Schliekelman

REPORT

ON THE

WATER POLLUTION INVESTIGATION

OF

EAST FORK DES MOINES RIVER

Below Algona, Iowa

1947 - 1952

Hearing

DIVISION OF PUBLIC HEALTH ENGINEERING

IOWA STATE DEPARTMENT OF HEALTH

Des Moines, Iowa

October 1952

Bancroft - 30 miles
901

Bart - 18 miles
572

Livermore
615

ALTER L. BIERRING, M. D.
COMMISSIONER

State of Iowa
Department of Health
Des Moines 19

DIVISION OF
PUBLIC HEALTH ENGINEERING
PAUL J. HOUSER, DIRECTOR

PLEASE ADDRESS ALL CORRESPONDENCE TO THE
DIVISION OF PUBLIC HEALTH ENGINEERING

October 17, 1952

Walter L. Bierring, M. D.
Commissioner, State Health Department
Office

Dear Dr. Bierring:

Transmitted herewith is a report on investigations of the pollutional condition of the East Fork of Des Moines River below the City of Algona, Iowa.

These investigations were instigated in November, 1947, and under date of January 30, 1950, a report of the findings together with recommendations was submitted to the Mayor and Council of Algona. Shortly thereafter, the city officials engaged a firm of consulting engineers who prepared and submitted a preliminary report on a sewage collection and treatment project, including an estimate of the probable cost. Later the city obtained a federal government loan for financing construction plans and specifications which were subsequently approved by this Division on September 7, 1951.

Several meetings were held with the city officials since presentation of the report and after the plans were approved, but to date, due primarily to financial limitations, construction of the project has not begun. In the meantime, additional data were obtained on the stream's pollutional condition, these data being presented in the supplementary report for the period December 19, 1950, to September 24, 1952.

In consideration of the pollution found to exist as shown in both the original and the supplementary reports, coupled with the city's apparent intention of not proceeding with construction of the necessary corrective works, I believe it advisable to proceed with a hearing as specified in the Stream and Lake Pollution law.

Respectfully submitted,

P. J. Houser, Director
Division of Public Health Engineering

PJH:hew

REPORT

and

SUPPLEMENTARY REPORT

On The

INVESTIGATION OF POLLUTION

Of The

EAST FORK DES MOINES RIVER

Below Algona, Iowa

1947 - 1952

By The

DIVISION OF PUBLIC HEALTH ENGINEERING

STATE DEPARTMENT OF HEALTH

Des Moines, Iowa

October, 1952

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November 13, 1947, to September 22, 1949

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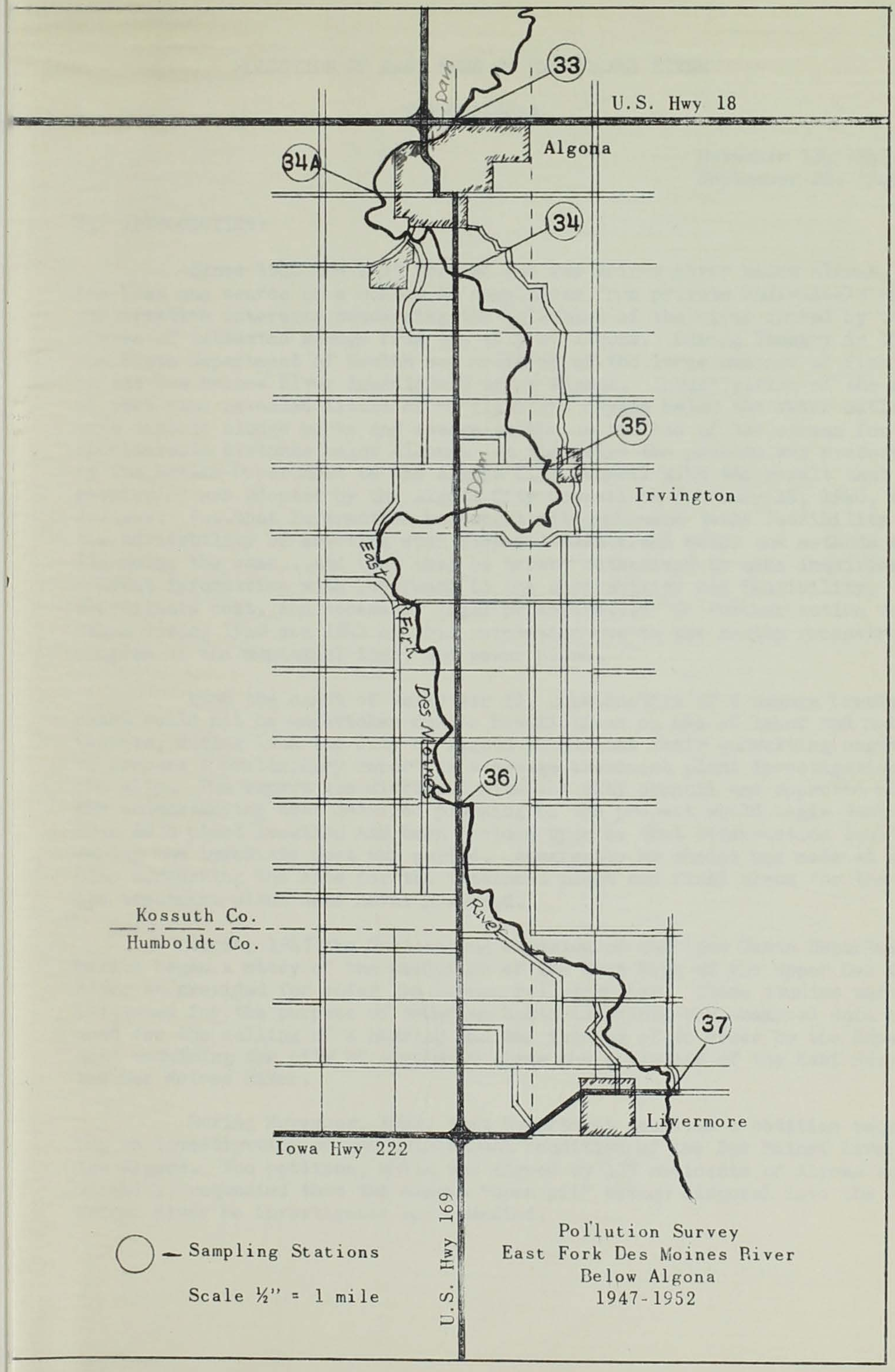


