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REPORT
ON THE
WATER POLLUTION INVESTIGATION
OF
THE TRIBUTARY TO
THE
MIDDLE FORK LITTLE MAQUOKETA RIVER
BELOW THE
HOLY CROSS COOPERATIVE CREAMERY ASSOCIATION
IN
DUBUQUE COUNTY

Division of Public Health Engineering
Iowa State Department of Health
Des Moines, Iowa

February 1962

Iowa

DIVISION OF

State Department of Health Public Health Engineering

EDMUND G. ZIMMERER, M. D., M. P. H., COMMISSIONER

Des Moines 19

Paul J. Houser, M. S.
DIRECTOR

February 9, 1962

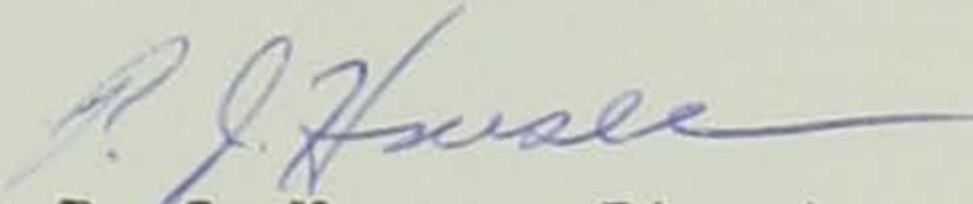
Edmund G. Zimmerer, M.D.
Commissioner of Public Health
Iowa State Department of Health
State Office Building
Des Moines 19, Iowa

Dear Dr. Zimmerer:

I am transmitting a report of your Division of Public Health Engineering relative to an investigation of the pollution of the Tributary to the Middle Fork Little Maquoketa River below the Holy Cross Cooperative Creamery Association located in Dubuque County.

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

Very truly yours,



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

JRS:ad

TABLE OF CONTENTS

	page
I INTRODUCTION	1
II DESCRIPTION OF STREAM	2
III SCOPE OF INVESTIGATION	2
IV SAMPLING STATIONS	2
V SCOPE OF TESTS	3
VI DEFINITIONS AND SIGNIFICANCE OF THE VARIOUS PHYSICAL, CHEMICAL AND BACTERIOLOGICAL TESTS USED DURING THE INVESTIGATION	3
VII DISCUSSION OF PHYSICAL, CHEMICAL AND BACTERIAL DATA . . .	4
VIII SIGNIFICANCE OF POLLUTION	5
IX CONCLUSION	6
X RECOMMENDATIONS	7

MAPS AND TABLES

TABLE I	8
FIGURE I	9
TABLE II	10

I. INTRODUCTION

The investigation of the pollution of the Tributary of the Middle Fork of the Little Maquoketa River, Dubuque County, was initiated following receipt by this Department of a petition from 25 residents of the state. The petition states in part as follows:

"We, do hereby request that you conduct an investigation of the pollution of the Creek Water by the Holy Cross Creamery Company, Holy Cross, Iowa, which flows through the farms of Ernest Ellerback, Frank Simon and Nicholas LeGrand in Concord Township, Dubuque County, Iowa, as this pollution of the creek creates an unhealthy condition for the public and livestock; that same also kills all fish in the creek."

During the course of this investigation it was determined that partially treated sanitary sewage and untreated industrial process wastes from a creamery operated by the Holy Cross Cooperative Creamery Association are discharged into the aforementioned creek, known as the Tributary to the Middle Fork of the Little Maquoketa River.

The creamery is located in Section 20, Concord Township, approximately 1/4 mile south of State Highway No. 3 on County Road G approximately 1/4 mile east and 1/2 mile south of the Town of Holy Cross. Prior to the spring of 1961, the creamery was located approximately 1/2 mile east of Holy Cross on Highway No. 3. A new plant was constructed and put into operation during April 1961 at the new site on County Road G. A permit for disposal of the sanitary sewage and industrial wastes from the newly constructed drain outlet for the new plant was not obtained as is provided for in Section 135.26 of the Iowa Stream and Lake Pollution Law.

The sanitary sewage from the creamery receives treatment in a septic tank prior to discharge to the receiving stream. All industrial process wastes, including whey at certain times, are discharged to the stream without treatment.

