1941
Parts per Million
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

4020 MOHLMAN EXHIBIT 18-b.

THE SANITARY DISTRICT OF CHICAGO

TOTAL DAILY DISCHARGE AT LOCKPORT

January 23, 1941.

Month	1938 C. F. S.	1939 C. F. S.	1940 C. F. S.	1941 C. F. S.
January				
1	6422	2774	2849	3573
2	6197	2674	2849	4196
3	6343	2830	2825	2812
4	6384	4525	2896	2450
5	6497	3952	2930	2327
6	6303	2807	2845	2418
7	6201	2793	2795	2463
8	6180	2872	2900	2331
9	6203	3360	2870	3106
10	6149	3020	2805	3007
11	6218	2759	2786	2326
12	6261	2835	2911	2242
13	6160	2841	2838	2339
14	6131	2854	6100	3496
15	6236	2711	4287	2679
16	6199	2797	3891	2471
17	6067	2711	2876	3188
18	6080	2817	2751	2579
19	6218	2776	2715	2357
20	6157	2817	2553	2344
21	6112	2795	2647	3474
22	6027	2728	2640	3008
23	6055	2739	2673	
24	9132	2788	2661	
25	6976	2751	2672	
26	7035	2693	2812	
27	7060	2815	2704	
28	6376	2751	2531	
29	6150	2672	2542	
30	6886	3302	2607	
31	6235	2695	2641	
Mean	6408	2911	2949	2781 (Jan. 1-22)

4021

Mohlman Exhibit 18-c.

The Sanitary District of Chicago

Main Channel and Illinois River

Dissolved Oxygen and Oxygen Demands

Station—Summit — Dates January, 1938-1941

Date Jan.	Dissolved Oxygen, P. P. M. 1938	1939	1940	1941	5-day B. O. D., P. P. M. 1938	1939	1940	1941	
2	—	—	8.0	7.1	—	—	18	34	
3	9.5	6.4	6.3	6.1	21.0	26.4	24	47	
4	9.9	6.2	4.5	—	29.6	47.0	21	—	
5	10.2	7.0	4.5	3.6	28.5	29.8	28	26	
6	10.5	5.8	4.4	4.4	35.0	40.1	—	29	
7	9.9	—	6.0	5.2	28.9	—	27	37	
8	—	0.0	5.2	5.1	—	37.1	24	39	
9	10.0	1.1	4.2	5.2	22.6	28.0	25	41	
10	10.4	2.1	2.1	6.1	20.7	42.0	27	36	
11	9.3	1.0	1.4	—	28.1	51.0	23	—	
12	—	0.5	1.4	4.9	—	52.0	32	32	
13	10.3	0.1	—	5.5	—	50.0	—	31	
14	9.6	—	4.1	6.1	28.1	—	35	37	
15	—	0.2	6.2	5.4	—	—	19	40	
16	10.5	0.9	5.0	5.3	25.3	26.0	35	47	
17	10.0	0.8	4.1	5.5	22.9	42.0	30		
18	9.8	0.5	—	—	25.9	47.0	27		
19	9.4	1.0	—	1.0	23.8	47.0	—		
20	9.9	0.3	—	3.2	27.7	52.0	—		
21	9.6	—	4.6	4.6	25.8	—	22		
22	—	0.5	4.8		—	48.0	25		
23	9.7	1.1	5.0		21.9	26.0	20		
24	5.9	2.2	4.9		35.9	53.0	23		
25	10.0	3.9	3.5		26.5	40.0	29		
26	10.3	3.7	2.1		29.0	51.0	25		
27	10.3	2.1	—		30.1	51.0	22		
28	10.3	—	3.0		30.0	—	22		
29	—	3.7	3.7		—	39.0	24		
30	9.1	—	4.2		27.5	—	23		
31	10.0	6.9	3.0		20.4	22.0	27		
				(Jan. 1-21)					
Avg. Jan. 1-17				4.9	26.8	38.9	26	37	(Jan. 1-16)
Avg. Month	9.8	2.4	4.4	—	26.8	40.3	26	—	

4022

Mohlman Exhibit 18-d.

The Sanitary District of Chicago

Main Channel and Illinois River

Dissolved Oxygen and Oxygen Demands

Station—Lockport — Dates January, 1938-1941

Date Jan.	Dissolved Oxygen, P. P. M. 1938	1939	1940	1941	5-day B. O. D., P. P. M. 1938	1939	1940	1941	
2	9.4	4.6	4.7	0.5	13.3	14.0	10.7	18.1	
3	9.0	2.6	5.3	1.8	12.0	15.8	10.3	11.6	
4	7.7	1.4	5.1	—	20.5	18.8	8.9	—	
5	7.8	0.7	3.0	1.0	26.3	24.3	12.2	23.8	
6	7.9	0.2	—	0.9	24.7	26.2	—	19.9	
7	8.2	—	1.8	0.7	22.5	—	14.5	13.5	
8	—	0.2	1.7	0.9	—	24.5	13.3	10.3	
9	7.6	0.1	1.7	0.7	21.1	30.4	13.5	21.6	
10	8.1	0.2	2.1	0.6	19.8	26.6	10.2	21.5	
11	8.0	0.2	0.9	—	19.9	22.5	14.5	—	
12	7.1	0.2	0.4	1.0	25.0	25.4	17.9	16.4	
13	7.3	0.2	—	0.5	23.4	33.6	—	24.3	
14	7.7	—	0.6	0.7	22.3	—	22.4	20.7	
15	—	0.2	1.6	0.8	—	33.8	20.6	25.0	
16	6.1	0.1	2.4	1.4	24.2	38.3	15.7	17.1	
17	7.7	0.2	4.0	0.6	18.0	32.5	18.0		
18	7.5	0.2	1.4	—	21.2	23.4	17.9		
19	7.0	0.2	1.9	0.7	21.3	32.2	15.6		
20	6.6	0.1	—	0.4	22.7	34.4	—		
21	5.8	—	1.1	0.3	24.0	—	17.0		
22	—	0.2	1.0		—	38.1	15.1		
23	5.8	0.1	1.0		21.3	38.1	15.6		
24	6.2	0.4	1.2		30.8	31.8	13.8		
25	3.6	0.2	1.6		31.4	23.0	11.9		
26	7.8	0.3	1.2		27.3	29.9	14.0		
27	8.6	0.2	—		24.1	29.7	—		
28	8.5	—	0.4		24.3	—	17.9		
29	—	0.2	0.5		—	34.0	16.3		
30	7.9	0.1	0.4		25.7	36.4	15.5		
31	7.4	0.5	0.7		20.4	21.7	12.8		
Avg., Jan. 1-16				0.8	21.2	25.7	14.2	18.9	(Jan. 1-16)
Avg. Month	7.4	0.5	1.8	—	22.6	28.5	14.8	18.9	(Month)

Jan. 1-21)

4466 MOHLMAN EXHIBIT 20.

THE SANITARY DISTRICT OF CHICAGO

MAIN CHANNEL AND ILLINOIS RIVER

DISSOLVED OXYGEN AND OXYGEN DEMANDS

Station—Lockport Dates—January 1941

Date	Temp. C°	Diss. Oxygen p. p. m.	Oxygen Demand, 20°C., p. p. m. 5 days
1			
2	7.0	0.5	18.1
3	6.0	1.8	11.6
5	3.5	1.0	23.8
6	3.5	0.9	19.9
7	2.0	0.7	13.5
8	3.0	0.9	10.3
9	3.5	0.7	21.6
10	4.0	0.6	21.5
12	5.5	1.0	16.4
13	5.0	0.5	24.3
14	4.0	0.7	20.7
15	4.0	0.8	25.0
16	4.5	1.4	17.1
17	4.5	0.6	
19	4.0	0.7	22.9
20	4.0	0.4	31.6
21	4.5	0.3	29.9
22	5.0	0.2	30.2
23	5.0	0.4	21.7
24	5.0	0.4	19.1
26	3.0	0.4	30.6
27	4.0	0.2	34.5
28	4.0	0.2	26.7
29	3.5	0.6	15.4
30	4.5	0.2	30.3
31	5.0	0.3	33.3
Average	4.5	0.6	22.9

3666 PEARSE EXHIBIT 1-A.

THE SANITARY DISTRICT OF CHICAGO

ACTIVATED SLUDGE SEWAGE TREATMENT WORKS

RECORD OF AIR USED—CUBIC FEET PER GALLON OF SEWAGE

NITRITES AND NITRATES—P.P.M.