Pollution Survey
East Fork Des Moines River
Below Algona
1947-1952

POLLUTION OF EAST FORK OF DES MOINES RIVER

Below Algona

November 13, 1947 to
September 22, 1949

I. INTRODUCTION:

Since 1940 the East Fork of the Des Moines River below Algona, Iowa, has been the source of a number of complaints from private individuals and conservation interests concerning the pollution of the river caused by the discharge of untreated sewage from the city of Algona. During January in 1940, the State Department of Health was notified of the large numbers of fish dying in the Des Moines River immediately below Algona. Investigation of the river at that time revealed little or no dissolved oxygen below the sewer outlets, with visible sludge banks and sewage solids on the bed of the stream for a considerable distance below Algona. At that time the problem was presented by the Health Department to the Algona City Council with the result that a resolution was adopted by the Algona City Council on February 15, 1940, as follows: "...that information be sought with reference to the feasibility and the advisability of erecting such disposal plants, and means and methods of financing the same...and that they be hereby authorized to make inquiries and solicit information with reference to the advisability and feasibility, approximate cost, and necessary legal procedure..." No further action was taken during 1940 and 1941 on this resolution due to the costly reconstruction program of the municipal light and power plant.

With the onset of World War II, construction of a sewage treatment plant could not be undertaken due to restrictions on use of labor and materials. However, during 1944 the City of Algona authorized their consulting engineer to prepare a preliminary report on a sewage treatment plant investigation for the city. The report was discussed with the city council and approved with the understanding that detailed planning of the project would begin just as soon as a plant location had been decided upon so that construction could begin during the immediate post war period. Apparently no choice was made at that time concerning the site for the treatment plant and final plans for the sewage treatment plant were never prepared.

During 1947 the Engineering Division of the Iowa State Department of Health began a study of the pollution of the East Fork of the Upper Des Moines River as provided for under the Stream Pollution Law. These studies were initiated for the purpose of securing bacteriological and chemical data to be used for the calling of a hearing and the issuing of an order by the Department requiring the city of Algona to abate the pollution of the East Fork of the Des Moines River.

During November, 1949, this Department received a petition requesting an investigation of the pollutional condition of the Des Moines River below Algona. The petition, which was signed by 135 residents of Algona and vicinity, requested that the Algona "open pit" sewage disposal into the Des Moines River be investigated and remedied.

The city of Algona is cognizant of the problem and has already purchased a 32 acre site for the sewage treatment plant and has installed a short interceptor to connect two outlets in the south part of town. During November, 1949, the city council enacted a sewer rental ordinance to become effective on December 20, with the first payment due March 1, 1950.

II. SCOPE OF INVESTIGATION:

The investigation included collection of stream samples immediately above Algona and at three or four points for a distance of approximately ten miles downstream from Algona. The investigation was begun on November 13, 1947, and continued until September 22, 1949. An average of nine to eleven samples were collected from these sampling stations during this period.

During this same period, stream samples were also collected above and below Armstrong, Iowa, which is also located on the East Fork of the Des Moines River, and together with Algona comprise the only two communities on the East Fork of the Des Moines River which are without sewage treatment. The East Fork of the Des Moines River was completely dry at the point where the river crosses Highway 169 approximately 14 miles north of Algona on several occasions during the fall of 1948 and also during the extremely cold weather during the winter of 1947 and 1948. The towns of Bancroft and Burt located in the drainage area of the East Fork of the Des Moines River above Algona, have complete sewage treatment plants which are old and obsolete and the by-passing of the sand filters at these installations contributed somewhat to the pollution of the stream as indicated by the investigation.

III. SCOPE OF TESTS:

Determinations in the field included temperature readings, pH determinations, and dissolved oxygen determinations. Samples for B.O.D. determinations were brought to the laboratory at Des Moines where these determinations were completed.

Samples for bacteriological examination were collected in sterile containers which were packed in ice and shipped to the State Hygienic Laboratory at Iowa City for analysis. The bacterial examination was for the most probable number (M.P.N.) which is a quantitative determination for organisms of the coliform group.

The samples for chemical analysis were preserved, iced, and forwarded to the laboratory at Iowa City for analysis. These determinations included ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, and organic nitrogen.

