REPORT

ON THE

WATER POLLUTION INVESTIGATION

of a

TRIBUTARY OF THE VOLGA RIVER

NEAR HAWKEYE, IOWA

DIVISION OF PUBLIC HEALTH ENGINEERING
IOWA STATE DEPARTMENT OF HEALTH

Des Moines, Iowa
November, 1954

Iowa
State Department of Health
EDMUND G. ZIMMERER, M. D., COMMISSIONER
Des Moines 19

DIVISION OF

DIRECTOR

December 6, 1954

Edmund G. Zimmerer, M. D.
Commissioner
State Department of Health
Office

Dear Dr. Zimmerer:

I am transmitting herewith a report of your Division of Public Health Engineering covering an investigation of the pollution of a tributary of the Volga River south of Hawkeye, Iowa.

This investigation was instituted in accordance with Sections 135.18 to 135.29 of the Iowa Stream and Lake Pollution Law.

Very truly yours,

P. J. Houser

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

RJS:mp

Table of Contents

Maps and Tables

WATER POLLUTION INVESTIGATION

TRIBUTARY OF VOLGA RIVER

Below Hawkeye, Iowa

I INTRODUCTION:

The present water pollution investigation of a tributary of the Volga River below Hawkeye, Iowa, was initiated following the receipt of a petition from the Windsor Township Board of Trustees, Fayette County, dated October 7, 1952. Complaints had also been received by the Department stating that a nuisance condition exists in the receiving stream due to the discharge of partially treated sewage and wastes from the Hawkeye sewage treatment plant and that it had become impossible to make use of the stream for livestock watering.

The principal source of pollution contributed to the stream is the Hawkeye sewage treatment plant. The town has a population of 511 (1950 census) and the sewage treatment plant provides settling only by means of an obsolete septic tank constructed in 1918. The files of this Department reveal that the plant has provided inadequate treatment since 1948. In addition, the records show that as early as 1933 the Department has repeatedly recommended that secondary treatment plant additions be provided for the plant in order to provide a higher degree of treatment for the sewage and wastes before discharge to the stream.

A second source of pollution contributed to this stream is the Hawkeye Creamery Company. The wastes from this plant are passed through a septic tank and discharged to the stream approximately one-half mile below the Hawkeye sewage treatment plant.

II STREAM DESCRIPTION:

The receiving stream ordinarily is a dry run which rises in Section 15 of Windsor Township, Fayette County, approximately three miles northeast of Hawkeye and flows in a southwesterly direction to a point south of Hawkeye and thence approximately seven miles southeast to the Volga River. The stream in the reach surveyed is very small with its major use being livestock watering.

III SAMPLING STATIONS:

Sampling stations are shown on a map contained in this report and geographical descriptions of the stations are also listed on the following page with their numerical or alphabetical designation.

Table I - Location of Sampling Stations

Station	Description
1	Stream at bridge on County Road "C" South of Hawkeye above sewage treatment plant outlet.
0	Hawkeye sewage treatment plant outlet.
2	Stream at one hundred feet below sewage treatment plant outlet.
3	Stream at point approximately one-half mile below sewage treatment plant outlet.
4	Stream at point approximately 20 feet above creamery outlet.
C	Hawkeye Creamery outlet.
5	Stream at point fifty feet below creamery outlet.
6	Stream at bridge on east-west county road between Sections 30 and 31.
7	Stream at bridge on east-west county road one mile south of station 6.

IV SCOPE OF TESTS:

Determinations made on the samples consisted of those made in the field at the sampling point immediately after collection of the sample and those made in the State Hygienic Laboratory in Iowa City and the State Hygienic Branch Laboratory located in Des Moines. The field determinations included temperature readings and dissolved oxygen determinations. In addition, the physical condition of the stream as to evidence of pollution material at the time of sampling was observed and recorded. Samples for the biochemical oxygen demand determinations and bacterial examinations were iced in the field and transported to the laboratory.

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

V DEFINITIONS AND SIGNIFICANCE OF THE VARIOUS PHYSICAL, CHEMICAL, AND BACTERIOLOGICAL TESTS USED IN SURVEY:

Temperature: Temperature values of the stream water at the sampling points are given in degrees Fahrenheit. The temperature governs the solubility of oxygen in the stream and influences the rate of purification. As the water temperature decreases the solubility of oxygen increases.