AVERAGE FOR YEAR 1928-1940

Year	North Side			Calumet			Southwest		
	Air	Nitrite	Nitrate	Air	Nitrite	Nitrate	Air	Nitrite	Nitrate
(a) 1928	0.97	0.2	4.5						
1929	0.80	0.2	5.0						
1930	0.52	0.7	2.0						
1931	0.47	0.4	2.2						
1932	0.44	0.4	3.3						
1933	0.37	0.6	2.7						
1934	0.38	0.3	2.3						
1935	0.36	0.6	1.6						
1936	0.36	0.3	1.0	0.41	0.5	1.3			
1937	0.35	0.3	0.6	0.38	0.4	1.0			
1938	0.35	0.3	1.1	0.36	0.6	1.2			
1939	0.37	0.2	0.7	0.38	0.7	1.9	(b) 0.46	(b) 1.2	(b) 1.2
1940	0.40	0.1	0.6	0.42	0.6	1.1	0.83	0.4	1.3

(a) Period 3 months, October to December, inclusive.
(b) Period 6 months, July to December, inclusive.

3320 PEARSE EXHIBIT 7.

At the present time the U. S. Census figures for 1940 are not completely available. However, certain figures released in the newspapers are indicative of the probable population of The Sanitary District of Chicago in 1940. The following comparisons are of interest, from U. S. Census figures:

Locality	1930	1940	Increase
Chicago	3,376,438	3,384,556	8,118
Cook County	3,982,123	4,049,331	67,208
Sanitary District	3,901,569		

For 25 of the smaller municipalities within the Sanitary District (out of 61) a growth of 4.3 per cent was

shown since 1930 by the 1940 census figures given out. Evidently this rate of growth was not sustained by the entire Sanitary District, because this would make a population estimate greater than Cook County, which contains the Sanitary District.

Taking from the 1930 census the population outside of the Sanitary District but within Cook County as 80,554, and assuming this as of 1940, the Sanitary District has in 1940 a population not to exceed 3,968,777, with a growth not exceeding 67,208. This upper limit is considerably under 4,815,000 estimated in 1930.

From the census releases to the press comes the additional information on municipalities within the Sanitary District:

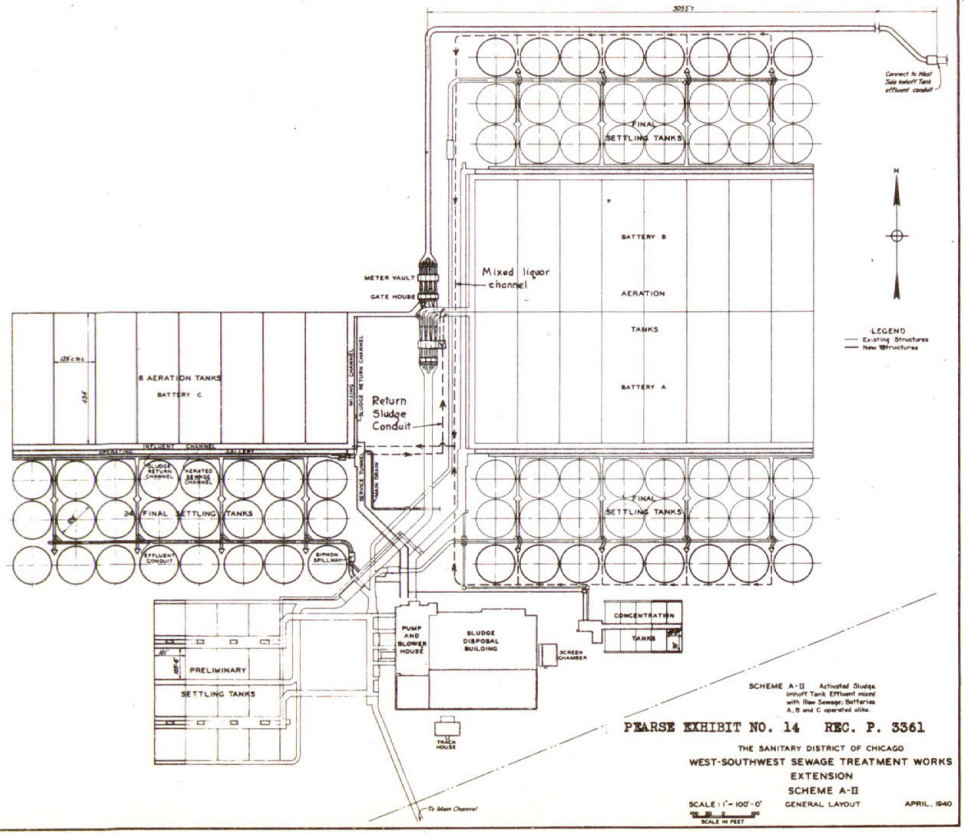
Locality	Growth
Chicago	8,118
Towns over 10,000 (16)	12,688
Towns under 10,000 (12)	3,986
Actual increase from 29 municipalities reporting	24,792

If 24,792 be added to 3,901,569, a low limit of 3,926,361 may be established. It is probable the true population of the Sanitary District lies in between this figure and 3,968,777 and may be taken at 3,966,569, or, in round figures, 3,966,600.

The changes in the populations of the various project areas may be estimated as:

Area	1930 Census	Increase	1940 Estimate
Calumet	319,588	5,500	325,088
North Side	977,024	22,000	999,024
West Side	1,288,763	— 3,500	1,285,263
Southwest	1,311,637	40,031	1,351,668
Miscellaneous	4,557	1,000	5,557
	3,901,569	65,031	3,966,600

FIGURE E-3



PEARSE EXHIBIT NO. 14 REC. P. 3361

THE SANITARY DISTRICT OF CHICAGO

WEST-SOUTHWEST SEWAGE TREATMENT WORKS

EXTENSION

SCHEME A-II

SCALE: 1"-100'-0" GENERAL LAYOUT APRIL, 1940

SCALE IN FEET

2220 RAMEY—EXHIBIT No. 2.

AVERAGE TIME OF FLOW—DAMEN AVE. TO BRANDON RD. DAM.

Lake Michigan Elevation—0.60

Average Lockport Discharge	2200 C.F.S.
Damen Ave. to Summit	62:22 Hrs.
Summit to Lockport	78:58 "
Lockport to Brandon Rd. Dam	24:48 "
Total	166:08 "

Lake Michigan Elevation—0.60

Average Lockport Discharge	2800 C.F.S.
Damen Ave. to Summit	37:34 Hrs.
Summit to Lockport	61:13 "
Lockport to Brandon Rd. Dam	19:21 "
Total	118:08 "

Average Lockport Discharge 10,000 C.F.S.

Lake Michigan Elevation—0.60

Damen to Summit	9:32 Hrs.
Summit to Lockport	16:24 "
Lockport to Brandon Rd.	5:39 "
Total	31:35 "

Opponent's Exhibit No. 6.

Communicable Diseases.

Cases and Deaths in Joliet and Will County.

(County Figures include City Figures.)

From Annual Reports of Illinois Department of Public Health.

	1939				1938				1937			
	Will Co.		Joliet		Will Co.		Joliet		Will Co.		Joliet	
	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths
Diptheria					7	2	4	2	8	1	3	1
Encephalitis			0		0	0	0	0	2	1	3	1
Influenza					10	10	2	5	56	43	14	24
Malaria					1	0	5	5	0	0	0	0
Measles					517	1	177	0	9	0	2	0
Meningitis					0	0	0	0	0	0	0	0
Pneumonia					56	46	15	19	113	64	46	29
Poliomyelitis					0	0	0	0	4	1	2	1
Scarlet Fever					535	6	166	5	277	1	107	0
Small Pox					14	0	0	0	3	0	1	0
Tuberculosis					96	45	57	11	111	54	78	15
Typhoid Fever					7	0	1	0	13	0	10	0
Whooping Cough					84	1	29	0	76	1	26	1

2127

	1936				1935				1934			
	Will Co.		Joliet		Will Co.		Joliet		Will Co.		Joliet	
	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths
Diptheria	12	0	3	0	18	2	3	2	18	2	9	1
Encephalitis	0	0	0	0	4	3	1	2	0	0	0	0
Influenza	24	24	14	15	12	23	7	13	15	15	9	6
Malaria	0	0	0	0	0	0	0	0	0	0	0	0
Measles	4	0	3	0	851	6	223	2	195	1	56	0
Meningitis	2	0	0	0	5	3	4	3	1	0	1	0
Pneumonia	63	51	21	24	80	61	30	23	101	86	38	1
Poliomyelitis	1	0	0	0	0	1	0	0	2	0	1	0
Scarlet Fever	79	0	20	0	214	7	69	5	1042	5	395	4
Small Pox	188	1	100	1	1	0	1	0	1	0	1	0
Tuberculosis	80	60	55	21	131	48	82	13	134	62	77	16
Typhoid Fever	24	3	11	3	20	0	10	0	23	1	12	1
Whooping Cough	39	2	5	1	132	7	39	4	63	1	7	0