All tests in the field and in the laboratories were carried out in accordance with procedures set forth in "Standard Methods for Examination of Water and Sewage" of the American Public Health Association.

IV. SIGNIFICANCE OF STREAM POLLUTION:

The pollution of a stream with sewage or industrial wastes is objectionable for the following reasons:

1. Sewage and industrial wastes contain millions of bacteria many of which, particularily in the domestic sewage, may be pathogenic or disease-producing.

2. All sewage and most industrial wastes contain unstable organic material which in being converted to harmless stable material robs the stream water of oxygen.

3. Sewage and industrial wastes contain solids which are objectionable when they are floating downstream and which settle to the bottom of the stream bed causing objectionable sludge deposits when undergoing decomposition.

4. Some industrial wastes contain material which is toxic to the fish, live-stock, and humans.

Bacteria

All domestic sewage contains bacteria in very high numbers. Many of these bacteria, however, are harmless. The bacteriological test for coliform bacteria is the most delicate and specific test for pollution by sewage as it shows the approximate density of a group of bacteria which are always present in large numbers in sewage and are relatively few in number in other stream pollutants. Coliform bacteria are the normal inhabitants of the intestines of warm-blooded animals, and are discharged in large numbers in human feces which constitute the principal source of these bacteria in sewage. If a stream water contains these organisms in large numbers, the stream must be considered unfit for bathing and other recreational purposes which require contact with the stream water.

Dissolved Oxygen and Biochemical Demand

All unpolluted stream water contains free oxygen in a dissolved form. This oxygen is essential to the maintenance of aquatic life, is drawn upon to support biochemical oxidation of organic wastes during natural purification of streams and is replaced by absorption from the atmosphere and the photosynthetic action of some water plants including algae. The dissolved oxygen in the water ia available to bacteria which oxidize the organic material present in the pollution entering the stream. These bacteria are dependent upon the presence of dissolved oxygen. If there is a sufficient quantity of oxygen present in the water, this bacterial action will result in the complete oxidation of the organic material present without creating any objectionable odor nuisance or destruction of aquatic life. If there is not a sufficient amount of oxygen present, anaerobic bacterial action takes place and the organic material present in the water undergoes putrefaction with accompanying foul odors and the black inky appearance of water which is familiar in a polluted stream.

In order to support aquatic life and prevent nuisances, there must always be present in the water a sufficiency of dissolved oxygen. Authorities agree that if fish life is to be properly maintained, there must always be from four to five parts per million of oxygen at all times. There is some evidence that some of the soft fish are more tolerant to a lower oxygen content than this level.

In addition to the direct effect of fish on pollution, there is evidence that fish will leave areas of deficient oxygen if they can find means of escape. Submerged vegetation promotes the propagation of fish life by furnishing shelter and nourishment to many forms of life which are necessary in the diet of the common game fish. These organisms and plants are all dependent upon oxygen and sunlight for existence and cannot grow under water made turbid and depleted of oxygen by sewage. Thus a low oxygen content not only kills or excludes the fish life at the time the deficiency occurs, but also kills a major portion of the food organisms. In general it is the worst conditions of pollution which occur occasionally, rather than the average conditions, which determine whether fish can be successfully propagated in a certain stream.

It is possible in the laboratory by means of B.O.D. determinations to measure the organic content in the sewage to determine if an orderly oxidizing process will take place. The B.O.D. indicates the amount of dissolved oxygen which may be expected to be absorbed from the stream water to support the biochemical oxygen oxidation of the organic material carried by the stream at the point of sampling.

In an area of the stream above a riffle or an artifical dam where the water velocity has been reduced, there is a tendency on the part of the heavier solids to settle forming banks of so called sludge. The sludge in the stream beds then undergoes bacterial putrefaction with accompanying foul odors, and large masses of sludge rise to the surface rendering the water black in color and odorous. These sludge deposites interfere seriously with propagation of fish life. The accumulation of sludge is most serious during the extended periods of low stream flow and if there is a considerable accumulation of sludge in the stream, a sudden rise in the stream will stir up these deposits carrying them in suspension with the result that the oxygen of the stream waters is depleted and aquatic life in the stream is destroyed.

V. RIVER SAMPLING STATIONS:

The following is a description of the sampling points above and below Algona:

Station 33	Bridge on Highway 18 north of Algona.
Station 34A	County Bridge west of Algona.
Station 34	First highway bridge south of Algona on Highway 169.
Station 35	County bridge near Irvington.
Station 36	Third bridge south of Algona on Highway 169.
Station 37	Bridge on highway east of Livermore.

VI. PHYSICAL CONDITIONS OF STREAM:

On all sampling trips the physical conditions of the stream at each station were noted. The stream was sampled during the late summer months under low flow conditions and during the winter under ice cover conditions.

Station 33 is located above all sources of pollution at Algona and the river was in very good condition, except on two occasions under heavy ice and snow cover conditions when the influence of the towns of Bancroft and Burt lowered the oxygen content of the stream. The sand filter units of the treatment plants of these towns were being by-passed during this period.

