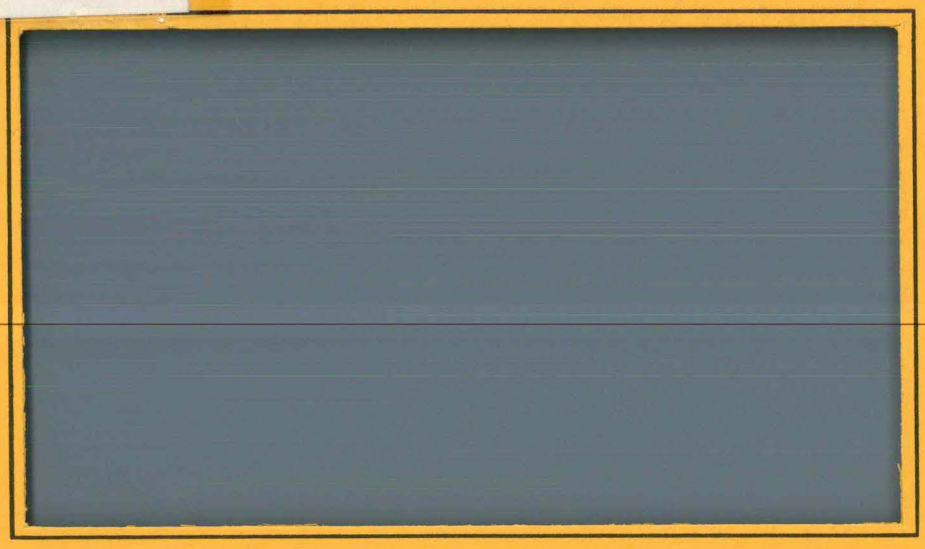


A REPORT FROM

The State Hygienic Laboratory

MEDICAL LABORATORIES BUILDING

THE UNIVERSITY OF IOWA

IOWA CITY, IOWA 52240

WINTER WATER QUALITY

of the

NORTH RACCOON RIVER

from

STORM LAKE to VAN METER, IOWA

#71-41

Submitted to the Iowa Water Pollution Control Commission
by the
State Hygienic Laboratory on March 26, 1971

INTRODUCTION

The North Raccoon River originates near Leverett, Iowa in northern Buena Vista County and flows approximately 175 miles in a southeasterly direction to its confluence with the South Raccoon River near Van Meter, Iowa. At the junction of these rivers the drainage area of the North Raccoon River is approximately 2,200 square miles. The combined rivers form the Raccoon River which flows another 30 - 35 miles and discharges into the Des Moines River at Des Moines, Iowa. Except for some 25 miles of river located upstream from the southern Buena Vista county line the entire Raccoon River is designated for aquatic life use as a warm water area and is subject to the Iowa Water Quality Criteria for such areas. Allegedly, the most heavily used area for recreation and fishing on the North Raccoon River is the reach just above and below the dam at Adel, Iowa. This area is noted particularly for its large Flathead Catfish and it also supports some Smallmouth Bass.

The study area considered in this report is approximately 150 miles of the North Raccoon River extending from the Buena Vista County Road C-49 Bridge northeast of Storm Lake, Iowa to an area approximately 1.5 miles upstream from the confluence of the North and South Raccoon Rivers near Van Meter, Iowa. Figure 1 (page 3) is a rough map indicating the study area and locations where samples were taken. The results reported here are based on two river surveys; the first on February 9-10, 1971 and the second during the following week on February 15-16, 1971. During both of these surveys the river was covered by a heavy layer of ice ranging in thickness from approximately 14 to greater than 24 inches. Consequently, at the time of these surveys the river was not affected to any significant degree by surface run-off and circumstances were ideal for studying winter low flow conditions. This would not have been true one week later because immediately following the February 15-16, 1971 survey, a warming trend coupled with heavy rain and snow melt broke the stream open and greatly increased the volume of flow to the point of flooding in many areas.

The U.S. Geological Survey maintains two gauging stations on the North Raccoon River; one at Sac City and a second one at Jefferson, Iowa. A U.S.G.S. gauging station is also located just below the confluence of the North and South Raccoon Rivers at Van Meter, Iowa.

The computed low flow levels for these three gauging stations as found in the Iowa Natural Resources Council Bulletin #10 are shown in Table A (page 4).

Provisional data for the volume of flow during mid-February, 1971 at these three gauging stations were obtained from the U.S. Geological Survey Office in Fort Dodge, Iowa. These data are indicated in Table B (page 4).