2128

	1933				1932				1931			
	Will Co.		Joliet		Will Co.		Joliet		Will Co.		Joliet	
	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths	Cases	Dths
Diptheria	25	3	7	0	58	3	38	3	35	3	7	1
Encephalitis	Not Reported				Not Reported				Not Reported			
Influenza	41	30	15	13	86	63	22	32	36	37	17	16
Malaria	7	0	7	0	0	1	0	0	0	0	0	0
Measles	122	1	4	0	11	0	3	0	400	4	82	3
Meningitis	3	2	2	2	1	0	1	0	4	4	3	4
Pneumonia	101	79	39	35	118	81	68	44	118	82	61	43
Poliomyelitis	0	0	0	0	0	0	0	0	2	0	1	0
Scarlet Fever	231	6	91	3	208	10	84	3	190	6	84	3
Small Pox	1	0	0	0	1	0	1	0	31	0	12	0
Tuberculosis	99	48	70	20	141	62	90	22	137	79	79	17
Typhoid Fever	38	7	27	7	33	5	17	1	9	1	5	0
Whooping Cough	5	0	0	0	63	3	29	1	67	3	40	3

2129

	1930			
	Will Co.		Joliet	
	Cases	Dths	Cases	Dths
Diptheria	34	2	21	1
Encephalitis	Not reported			
Influenza	26	27	6	13
Malaria	0	0	0	0
Measles	19	0	11	0
Meningitis	3	0	2	0
Pneumonia	117	74	66	38
Poliomyelitis	1	0	0	0
Scarlet Fever	84	4	41	1
Small Pox	1	0	0	0
Tuberculosis	150	93	103	34
Typhoid Fever	25	3	20	2
Whooping Cough	43	4	18	2

2133 OPPONENT'S EXHIBIT No. 7.

CITY OF JOLIET.
State of Illinois.

January 6, 1940.

Honorable Mayor and City Commissioners,
City of Joliet, Illinois.

GENTLEMEN:

I wish to submit my report for the year ending as of December 31, 1939.

Communicable Cases Reported.

Chicken Pox	28
Diptheria	5
Infantile Paralysis	1
Influenza	6
Measles	1
Pneumonia	31
Scalet Fever	10
Typhoid Fever Pos	9
Erysipelas	1
Venerial Diseases	63
Tuberculosis	41
Whooping Cough	11
Meningitis	1
Mumps	21
German Measles	1
Miscellaneous Inspections and Complaints	326
Dilapidated Homes Inspected	52
Barber Shops Inspected	167
Restaurants and Hotel Inspections	211

The health department also participated in a Weed, and Rat and Mice Exterminating Campaign, both proving very successful.

Respectfully submitted,

FRANK WEDIC,
City Sanitarian.

FW:rm

2641 and
2642

OPPONENT'S EXHIBIT No. 7.

Culture plates were exposed to the air in the vicinity of the Des Plaines River and the Sanitary and Ship Canal from Lockport to Joliet. Ten locations were selected along the banks of the waterway and six locations about seven miles west and six locations about four miles east of the waterway. One plate of nutrient agar and one plate of Sabouraud's were exposed at east location for periods of from 3½ to 4¾ hours on July 16, 1940. After exposure the plates were collected, taken to the laboratory, and incubated for 48 hours at 37.5°C, after which colony counts were made.

Following is a description of the various bacteria together with the time of exposure at each location and results of colony counts:

	Colonies on Agar Plates Nutrient	Sabouraud's	Hours of Exposure	Bacterial Forms
No. 1	100	3	4.63	1-2-4-5-8
No. 2	36	10	4.21	1-8
No. 3	38	6	4.15	1-2-6-8
No. 4	0	3	4.21	8
No. 5	35	30	4.23	1-6-8
No. 6	90	10	4.17	1-6-7-8
No. 7	23	15	3.81	1-5-8
No. 8	52	7	3.77	1-5-8
No. 9	8	5	3.81	1-7-8
No. 10	35	0	3.83	1-8
No. 11	32	11	3.63	1-7-8
No. 12	5	2	3.58	1-8
No. 13	27	5	3.55	1-7-8
No. 14	91	75	3.48	1-7-8
No. 15	5	12	3.51	1-7-8
No. 16	42	7	3.43	1-8
No. 17	0	13	4.83	8
No. 18	27	15	4.85	1-8
No. 19	147	2	4.85	1-3-7-8
No. 20	18	125	4.85	1-7-8
No. 21	overgrown	overgrown	4.91	1-8
No. 22	overgrown	overgrown	4.88	1-8

No. 1	Gram positive rods	(Hay Bacillus)
No. 2	Gram positive rods	(Diptheroid)
No. 3	Gram positive rods	(Streptobacilli)
No. 4	Gram positive cocci	(Staphylococci)
No. 5	Gram positive cocci	(Staphylococci)
No. 6	Gram negative threads	
No. 7	Gram negative rods	
No. 8	Molds	

Description of Locations.

1. Plates exposed on window ledge of vacant house overlooking the Des Plaines River on the north side of Jefferson Street, Joliet, at the west end of the Jefferson Street bridge from 10:15 A. M. to 2:53 P. M.

2. Plates exposed on west bank of Des Plaines River south of Jackson Street bridge, Joliet, from 10:45 A. M. to 2:58 P. M.

3. Plates exposed on west bank of Des Plaines River east of factory sidings southeast of Phoenix Mfg. Co. plant, between Joliet and Lockport, from 10:35 A. M. to 3:04 P. M.

4. Plates exposed on top of concrete abutment out-

side rails of bridge approach at west end of 16th Street bridge over the Sanitary and Ship Canal on the south side of 16th Street, Lockport, from 11:00 A. M. to 3:13 P. M.

5. Plates exposed on top of south concrete wall of west approach to bridge over the Sanitary and Ship Canal at 9th Street, Lockport, from 11:08 A. M. to 3:22 P. M.

6. Plates exposed on top of concrete wall just outside of railing on east bank of Sanitary and Ship Canal just south of east end of 9th Street Bridge, Lockport, from 11:10 A. M. to 3:20 P. M.

2643 7. Plates exposed on top of concrete wall just outside of railing on east bank of Sanitary and Ship
2644 Canal just south of east end of 16th Street bridge, Lockport, from 11:25 A. M. to 3:14 P. M.

8. Plates exposed on top of concrete wall at east bank of Des Plaines River at the locks, about one mile south of 16th Street, Lockport, from 11:30 A. M. to 3:16 P. M.

9. Plates exposed on top of concrete wall just north of Cass Street bridge on east side of Des Plaines River at Joliet, from 11:45 A. M. to 3:34 P. M.

10. Plates exposed on roof of cabin of boat tied in the Des Plaines River north of Jefferson Street bridge on the east side of the river from 11:50 A. M. to 3:40 P. M.

11. Plates exposed in depression in earth around the base of a small tree on east bank of Plainfield-W. of Chicago Road beside the first gravel parking space just north of Troy Road, about six miles west of Joliet, from 12:10 A. M. to 3:45 P. M.

12. Plates exposed on top of concrete culvert at

northeast corner of intersection of Plainfield-W. Chicago Road and Black Road, from 12:15 P. M. to 3:50 P. M.

13. Plates exposed on top of concrete culvert at northeast corner of intersection of Plainfield-W. Chicago Road and cross road one mile north of Black Road, from 12:30 P. M. to 3:53 P. M.

14. Plates exposed on top of concrete culvert at northeast corner of intersection of Plainfield-W. Chicago Road and Caton Farm Road (175th St.) from 12:25 P. M. to 3:54 P. M.

15. Plates exposed on stump near northwest corner of intersection of Plainfield-W. Chicago Road and
2645 cross road 2 miles north of Caton Farm Road, opposite Bundy Farm, from 12:26 P. M. to 3:58 P. M.

2646 16. Plates exposed on top of concrete curb at the rear of (east) Johnson's Filling Station, Plainfield, on the east side of Plainfield-W. Chicago Road near Route U. S. 30, from 12:33 P. M. to 3:59 P. M.

17. Plates exposed in Pilcher Park about 3½ miles east of Joliet via Route U. S. 30, on top of sign reading "Short Way Out", from 1:10 P. M. to 6:00 P. M.