Station 34 is located on Highway 169 south of Algona and is approximately 3/4 mile below the Algona outlets. The entire river circling north of Algona above this station shows evidences of pollution from the various sewage outlets as indicated by the presence of floating solids and sludge banks. On at least three occasions the State Department of Health has been notified that fish were dying in this stretch of the river. Conditions of zero or deficient oxygen in the stream in this stretch of river have been noted both under warm weather conditions in the fall and during the winter months under ice cover when the water cannot absorb oxygen from the air. On November 2, 1948, with a water temperature of 12° in the stream, zero oxygen and black septic conditions were noted at Station 34 with a very pronounced odor noticeable from Highway 169 bridge. No general fish destruction was observed on this occasion apparently due to the fish leaving this area of deficient oxygen although some dead fish were observed at a number of sewer outlets. Septic conditions with bad odors prevailed at this station for a period of several weeks during the late fall of both 1948 and 1949. Sewage solids and a very pronounced odor were also noted on the samples collected on February 8 and 16, 1949, under ice covered conditions.

Station 35 is located approximately 4-1/2 miles below the Algona sewage outlets. The river at this point also at times showed evidence of gross pollution as indicated by the presence of floating solids, a deficiency of oxygen and the presence of sewage odors. On February 16, 1949, a considerable number of dead fish were observed in a spring seepage area near this station.

Station 36 is located approximately 10 miles below Algona and although the appearance of the stream is usually improved at this point, oxygen has been low on a number of occasions and a very heavy algae growth stimulated by the organic pollution was also noted on a number of occasions.

Station 37 is approximately 13 miles below Algona and is located just below the outlet of the Livermore sewage treatment plant. The stream at this point appeared to be in good physical condition at all times although the discharge of the treated sewage above this point by the Livermore sewage treatment plant increased the B.O.D. and coliform bacteria count to some extent.

VII. INTERPRETATION OF BACTERIOLOGICAL AND CHEMICAL DATA:

Coliform Findings

The determinations for organisms of the coliform group expressed as the most probable number per 100 milliliter (M.P.N.) are tabulated in Table II of the report. Both the average and the maximum most probable number per 100 milliliter are tabulated in the Table I. The average coliform results are also plotted on the chart accompanying the report.

The sewage of Algona shows a marked effect on the river as far as the organisms of the coliform group are concerned. The coliform content of the river at Station 33 above Algona was found to be extremely low except on two occasions with an average of 3900, whereas the coliform content in the river caused by the Algona sewage ranged as high as 13,000,000 coliforms per 100 milliliter. The high value at Station 33 on September 22, 1949, was not included in the average since it appears this sample was contaminated during collection and is not representative. The river has shown a very rapid recovery from a coliform standpoint since the M.P.N. at Station 36 has decreased to an average of 1000.

The reason for this rapid decrease is the fact that at low stream flows the solids in the sewage which contain vast numbers of organisms settle out carrying with them many of the organisms, and consequently the stream farther down is in better condition by virtue of these organisms having been settled out with the solids.

Oxygen Findings

In Table II are tabulated the summaries of the dissolved oxygen and biochemical oxygen demand determinations. The average and maximum dissolved oxygen and B.O.D. values are tabulated in Table I and the average values are also plotted on the chart accompanying the report. The majority of these determinations were made during periods when algae thrives and all of the samples for oxygen determinations were collected during the day time. Because of the possibility of the algae increasing the dissolved oxygen content of the water through photosynthesis, it is believed that the results as indicated in the tabulation represent for the most part the best conditions of the dissolved oxygen content during the survey. It will be noted that the average dissolved oxygen content above Algona was 6.8 compared with the value of 4.8 immediately below the city. More significant is the fact that a negative oxygen balance, which is the difference between the dissolved oxygen and B.O.D., was found immediately below the city.

The dissolved oxygen content of Station 33 above the Algona sewage outlet was high at all times except during the period during the first part of February, 1949, when extremely low flow conditions and ice cover prevailed and by-passing of the sand filter units by the two upstream treatment plants occurred. It will be noted, however, that on these two occasions the B.O.D. of the stream at this point was low, indicating that very little organic material was present but reaeration could not occur due to ice cover. The B.O.D. of the river at Stations 34 and 35 below the sewage outlets was not exceptionally high, indicating that a considerable amount of settling of solids had taken place between the outlets and the point of collection. The highest B.O.D. noted was 22 parts per million at Station 34, which is much closer to the sewer outlets. However, this deposited sludge is not completely stabilized and when this material is again picked up and mixed with the stream, it will add materially to the oxygen demand of the stream water.

Other Chemical Data

In Table III are summaries of the various nitrogen determinations. These are additional chemical determinations which are used as criteria of pollution. The organic nitrogen content of the stream water shows a marked increase below the Algona sewer outlet. This is a measure of the organic pollution of the water whether it is contributed by plant or animal life. The ammonia, nitrate, and nitrite nitrogen values did not show any marked change.

VIII. RIVER DISCHARGE AND OXYGEN REQUIREMENTS OF SEWAGE:

No flow records or river discharge measurements are available for the East Fork of the Des Moines River at Algona. The nearest gage of the U. S. Geological Survey is located at Hardy, Iowa, located downstream from Algona. The drainage area at the U. S. Geological Survey gage at Hardy is 1230 square miles and the drainage area above Algona is estimated from a U. S. Geological Survey mineral resources map at 780 square miles. It is believed that the river discharge at Algona can be estimated from that at Hardy by using a direct drainage area relationship. Preliminary discharge computations at Hardy are available for 1947 only, but by making a comparison with preliminary computations at Humboldt on the West Fork it is estimated that flows at Algona during January, 1948, and September through December, 1948, reached a minimum of 10 second-feet and possibly much lower. Periods of no flow have been recorded on river drainage areas of similar size in the vicinity of Algona.