Dissolved Oxygen (DO): Oxygen in the dissolved form is essential to the natural purification of streams and the maintenance of aquatic life. This oxygen is drawn upon to support biochemical oxidation of organic wastes and is replaced by absorption from the atmosphere and photosynthetic action of some water plants, including algae. A deficiency in dissolved oxygen below the saturation level generally indicates the presence of polluting organic

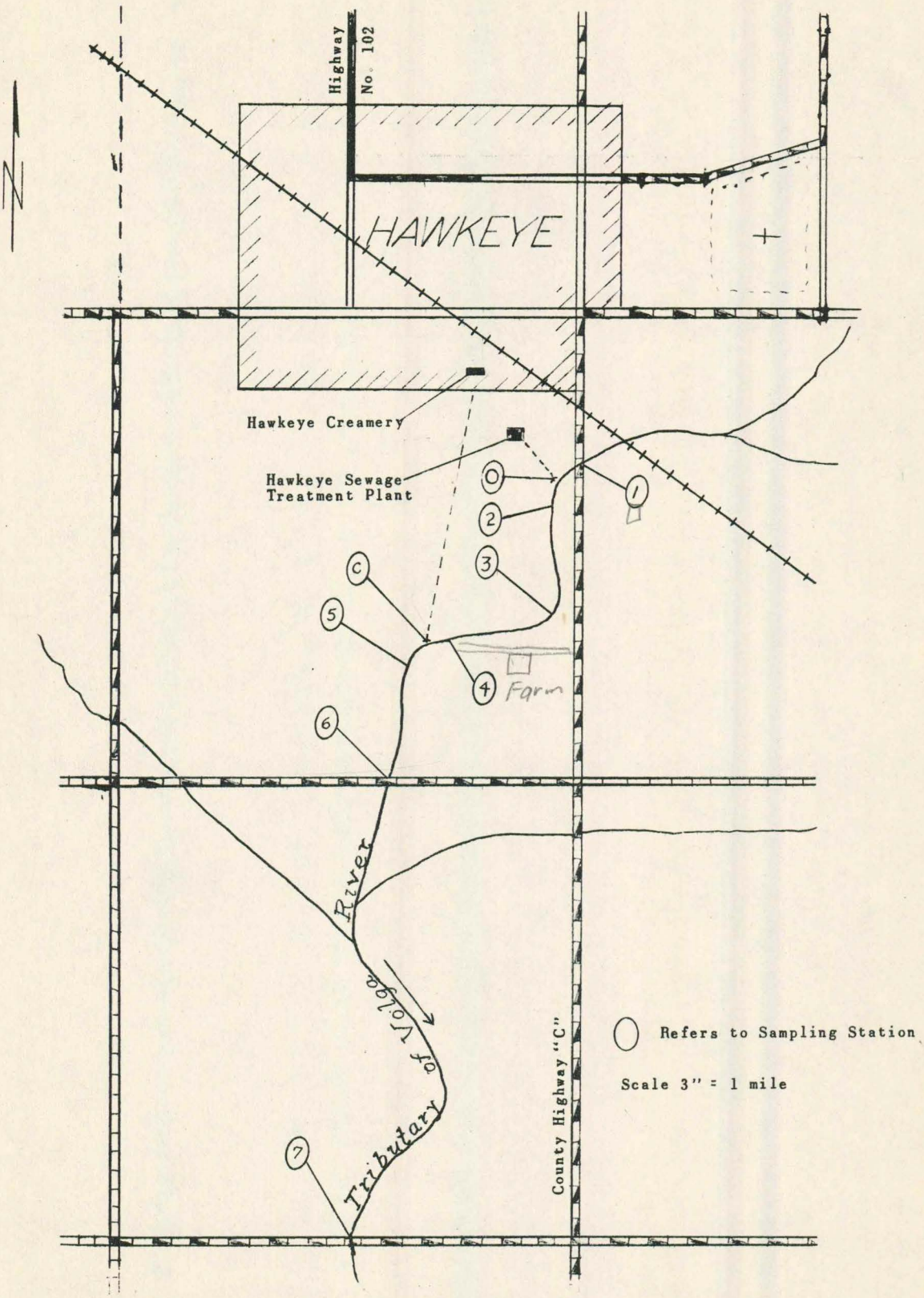

FIGURE 1

LOCATION OF SAMPLING STATIONS

NEAR HAWKEYE, IOWA

substances which are absorbing oxygen from the stream water. The degree of this deficiency is a measure of the deoxygenating effect of the pollutant; hence, an index of the degree of pollution in a particular stream zone. If there is a sufficient quantity of oxygen present in the water, the organic material will be oxidized without creating any objectionable odor nuisance. However, if the amount of dilution provided by the stream flow is too small and there is not a sufficient amount of oxygen present, anaerobic decomposition takes place and the organic material present in the water undergoes putrefaction with the accompanying foul odor and dark appearance of the water which is indicative of a polluted stream.

Five Day Biochemical Oxygen Demand at 20° Centigrade (BOD): This determination indicates the amount of dissolved oxygen in parts per million which may be expected to be utilized in five days at 20° Centigrade (68° Fahrenheit) to support the biochemical oxidation of the organic pollution carried by the stream at the point of sampling.

Coliform Bacteria (MPN): The result of this determination is expressed as the most probable number of coliform bacteria per 100 milliliters of sample. This test is perhaps the most delicate 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. Coliform bacteria are normal inhabitants of the intestinal tract of warm-blooded animals and are discharged in large numbers in human feces which constitute the principal sources of these bacteria in sewage. These bacteria are also found in varying numbers in certain industrial wastes.

VI SIGNIFICANCE OF STREAM POLLUTION:

Pollution of a stream with sewage or industrial wastes is objectionable and detrimental to normal stream use for the following reasons:

1. Sewage and some industrial wastes contain millions of bacteria, many of which may be pathogenic.

2. All sewage and most industrial wastes contain unstable organic material, which in being stabilized, 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.