18. Plates exposed on stone under tree at southeast corner of intersection of Smith Road and Maple Road, from 1:15 P. M. to 6:05 P. M.

19. Plates exposed on top of concrete abutment on east side of north end of bridge over Spring Creek on road passing north and south through Gaugers, about 4½ miles east of Joliet, from 1:18 P. M. to 6:10 P. M.

20. Plates exposed on step of transformer shed at southeast corner of "Gaugers" road and 175th Street, from 1:23 P. M. to 6:15 P. M.

21. Plates exposed on top of John Lane memorial

stone at northeast corner of intersection of "Gaugers" road and 167th Street, from 1:27 P. M. to 6:22 P. M.

22. Plates exposed on top of concrete culvert at southeast corner of intersection of "Gaugers" road and 159th Street.

2828 OPPONENT'S EXHIBIT No. 10.

SOURCES OF OXYGEN

FOR

PREVENTION OF COMPLAINTS FROM BRANDON POOL.

	Pounds of Oxygen per 24 Hours
1. Increase of diversion from 1500 to 5000 c.f.s.—3500 c.f.s @ 8 p.p.m.	150,000
2. Increased air used to produce 15 p.p.m. of nitrate and nitrite oxygen and 7 p.p.m. of D.O. in effluents of N. Side and Calumet plants 370 M.G.D. @ 18 p.p.m.	55,000
3. Reaeration at Lockport over properly designed cascades. Average flow 3130 c.f.s. D.O. pickup average of 6¾ p.p.m. (equivalent to 2650 c.f.s. of lake water)	113,000
4. Reaeration at Lockport if flow is regulated to equalize D.O. rather than flow. Summer flow = 4200 c.f.s. @ Ave. D.O. pickup of 6¾ p.p.m. =	152,000
5. Regulation of annual diversion so as to equalize pounds of oxygen diverted rather than quantity of water. (Ave. D.O. of Lake Michigan water 10.75 p.p.m.) Equivalent to adding during the critical summer months	22,000

2832 OPPONENT'S EXHIBIT No. 11.

MEANS OF REDUCING B.O.D. LOAD TO CANAL TO AMELIORATE OR REMEDY CONDITIONS COMPLAINED OF AT BRANDON'S POOL.

B.O.D. of Brandon Pool 3130 c.f.s. @ 25 p.p.m. .420,000#/day
Major Sources of B.O.D. during summer of 1940

West Side effluent (June) 391 MGD @ 64 p.p.m.	208,000#
S.W. Side (June) 365 MGD @ 71 p.p.m.	216,000#
S.W. & N. Side sludge to canal 19,409 tons of total of 63,643 tons i.e. 30½% of 60% B.O.D. of 3,721,000 population @ .167# B.O.D./cap./day	105,000#
	529,000#

Ameliorating Measures other than more Oxygen

(Activated sludge plant effluents assumed in oxygen balance)

1. Chemical treatment @ West Side reduce B.O.D. 21 p.p.m.—437 M.G.D. (May) (April 1940 report) ..... 76,000# B.O.D./day
2. Activate entire West Side Imhoff effluent at S.W. plant ..... 200,000# B.O.D./day
3. Eliminate by-passing of part of S.W. flow after primary treatment only..... 81,000# B.O.D./day
4. Keep all sludge out of canal..... 105,000# B.O.D./day
5. Chlorination @ 2 p.p.m. B.O.D. removal per p.p.m. of chlorine—6 p.p.m. chlorine on entire canal flow of 3130 c.f.s. ..... 200,000# B.O.D./day

Total B.O.D. reduction by methods other than chlorination and chemical treatment (Nos. 2, 3 & 4)..... 386,000#/day

Total B.O.D. reduction by methods Nos. 1, 3, 4 & 5)..... 462,000#/day

2847 OPPONENT'S EXHIBIT No. 12.

ESTIMATED COST OF MEASURES TO ALLEVIATE OR REMEDY CONDITIONS COMPLAINED OF AT BRANDON'S POOL.

Description	Approx. Cost to Install	Approx. Annual Operating Cost	Time Required
1. Increased air used at N. Side and Calumet activated sludge plants			
(a) Based on 5 mos. operation	0	$ 89,000	None
(b) Based on 12 mos. operation	0	216,000	None
2. Chemical treatment at West Side Plant			
(a) Based on 5 mos. operation	$1,300,500	200,000	
(b) Based on 12 mos. operation	1,300,500	481,700	
3. Chlorination of Canal water	360,000	70,000 to 300,000	6 to 9 mos.
4. Aeration of Canal water above Lockport.	50,000 to 100,000	0*	3 to 6 mos.
5. Regulate annual diversion to equalize D.O. rather than flow	0	0	None
6. Dredge Brandon Pool to remove more compact solids and some of the lighter material	400,000 to 750,000	0	
7. Flush Brandon Pool to remove active sludge and flocculent material	Nominal	0	1 to 2 wks.
8. Divert all of W. Side effluent to S.W. aeration plant—Conduit	341,300(a)	Nominal	6 months
16 Final settling tanks	1,059,700(a)		9 months
24 Final settling tanks	1,256,200(a)		9 months
Conduits, gatehouses, etc.	610,000(a)		6 months
9. Chlorination of W. Side effluent for 150 days	100,000	105,000	6 to 9 mos.

(a) Part of Permanent program.

* Exclusive of loss of power generated at Lockport @ $1,500/day for 100 days = $150,000.

2853

Opponent's Exhibit No. 13.

Sources of D.O. and B.O.D. of Canal at Lockport.

		1938	1939	1940	1941
1.	Flow (c.f.s.) (June)	6,701	4,227	2,876	3,130
2.	Diversion (Flow—1,650 c.f.s.)	5,051	2,577	1,226	1,480
3.	D.O. in diversion water @ 8 p.p.m.	216,000#	110,000#	52,500#	63,500#
4.	B.O.D. at Lockport (#per 24 hours)	685,000#	860,000#	430,000#	150,000# ±
5.	D.O. at Lockport p.p.m. ave.	.3	0	0	
6.	Excess of B.O.D. in Pool over D.O. in diversion water (Line 4-Line 3)	469,000#	750,000#	379,500#	
7.	Tons of sludge discharged to canal	4,744	4,316	2,287	0
	Principal Sources of B.O.D.				
A.	Excess of B.O.D. over D.O. in effluents				
	(a) N. Side Plant	0	0	0	0
	(b) Calumet Plant	3,000	2,500	0	0
B.	North Side sludge @ 60% raw sewage	129,000#	139,000#	65,000#	0
C.	S.W. Side sewage	410,000#	266,000(b)	216,000#	0
D.	S.W. Side sludge to canal after activation	0	0	40,000(c)	0
E.	West Side effluent	115,000#	89,000#	208,000#	169,000(a)
F.	Calumet sludge to canal after activation	23,000#	0	0	0
	Total Principal Sources of B.O.D.	680,000#	496,500#	529,000#(e)	169,000#

(a) 356 M.G.D. @ 57 p.p.m. with Imhoff treatment only.
(b) 160 M.G.D. activated for 21 days taken as half of flow for 70% of month.
(c) 16.4% of total sludge @ 60% of raw sewage.
(d) 130 M.G.D. in oxygen balance.
(e) 410,000# in July.

3030

Opponent's Exhibit No. 14.

Sources of Dissolved Oxygen and B.O.D. at Lockport.

(Ave. of June, July and August.)

	1938	1939	1940	1941	1942
1. Ave. Flow—(c.f.s.)	6,752	3,336	3,552	3,800	3,800
2. Diversion (Flow — 1650 c.f.s.)	5,102	1,686	1,902	2,150	2,150
3. Dissolved Oxygen in diversion water @ 8 p.p.m. ...	220,000#	72,500#	82,000#	92,000#	92,000#
4. B.O.D. @ Lockport (# per 24 hrs.).....	627,000#	558,000#	389,000#	150,000# ±	100,000# ±
5. D.O. (p.p.m. average).....	.17	0	.03	Present	Present
6. (This line of Op. Exh. 13 omitted as of no significance)					
7. Tons of sludge discharged to canal from treatment plants	11,893	15,731	4,468	0	0
Principal Sources of B.O.D. except old sludge					
A. Excess of B.O.D. over D.O. in effluents (Ave.)					
(a) N. Side Plant.....	0	0	0	0	0
(b) Calumet Plant.....	4,100#	3,400#	350#	0	0
B. North Side Sludge @ 60% raw sewage	102,000#	112,000#	39,000#	0	0
C. South West sewage @ .167# equiv. pop.	410,000#	240,000#	156,300#	0	0
D. South West sludge to canal after activation	0	102,000#	21,400#	0	0
E. West Side effluent.....	106,000#	82,000#	224,000#	160,000#	0
F. Calumet sludge to canal after activation	23,000#	0	0	0	0
Total—Principal Sources of B.O.D. other than old sludge.	645,000#	539,400#	421,050#	169,000#	0

3104 OPPONENT'S EXHIBIT No. 15.

STATE LABORATORY OF HYGIENE.