With the meager discharge information available it would appear that this discharge of 10 second-feet will occur for sustained periods and this flow is not sufficient to oxidize the sewage waste discharged by the city of Algona. Assuming a population of 5,000, the five day oxygen requirement of the city sewage is approximately 835 pounds. Likewise assuming six parts per million of oxygen available in the river water, 10 second-feet of flow provides only 320 pounds of oxygen for oxidizing sewage under winter conditions with no reaeration. It is evident therefore, that unsatisfactory conditions may be expected in the East Fork of the Des Moines River unless a high degree of treatment is provided for the city waste since flows considerably below 10 second-feet may be expected at Algona due to the relatively small drainage area of the river.

IX. CONCLUSIONS:

1. The East Fork of the Des Moines River below the city of Algona was found to be in a grossly polluted condition from Algona to a point at least five miles downstream during the late fall and winter months. This condition is created by the discharge of untreated sewage and wastes from the city of Algona.

2. A hazard exists, from a public health standpoint, to persons bathing or wading in the river or otherwise coming in intimate contact with the river water in the section of the river covered by this survey. Likewise milk from dairy animals having access to the polluted stream presents a public health hazard.

3. Losses of fish life have occurred during the past two winters in this zone of gross pollution and it is likely a normal fish population cannot develop in this zone due to depletion of oxygen at low flows and the general effect of pollution on normal aquatic life.

X. RECOMMENDATIONS:

1. It is recommended that the city of Algona retain a consulting engineer to proceed immediately with the preparation of detailed plans and specifications for an interceptor sewer and sewage treatment plant with this Department to be notified of the date the plans will be completed.

2. It is recommended that construction of the interceptor sewer and treatment plant begin at an early date after approval of the plans with the intention of completing construction as early as possible before or during 1951.