Whey may be stored in an outside tank of 17,000 gallon capacity. It is intended that farmers will haul the whey from this tank for hog feeding purposes. However, it was reported to the writer at the time of this investigation that there was not a great demand for the whey. As a result it was being discharged to the receiving stream together with other milk processing wastes and the partially treated sanitary sewage.

The writer conferred with Messrs. Ernest Ellerback and Frank Simon, signatory residents to the petition. Mr. Ellerback's farm land is located in Section 29, approximately 1/4 mile below the creamery outlet. He stated the condition of the stream interferes with livestock watering. He maintains a herd of approximately 55 milk cows and during the summer the cattle are pastured on lands through which the creek traverses. He further stated that the stream used to maintain some fish life, but that he did not observe any during the summer of 1961.

Mr. Frank Simon complained that the condition of the creek this past summer was a nuisance to him. He stated that his milk cows that were pastured on land near the creek did not drink of the stream and that he had to provide the animals with well water. He further stated that obnoxious odors emanated from the stream, particularly during the summer and especially since the spring of 1961.

II. DESCRIPTION OF STREAM

The Tributary to the Middle Fork of the Little Maquoketa River rises in Section 20 of Concord Township. It reportedly is a spring fed stream which, within approximately 2 miles below the entrance of inadequately treated sewage and wastes from the creamery, has an estimated flow of 15-20 cubic feet per second. The stream gradient is rather steep and the stream velocity is high. Numerous riffles were observed in the reach of stream observed during this investigation. The stream bottom contains numerous rocks of large size and is generally a rocky bottomed stream.

Between the point of discharge of sewage and wastes and a point approximately $1\frac{1}{2}$ miles below, it is reported that two spring fed streams enter the receiving stream.

The relatively large stream flow, high velocity, numerous riffles, and shallow depth, even in the pools, provides stream characteristics which are conducive for rapid recovery from the effects of the discharge of the sewage and wastes.

The tributary valley in the upper reach of the stream is very narrow, heavily wooded and not accessible to livestock. At Station 3, however, the stream is accessible to livestock. At Stations 4 and 5 the valley is wide and the stream passes through pasture land. In this reach, the stream is readily accessible to livestock.

III. SCOPE OF INVESTIGATION

During the course of this investigation the following officials of the Holy Cross Cooperative Creamery Association were interviewed:

Mr. Alfred Pfeiler, President

Mr. Cletus Osterhaus, Manager

The receiving stream was observed during this investigation. Observations of the physical condition of the stream both above and below the creamery outlet were made and were recorded. Samples from the creamery outlet and from the stream were collected for the purpose of conducting chemical and bacteriological examinations.

IV. SAMPLING STATIONS

The stream sampling stations in the tables and in the narrative of this report are referred to by numbers. The drain tile which discharges sewage and industrial process wastes from the Holy Cross Cooperative Creamery is referred to as "C.O.".

The location of the sampling stations and of the outlet are shown in the sketch (Figure I) on page 9 of this report. Descriptions of the stations are given in Table I, page 8.

V. SCOPE OF TESTS

Determinations made on samples consisted of those made in the field at the time of sampling and those in the State Hygienic Branch Laboratory in Des Moines, Iowa.

Observations of the water temperature and pH and the stabilizing of a portion of the samples for determination of dissolved oxygen in the laboratory were done in the field.

Samples collected for biochemical oxygen demand and bacterial determinations were kept under refrigeration in the field and were transported directly to the laboratory where the determinations were conducted.

All tests in the field and in the laboratory were conducted in accordance with the procedures as set forth in the current edition of "Standard Methods for the Examination of Water, Sewage and Industrial Wastes" published jointly by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation.

VI. DEFINITIONS AND SIGNIFICANCE OF THE VARIOUS PHYSICAL, CHEMICAL AND BACTERIOLOGICAL TESTS USED DURING THE INVESTIGATION

Temperature (°C): The temperature values are of the stream water at the time and point of sampling are reported in degrees centigrade. Temperature of the water governs the solubility of oxygen in the stream and influences the rate of purification.

pH: Hydrogen ion concentration, or pH, indicates the relative acidity or alkalinity of a water. A value of 7 is considered to be neutral; whereas values above 7 are alkaline and those below 7 are acid.

Dissolved Oxygen (DO): Oxygen in the free 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 by photosynthetic action of some water plants, including algae. A deficiency in dissolved oxygen below the saturation level generally indicates the presence of polluting organic 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 (BOD) at 20° Centigrade: This determination indicates the amount of dissolved oxygen in milligrams per liter which may be expected to be used 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 (MPN) of coliform bacteria per 100 milliliters of sample. The 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 and in the soil.