LABORATORY OF THE STATE BOARD OF HEALTH.

Madison, Wis., October 1, 1940.

Wisconsin, *et al. vs.* Illinois, *et al.*,
1940 Hearings.
Mr. H. H. Naujoks,
c/o Ekern and Meyers,
No. 1 La Salle Street,
Chicago, Illinois.

DEAR MR. NAUJOKS:

Re: Joliet, Illinois, Air and Water Pollution.

On September 17, 1940, at your request Mr. L. F. Warrick and I visited Joliet, Illinois, and took air and water samples. The results of tests made on these materials constitute the first part of this report. There on September 27 and 28, 1940, at your request for additional data, air and water tests were conducted. Mr. William Z. Fluck, Chemical Engineer for Wisconsin Industrial Hygiene unit, accompanied me on this trip and assisted in the collection of the samples. The second part of this report will cover the results of tests made September 27 and 28, 1940.

Part I.

This part of this report covers work done at Joliet, Illinois on,

(a) Amount and type of bacterial present in the air near the canal and at other points somewhat distant;

(b) Nature of scum present at certain points in and adjacent to the canal waters, scrapings present

on the walls at Brandon Locks, and test made on effluent from Texas Company Oil Refinery Plant which flows into a ditch adjacent to canal and enters Brandon Pool about 150 feet below the Lockport Locks.

(a) Bacterial Content of Air (9-17-40).

Culture plates containing both nutrient and malt agar, respectively were exposed for four hour periods at designated points in Joliet, Illinois; Lockport, Illinois; and environs. These plates were then transported to Madison, Wisconsin, and incubated for 24 hours at 37 deg. C. Colony counts were then made using a "Quebec" counter. Stains were made on ten separate colonies from each of the nutrient agar plates and smears examined for bacterial types. No attempt was made to identify species of bacteria which grew on these plates. Satisfactory results were obtained from five different locations as listed below.

3105 2. Joliet, Illinois. Yard at F. C. Burrow's home. Off highway in woods. Plates exposed from 11:50 A. M. to 3:50 P. M., 9-17-40. Height above ground 5 fee. This location is about 1.5 miles air line from Brandon Pool. Day bright. Plates on post top in shade. Light wind. Air temperature = 78 deg. F. noon.

3. Joliet, Illinois. Brandon Locks. In shade on ledge at side of steps. N. side of Control House, 3 feet above ground. Locks Illinois Waterway. Plates exposed, from 12:20 P. M. to 4:20 P. M., 9-17-40. Light wind.

6. Joliet, Illinois. St. Joseph's Hospital. In shade on wall 6 feet about street on North side of building. Two blocks from canal. Plates exposed from 12:56 P. M. to 4:56 P. M., 9-17-40.

12. Joliet, Illinois. In cornfield 1 mile west Stateville prison. Plates placed on cardboard support on ground in sunlight from 2:14 P. M. to 6:19 P. M., 9-17-40.

13. Joliet, Illinois. Guardian Angel home. About three miles from Joliet Court House on U. S. 30. Plates exposed in shade on window ledge from 2:20 P. M. to 6:30 P. M., 9-17-40.

In the following table are given the results of bacterial counts on the plates exposed as above described, the time of exposure, and the morphological type of bacteria found.

Description of plate and location number.	Colonies on Agar plates grown for 48 hours at 37.5 deg. C.				Hours of Exposure	*Bacterial Forms (See key below)
	Nutrient:		Malt			
	Bact.	Molds	Bact.	Molds		
No. 2 Burrow's home	66	40	35	50	4.0	6, 4, 1, 2, 10, 15
No. 3 Brandon Locks	63	37	5	110	4.0	7, 1, 15, 2, 5, 10
No. 6 St. Joseph's Hosp.	292	1	110	12	4.0	7, 12, 4, 6, 5, 10
No. 12 Cornfield	560	4	100	Many	4.1	5, 1, 6, 7, 10, 2
No. 13 Guardian Angel Home	350	0	0	10	4.2	4, 2, 16, 1, 5

* Key to morphological types.
1.—Gram positive rods (Similar to B. subtilis).
2.—Gram positive rods (Similar to B. flexus).
3.—Gram positive rods (Diphtheroids).
4.—Gram positive cocci (Staphylococci).
5.—Gram positive cocci (Large diplococci).
6.—Gram negative rods (Similar to Escherichia coli).
7.—Gram positive threads.
8.—Gram positive cocci (Streptococci).
9.—Yeast like fungi (Resembling Monilia Candida).
10.—Molds.
12.—Gram positive coccus (Resembling Diplococcus pneumoniae).
13.—Tetragenes (Gram positive cocci).
14.—Sarcina (Gram positive cocci).
15.—Gram positive bacillus (Streptobacillus).
16.—Gram negative threads.
17.—Gram negative bacillus (long rods).
18.—Gram negative cocci (similar to micrococcus catarrhalis).
19.—Small short Gram positive bacillus.

(b) Chemical Tests on Scrapings, Scum, and Effluent.

1. Sample of scrapings removed from canal wall just above upper lock gate at Brandon Locks, Joliet, Illinois. 6.8846 grams of moist scrapings yielded 3.5484 grams of dry substance of which 1.5044 grams was an "oily tar-like" material. This amount of chloroform soluble material represents 21.8 per cent by weight of moist scrapings or 42.3 per cent of the dry weight of the scrapings. Lab. No. 84100.

2. Scum inside future power development pool at Brandon Locks, Joliet, Illinois, near northwest corner. 140 ml. of scum yielded 3.9138 grams of dry oily tar-like material which amounts to 2.79 per cent by weight. Lab. No. 84101. Sample of this "oily tar-like" material saved.

3. Scum in eddy in ditch just below Texas Company Oil Refinery. This ditch serves as the channel to carry the effluent from this plant to a point about 150 feet below the downstream lock gate at Lockport Locks, Illinois Waterway near Lockport, Illinois. 130 ml. of this scum and water yielded 1.74 grams of "oily tar-like" material. This amounts to 1.34 per cent or 13,400 parts per million. Lab. No. 84103. Sample of this "oily tar-like" material saved.

4. Sample of Effluent flowing away from Texas Company Plant, Lockport, Illinois. This sample was collected at 5:00 P. M., September 17, 1940, from near the center of stream flow about 100 feet below wire fence enclosure of plant. The flow borders the canal at and above Lockport, Illinois, and enters Brandon Pool about 150 feet downstream from Lockport Locks.

The sample above referred to yielded the following results:

Oily tar-like extract	58.7 p.p.m.*
Sulphates (SO_4)	62.8 p.p.m.*
Hydrogen Sulphide (H_2S)	0 p.p.m.*
Phenolic Substances	0.2 p.p.m.*
p^H	7.1

Part II.

The following report covers tests made on the air and water at Illinois Waterway at Joliet, Illinois and environs. Certain other air samples were collected at points distant from this location for matter of comparison. The tests cover: 1. Chemical tests for hydrogen sulphide made on the site at which the samples of water were collected. 2. Air Tests for the number of live bacteria per cubic foot of air.

1. Chemical tests on the water collected at three separate points as indicated in the following tabulation yielded the result shown.

(a) Sample of water collected from west side of canal one block above Jefferson Street bridge showed 0.2 parts per million of hydrogen sulphide (H_2S).

3107 (b) Sample of water collected from canal at Brandon Locks just above upper gate on west side showed 0.2 parts per million of hydrogen sulphide (H_2S).

(c) Sample of water collected from canal at Lockport Locks just above upper gate on east side of canal showed 0.1 parts per million of hydrogen sulphide (H_2S).

2. Measured samples of air were examined for bacterial life in accordance with a method described by

* p.p.m. = parts per million by weight. These results multiplied by 8.33 will convert these results to lbs. per million gallons.