Stream Pollution Survey

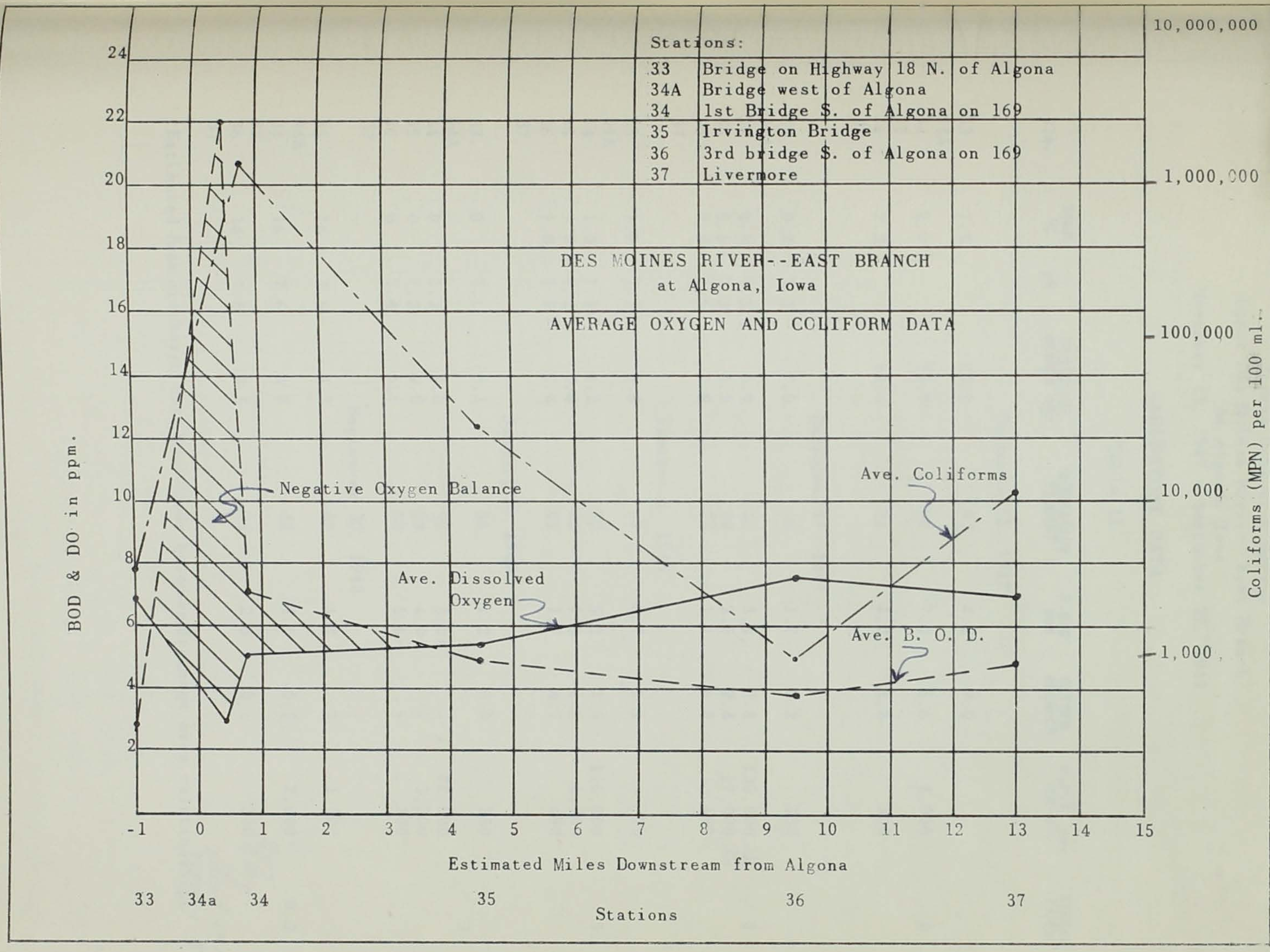
Upper Des Moines River - East Branch

at Algona, Iowa

SUMMARY OF LABORATORY DATA

Table I

STA.	D.O. p.p.m. MIN.	D.O. p.p.m. AVE.	D.O. % SATURATION MIN.	D.O. % SATURATION AVE.	5 - DAY B.O.D. p.p.m. MAX.	5 - DAY B.O.D. p.p.m. AVE.	OXYGEN BALANCE MIN.	OXYGEN BALANCE AVE.	M.P.N. PER. ml MAX.	M.P.N. PER. ml AVE.
33	0	6.8	0	53	4.5	2.7	-1.2	4.4	35000	3900
34	0	4.8	0	37	19.0	7.2	-7.6	-2.4	13000000	1740000
35	1.9	5.4	13	41	8.0	4.7	-2.7	1.9	200000	48000
36	2.5	7.5	19	58	7.0	3.9	-8.0	3.2	5400	1000
37	2.4	6.7	16	57	5.0	4.8	2.4	4.3	490000	126000
34A	2.8	2.8	28	28	22.0	22.0	-19.2	-19.2	-	-


Stations:
33 Bridge on Highway 18 N. of Algona
34A Bridge west of Algona
34 1st Bridge S. of Algona on 169
35 Irvington Bridge
36 3rd bridge S. of Algona on 169
37 Livermore
DES MOINES RIVER--EAST BRANCH
at Algona, Iowa
AVERAGE OXYGEN AND COLIFORM DATA
Negative Oxygen Balance
Ave. Dissolved Oxygen
Ave. Coliforms
Ave. B. O. D.
BOD & DO in ppm.
Coliforms (MPN) per 100 ml.
10,000,000
1,000,000
100,000
10,000
1,000
24
22
20
18
16
14
12
10
8
6
4
2
-1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Estimated Miles Downstream from Algona
33 34a 34 35 36 37
Stations

Stream Pollution Survey
Upper Des Moines River - East Branch
At Algona, Iowa
November 13, 1947 - September 22, 1949

LABORATORY DATA

Table II

STA.	TEMP. °C	pH	DISSOLVED OXYGEN ppm	SATURATION PERCENT	B.O.D ppm	OXYGEN BALANCE	M.P.N. per 100 ml.	STREAM FLOW*
				November 13, 1947				
33	1.0		13.2	93	4.2	9.0		
34A								
34	2.0		13.0	94	7.4	5.6	4,900	4
35								
36	2.0		12.6	91	4.3	8.3	330	
37								
				December 17, 1947				
33	0.5	7.3	7.9	55	1.7	6.2	330	
34A								
34	0.5	7.3	5.9	41	3.4	2.5	130,000	8
35	0.5	7.3	4.9	34	2.5	2.4	17,000	
36	0.5	7.5	7.9	55	1.1	6.8	490	
37								
				January 6, 1948				
33	1.0	7.1	8.8	62	2.7	6.1	20	
34A								
34	1.0	7.1	4.2	39	5.2	1.5	110,000	5
35	1.0	7.1	3.4	25	1.8	1.6	4,900	
36	1.0	7.1	6.4	45	1.7	4.7	490	
37								
				January 20, 1948				
33	0	7.1	8.1	56	1.2	6.9	230	
34A								3
34	0	7.2	3.0	20	3.0+	-	70,000	
35	0	7.2	4.0	22	4.0+	-	3,300	
36	0	7.4	5.6	38	5.6+	-	330	
37								
				September 30, 1948				
33	16	7.8	4.2	42	4.1	.1	1,200	
34A								
34	16	7.6	4.8	48	11.0	-6.2	2,800	0.3
35								
36	16	7.8	2.5	25	2.5	0	330	
37								

*Estimated from discharge data near Hardy based on drainage area relationship.

Table II (Continued)