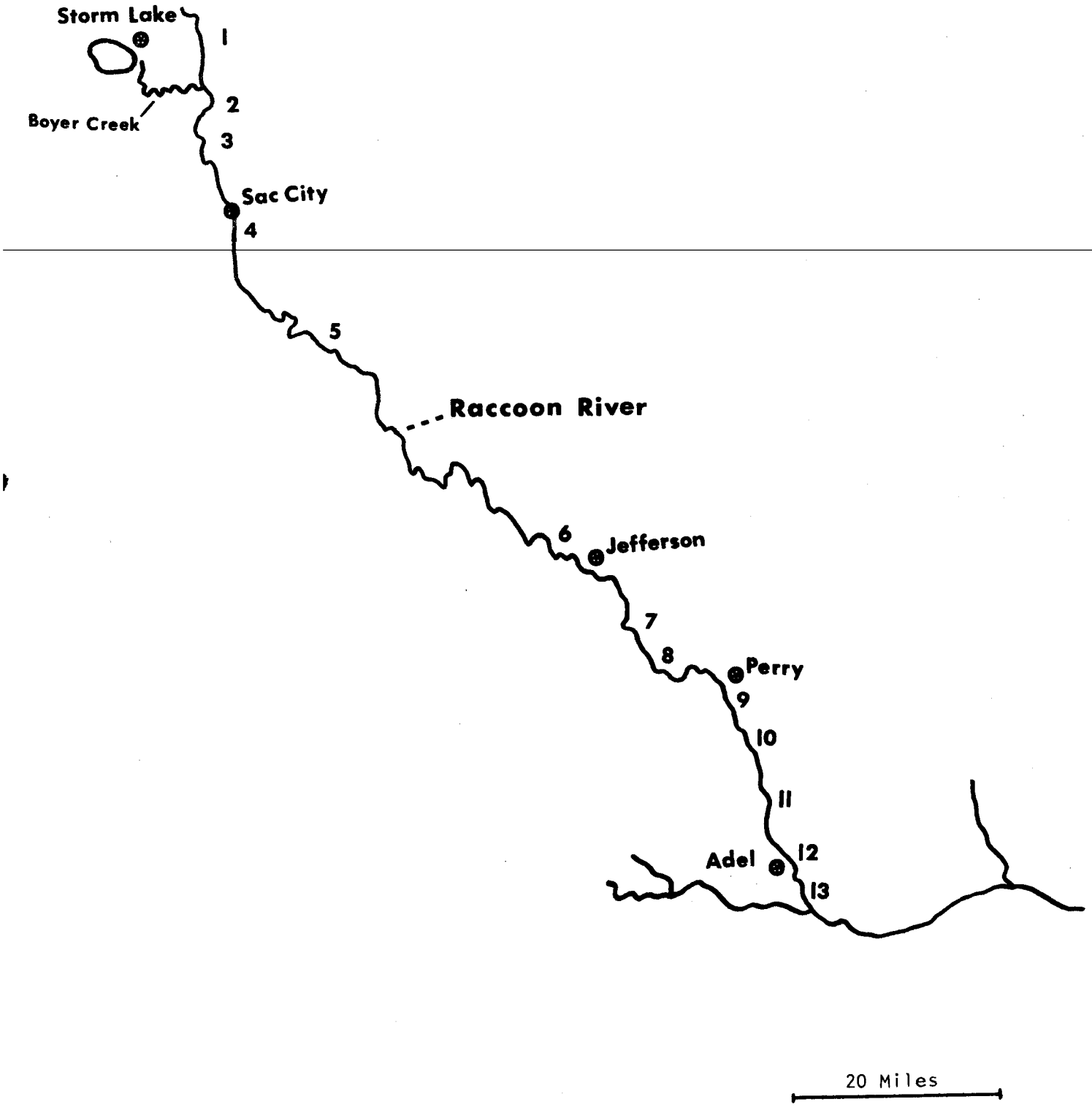

Storm Lake
1
Boyer Creek
2
3
Sac City
4
5
Raccoon River
6
Jefferson
7
8
Perry
9
10
11
Adel
12
13
20 Miles

TABLE A

Low Flows of the North Raccoon and Raccoon Rivers

River	Location	Recurrence Frequency	Flow (cfs)
North Raccoon	Sac City	7-day, 2-yr	6.5
North Raccoon	Jefferson	7-day, 10-yr	12
Raccoon	Van Meter	7-day, 10-yr	31

TABLE B

Provisional Flow Data (cfs) for the North Raccoon and Raccoon Rivers
(Obtained from the U.S. Geological Survey)

Date	North Raccoon at Sac City, Ia	North Raccoon at Jefferson, Ia	Raccoon at Van Meter, Ia
Feb 7, 1971	19	37	120
" 8 "	19	36	116
" 9 "	18	36	114
" 10 "	18	35	112
" 11 "	18	35	110
" 12 "	18	35	110
" 13 "	18	35	110
" 14 "	18	35	110
" 15 "	18	35	110
" 16 "	18	38	110
" 17 "	40	90	112
" 18 "	600	940	3,000
" 19 "	2,500	4,000	16,900

TABLE C

Estimated Organic Waste Loading to the North Raccoon River in Pounds of BOD per Day

City	Source	Treatment Type	Organic Load (lbs BOD/day)	
Storm Lake	Municipal	Trickling Filter	225	
Storm Lake	Hygrade	Lagoons	140	
		Total Storm Lake		365
Sac City	Municipal	Trickling Filter	77	
Jefferson	Municipal	Trickling Filter	53	
Perry	Municipal	Trickling Filter	222	
Perry	Oscar Mayer	Lagoons	258	
		Total Perry		480

FIGURE 2

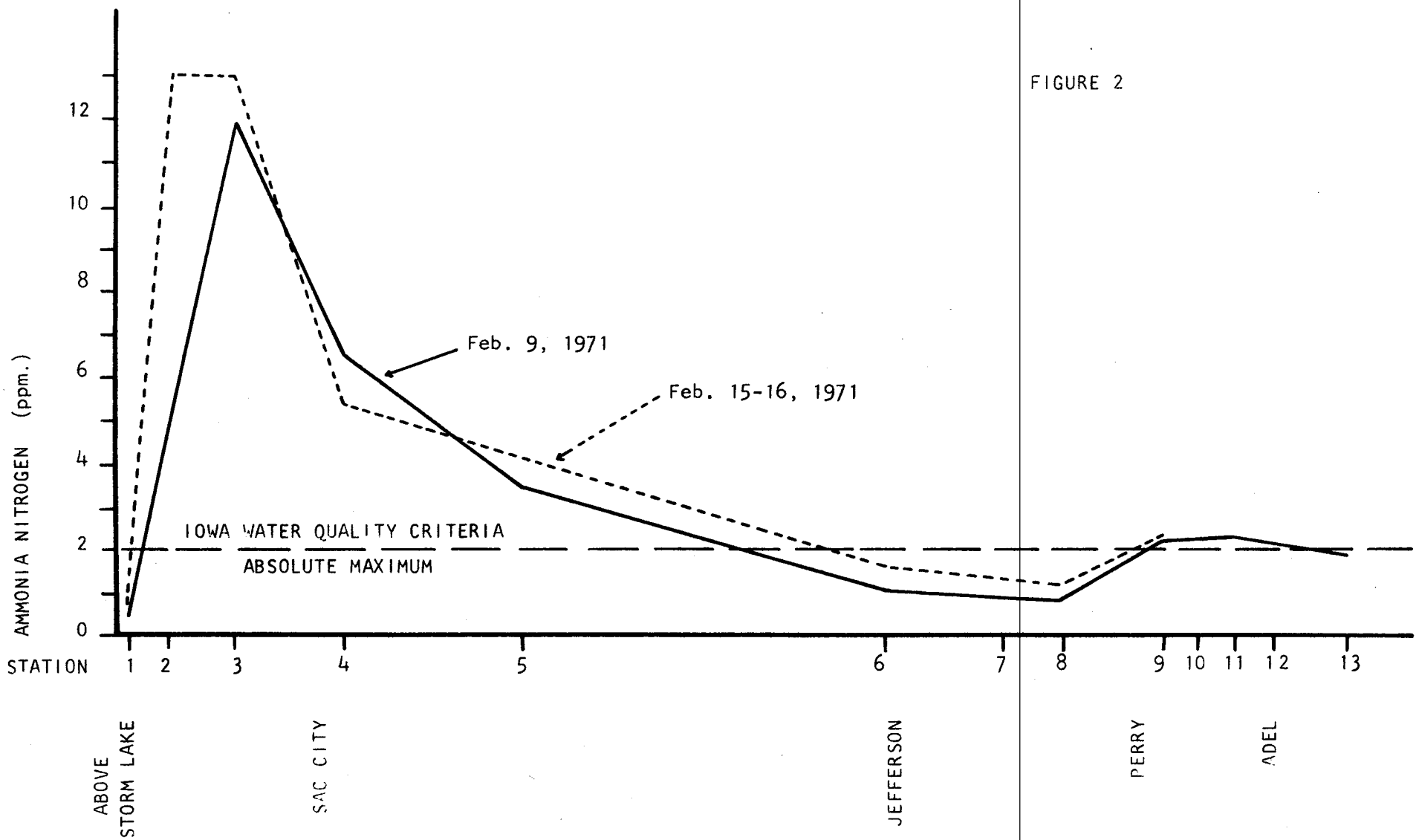

AMMONIA NITROGEN (ppm.)
12
10
8
6
4
2
0
Feb. 9, 1971
Feb. 15-16, 1971
IOWA WATER QUALITY CRITERIA
ABSOLUTE MAXIMUM
STATION
1
2
3
4
5
6
7
8
9
10
11
12
13
ABOVE STORM LAKE
SAC CITY
JEFFERSON
PERRY
ADEL