Alexander Hollaender and J. M. Dalla Valle of the United States Public Health Service as described in Public Health Reports, Volume 54, Number 14 of April 7, 1939. In brief, this method makes use of the impingement principle in which a measured amount of air drawn by an ordinary impinger pump through an inverted funnel onto the surface of a sterial Petri plate containing an appropriate solid bacteriologic culture medium. The dust and bacteria are caught on the moist surface of the culture medium. The pump is calibrated to pump a definite volume of air per minute. A six volt motor and storage battery for power and a rubber hose connection of suitable length completes the apparatus and permits samples to be taken at convenient and suitable locations. Incubation of such exposed plates permits growth of bacteria caught and enumeration is then made by use of a "Quebec" type of bacteria colony counter. Three different sized air samples were taken at each sampling point namely, 1, 3, and 5 cu. ft. samples. This permitted enumeration of bacteria from air containing small numbers per cubic foot per minute. The results given are averages of the three determinations at each location selected.

Physical data taken and Location of place at which air samples were collected September 28, 1940.

A. Joliet, Illinois. One block north of Jefferson Street bridge on west side of canal. Air taken on canal structure at point about 5 feet above canal water level. Very slight SE wind. Sun shining. Cloudless sky. Odor slight of tarry waste. Slight oil film on canal water. 9:30 A. M., C. D. S. Time.

B. Joliet, Illinois. North end St. Joseph's Hospital, about one block from canal (west side). Sample

taken 4 feet above ground about 15 feet from hospital structure. No air movement perceptible. Ne pedestrians. One car passed on gravel road during collection of 3 cu. ft. sample. 9:50 A. M., C. D. S. Time.

C. Joliet, Illinois. Brandon Locks. West side of upper gate. Samples taken above shelter block about 8 feet above surface of canal water. Lock chamber empty. No boats passed. Sun shining. Tarry odor distinctly perceptible. Light wind from SW. 10:45 A. M., C. D. S. Time.

D. Joliet, Illinois. Brandon dam at west end of proposed power dam. Sun shining. Mild SW wind. Odor negligible. Some oily scum on water below dam. Temperature 70° F. at Lockhouse (outside). 11:25 A. M., C. D. S. Time.

3108 E. Joliet, Illinois. Rural; five miles south of Hy. 66 then one mile west on Town line road to intersection with Ry. Sun shining, slight south wind. No activity on either road or Ry. Cornfield 500 feet NW. Gravel road 100 feet south of sampling point. Ry. 25 feet to west. 12:10 P. M., C. D. S. Time.

F. Joliet, Illinois. About three-fourths of a mile east of Old Joliet Prison. In valley near Ry. and about 200 feet N. of dusty street. Gravel road passed near sampling point. Rather untidy location. Samples taken on concrete foundation and wind from south fairly strong. Truck passed on gravel road during collection of 5 cu. ft. sample of air. 2:05 P. M., C. D. S. Time.

G. Lockport, Illinois. Near stone school house just off Hy. 6 and one block off Main N. and S. street. Four cars passed our location during the nine minute sampling period. Slight south wind. Samples taken

in shade four feet above street. 2:30 P. M., C. D. S. Time.

H. Lockport, Illinois. Samples taken on east side of Lockport Locks of canal near upper lock gate. Fairly strong wind. No traffic. Concrete walls and walk. Air temperature 75 deg. F. 3:05 P. M., C. D. S. Time.

I. Romeo, Illinois. At canal just south of canal bridge Air was sampled four feet from ground. Mild breeze from south. No odors perceptible. Sun shining. 5:00 P. M., C. D. S. Time.

J. Plainfield, Illinois. Samples taken along side of Illinois street about 150 feet off Lincoln Hy. at a height of about 4 feet. Very light air movement. Very little traffic. 5:50 P. M., C. D. S. Time.

K. Aurora, Illinois. Taken in small park at entrance to city on Hy. 30 at site of elevated water tank. Flower garden surrounding. No noticeable air movements. Sun still shining. 6:14 P. M., C. D. S. Time.

L. Aurora, Illinois. On park side of street just across street from Park Place Baptist Church. Dusk. Not much traffic. 6:35 P. M., C. D. S. Time.

M. Rochelle, Illinois. Rural samples taken at Junction of Hys. U. S. 30 and 51 north of city where 30 meets 51 from East. This location is in open country. No air movement. Very little dust. Temperature 63 deg. F. 9:00 P. M., C. D. S. Time.

N. Rockford, Illinois. About one-half mile from business district toward N. side on U. S. 51. Four cars per minute passed as samples were being taken about 4 feet from ground on side of street. Location definitely residential. No air movement. Very little dust noticeable. 10:19 P. M., C. D. S. Time.

3109 The above locations for air sampling were selected with care to ascertain the comparative bacterial pollution of the air. No attempt was made to obtain very clean air or very polluted air. At the locks very little choice was to be had of sampling locations.

Table showing number of viable bacteria in air at various locations in and near Joliet, Illinois, as compared with numbers found in rural areas and some other Illinois cities:

Sampling Station	Description of Location (See descriptive matter under Station letter for details)	Bacteria count on Nutrient agar per cubic foot air 24 hrs.—37.5 deg. C.	Morphological Types of Bacteria Present
A	Near Jefferson St. Bridge, Joliet, Ill ..	21.	1, 5, 6, 3, 2, 19, 10
B	St. Joseph's Hospital, Joliet, Ill.	13.	4, 19, 1, 5, 2, 7, 10
C	Brandon Locks, Joliet, Ill.	2.1	17, 5, 18, 19, 6, 15, 1, 10
D	Brandon Dam, Joliet, Ill.	1.9	7, 6, 17, 2, 1, 4, 10
E	Rural, 5 miles S. Joliet, Ill	9.5	7, 6, 2, 1, 19, 10
F	Lockport, Ill. Near school.....	47.0	19, 6, 7, 1, 4, 10
G	Lockport Locks, upper gate.....	13.6	7, 4, 19, 6, 8, 10
H	Romeo, Ill., near canal bridge.....	1.3	17, 2, 19, 6, 15, 1, 10
I	Plainfield, Ill., side street.....	26.1	15, 6, 19, 1, 17, 10
J	Aurora, Ill., Hy. 30.....	14.3	19, 4, 6, 8, 17, 10
K	Aurora, Ill., Baptist Church.....	22.0	7, 6, 5, 3, 19, 10
L	Rural, Jct. U. S. 30 and U. S. 51.....	12.0	18, 2, 17, 19, 8, 6, 4, 10
M	Rockford, Ill., U. S. 51 res.	10.3	1, 17, 19, 6, 7, 10
N	.....	35.0	1, 15, 6, 18, 2, 19, 10

* For key to these morphological types kindly refer to page 2 of this report.

3454 OPPONENT'S EXHIBIT No. 23.

REPORTED CASES AND DEATHS FROM COMMUNICABLE DISEASES.

WILL COUNTY AND STATE OF ILLINOIS.

1930-1939 Inclusive.

From Annual Reports Illinois Department of Public Health.

Rate per 100,000 calculated on basis of 1930 Population.

	WILL COUNTY				STATE TOTAL			
	1930 Pop. 110,732				1930 Pop. 7,620,544			
Year	Cases	Rate	Deaths	Rate	Cases	Rate	Deaths	Rat
				Dyphtheria				
1930	34	31.0	2	1.8	6843	89.8	543	7.
1931	35	31.8	3	2.7	5413	71.0	383	5.
1932	58	52.7	3	2.7	3811	50.0	240	3.
1933	25	22.7	3	2.7	1695	22.2	134	1.
1934	18	16.4	2	1.8	2092	27.5	153	2.
1935	18	16.4	2	1.8	2663	35.0	208	2.
1936	12	10.9	0	.0	1784	23.4	170	2.
1937	8	7.3	1	.9	1671	21.9	153	2.
1938	7	6.4	2	1.8	1634	21.4	120	1.
9 Yr. Ave.	24	21.8	2	1.8	3067	40.3	234	3.
1939	8	7.3	1	.9	1446	19.0	118	1.
				Encephalitis				
1930				Not Reported				
1931				Not Reported				
1932				Not Reported				
1933				Not Reported				
1934	0	.0	0	.0	297	3.9	81	1.
1935	4	3.6	3	2.7	123	1.6	35	.
1936	0	.0	0	.0	74	1.0	35	.
1937	2	1.8	1	.9	103	1.4	36	.
1938	0	.0	0	.0	67	.9	31	.
5 Yr. Av.	1	.9	1	.9	133	1.7	44	.
1939	0	.0	0	.0	48	.6	19	.
				Influenza				
1930	26	23.6	27	24.5	1239	16.3	946	12.
1931	36	32.7	37	33.6	3562	48.7	1673	22.
1932	86	78.2	63	57.3	3908	51.3	1900	24.
1933	41	37.3	30	27.3	2179	28.6	1200	15.
1934	15	13.6	15	13.6	1168	15.3	838	11.
1935	12	10.9	23	20.9	2034	26.7	1255	16.
1936	24	21.9	24	21.9	2065	27.1	1140	15.
1937	56	50.9	43	40.0	3597	47.2	1331	17.
1938	10	9.1	10	9.1	727	9.5	439	5.
9 Yr. Av.	34	30.9	30	27.3	2295	30.1	1191	15.
1939	36	32.7	25	22.7	6445	84.6	967	12.