STA.	TEMP. °C	pH	DISSOLVED OXYGEN ppm	SATURATION PERCENT	B.O.D. ppm	OXYGEN BALANCE	M.P.N. per 100 ml.	STREAM FLOW*	
				November 2, 1948					
33	12	7.8	4.1	38	-	4.1	230		
34A								17	
34	12	7.4	0	0	19	-19	1,800,000		
35	12	7.5	3.3	30	-	3.3	78		25
36	12	7.7	3.2	29	-	3.2			
37									
				November 10, 1948					
33	5.0	7.9	9.6	75	4.5	5.1	78		
34A									
34	5.0	7.6	5.4	42	13.0	-7.6	79,000	20	Black odors gas 36
35	5.0	7.5	6.2	48	3.5	2.6	490		Odor
36	5.0	7.9	10.0	78	5.0	5.0	130		Heavy algae
37	5.0	8.0	11.4	89	5.0	6.4	1,300		
				December 2, 1948					
33	3.0	7.7	12.3	92	2.9	10.4	260		
34A									
34	1.0	7.7	9.6	67	3.2	6.4		17	25
35	2.0	7.9	12.4	89	5.2	7.2	230		
36	1.0	7.9	13.2	93	6.2	7.0	230		
37									
				February 8, 1949					
33	0	7.2	0	0	1.2	-1.2	35,000		
34A									
34	0	7.4	1.8	12	7.1	-5.3	240,000		
35	0	7.2	2.6	18	5.3	-2.7	18,000	17	27
36	0	7.2	2.8	19	1.5	1.3	5,400		
37	0	7.1	2.4	16	0	2.4	1,100		
				February 16, 1949					
33	0	7.1	.5	3	1.0	-0.5	2,400		
34A									
34	0	7.1	.6	4	34	-33	180,000	17	Bad odor, solids 27
35	0	7.1	1.9	13	8.0	-6.1	180,000		Dead fish
36			-			-			
37	0	7.1	2.8	19	0	-2.8	11,000		
				September 22, 1949					
33	16	7.6	6.6	66	4.0	2.6	790,000		
34A	16	7.6	2.8	28	22.0	-19.2			
34	16	7.6	4.5	45	3.5	1.0	13,000,000	17	Gray color
35	16	7.8	9.4	95	7.0	2.4	200,000		Gray 11
36	16	8.0	10.6	107	7.0	3.6			
37	16	8.0	10.1	102	4.6	3.5	490,000		

*Estimated from discharge data near Hardy based on drainage area relationship.

Stream Pollution Survey
Upper Des Moines River - East Branch
at Algona, Iowa

LABORATORY DATA

Table III

STA.	1947 NOV. 13-14	1947 DEC. 17-18	1948 JAN. 6-7	1948 JAN. 20-21	1948 SEPT. 30	1948 NOV. 2	1948 NOV. 10	1948 DEC. 2-3	1949 SEPT. 22-23
Organic Nitrogen									
33	4.27	3.50	4.20	3.50	4.10	6.44		1.40	2.30
34	4.06	3.08	7.28	3.08		13.40	2.40	1.50	2.10
35		1.82	7.56	6.02	3.40			2.10	3.30
36	4.76	3.50	5.46	2.10				2.10	
37									3.00
34A									
Ammonia Nitrogen									
33	.03	.32	.40	.32	.50	.04	1.60	1.60	.16
34	.34	.60	1.20	1.10		1.92	1.10	.76	2.00
35		.03	1.00	1.06	3.00			.48	1.00
36	0	.02	.60	.66				.04	
37									.09
34A									
Nitrite Nitrogen									
33	.030	.014	.011	.008	.008	0		.001	0
34	.015	.030	.075	.125		0	.002	.001	.006
35		.035	.070	.078	.008			.001	.024
36	.004	.020	.020	.120				.001	
37									0
34A									
Nitrate Nitrogen									
33	0	0	0	0	0	0		.3	0
34	0	0	0	0		0	0	.3	0
35		0	0	0	0			.4	0
36	0	0	0	0				.4	
37									0
34A									
Total Nitrogen									
33	4.33	3.83	4.61	3.83	4.61	6.4		3.301	2.47
34	4.41	3.71	8.55	4.30		15.32	3.50	2.561	4.11
35		1.89	8.63	7.16	6.41			2.981	4.32
36	4.76	3.54	6.08	2.88				2.541	
37									3.09
34A									

SUPPLEMENTARY REPORT

POLLUTION OF EAST FORK OF DES MOINES RIVER

Below Algona

December 19, 1950 to
September 24, 1952

A. INTRODUCTION:

The following report covers a continuing investigation of the East Fork of the Des Moines River below Algona during the period December 19, 1950, to September 24, 1952, and is a supplement to the preceding original report covering the period November 13, 1947, to September 22, 1949. Additional river surveys are included in the report with the sampling procedures and stations remaining the same.

B. PHYSICAL CONDITION OF STREAM:

On all sampling trips the physical condition of the stream at each station was noted. The first two surveys of this supplementary report were conducted during low flows under ice cover conditions whereas the 1952 surveys were conducted during much higher flows. During the 1952 surveys, flows appeared too high to be appreciably affected from a physical standpoint by the discharge of the sewage and industrial wastes of Algona. The survey of February 20, 1951, was made in response to a request from the State Conservation Commission which reported fish had been killed in that reach of the stream below Algona.

At Station 33, which is above all sources of pollution at Algona, the river appeared to be in good condition during the surveys of December, 1950, and February, 1951. At Station 34, located on Highway 169 south of Algona and below the outlets, the river showed evidences of pollution during the two surveys as shown by the presence of floating solids, a dark colored water and a strong obnoxious odor indicative of septic sewage. At Station 35 a very strong obnoxious odor was noticeable on the February, 1951, survey and dead fish were observed at this station. A visual check of the river revealed a heavy loss of fish of all kinds for several miles below this point. At Station 36 on the February, 1951, survey the water remained dark in color and retained a strong odor. No dead fish were observed at this station or at Station 37 near Livermore.

