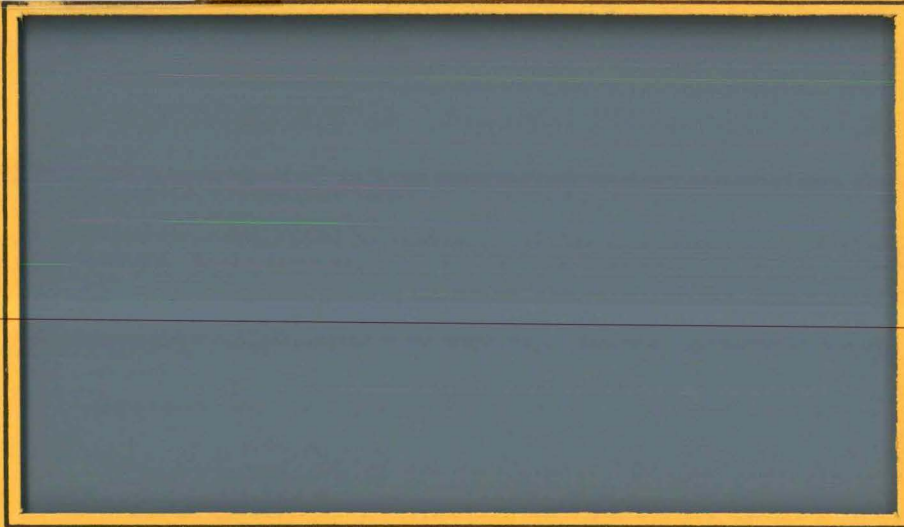


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A REPORT FROM

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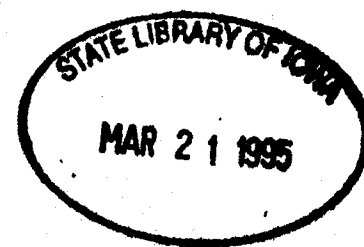
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WEST FORK DES MOINES RIVER  
WATER QUALITY SURVEY

ESTHERVILLE AREA

#72 - 38

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Submitted to the Iowa Water Pollution Control Commission  
by the  
State Hygienic Laboratory on February 24, 1972

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## Introduction

The West Fork Des Moines River originates in southern Minnesota, flows in a southeasterly direction through northern Iowa and finally joins with the East Fork near Humboldt, Iowa to form the main stem Des Moines River. Throughout this reach the only towns of significant size located near the river are Estherville (population 8,108) and Emmetsburg (population 4,150).

The drainage area of the West Fork Des Moines River at Estherville totals 1,372 square miles. A U.S. Geological Survey stream flow gage is located at Estherville and flow records are available back to 1951. During the period since 1951 the average river flow has been 271 cfs and the seven day, ten year low flow less than 0.1 cfs. ~~The entire reach of the West Fork Des Moines River from the Des Moines River (near Humboldt) to the Iowa-Minnesota state line is~~ classified for aquatic life use and is therefore regulated by both the general and specific water quality criteria of Iowa Water Quality Standards.

The Limnology Division of the State Hygienic Laboratory has conducted two water quality surveys in the Estherville area in the past six months, one in August and the other in January while the river was predominately ice-covered. The results of these two surveys are discussed in the remainder of this report.

The city of Estherville has a sizeable industrial waste load in addition to domestic wastes from more than 8000 people. At least two industries are major waste contributors, the John Morrell Company and WADCO Foods, Inc. According to information in the monthly operational reports submitted by Estherville to the State Department of Health, the average monthly hydraulic loading in the Estherville STP from April to November, 1971 ranged from 1.445 to 2.073 mgd (2.2-3.2 cfs) and the average monthly Biochemical Oxygen Demand (BOD) in the final effluent ranged from 92 to 246 ppm.

River flows during the study periods varied substantially. Artificial substrate samplers for biological studies were in place from July 1 to August 17, 1971. The river flow on July 1 was 895 cfs and it gradually decreased during the next six weeks to 41 cfs on August 17 when the samplers were removed. On August 19, 20, 23 and 24 samples for dissolved oxygen and other chemical parameters were taken in the Estherville area and river flows for these dates were 51, 51, 49 and 48 cubic feet per second respectively. During the January 11 survey the river flow was 28 cfs.

All of the flows were obtained from U.S. Geological Survey and are preliminary data subject to final revision.

Figure 1 represents the study area in the vicinity of Estherville. The majority of sampling stations are represented by a number which coincides to the list of sampling locations depicted by Table 1.