3455

	WILL COUNTY				STATE TOTAL			
Year	Cases	Rate	Deaths	Rate	Cases	Rate	Deaths	Rate
				Malaria				
1930	0	.0	0	.0	366	4.8	50	.7
1931	0	.0	0	.0	561	7.4	61	.8
1932	0	.0	1	.9	130	1.7	39	.5
1933	0	.0	0	.0	253	3.3	62	.8
1934	0	.0	0	.0	322	4.2	60	.8
1935	0	.0	0	.0	378	5.0	71	.9
1936	0	.0	0	.0	221	2.9	55	.7
1937	0	.0	0	.0	207	2.7	38	.5
1938	1	.9	0	.0	263	3.5	35	.5
Yr. Av.	.11	.001	.11	.001	300	3.9	52	.7
1939	3	2.7	9	.0	423	5.6	35	.5
				Measles				
1930	19	17.3	0	.0	16678	218.9	91	1.2
1931	400	363.6	4	3.6	39206	514.5	339	4.4
1932	11	10.0	0	.0	16070	210.9	51	.7
1933	122	111.0	1	.9	12357	162.2	52	.7
1934	195	177.3	1	.9	44679	586.3	210	2.8
1935	851	773.6	6	5.5	58103	762.5	286	3.8
1936	4	3.6	0	.0	1228	16.1	9	.1
1937	9	8.2	0	.0	12432	163.1	95	1.2
1938	517	470.0	1	.9	88150	1156.8	207	2.7
Yr. Av.	236	214.5	1.44	.13	32100	421.3	149	2.0
1939	4	3.6	0	.0	1269	16.6	3	.0
				Meningitis				
1930	3	2.7	0	.0	445	5.8	208	2.7
1931	4	3.6	4	3.6	490	6.4	257	3.4
1932	1	.9	0	.0	323	4.2	153	2.0
1933	3	2.7	2	1.8	557	7.3	208	2.7
1934	1	.9	0	.0	337	4.4	119	1.6
1935	5	4.5	3	2.7	554	7.3	207	2.7
1936	2	1.8	0	.0	436	5.7	175	2.3
1937	0	.0	0	.0	226	3.0	95	1.2
1938	0	.0	0	.0	91	1.2	21	.3
Yr. Av.	2	1.8	1	.9	384	5.4	160	2.1
1939	0	.0	0	.0	76	1.0	13	.2

3456

Year	WILL COUNTY Cases	Rate	Deaths	Rate	STATE TOTAL Cases	Rate	Deaths	Rate
Pneumonia								
1930	117	106.4	24	21.8	11829	155.2	5179	68.0
1931	118	107.3	82	74.2	13467	176.8	5564	73.0
1932	118	107.3	81	73.6	12295	161.3	5332	70.0
1933	101	91.8	79	71.8	10933	143.5	4966	65.2
1934	101	91.8	86	78.2	12423	163.0	5906	78.8
1935	80	72.7	61	55.5	13159	172.7	5984	78.5
1936	63	57.3	51	46.4	15926	209.0	6312	82.8
1937	113	102.7	64	58.2	14970	196.4	5512	72.3
1938	56	51.0	46	41.8	12834	162.5	4595	60.3
9 Yr. Av.	96	87.3	64	58.2	13095	171.8	5485	72.0
1939	85	77.3	35	31.8	13472	176.8	4193	55.0
Poliomyelitis								
1930	1	.9	0	.0	402	5.3	61	.8
1931	2	1.8	0	.0	700	9.2	102	1.3
1932	0	.0	0	.0	202	2.6	40	.5
1933	0	.0	0	.0	207	2.7	29	.4
1934	2	1.8	0	.0	213	2.8	27	.4
1935	0	.0	1	.9	243	3.2	40	.5
1936	1	.9	0	.0	689	9.0	70	.9
1937	4	3.6	1	.9	779	10.2	90	1.2
1938	0	.0	0	.0	106	1.4	16	.2
9 Yr. Av.	1	.9	.22	.02	393	5.2	52	.7
1939	2	1.8	0	.0	192	2.5	21	.3
Scarlet Fever								
1930	84	76.4	4	3.6	17352	227.7	306	4.0
1931	190	172.7	6	5.5	16775	220.2	360	4.7
1932	308	189.1	10	9.1	14876	195.2	263	3.5
1933	231	210.0	6	5.5	16604	217.9	277	3.6
1934	1042	947.3	5	4.5	21403	280.9	306	4.0
1935	214	194.5	7	6.4	34727	455.7	407	5.3
1936	79	71.8	0	.0	22451	294.6	233	3.1
1937	277	251.8	1	.9	21525	282.5	160	2.1
1938	535	486.4	6	5.5	18245	239.4	136	1.8
1939	102	92.7	0	.0	15060	197.6	74	1.0
9 Yr. Av.	318	289.1	5	4.5	20440	268.2	272	3.6

3457

Year	WILL COUNTY Cases	Rate	Deaths	Rate	STATE TOTAL Cases	Rate	Deaths	Rate
Small Pox								
1930	1	.9	0	.0	3782	49.6	7	.1
1931	31	28.2	0	.0	1766	23.2	4	.1
1932	1	.9	0	.0	318	4.2	2	.0
1933	1	.9	0	.0	248	3.3	3	.0
1934	1	.9	0	.0	88	1.2	0	.0
1935	1	.9	0	.0	83	1.1	1	.0
1936	188	170.9	1	.9	422	5.5	2	.0
1937	3	2.7	0	.0	919	12.1	0	.0
1938	14	12.7	0	.0	965	12.7	1	.0
9 Yr. Av.	27	24.5	.11	.01	935	12.5	2	.03
1939	0	.0	0	.0	376	4.9	0	.0
Tuberculosis								
1930	150	136.4	93	84.5	11179	146.7	4789	62.9
1931	137	124.5	79	71.8	10423	136.8	4799	63.0
1932	141	128.2	62	56.4	10465	137.3	4291	56.3
1933	99	90.0	48	43.6	9193	120.6	4174	54.8
1934	134	121.8	62	56.4	9734	127.7	4124	54.1
1935	131	119.1	48	43.6	9911	130.1	4075	53.5
1936	88	80.0	60	54.5	8506	111.6	4050	53.2
1937	111	100.9	54	49.1	9064	119.0	3995	52.4
1938	96	87.3	45	40.9	8222	107.9	3686	48.4
9 Yr. Av.	121	110.0	61	55.5	9633	126.4	4220	55.4
1939	82	74.5	38	34.5	7752	101.7	3608	47.4
Typhoid Fever								
1930	25	22.7	3	2.7	960	12.6	154	2.0
1931	9	8.2	1	.9	804	10.6	127	1.7
1932	33	30.0	5	4.5	1045	13.7	125	1.6
1933	38	34.5	7	6.4	770	10.1	113	1.5
1934	23	20.9	1	.9	1085	14.2	131	1.7
1935	20	18.2	0	.0	775	10.2	91	1.2
1936	24	21.8	3	2.7	566	7.4	73	1.0
1937	13	11.8	0	.0	540	7.0	61	.8
1938	7	6.4	0	.0	523	7.0	59	.8
9 Yr. Av.	21	19.1	2	1.8	785	10.3	104	1.4
1939	8	7.3	1	.9	906	11.9	105	1.4

3458

Whooping Cough

Year	WILL COUNTY Cases	Rate	Deaths	Rate	STATE TOTAL Cases	Rate	Deaths	Rate
1930	43	39.1	4	3.6	8573	112.5	181	2.4
1931	67	60.9	3	2.7	10911	143.2	223	2.9
1932	63	57.3	3	2.7	11786	154.7	228	3.0
1933	5	4.5	0	.0	6439	84.5	81	1.1
1934	63	57.3	1	.9	15352	201.5	307	4.0
1935	132	120.0	7	6.4	11064	145.2	210	2.8
1936	39	38.5	2	1.8	10171	133.5	146	1.9
1937	76	69.1	1	.9	7906	103.8	149	2.0
1938	84	76.4	1	.9	15137	198.6	169	2.2
9 Yr. Av.	64	58.2	2	1.8	10615	139.3	188	2.5
1939	56	50.9	1	.9	12922	169.6	157	2.1

3460 OPPONENT'S EXHIBIT NO. 24.

	Will Co. Average compared with State Average—per 100,000 Cases Over	Cases Under	Deaths Over	Deaths Under	Will County 1939 compared with Will County Average Cases Over	Cases Under	Deaths Over	Deaths Under
Whooping Cough.....		81.8		.7		7.3		.9
Typhoid	8.8		.4			11.8		.9
Tuberculosis		16.4	.1			27.2		19.0
Small Pox 12.0				.02		24.5		.01
Scarlet Fever.....20.9			.9			196.4		4.5
Poliomyelitis		4.3		.68	.9			.02
Pneumonia		84.5		13.8		10.0		26.4
Meningitis		3.6		1.2		1.8		.9
Measles		206.8		1.87		210.0		.13
Malaria		3.899		.699	2.699			.001
Influenza	.8		11.7		1.8			4.6
Encephalitis		.8	.3			.9		.9
Dyphtheria		18.5		1.3		14.5		.9

3985 OPPONENT'S EXHIBIT No. 30.

AMERICAN HOSPITAL ASSOCIATION,
Incorporated 1920
Eighteen East Division Street,
Chicago, Ill.