C. INTERPRETATION OF BACTERIOLOGICAL AND CHEMICAL DATA

Coliform Findings

The determinations of the most probable numbers per 100 ml. (MPN) of coliform bacteria are tabulated in Table A. Results of all surveys indicated a low coliform content in the river above Algona and a very marked increase to as high as 350,000 at Station 34 just below Algona due to the introduction of sewage and industrial wastes. These extremely high numbers of coliform bacteria greatly exceed any suggested standards of water purity.

Oxygen Findings

A study of the oxygen and oxygen demand data in Table A confirms the observations made of the physical condition of the stream particularly during the surveys of 1950 and 1951. During these two surveys very low oxygen values were found below Algona with slow recovery occurring under the winter conditions of ice cover. An extremely high BOD was noted on February 20, 1951, with values of 20 and 25 at Stations 34 and 35 respectively. This high oxygen demand was found during the period when the fish kill occurred.

D. RIVER DISCHARGE AND OXYGEN REQUIREMENTS:

Published flow records are now available for the years 1947, 1948, and 1949, at Hardy, Iowa, and preliminary flow data were obtained from Mr. V. R. Bennion, District Engineer, U. S. Geological Survey, for the survey dates from that period to the present time. These flow data computed for the drainage area at Algona are tabulated in the last column of Tables II and A accompanying the report. Flows are given in cubic feet per second (cfs).

It will be noted from a study of these tables that river discharges at Algona on the survey dates varied from 0.3 cfs on September 30, 1948, to 105 cfs on August 28, 1952. A further study of the tables reveals that severe oxygen deficiencies occurred both under warm water conditions with low flow and under cold water conditions with ice cover and low flow. Surveys of November 2, 1948, and September 22, 1949, under warm water conditions revealed critical oxygen deficiencies with river flows as high as 17 cfs. For some reason the limited number of samples collected on September 30, 1948, with the extremely low flow of 0.3 cfs did not indicate as critical a stream condition as at higher flows.

River discharge records below the city of Algona confirm the estimates of low flows prevailing for sustained periods of time stated in the original report. The critical oxygen conditions and repeated loss of fish substantiate the opinion that the low flows are not sufficient to oxidize the wastes discharged by the city of Algona. It is evident that unsatisfactory conditions may be expected below Algona unless a high degree of sewage treatment is provided.

E. CONCLUSIONS:

The chemical, bacteriological and physical data obtained during the river surveys from December 19, 1950, to September 24, 1952, further confirms the conclusions stated on page 7 of the original report regarding the grossly polluted condition and health hazard resulting from the discharge of untreated wastes from the city of Algona.

F. RECOMMENDATIONS:

1. It is recommended that the city of Algona proceed with the installation of the interceptor sewer and treatment plant as shown by the plans and specifications approved by this Department.

Stream Pollution Survey
Upper Des Moines River - East Branch
at Algona, Iowa
December 19, 1950 - September 24, 1952

LABORATORY DATA

Table A

STA.	TEMP. °C	pH	DISSOLVED OXYGEN ppm	SATURATION PERCENT	B.O.D. ppm	OXYGEN BALANCE	M.P.N. per 100 ml.	STREAM FLOW*
				December 19, 1950				Dennis
33	0	7.4	3.7	25	2	1.7	330	
34A								
34	0	7.4	2.9	20	6	-3.1	170,000	
35	0	7.4	1.8	12			160,000	13
36	0	7.4	4.8	33			3,500	
37								
				February 20, 1951				Dennis
33	0	7.9	2.0	14	2	0	780	
34A								
34	0	7.1	1.8	12	20	-18.2	170,000	
35	0	7.3	4.0	27	25	-21	350,000	16
36	0	7.1	3.7	25	8	- 4.3	92,000	
37								
				February 7, 1952				Morgan
33	1	7.0	6.1	43	0.4	5.7	680	
34A	1	7.2	7.3	52	4.3	3.0	110,000	
34	2	7.2	6.3	45	3.3	3.0	33,000	95
35	1	7.1	5.5	39	1.8	3.7	46,000	
36	1	7.3	7.6	53	2.0	5.6	2,000	
37								
				August 28, 1952				
33	15	7.6	7.4	72	6.3	1.1	1,700	
34A	18	7.2	1.5	15	6.3	-4.8	170,000	
34	23	7.8	6.0	69	10.8	-4.8	79,000	105
35	24	7.2	6.8	80	6.4	0.4	2,300	
36	24	8.0	8.9	104	8.2	0.7	13,000	
37	24	7.8	8.4	99	5.6	2.8	3,300	
				September 9, 1952				
33	22	7.5	9	103	2.5	6.5	1,700	
34A	23	8.0	8.5	98	6	1.5	130,000	
34	22	8.1	8.7	100	4	4.7	31,000	100
35	23	8.2	8.6	99	6	2.6	13,000	
36	22	8.0	8.4	96	3.2	5.2	9,500	
37	22	8.1	9.6	110	6.7	2.9	2,300	
				September 23-24, 1952				
33	17	8.4	7.6	78	6.2		<200	
34A	18	8.4	7.5	79	5.3		35,000	
34	17	8.4	8.2	85	4.0		17,000	32
35	17	8.4	9.0	93	3.1		33,000	
36	18	8.4	11.2	107	6.2		200	

*Estimated from preliminary discharge data at Hardy based on drainage area relationship.