FIGURE 3

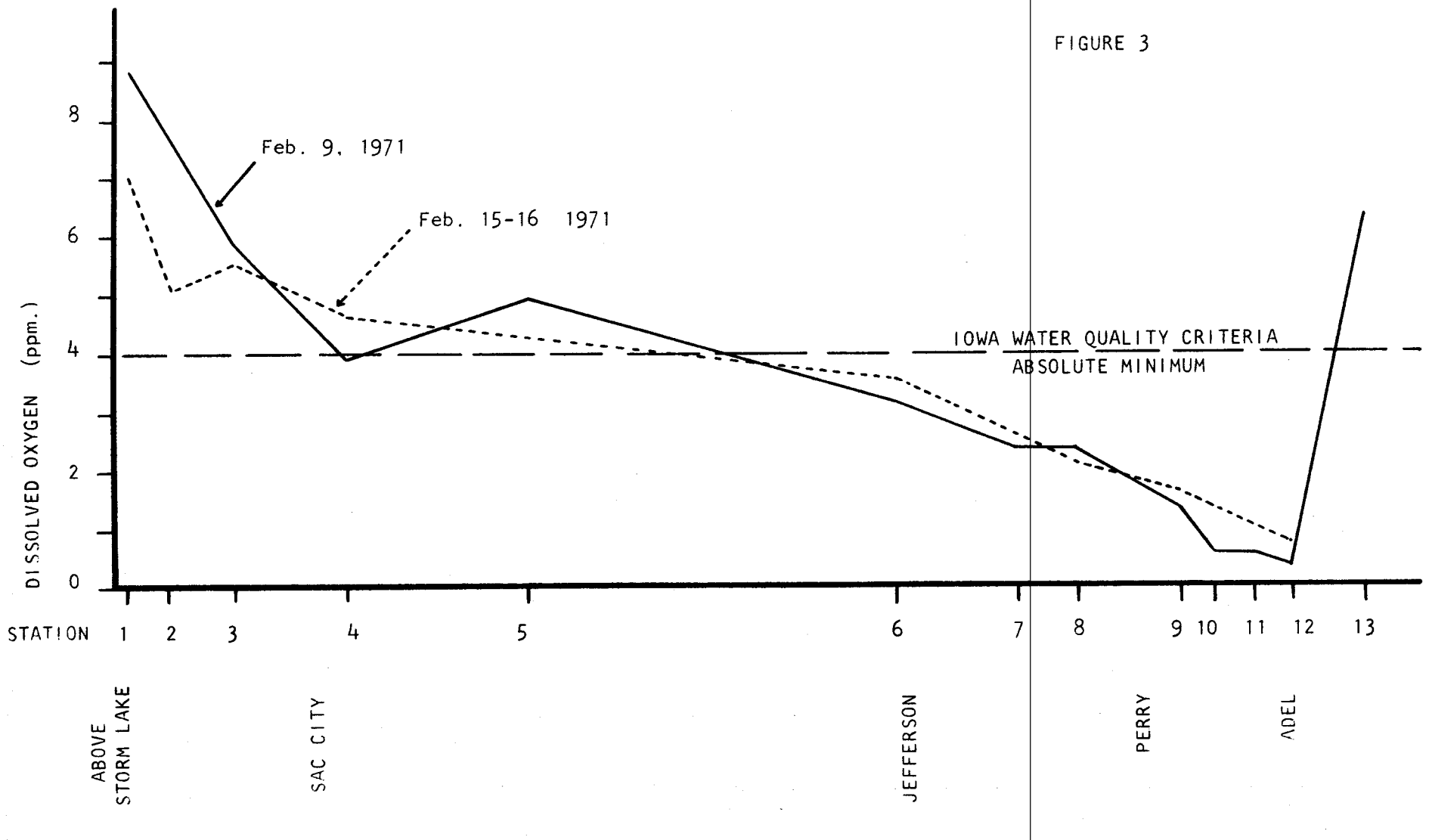
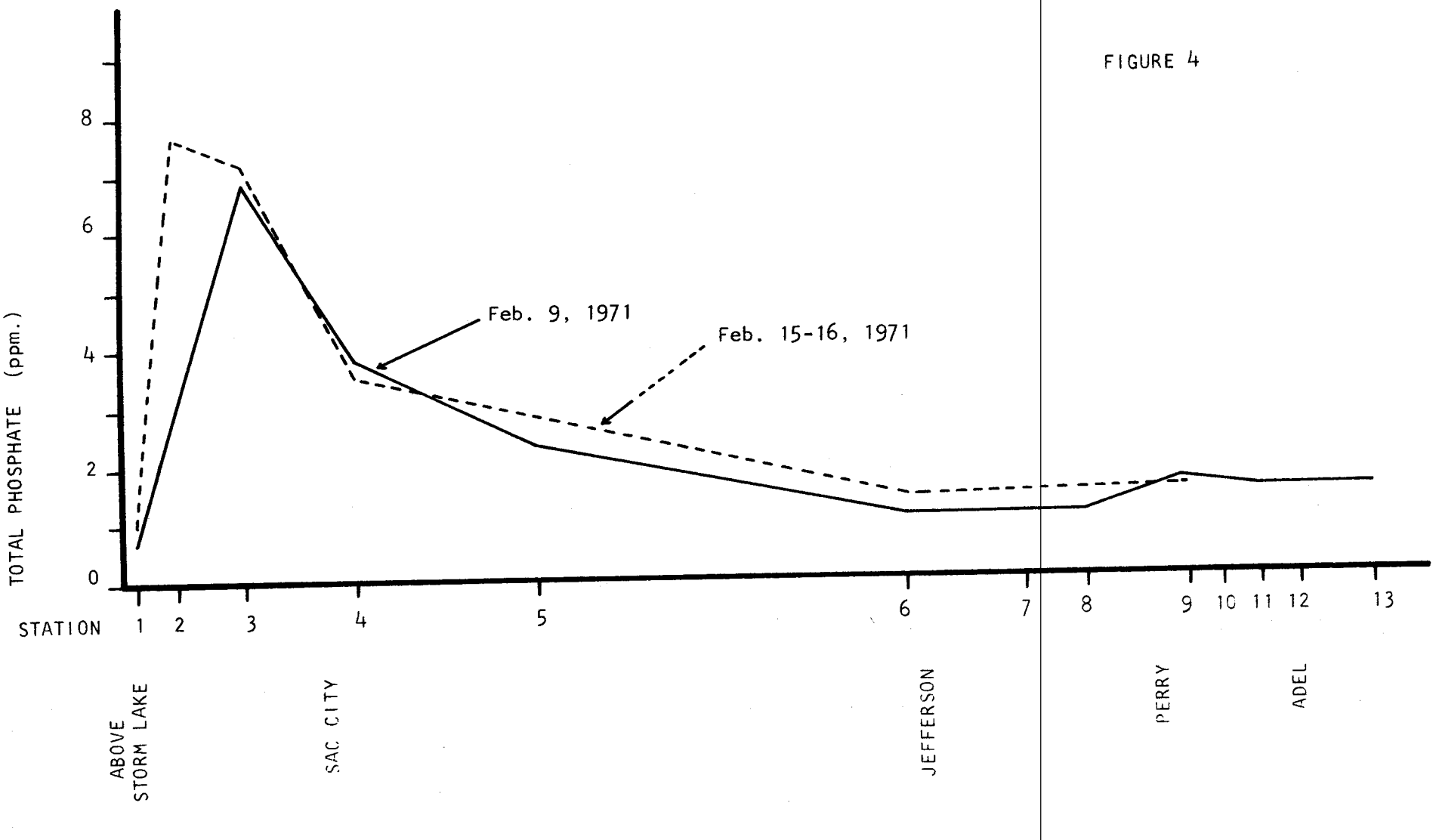