Fungus Growths: As decomposition processes become established following the entrance of organic wastes into a stream certain typical growths appear. These growths are referred to as sewage fungi. However, bacteria and protozoans, as well as fungi, are among the organisms that make up this growth. These growths form dense masses and cling to bottom mud, stones, stream obstructions, and submerged plants. Newly developed forms may be white while older forms tend toward a putty-grey color.

The observance of fungus growths are important in stream pollution studies. Such growths occur only in streams which are grossly polluted with organic wastes. They are, therefore, considered to be positive indicators of pollution conditions.

VII. DISCUSSION OF PHYSICAL, CHEMICAL AND BACTERIOLOGICAL DATA

Results of laboratory examinations conducted on samples collected during this investigation are presented in tabular form in Table II, page 10 of this report.

The following is a discussion of the findings. The stream at Station I was found to be in excellent condition. The stream bottom was clean and the water was sparkling clear. A low BOD value of 1 ppm and a DO value of 11.3 ppm indicated a stream water of good quality. The MPN value of 70,000 was higher than expected for a clean stream.

At the time the sample was collected direct from the creamery drain outlet, Station C.O., the wastes had the physical appearance of dilute milk. The wastes were white in color and at the time did not appear to contain an appreciable quantity of whey. The BOD of 450 ppm is in an expected range for milk processing waste, exclusive of whey. The MPN value of 60,000 is considered to be low since it is known that the wastes contain septic tank effluent which normally contains large numbers of coliform bacteria. The wastes from the creamery drain discharge onto high ground above the bed of the stream and flow over the ground for a short distance and then cascade over an outcropping of stone to the stream. The ground surface and the stone outcropping were covered with white milk wastes solids and fungus growths.

At Station 2, approximately 100 feet below the entry of the wastes from the creamery, the stream water was white in color. The stream bottom was covered with a profuse growth of fungus. Near the edge of the stream in more quiescent waters, black septic conditions existed in small pools of water behind large rocks in the stream bed. The high BOD value of 75 ppm together with the profuse fungus growths are evidence of the adverse affect of the discharge of inadequately treated sewage and wastes from the creamery.

The stream at Station 3, approximately 1/4 mile below C.O., was observed earlier in the day than at any of the other stations, including the creamery drain outlet. At the time of observation the stream water was yellowish-green in color, indicating the presence of whey in the flow. Very profuse fungus growths were noted on the entire bottom of the stream in this area. The BOD value of greater than 200 ppm is indicative of a strong waste being present in the stream. As a means of comparison, the average BOD value of untreated domestic sewage is in the range of 200 ppm. The dissolved oxygen value of 4.7 ppm was significantly less than at Station 1 above the point of discharge of sewage and wastes where the value was 11.3 ppm.

At Station 4, approximately 2 miles below C. O., the stream was observed to be recovering from the effects of the discharge of sewage and wastes. The stream flow was clearer and the stream bottom was clean. A BOD value of 3 ppm was recorded. Profuse fungus growths were observed, however, at a point approximately 800 feet upstream from this station. Immediately below this station, floating white scum was observed in quiescent back waters.

The stream at Station 5, approximately 2-1/2 miles below C.O., continued to show improvement. The water was clear and the bottom could be observed in several feet of water near the bridge abutment. Minnows and larger fish were observed in deep water at this point. The high DO value of 11.2 ppm and the low BOD value of 1 ppm indicated that the sewage and wastes from the creamery were having little if any affect on the stream at this station at this time.

VIII. SIGNIFICANCE OF POLLUTION

In accordance with the Iowa Stream and Lake Pollution Law, pollution is defined as follows:

"....pollution means such contamination, or other alteration to the physical, chemical or biological properties, of such waters of the state, or such discharge of such liquid, gaseous or solid substances into such water of the state as will create a nuisance or render such waters harmful or detrimental or injurious to public health, safety or welfare or to domestic, commercial, industrial, or to livestock, wild animals, birds, fish or other aquatic life."