The pollution of a stream is a serious public health problem because of the very high numbers of bacteria found in sewage. Many of these are harmless but disease-producing bacteria may be present in the bodily wastes of people having a disease or who are carriers of disease. If a stream water contains coliform bacteria in large numbers, it must be considered unfit for any activity which may require contact with the stream water. Likewise, milk from dairy animals having access to the stream presents a public health hazard.

VII PHYSICAL CONDITIONS OF THE STREAM:

During each of the four surveys, the physical condition of the stream was observed. The following is a review of these observations.

At Station 1, located above the sources of pollution, the stream showed no visible evidence of pollution. The small flow was usually clear and on two surveys many minnows were present.

Station 0, or the sewage treatment plant outlet, was observed to contain many sewage solids and have a strong odor of septic sewage.

At Station 2, located 100 feet below the sewage treatment plant outlet, conditions of gross pollution existed as evidenced by the presence of several inches of black digesting sludge on the bottom, suspended sewage solids, and grey appearance of the water. At times, a grey sewage fungus was noted growing attached to sticks on the bottom. A very offensive septic sewage odor was noted during one survey.

At Station 3, located one quarter mile below the sewage treatment plant outlet, conditions of gross pollution existed on most surveys as evidenced by the presence of sludge on the bottom, a cloudy appearance of the water, and an offensive odor. On one survey at this station, gas bubbles were noted rising to the surface from the digesting bottom sludge.

At Station 4, located just above the junction of the receiving stream and the creamery ditch, the stream showed considerable recovery from the gross pollution conditions of the upstream stations. A dark green growth covered the bottom on one survey.

The creamery outlet showed no sustained flow and the effluent was slightly milky at times. Black sludge was sometimes noted in the creamery ditch.

Station 5, located 50 feet below the creamery ditch, again showed evidence of pollution with sludge on the bottom, a grey fungus growth on sticks in the stream water, and sometimes an odor.

Station 6, located at the east-west county road showed considerable recovery since the flow was relatively clear and only a green-grey growth was noted on the bottom at times.

Station 7, located about two miles below the plant, showed complete recovery since there were no visible evidences of pollution.

VIII INTERPRETATION OF CHEMICAL AND BACTERIOLOGICAL DATA:

The data contained in table 2 confirms in a chemical and bacteriological sense the observations made relative to the physical conditions of the stream.