DISSOLVED OXYGEN (ppm.)
8
6
4
2
0
Feb. 9, 1971
Feb. 15-16 1971
IOWA WATER QUALITY CRITERIA
ABSOLUTE MINIMUM
STATION 1 2 3 4 5 6 7 8 9 10 11 12 13
ABOVE STORM LAKE
SAC CITY
JEFFERSON
PERRY
ADEL

FIGURE 4


TOTAL PHOSPHATE (ppm.)
0
2
4
6
8
Feb. 9, 1971
Feb. 15-16, 1971
STATION
1
2
3
4
5
6
7
8
9
10
11
12
13
ABOVE STORM LAKE
SAC CITY
JEFFERSON
PERRY
ADEL

As can be seen from Table B the flow conditions during both of the surveys reported here (February 9-10 and 15-16, 1971) were nearly identical and the levels for those periods were approximately 3 times greater than the 7-day, 10-year low flow levels (see data for Jefferson and Van Meter, Iowa in Table A). The effects of the snow melt and heavy rains following the second survey are also strikingly evident from Table B.

The major waste effluents discharged to the North Raccoon over the 150 mile study area originate from the Iowa towns of Storm Lake, Sac City, Jefferson and Perry. There are two major treated waste effluents from Storm Lake. The first is the municipal plant which receives primarily domestic wastes and provides secondary treatment by a trickling filter system. The second source is a lagoon system, also owned and operated by the city, which treats the packing wastes from Hygrade Food Products Inc. The extensive lagoon system consists of anaerobic lagoons, followed by a mechanical aerator system and then by a series of aerobic ponds. Both of these treated effluents are discharged to Boyer Creek which carries the wastes for about 7.5 miles (from the lagoon discharge) to the North Raccoon River. Boyer Creek enters the North Raccoon River at a point approximately 4 miles upstream from the southern Buena Vista County line below which Iowa Water Quality Standards for aquatic life use become effective. Both Sac City and Jefferson, Iowa have trickling filter plants which treat primarily domestic wastes.

Sac City has been negotiating with the Iowa State Department of Health and will soon be under a consent order for additional facilities. According to the Iowa State Department of Health, the Jefferson plant is hydraulically overloaded and the city government has already taken steps to improve the waste treatment facility.

In addition to the municipal waste from the Perry sewage treatment plant, Oscar Mayer discharges from its own lagoon system at Perry. Together, the two treated wastes represent a heavy load on the North Raccoon River. Table C (page 5) depicts the estimated waste loads to the river from each of the major contributors. These data were obtained from the Iowa State Department of Health.

RESULTS

The analytical data generated from the two February sampling surveys can be found in Appendix A (page 17) of this report. The results of the dissolved oxygen, ammonia, and total phosphate analyses are summarized in graphical form in Figures 2 and 4 (pages 6-8).

Above the influence of Storm Lake wastes the water quality in the North Raccoon River was excellent considering that the stream is very small at this point and was covered by a thick layer of ice and snow. At the Buena Vista County Road C-49 Bridge (Station 1 on the map), located

approximately 5 miles above the point where Storm Lake wastes enter the North Raccoon River via Boyer Creek dissolved oxygen concentrations ranged from 7.0 - 8.8 ppm. At this point the ammonia-nitrogen levels were low (0.46 - 0.69 ppm) as were the total phosphate levels (0.7 - 1.0 ppm). The organic content of the water was also low with COD values of 12.1 - 24.8 ppm and BOD values of 2 - 4 ppm.

The upstream picture of good water quality in the North Raccoon River was drastically altered by the addition of Storm Lake wastes via Boyer Creek. A sample collected approximately 3/4 mile below the confluence of Boyer Creek with the North Raccoon River (Station 2 on the map) indicated that the ammonia-nitrogen concentration was increased about 20-fold to 13.0 ppm and the total phosphate concentration was increased to 7.6 ppm. Dissolved oxygen at this station was decreased to 5.1 ppm. The COD and BOD levels at this point were 45.5 and 5 ppm respectively on February 16, 1971. On this same day grab samples were collected from the effluents of the Storm Lake Municipal Treatment Plant and from the lagoon system which handled the Hygrade wastes. A sample was also taken from Boyer Creek approximately 1.5 miles above where it joins the North Raccoon River. The Storm Lake Municipal Plant showed a fairly typical winter effluent with an ammonia-nitrogen concentration of 22 ppm, a total phosphate concentration of 34 ppm and a dissolved oxygen concentration of 4.7 ppm. The COD and BOD levels of this effluent were 176 and 60 ppm respectively. The lagoon effluent contained an extremely high ammonia concentration (96 ppm) and a BOD level of 35 ppm. The general range of these data were confirmed by data obtained through the mail-order BOD program (on February 26, 1971 mail-order samples had an ammonia concentration of 97 ppm and a BOD of less than 25 ppm). The February 16th grab sample indicated a high total phosphate level of 36 ppm. The COD of the lagoon effluent was high (167 ppm) however, the discharge was well aerated by passing over the weirs (13.7 ppm of dissolved oxygen). The Boyer Creek sample taken above its discharge to the North Raccoon contained 37 ppm ammonia, 22 ppm total phosphate and 4.1 ppm of dissolved oxygen. The COD and BOD levels in Boyer Creek were 93 and 14 ppm respectively.

The Sac County Road D-15 Bridge (Station 3 on the map) is east of Nemaha, Iowa and is approximately 8 miles below the entrance of Boyer Creek. This station is well within (about 4 miles) of the zone designated as an aquatic life area by the Iowa Water Quality Criteria. The conditions at this station were quite similar to those at the station just below the entrance of Boyer Creek and violation of Iowa Water Quality Standards were observed for ammonia. The ammonia levels at this station were 12.0 and 13.0 ppm on February 9 and 15 respectively. The Iowa standard for ammonia is a maximum of 2.0 ppm. Total phosphate levels were also quite high; 6.8 and 7.2 ppm on the respective dates. The dissolved oxygen levels were lower than the upstream control station and for the two dates were 5.9 and 5.5 ppm. The organic load was also similar to that just below the entrance of Boyer Creek with COD levels of 30.3 and 41.3 ppm as well as BOD levels of 4 and 5 ppm on the respective dates of February 9 and 15, 1971.