### Bacteriological Results

As would be expected downstream from a non-chlorinating waste treatment plant which receives packing plant wastes, significant increases in fecal coliform contamination were observed below Estherville. Tables 2 and 3 contain these data. At the August 24 sampling there had been rainfall in the area a few days earlier and upstream levels of fecal coliform were rather high (1300-1500 per 100 ml.). Nevertheless, there was still a large increase in fecal coliforms (810,000 per 100 ml.) observed at the Highway 4 bridge which was attributable to Estherville. Levels of contamination decreased as the waste traveled downstream but persisted over background levels for several miles.

During the January study, upstream controls for fecal coliform were very low (20 per 100 ml. or less) but increased to 98,000 per 100 ml. just below the Estherville discharge. Again the increase over background contamination persisted several miles downstream.

There are no designated recreational areas in the river reach affected by the fecal coliforms in the Estherville discharge.

### Physico-Chemical Results

The general physico-chemical results of the August 24 and January 11 river surveys are depicted by Tables 2 and 3 respectively in this report. Significant changes in water quality of the West Fork Des Moines River were caused by the Estherville discharge. These quality changes were more obvious in the winter than the summer due to lower flows, colder water temperatures and ice cover which prevented oxygenation of the water by atmospheric diffusion.

In August Ammonia-nitrogen concentrations were in violation of the Water Quality Standard at the Highway 4 bridge which is a short distance downstream from the sewage outfall. At Emmet County Road A-33, about 3.5 miles below the Estherville outfall, ammonia-nitrogen concentrations were within standards but still considerably higher than normal for that river. Increases in organic-nitrogen were also attributable to the Estherville discharge. During the August survey, BOD's and phosphates were also considerably higher below the Estherville outfall than upstream from the outfall.

Table 1

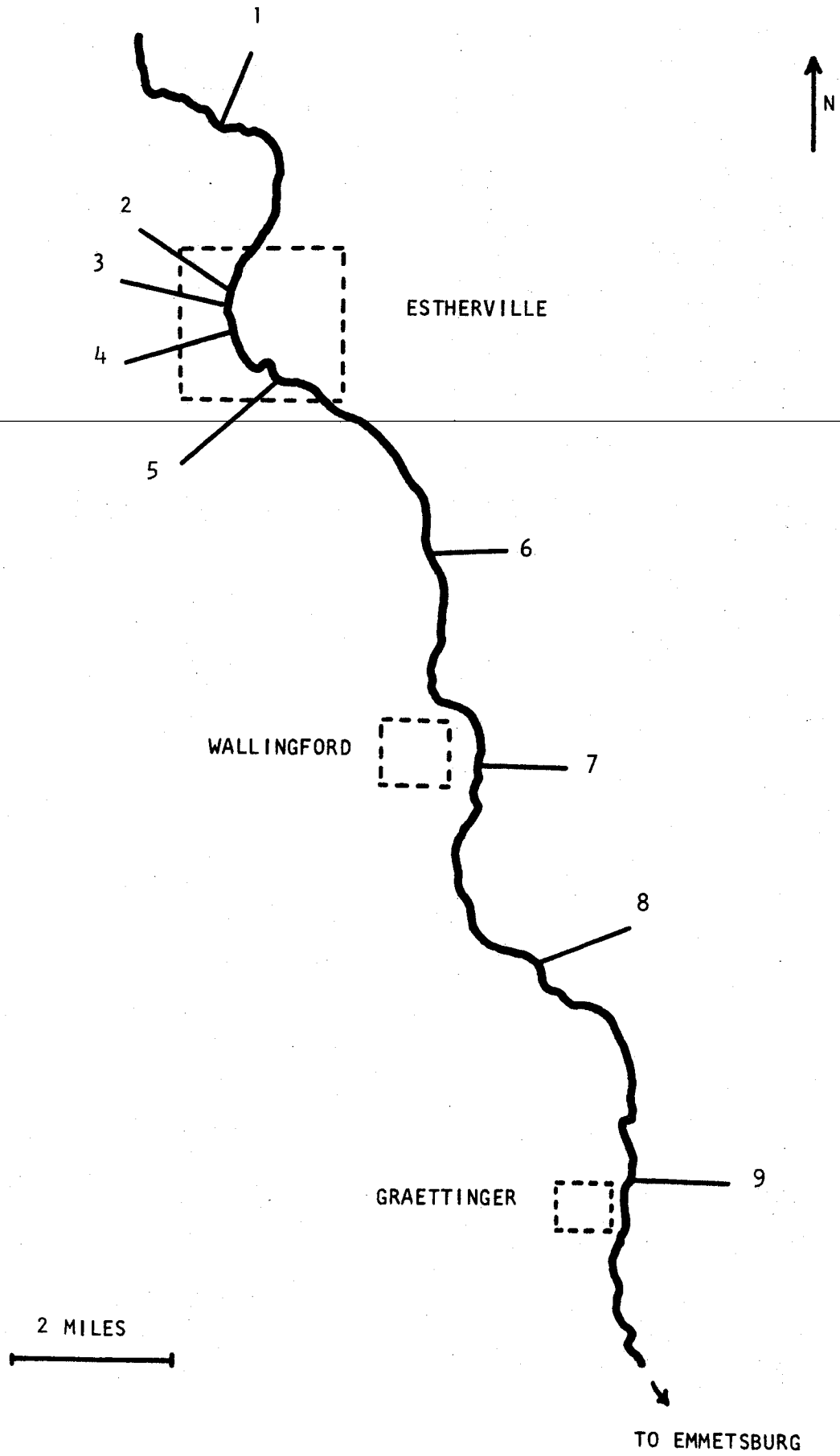
Des Moines River - West Fork  
Sampling Stations in Vicinity of Estherville, Iowa  
(River Mile Designations Approximate)