Table 2 - Chemical and Bacteriological Data

Station	Temp	pH	DO	BOD	MPN
			October 3, 1952		
1			9.8	1	170
2			7.4	20	>1,600,000
3			7.1	5	79,000
5			12.0	>10	> 160,000
6			8.4	7	3,500
			December 30, 1952		
1	32	>7.6	10.0	1	40
0	41	>7.6	1.5	170	>16,000,000
2	34	>7.6	8.6	6	5,400,000
3	32	>7.6	6.0	30	3,500,000
4	32	-	4.2	30	130,000
C	32	-	2.0	110	540,000
5	32	-	4.5	15	240,000
			November 25, 1953		
1	32	7.6	11.6	3	2,400
0	50	7.6	0.4	130	70,000,000
2	37	7.6	8.2	30	2,300,000
3	34	7.9	11.9	10	620,000
4	32	7.8	10.2	6	62,000
C	32	7.3	1.0	7	600
5	32	7.8	10.4	7	>70,000
6	32	7.8	11.4	7	70,000
7	32	8.0	12.4	4	6,200
			July 26, 1954		
1	77		5.8	1	1,300
0			0.0	200	>70,000,000
2	77		0.0	>700	70,000,000
3	77		0.0	25	700,000
4	77		2.1	2	23,000
C			0.0	310	2,300,000
5	77		0.8	17	600,000
6	77		2.7	4	6,200

Chemical and bacteriological determinations made at Station 1 upstream from the sources of pollution consistently showed the stream to be free of detrimental pollution in as much as there was adequate dissolved oxygen, a low oxygen demand, and low numbers of coliform bacteria.

The sewage treatment plant outlet shows an average BOD of 150 ppm and a maximum BOD of 250 ppm. This compares with an average expected BOD of 200-250 ppm for normal domestic sewage and indicates that insufficient treatment is being provided by the present treatment facilities. The effluent from the creamery outlet had BOD values ranging from 6 ppm (probably at a time when no wastes were being discharged) to a maximum of 310 ppm.

Samples taken from Station 2 which is approximately 100 feet below the plant outlet showed the effect the inadequately treated waste was having on the stream. BOD values were generally very high with values ranging from 6 ppm to greater than 700 ppm. Dissolved oxygen values were lowered by the effect of the sewage and wastes added and on the July 26, 1954, survey, the oxygen was completely depleted. The coliform MPN values remained extremely high throughout the study with values greater than 70,000,000 during one survey.

BOD values at Stations 3 and 4 remained generally high with no significant changes taking place in the dissolved oxygen values except for the July 26 survey when the dissolved oxygen remained at or near depletion. MPN values showed some decrease from the extremely high values of the preceding station.

The intermittent discharge of creamery wastes is reflected in the variance in chemical and bacterial values at Station 5 but it is apparent that this outlet has an appreciable pollution effect on the stream as indicated by high BOD and MPN values.

Further recovery is noted by the decreasing BOD and MPN values noted at Stations 6 and 7. MPN values at Station 6 remained somewhat higher than that considered normal for a stream free from detrimental pollution.

IX CONCLUSIONS:

1. The small stream which flows south of Hawkeye was found to be grossly polluted for a distance of approximately one mile downstream from the town as evidenced by the presence of sludge deposits, deficient oxygen conditions, offensive odors, and extremely high numbers of coliform bacteria.

2. The pollution condition was found to be due to the discharge of partially treated sewage and wastes from the Town of Hawkeye and the Hawkeye Creamery Company.

3. The pollution renders the stream unfit for normal uses in this reach of the stream.

4. Milk from dairy animals having access to the stream presents a public health hazard. Dairy cows wading in the polluted waters may easily pick up disease-producing bacteria on their udders or bodies and such bacteria may be transferred to the milk in the milking process. The heavy

pollution renders the water unfit for livestock watering purposes.

5. A hazard exists from a public health standpoint to persons coming in contact with the stream water or from flies that may carry disease organisms from sludge deposits in the streams.

X RECOMMENDATIONS:

1. It is recommended that treatment facilities adequate to correct the present gross pollution conditions and to prevent a recurrence of the condition be provided singly or in combination for the sewage of the Town of Hawkeye and for the industrial wastes of the Hawkeye Creamery Company.