After the initial degradation by Storm Lake wastes (particularly with respect to the high ammonia levels) the North Raccoon River had little opportunity to recover. The wastes from Sac City are discharged into the river approximately 18 miles below the entrance of Boyer Creek. A grab sample from the final effluent of the Sac City Municipal Treatment Plant on February 15, 1971 indicated a value for dissolved oxygen of 7.8 ppm, the ammonia level was 13.0 ppm, the total phosphate concentration was 51 ppm. The COD and BOD levels were 171 and 60 ppm respectively. This effluent undoubtedly affected the recovery of the river, however, the Sac City waste load is less than 1/3 the load contributed by Storm Lake (see Table C, page 5). During both surveys, river samples were taken at the Sac County Road D-42 Bridge which is about 2 miles below the Sac City discharge. Here there was an ammonia level ranging from 5.4 - 6.6 ppm which is a reduction from the levels observed below Storm Lake but still about 3 times greater than the level allowed by Iowa Standards. At this point total phosphate levels were still fairly high (3.5 - 3.8 ppm). Dissolved oxygen concentrations were further reduced (see Figure 3, page 7) to 3.9 ppm (a slight violation of the Iowa Standard minimum of 4.0 ppm) on February 9, 1971 and to 4.6 ppm on February 15, 1971. The COD (24.2 - 31.0 ppm) and BOD (2 - 4 ppm) levels were fairly low.

At the Highway 175 Bridge near Lake City, Iowa the ammonia level was further reduced to 3.5 ppm on February 9, 1971. However, this is still well above the maximum allowed by the Iowa Standard for ammonia. This station is over 40 miles downstream from the point where the high ammonia Storm Lake wastes enter the river. This station also shows further recovery regarding total phosphate (2.3 ppm) and a small increase in dissolved oxygen (4.9 ppm).

Between Highway 175 and Jefferson, Iowa the ammonia-nitrogen concentrations further decreased to the extent that just upstream from Jefferson (Station 6 on the map) the ammonia levels ranged from 1.1 - 1.6 ppm and the total phosphate level had also decreased substantially (1.1 - 1.4 ppm). COD and BOD levels were similar to those found above Storm Lake. The dissolved oxygen level had continued to decrease as waste assimilation occurred and at the point just above Jefferson the dissolved oxygen level ranged from 3.2 - 3.5 ppm. The Jefferson effluent did not seem to greatly affect the ammonia and total phosphate levels in the river. However, this effluent did have a high organic load (COD was 324 ppm, BOD was 140 ppm) in a grab sample taken on February 15, 1971. This high organic load probably contributed to the further decline in dissolved oxygen which was observed between Jefferson and Perry (2.1 - 2.4 ppm).

From all indications, the degredation of water quality from upstream wastes leveled off between Jefferson and Perry (see Figures 2-4, pages6-8). In this river reach ammonia-nitrogen concentrations ranged from 0.88 - 1.2 ppm, total phosphate levels ranged from 1.1 - 1.5 ppm. Dissolved oxygen levels in this reach ranged from 2.1 - 2.4 ppm. The water quality coming to Perry was poor in that there was a violation of Iowa Standards with respect to dissolved oxygen. However, it is conceivable that this

reach could still support some aquatic life at ambient river temperatures. The addition of the wastes from the Perry, Iowa area (the Perry Municipal Plant and the Oscar Mayer Lagoon) to this already poor situation further degraded the river until there was little possibility that fish or other aquatic life could survive. Grab samples of the final effluents from the Perry Municipal Plant and the Oscar Mayer Lagoon were obtained on February 15, 1971. The Perry Municipal Plant exhibited a fairly good winter effluent with an ammonia level of 11 ppm, a COD level of 82.6 ppm, and a BOD of 35 ppm. The Oscar Mayer Lagoon effluent was very high in ammonia-nitrogen (70 ppm) and showed a higher organic load than the Perry Municipal Plant with a COD of 140 ppm and a BOD of 81 ppm. The dissolved oxygen concentration in the Oscar Mayer effluent was zero.

At the Dallas County Road P-58 Bridge, approximately 3 miles below the last Perry discharge the dissolved oxygen concentration was further reduced to a range of 1.3 - 1.6 ppm. At this point the ammonia level had again been increased to a range of 2.2 - 2.3 ppm which is a violation of Iowa Water Quality Standards. From the Dallas County Road F-31 Bridge southwest of Minburn, Iowa to the dam in Adel, Iowa the dissolved oxygen concentrations were less than 1.0 ppm. This is approximately a 10 mile segment of river. The lowest stream dissolved oxygen level recorded (0.3 ppm) was found just above the Adel Dam on February 9, 1971. On that date a number of dead fish including some sizeable suckers were observed trapped in the ice at the lip of the dam. The following week no dead fish were observed at the dam, however, many dead caddis fly larvae of considerable size were trapped in old algal growths covering the rocks near the lip of the dam. It was difficult to evaluate the extent of fish mortality in the area between Perry and Adel, Iowa while the river was covered with ice. Many dead fish may already have been carried down under the ice and gone over the dam before our observations on February 9, 1971.

The waste loads entering the North Raccoon River seem to have become stabilized by the time the river passes over the dam at Adel where it is re-oxygenated. Just north of Interstate 80 or approximately 8 miles downstream from the Adel Dam (Station 13 on the map) the dissolved oxygen concentration was 6.4 ppm which is above the minimum levels set by Iowa Water Quality Standards. At this point the ammonia level was still a high 1.9 ppm but is less than the 2.0 ppm ammonia maximum set by Iowa Standards.

DISCUSSION

The water quality surveys reported here demonstrated that the North Raccoon River was polluted over the entire river reach above the dam at Adel, Iowa which is subject to Iowa Water Quality Criteria for Aquatic Life Use (a distance of approximately 130 miles). The Iowa Standard for dissolved oxygen which establishes 4.0 mg/l as the absolute

minimum was violated over roughly 70 miles of this reach from above Jefferson to the Adel Dam. The Iowa Standard for ammonia which establishes 2.0 mg/l as the absolute maximum acceptable level was violated over approximately 85 miles from below Storm Lake to above Jefferson and again for roughly 10 miles below Perry.

From the standpoint of ammonia-nitrogen levels the most serious conditions were observed below the entrance of Storm Lake wastes, particularly due to the discharge from the packing waste lagoon. Another heavy ammonia load enters the river in the Perry, Iowa area particularly from the Oscar Mayer Lagoon. This causes another, though less severe violation of Iowa Standards regarding ammonia. A probable reason for the ammonia effect being less pronounced below Perry than below Storm Lake is that the volume of water below Perry is 2 - 3 times as great as in the region below Storm Lake.