Sections 657.1 and 657.2, Code of Iowa, define a nuisance as follows:

Section 657.1 - "whatever is injurious to health, indecent, or offensive to the senses, or an obstruction to the free use of property, so as essentially to interfere with the comfortable enjoyment of life and property, is a nuisance,"

Section 657.2 - ".....4. The corrupting or rendering unwholesome or impure the water of any river, stream, or pond,, to the injury or prejudice of others."

During the course of this investigation, the following conditions pertaining to the definitions of pollution and/or nuisance were found to exist:

1. The organic sewage and process waste solids being discharged from the Holy Cross Cooperative Creamery Association were found to be providing excellent nutrients for the support of profuse fungus growths in the receiving stream.

These growths were observed to cover the entire stream bed in the reach of stream approximately 1-3/4 miles below the creamery drain outlet. This blanketing effect tends to interfere with normal stream aquatic life.

Furthermore, these growths, which are organic in nature, are subject to decomposition. Due to the low water temperatures during this investigation, no objectionable odors were noted as a result of the fungus growths. However, during summer months, with increased temperatures, increased bacterial activity, and lower stream flows, objectionable odors would be expected and such odors would be a nuisance to downstream riparian owners.

2. The wastes being discharged from the creamery contain unstable organic material which is being stabilized utilizes the oxygen that is dissolved in the stream water.

During the investigation, the dissolved oxygen values in the stream were found to be sufficient to sustain fish life and to maintain aerobic conditions in the stream. However, the effect of the discharge of the wastes could be clearly demonstrated by the sharp reduction in dissolved oxygen from 11.3 ppm at Station 1, to 4.7 ppm at Station 3, approximately 1/4 mile below the creamery outlet. Therefore, there no doubt are periods of time in which the dissolved oxygen concentrations in the stream are reduced to critical levels for aquatic life. Furthermore, should dissolved oxygen be depleted anaerobic decomposition would result. Foul odors are associated with such decomposition and such odors would constitute a nuisance to riparian owners.

IX. CONCLUSIONS

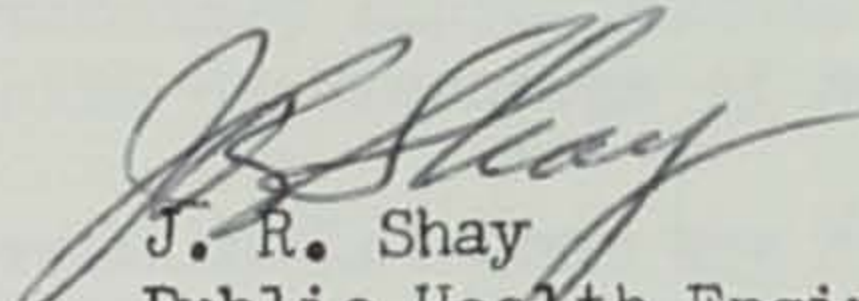
The Tributary to the Middle Fork of the Little Maquoketa River was found to be polluted as a result of the discharge of whey and inadequately treated sanitary sewage and milk processing wastes from the Holy Cross Cooperative Creamery Association.

X. RECOMMENDATIONS

1. It is recommended that the Holy Cross Cooperative Creamery Association discontinue the practice of discharging whey into the receiving stream.

2. It is further recommended that sewage and waste treatment facilities adequate to abate and prevent the recurrence of the pollution condition in the receiving stream, be installed by the creamery.

Respectfully submitted,


J. R. Shay
Public Health Engineer

JRS:ad

TABLE I

DESCRIPTION OF SAMPLING STATIONS
The Tributary to the Middle Fork
Little Maquoketa River

Station No.	Description
1	Tributary approximately 75 feet above the point of discharge of sewage and wastes.
C.O.	Drain outlet from the Holy Cross Cooperative Creamery Association.
2	Tributary approximately 100 feet below C.O.
3	Tributary approximately 1/4 mile below C.O.
4	Tributary approximately 2 miles below C. O.
5	Middle Fork Little Maquoketa River approximately 2 $\frac{1}{2}$ miles below C. O.