Bert W. Caldwell, M. D.
Executive Secretary,
December 11, 1940

Mr. H. H. Naujoks,
Ekern and Meyers,
One North La Salle Street,
Chicago, Illinois.

Received
Dec 12 1940
Ekern & Meyers

DEAR MR. NAUJOKS:

Referring to our conversation of the 10th according to the records of the 1940 issue of Hospital Service
3986 in the United States of the American Medical Association there were 9.018.316 patients admitted to general hospitals in the United States during 1939 and that the average census in these hospitals was 307.991. Computed from this the average day stay of patients was 12.46 per patient. From the same source the St. Joseph's Hospital at Joliet, Illinois had 5.561 admissions and an average census of 175 patients which computed in the same manner would show an average days stay of patients of 11.48.

Yours very truly,

W. P. MORRILL,
M. D.

WPM:FSK

4476 HOWSON EXHIBIT No. 6.

ALVORD, BURDICK & HOWSON
John W. Alvord — Donald H. Maxwell
Chas. B. Burdick — Louis R. Howson
ENGINEERS
Suite 1401 Civic Opera Building
Chicago

Feb. 18, 1941.

Mr. Herbert H. Naujoks,
c/o Hotel Monteleone,
New Orleans, La.

DEAR NAUJOKS:

I have analyzed Pearse's Exhibit 61-A. It seems to me it is just as much in error as the original. On the enclosed table I have shown what I believe to be a proper analysis of this table.

The first three years 1938, 1939 and 1940 have actual recorded data of the C.O.D. at Lockport. This is shown in my line 6. Pearse's table has estimated the total B.O.D. exclusive of sludge (my line 1) and the B.O.D. of the sludge deposits (my line 2). The sum
4477 of these two is the total B.O.D. (my line 3).

Pearse's table also shows the sources of dissolved oxygen (my line 4). Oxygen balance is the difference between the total B.O.D. and the total D.O. That is line 3 minus line 4 shown on my table as line 5. The relation between the actual recorded B.O.D. at Lockport (my line 6) and the excess in line 7. The relation of the actual to the computed has varied from 50% to 61% with a year average of 57%.

If this average of 57% was applied to the critical years of 1941 and 1942 as shows in my line 8, the resulting B.O.D. at the pool would be 233,000 lbs. in

1941, the equivalent of 13.5 p.p.m., and 198,000 lbs. in 1942, the equivalent of 11.5 p.p.m.

Actually, Pearse for 1941 had a per cent of pool B.O.D. to the excess which he computed in the ratio of 361,500 to 409,000 or 88½% and in 1942 the relation of 303,000 to 347,000 or 67½%. Certainly I see no reason why for these two years the percentage of error should have been any greater than in the former
4478 years and certainly actual experience as recorded by analytical data in the past is the best foundation for future predictions. I believe the facts are closely represented by the figures in line 8 of my table and these you will note do not differ a great deal from Pearse's original Exhibit 61-A figures.

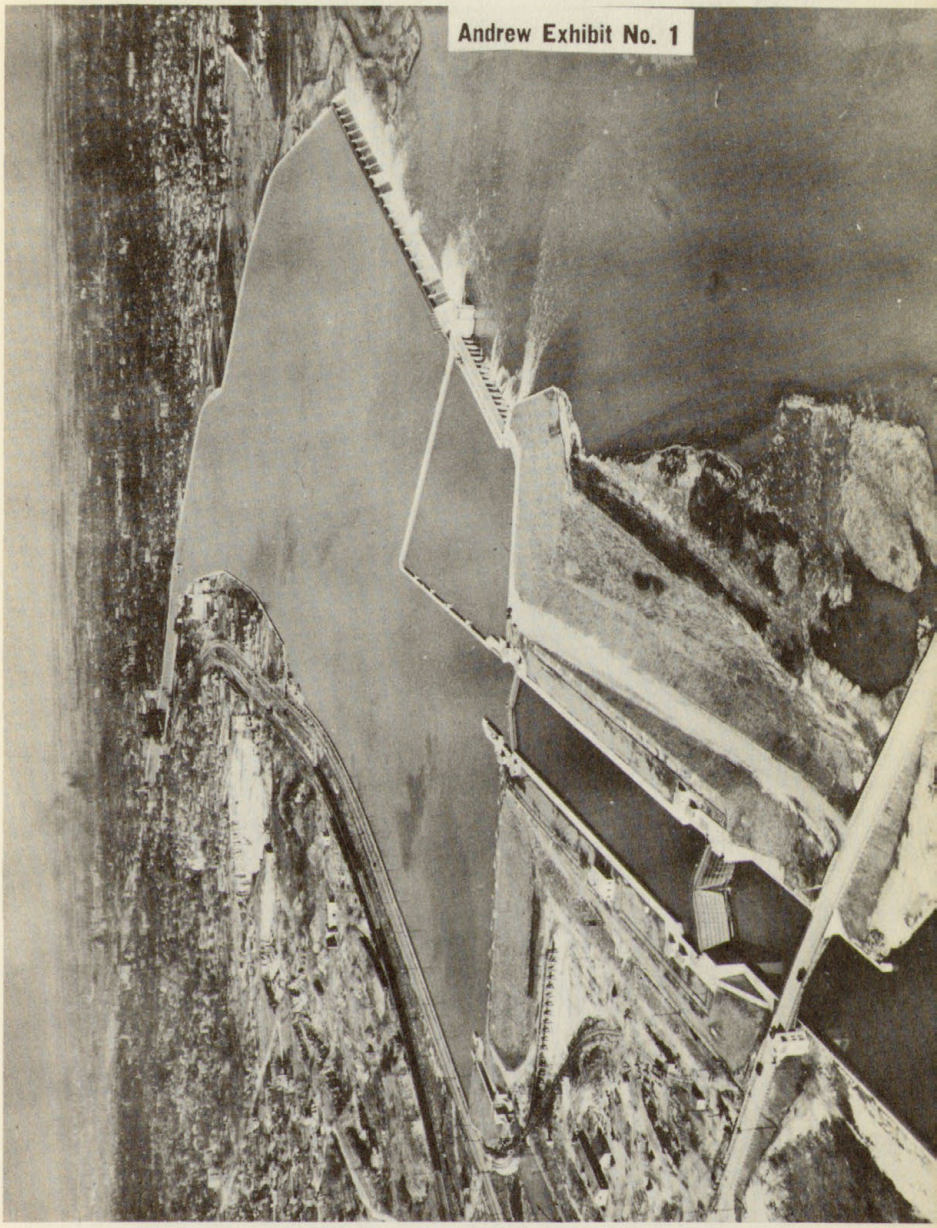
Another way to look at it would be to find what Pearse's error amounted to. That is, line 5 minus line 6. These errors were:

1938	405,300 lbs.
1939	559,800
1940	262,800
3 yr. Ave.	409,300

While the variation will be somewhat less than these three years would indicate due to partial satisfaction of the oxygen demand, there will certainly be a material credit for reaeration in any period in the future and that Mr. Pearse has wholly ignored. There is much discussion of reaeration in part 3, appendix 1 of the 1925 investigation.

Yours very truly,
ALVORD, BURDICK & HOWSON,
By L. R. HOWSON,

LEH:VB


Andrew Exhibit No. 1

Respectfully submitted,

GEORGE F. BARRETT,
Attorney General of the State of Illinois,

JOHN E. MARTIN,
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J. A. A. BURNQUIST,
Attorney General of Minnesota,

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Special Assistant to the Attorneys General.