In addition to the direct effect of high ammonia levels because of its very toxic nature regarding aquatic life there is another, perhaps equally important, indirect effect which must be considered when an ammonia load enters a stream. This indirect effect is the considerable oxygen demand which can be exerted upon the stream when nitrification (that is the oxidation of organic and ammonia nitrogen to nitrate through biological action) occurs. Studies concerning nitrogenous oxygen demand have been conducted on Michigan streams (Courchaine, 1963, Proceedings of the 18th Industrial Waste Conference, Purdue University). Those studies indicate that the potential oxygen demand of each part per million of ammonia and organic nitrogen is equivalent to 4.57 parts per million of BOD. This nitrogenous oxygen demand is in addition to the demand measured in standard COD and 5-day BOD tests. An example of the importance of the potential nitrogenous oxygen demand can be gained by considering the Storm Lake Lagoon discharge. The measured COD level of that waste was 165 ppm. The 5-day BOD of the waste was 35 ppm. However, a rough calculation of the potential nitrogenous oxygen demand based on the 4.7 conversion factor of Courchaine (1963) is approximately 465 ppm. This is obtained by adding the ppm of ammonia and the ppm of organic nitrogen (96 + 5.8 = 101.8) and multiplying the result by 4.57. This indicates that even though the COD and BOD levels are not abnormally high, there is still a considerable potential demand for oxygen which probably accounts for the sustained drop in dissolved oxygen levels observed in our studies. A probable explanation for the greatly extended oxygen sag shown by these studies is that nitrification, like BOD, is dependent on biological processes which are slowed down by low temperatures and consequently an extended reach of river was required for the stabilization of the various waste loads which it received. The entire situation, of course, was aggravated by the heavy snow and ice cover which prevented re-oxygenation above the dam at Adel, Iowa.

All facts considered, under winter conditions the North Raccoon River carries water of sufficient quality to support aquatic life before any major wastes are added. This quality was destroyed first by the addition of Storm Lake wastes via Boyer Creek. The Storm Lake Municipal Plant

and Lagoon System are not providing a sufficient degree of treatment to protect water quality in the North Raccoon River particularly with respect to ammonia-nitrogen levels and consequently the nitrogenous oxygen demand. As stated earlier in this report, in the Storm Lake area Boyer Creek carries both the municipal and industrial waste effluents for about 7.5 miles before joining with the North Raccoon River. While we were sampling in the area, a farmer who owned land bordering on Boyer Creek stopped and registered a complaint. This man indicated that he and other landowners had been quite upset over the condition of the creek. He said that Boyer Creek created a serious odor problem, was unfit to use for watering stock and was unaesthetic from the standpoint of the strong yellow color which was often present.

The effluent from the Sac City sewage treatment plant did not seem to have a major effect on the North Raccoon River although any effect would have been well masked by the Storm Lake wastes. Undoubtedly Sac City further retarded the recovery process in the stream.

At the time of our visit, the trickling filter arms at the Jefferson treatment plant were not rotating, although the waste was being discharged over the rocks, but in the same place on the filters. The plant operator stated that he had back trouble and had not been able to remove the snowdrifts from the filters so the arms could rotate freely. The Jefferson effluent quality reflected this inadequacy of treatment particularly with respect to high COD (324 ppm) and BOD (140 ppm) levels.

Consequently, the further decrease in dissolved oxygen observed below Jefferson is at least partially attributable to the Jefferson plant even though other parameters did not seem to be greatly affected.

As mentioned earlier, recovery from waste loadings in a small stream during winter conditions is an extremely slow process due to cold water temperatures, snow and ice cover, and minimum dilution. Over the entire stretch from Storm Lake to Jefferson, ammonia, phosphate, COD and BOD concentrations decreased as these materials were oxidized or otherwise assimilated biologically. Concurrent with this was a decrease in the level of dissolved oxygen. This condition which was initiated by Storm Lake wastes was aggravated by discharges from Sac City and Jefferson.

Between Jefferson and Perry water quality conditions were relatively unchanged and the waste loadings seemed to have become stabilized. The dissolved oxygen levels remained at a low 2.1 - 2.4 ppm because of the heavy ice cover which provided little opportunity for re-oxygenation. The introduction of a heavy waste load at Perry, Iowa caused the further and rapid deterioration of water quality which was discussed earlier in this report.

During the study periods there was very little surface runoff due to the low temperatures and ice cover. Ground water contributions during this period would theoretically have provided a substantial portion of the

total flow in the North Raccoon River. Because the predominate groundwater addition in this area would have come from shallow water aquifers it is doubtful that groundwater would have been responsible for the low dissolved oxygen levels which were observed. Water from shallow aquifers generally contains 5 - 6 ppm dissolved oxygen.

CONCLUSIONS

Under winter conditions and at a volume of flow approximately 3 times greater than the 7-day, 10-year minimum the North Raccoon River was found to be polluted for a distance of approximately 135 miles extending from near Storm Lake, Iowa to the dam in Adel, Iowa. Over this entire reach severe violations of Iowa Water Quality Standards for Ammonia-Nitrogen and/or Dissolved Oxygen were observed (see Figures 2 and 3, pages 6-7). The Iowa Standards set a maximum of 2.0 ppm for Ammonia and in this study levels as high as 13.0 ppm were observed. Iowa Standards set an absolute minimum of 4.0 ppm for Dissolved Oxygen and in this study levels as low as 0.3 ppm were observed. In addition to the ammonia and/or dissolved oxygen violations for which there are specific Iowa Standards there was also a considerable increase in the total phosphate levels particularly below the entrance of Storm Lake area discharges (see Figure 4, page 8).

It is felt that the wastes discharged from Storm Lake, Iowa (particularly those from the lagoons which handle the packing wastes from the Hygrade Company) were primarily responsible for the poor water quality observed over the entire 120 mile reach extending from Storm Lake to Perry, Iowa with Sac City and Jefferson being secondary contributors to the problem. Even though the quality of water coming to the Perry area was poor (the standard for dissolved oxygen was being violated) the river had recovered sufficiently with respect to ammonia-nitrogen levels to be well within the Iowa Standard for Ammonia. However, discharges from the Perry area (particularly from the Oscar Mayer Lagoon) increased the ammonia level to again violate Iowa Standards and utilized most of the remaining 2.1 - 2.2 ppm of dissolved oxygen which was in the water coming to the Perry area.

RECOMMENDATIONS

We recommend that a formal declaration of pollution be made for the entire 130 mile reach extending from the southern Buena Vista county line to the dam at Adel, Iowa.

It is also recommended that the City of Storm Lake, Hygrade Food Products Inc of Storm Lake, the City of Jefferson, the City of Perry and Oscar Mayer Inc of Perry be called in for negotiations. According to the Iowa State Department of Health negotiations have already been held with Sac City, Iowa and a consent order is said to be forthcoming.

The Limnology Division feels that a complete engineering appraisal is in order for the waste treatment facilities for these areas and companies, particularly for the lagoon systems which handle packing plant wastes in Storm Lake and Perry. We feel that the most serious problems encountered in our studies were related to the high ammonia levels and that strong consideration should be given to ammonia removal. We also suggest that consideration be given to further carbonaceous removal and to the addition of phosphate removal processes.