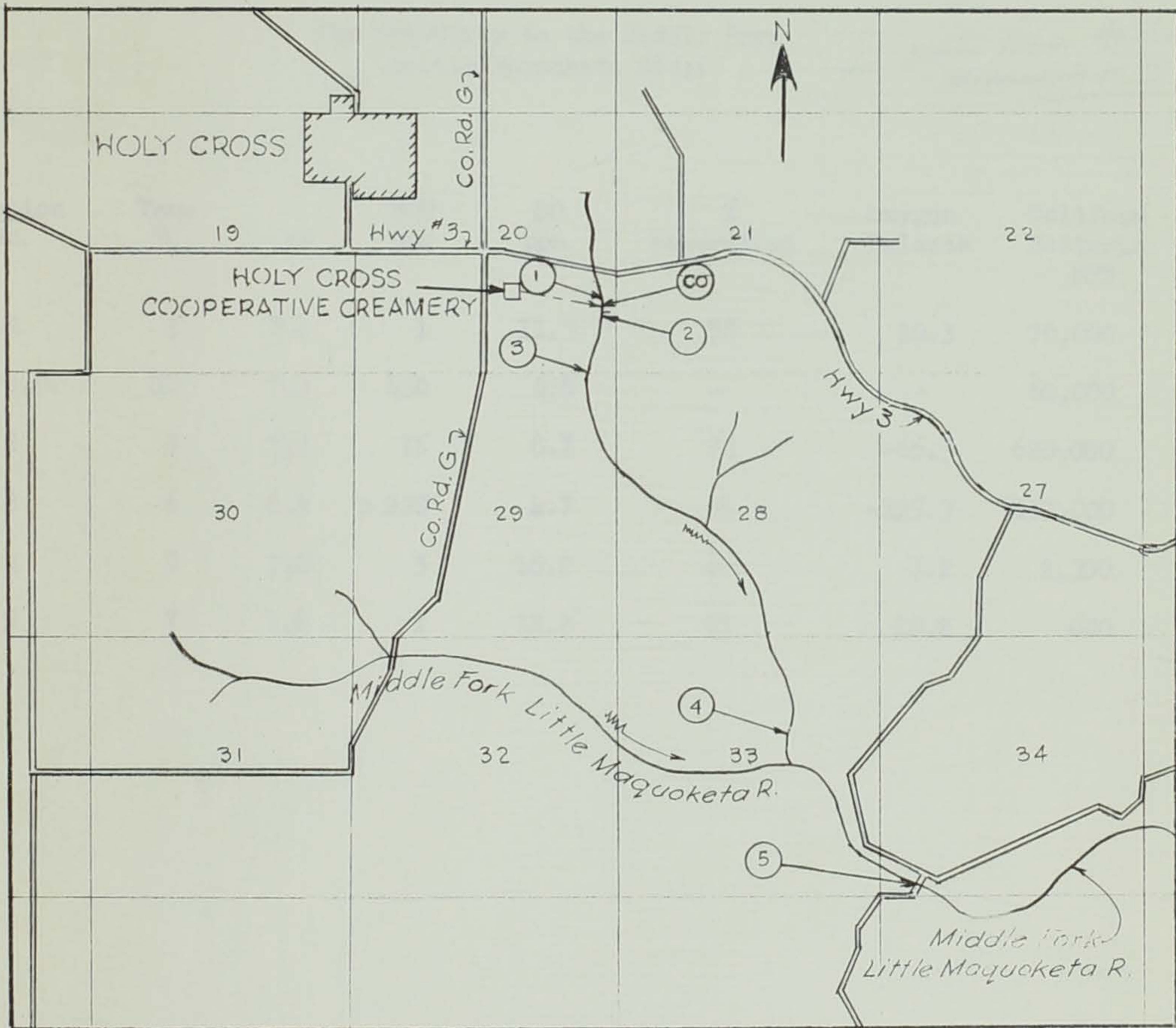


FIGURE - 1
 SKETCH SHOWING
 REACH OF STREAM BELOW
 HOLY CROSS COOPERATIVE CREAMERY
 Scale: $1\frac{1}{2}'' = 1$ mile

TABLE II

CHEMICAL AND BACTERIOLOGICAL DATA

The Tributary to the Middle Fork
Little Maquoketa River

*Data from November 30, 1962
stream survey.*

Station No.	Temp °C	pH	BOD ppm	DO ppm	% Saturation	Oxygen Balance	Coliform Bacteria MPN
1	5	7.4	1	11.3	88	10.3	70,000
C.O.	14	7.3	450	6.8	-	-	60,000
2	8	7.2	75	8.7	73	-66.3	620,000
3	6	6.9	> 200	4.7	38	-195.3	130,000
4	5	7.6	3	10.2	80	7.2	2,300
5	7	7.8	1	11.2	92	10.2	600

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