Jack H Gakstatter

Jack H Gakstatter, PhD
Principal Limnologist

W. Randall Shobe

W Randall Shobe, PhD
Limnologist

jt

APPENDIX A

Pages 18 - 20: Analytical data from February 9 - 10, 1971

Pages 21 - 24: Analytical data from February 15 - 16, 1971

STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
East 7th & Court
Des Moines 9, Iowa

Town or Station	Storm Lake	Nemaha	Sac City	Lake City
Source	Raccoon River	Raccoon River	Raccoon River	Raccoon River
Specific Location	Co Rd C-49 N of Storm Lake	Co Rd D-15 Above cattle feed lot	Co Rd D-42 Below Sac City	H-way 175 W of Lake City
Date Collected	9 Feb 71	Collected 9th	9 Feb 71	9 Feb 71
Date Received	10 Feb 71		10 Feb 71	10 Feb 71
Bottle Number				
Bottle Number				
Laboratory Number	4605	4606	4607	4608
Bacterial: Exam. By				
XXXX. Coliform/100 ml.	510	5000	2900	350
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	7.3	7.4	7.35	7.45
Alkalinity P				
T				
Organic Nitrogen As N	0.51	0.89	0.72	0.75
Ammonia Nitrogen As N	0.46	12	6.6	3.5
Nitrite Nitrogen As N	0.040	0.030	0.056	0.038
Nitrate Nitrogen As N	3.6	2.4	2.4	3.6
Total Nitrogen As N				
Total Solids	730			
Fixed Solids	506			
Volatile Solids	224			
Total Suspended Solids	50			
Fixed Suspended Solids	36			
Volatile Suspended Solids	14			
Total Dissolved Solids	680			
Fixed Dissolved Solids	470			
Volatile Dissolved Solids	210			
Soluble Phosphate (PO_4)	0.7	6.6	3.6	2.2
Total Phosphate (PO_4)	0.7	6.8	3.8	2.3
Dissolved Oxygen	8.8	5.9	3.9	4.9
B. O. D. 5-day 20° C.	2	4	2	1
COD	12.1	30.3	24.2	20.2
Field Data				
Temperature °C	0	0	0	0
Time	5:00 pm	4:15 pm	3:30 pm	3:00 pm

Remarks:

Collector Drs Gakstatter & Shobe

Report To Limnology Division

R. L. Morris, Ph.D.
JHG Assistant Director & Principal Chemist
17 Feb 71

STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
East 7th & Court
Des Moines 9, Iowa

Town or Station	Jefferson	Cooper	Dawson	Perry
Source	Raccoon River	Raccoon River	Raccoon River	Raccoon River
Specific Location	Co Rd E-53 above Jefferson	Co Rd E-57 E of Cooper	Co Rd P-46 N of Dawson	Co Rd P-58 S of Perry
Date Collected	9 Feb 71	9 Feb 71	9 Feb 71	9 Feb 71
Date Received	10 Feb 71	10 Feb 71	10 Feb 71	10 Feb 71
Bottle Number				
Bottle Number				
Laboratory Number	4609	4610	4611	4612
Bacterial: Exam. By				
XXXXX Coliform/100 ml.	120	4800	2700	8000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	7.2	7.3	7.4	7.3
Alkalinity P				
T				
Organic Nitrogen As N	0.48	0.49	0.67	0.89
Ammonia Nitrogen As N	1.1	0.93	0.88	2.2
Nitrite Nitrogen As N	0.048	0.052	0.054	0.087
Nitrate Nitrogen As N	4.0	4.0	4.0	4.0
Total Nitrogen As N				
Total Solids				
Fixed Solids				
Volatile Solids				
Total Suspended Solids				
Fixed Suspended Solids				
Volatile Suspended Solids				
Total Dissolved Solids				
Fixed Dissolved Solids				
Volatile Dissolved Solids				
Soluble Phosphate (PO_4)	1.1	1.1	1.1	1.5
Total Phosphate (PO_4)	1.1	1.1	1.1	1.7
Dissolved Oxygen	3.2	2.4	2.4	1.3
B. O. D. 5-day 20° C.	<1	<1	3	2
Sulfate			110	110
COD	14.1	12.1	18.2	20.2
Field Data:				
Temperature °C	0	0	0	0
Time	1:45 pm	11:15 am	12:45 pm	11:25 am

Remarks:

Collector Drs Gakstatter & Shobe

Report To Limnology Division

R. L. Morris, Ph.D.
Assistant Director & Principal Chemist

JHG
17 Feb 71

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STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
East 7th & Court
Des Moines 9, Iowa

Town or Station	Minburn	Dallas Center	Adel	Van Meter
Source	Raccoon River	Raccoon River	Raccoon River	Raccoon River
Specific Location	Co Rd F-31 W of Minburn	H-way 44 W of Dallas Center.	¼ mi below H-way 169 Br (above dam)	Co. Rd R-16 -3/4m Above I-80
Date Collected	9 Feb 71	9 Feb 71		9 Feb 71
Date Received	10 Feb 71	10 Feb 71	10 Feb 71 collected 9th	10 Feb 71
Bottle Number				
Bottle Number				
Laboratory Number	4613	4614	4615	4616
Bacterial: Exam. By				
MXXX. Coliform/100 ml.		1200		2200
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value		7.3		7.3
Alkalinity P				
T				
Organic Nitrogen As N		0.51		0.48
Ammonia Nitrogen As N		2.3		1.9
Nitrite Nitrogen As N		0.090		0.070
Nitrate Nitrogen As N		4.0		4.0
Total Nitrogen As N				
Total Solids				622
Fixed Solids				402
Volatile Solids				220
Total Suspended Solids				3
Fixed Suspended Solids				3
Volatile Suspended Solids				0
Total Dissolved Solids				619
Fixed Dissolved Solids				399
Volatile Dissolved Solids				220
Soluble Phosphate (PO_4)		1.4	Dissolved oxygen	1.4
Total Phosphate (PO_4)		1.5	levels were:	1.5
Dissolved Oxygen	0.6	0.6	East Side 0.4	6.4
B. O. D. 5-day 20° C.		1	West Side 0.3	1
COD		14.1		14.1
Field Data:				
Temperature °C	0	0	0	0
Time	11:00 am	10:30 am	1:00 pm	9:30 am

Remarks:

Collector Drs Gakstatter & Shobe

Report To Limnology Division

R. L. Morris, Ph.D.
JHG Assistant Director & Principal Chemist
17 Feb 71

STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
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Des Moines 9, Iowa

Town or Station	Storm Lake			
Source	Raccoon River	STP	Hygrade Lagoon	Boyer Creek
Specific Location	Co Rd C-49 N of Storm Lake	Final Effluent	Discharge to Boyer Creek	(Outlet Creek) Co Rd Bridge, 1 mi E of M-50
Date Collected	16 Feb 71			
Date Received	17 Feb 71			
Bottle Number				
Bottle Number				
Laboratory Number	4656	4657	4658	4659
Bacterial: Exam. By				
~~MxPxN~~ Coliform/100 ml.	730	640,000	< 1000	32,000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	7.6	7.35	8.1	7.85
Alkalinity P				
T				
Spec Cond at 25° Cx10^{-5}	94	160	390	200
Organic Nitrogen As N	0.80	7.2	5.8	2.9
Ammonia Nitrogen As N	0.69	22	96	37
Nitrite Nitrogen As N	0.040	0.15	0.035	0.048
Nitrate Nitrogen As N	3.6	1.0	0.2	0.8
Total Nitrogen As N				
Total Solids	673	942	1798	1030
Fixed Solids	472	731	1594	845
Volatile Solids	201	211	204	185
Total Suspended Solids	12	44	28	19
Fixed Suspended Solids	10	5	2	4
Volatile Suspended Solids	2	39	26	15
Total Dissolved Solids	661	898	1770	1011
Fixed Dissolved Solids	462	726	1592	841
Volatile Dissolved Solids	199	172	178	170
Soluble Phosphate (PO_4)	0.9	25	36	20
Total Phosphate (PO_4)	1.0	34	36	22
Dissolved Oxygen	7.0	4.7	13.7	4.1
B. O. D. 5-day 20° C.	4	60	35	14
COD	24.8	176	165	93.0
Sodium	25		480	230
Chloride	34		800	310
Field Data:				
Temperature °C	0			
Remarks: Time	9:15 am	1:30 pm	11:30 am	10:00 am

Collector Dr Shobe, Dr Gakstatter

Report To Limnology Division

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JHG

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STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
East 7th & Court
Des Moines 9, Iowa

Town or Station	Storm Lake		Nemaha	Sac City
Source	Raccoon River		Raccoon River	STP
Specific Location	Co Rd Bridge 1	mi S of Hwy 7&	Co Rd D-15	Plant Effluent
	3/4 mi below	confluence with Boyer Creek	above cattle	
Date Collected	16 Feb 71		feed lot	
Date Received	17 Feb 71		Collected 15th	
Bottle Number				
Bottle Number				
Laboratory Number	4660		4661	4662
Bacterial: Exam. By				
~~M×B×N~~. Coliform/100 ml.	3200		3000	760,000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	7.8		7.9	7.45
Alkalinity P				
T				
Spec Cond at $25°C \times 10^{-5}$	110		110	120
Organic Nitrogen As N	1.3		1.1	6.1
Ammonia Nitrogen As N	13		13	13
Nitrite Nitrogen As N	0.045		0.027	0.36
Nitrate Nitrogen As N	2.4		2.4	5.2
Total Nitrogen As N				
Total Solids	783			771
Fixed Solids	588			573
Volatile Solids	195			198
Total Suspended Solids	0			49
Fixed Suspended Solids	0			10
Volatile Suspended Solids	0			39
Total Dissolved Solids	783			722
Fixed Dissolved Solids	588			563
Volatile Dissolved Solids	195			159
Soluble Phosphate (PO_4)	7.1		6.8	42
Total Phosphate (PO_4)	7.6		7.2	51
Dissolved Oxygen	5.1		5.5	7.8
B. O. D. 5-day 20° C.	5		5	60
COD	45.4		41.3	171
Sodium	85			
Chloride	120			
Field Data:				
Temperature °C	0	0		0
Remarks: Time	10:30 am	5:50 pm	5:12 pm	4:50 pm

Collector Dr Shobe, Dr Gakstatter

Report To Limnology Division

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2 Mar 71 bj

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STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
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Des Moines 9, Iowa

Town or Station	Sac City	Jefferson	Jefferson	Dawson
Source	Raccoon River	Raccoon River	STP	Raccoon River
Specific Location	Co Rd D-42 Below Sac City	Co Rd E-53 Bridge	Effluent	Co Rd P-46 Br N of Dawson
Date Collected	15 Feb 71			
Date Received	17 Feb 71			
Bottle Number				
Bottle Number				
Laboratory Number	4663	4664	4665	4666
Bacterial: Exam. By				
F ~~XXXX~~ Coliform/100 ml.	3200	570	1,900,000	3000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	7.45	7.7	7.15	7.4
Alkalinity P				
T				
Spec Cond at 25°C x 10^{-5}	110	84	100	95
Organic Nitrogen As N	0.80	0.31	10	0.55
Ammonia Nitrogen As N	5.4	1.6	30	1.2
Nitrite Nitrogen As N	0.030	0.054	0.002	0.037
Nitrate Nitrogen As N	2.3	3.6	0.2	3.2
Total Nitrogen As N				
Total Solids			682	
Fixed Solids			447	
Volatile Solids			235	
Total Suspended Solids			90	
Fixed Suspended Solids			12	
Volatile Suspended Solids			78	
Total Dissolved Solids			592	
Fixed Dissolved Solids			435	
Volatile Dissolved Solids			157	
Soluble Phosphate (PO_4)	3.1	1.4	32	1.3
Total Phosphate (PO_4)	3.5	1.4	53	1.5
Dissolved Oxygen	4.6	3.5	0.4	2.1
B. O. D. 5-day 20° C.	4	2	140	2
COD	31.0	24.8	324	18.6
Field Data:				
Temperature °C	0	0		0
Time	4:50 pm	3:15 pm	3:10 pm	2:35 pm

Remarks:

Collector Dr Shobe, Dr Gakstatter

Report To Limnology

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STATE HYGIENIC LABORATORY

Des Moines Branch
405 State Office & Lab Bldg.
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Des Moines 9, Iowa

Town or Station	Perry			Adel
Source	STP	Oscar Mayer	Raccoon River	Raccoon River
Specific Location	Discharge	Lagoon Discharge	Co Rd P-58	Adel Dam
Date Collected	15 Feb 71			
Date Received	17 Feb 71			
Bottle Number				
Bottle Number				
Laboratory Number	4667	4666	4669	4670
Bacterial: Exam. By				
~~M P N~~ Coliform/100 ml.	320,000	10,000	4000	
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	7.5	7.65	7.45	
Alkalinity P				
T				
Spec Cond at 25°C x 10^{-5}	90	260	99	
Organic Nitrogen As N	5.2	3.9	0.57	
Ammonia Nitrogen As N	11	70	2.3	
Nitrite Nitrogen As N	0.34	< 0.001	0.062	
Nitrate Nitrogen As N	4.0	0.2	3.6	
Total Nitrogen As N				
Total Solids	538	1371		
Fixed Solids	386	1106		
Volatile Solids	152	265		
Total Suspended Solids	16	11		
Fixed Suspended Solids	0	2		
Volatile Suspended Solids	16	9		
Total Dissolved Solids	522	1360		
Fixed Dissolved Solids	386	1104		
Volatile Dissolved Solids	136	256		
Soluble Phosphate (PO_4)	20	19	1.6	
Total Phosphate (PO_4)	24	20	1.6	
Dissolved Oxygen	7.7	0.0	1.6	0.7
B. O. D. 5-day 20° C.	35	81	2	
COD	82.6	140	24.8	

Remarks:

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2 Mar 71 bj

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