1	RM 407.9	Emmet Co. Rd. N-26 Bridge
1A	RM 405.0	Unnamed Bridge NW corner of Estherville
2	RM 404.7	Power Plant Footbridge
3	RM 404.5	Highway 9 Bridge
4	RM 404.0	Estherville Water Pollution Control Plant
5	RM 403.5	Highway 4 Bridge
6	RM 400.3	Emmet Co. Rd. A-33 Bridge (Golf Course)
7	RM 397.0	Emmet Co. Rd. A-34 Bridge (Wallingford)
8	RM 393.6	Unmarked Co. Rd. Bridge
9	RM 389.7	Palo Alto Co. Rd. B-14 Bridge (Graettinger)

The Following Stations Are Not Shown On The Map

10	RM 380.5	Highway 18, NW of Emmetsburg
11	RM 375.5	Highway 4, S of Emmetsburg
12	RM 367.0	Palo Alto Co. Rd. B-55 SW of Rodman
13	RM 356.0	Highway 15 Bridge W of Ottosen
14	RM 343.5	Humboldt Co. Rd. C-29 SE of Bradgate
15	RM 334.5	Highway 169 Bridge at Humboldt

Figure 1. West Fork Des Moines River in the vicinity of Estherville, Iowa.



## WATER QUALITY REPORT

STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town Source Specific Location	Estherville W Fork DM River Emmett Co. Rd. N-26	Estherville Hwy 9 Bridge	Estherville STP Fin. Eff. Outflow of Clarifier
Date Collected	24 August 1971		
Date Received	25 August 1971		
Lab Number	929	930	931
Collection Time	3:15	FIELD DATA 3:26	2:15
pH			
Temperature	77	77	
Dissolved Oxygen	10.5	7.4	1.8
	BACTERIOLOGICAL EXAMINATION		
Fecal Coliform/100 ml	5100	1300	18,000,000
	CHEMICAL ANALYSIS (as mg/l unless designated otherwise)		
Conductance (micromhos)			
MBAS (as LAS)			
pH (units)	8.0	7.9	7.4
Alkalinity: P	None		
T	201		
NITROGEN: Organic N	1.9	2.0	11
Ammonia N	0.01	< 0.01	24
Nitrite N	0.003	0.004	0.014
Nitrate N	< 0.1	< 0.1	0.2
Nitrate as NO <sub>3</sub>			
RESIDUE: Total	695		
Fixed	500		
Volatile	195		
Filtrable Residue T	625		
F	448		
V	177		
Nonfiltrable Residue T	70		
F	52		
V	18		
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.06	0.03	7.6
Total P	0.14	0.16	7.9
Dissolved Oxygen			
BOD	10	9	130
COD	52.6	60.7	255
Grease or Oil			
Turbidity (JTU)	88	172	122
Total Hardness (as CaCO <sub>3</sub> )			
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )			
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

COLLECTOR  
REPORT TO Limnology

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

JHG 31 August 1971 jb

Table 2B  
WATER QUALITY REPORT

-6-

STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Estherville	Estherville	Graettinger
Source	W Fork DM River	W Fork DM River	
Specific Location	Hwy 4 Bridge	Golf Course -- Co. Rd. A-33	Palo Alto Co. Rd. B-14 Bridge
Date Collected	24 August 1971		
Date Received	25 August 1971		
Lab Number	932	933	934
Collection Time	3:45	FIELD DATA 3:55	4:25
pH			
Temperature	79	79	79
Dissolved Oxygen	3.7	7.2	12.2
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	810,000	33,000	800
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)			
MBAS (as LAS)			
pH (units)	7.7	7.6	8.0
Alkalinity: P			
T			
NITROGEN: Organic N	2.4	2.1	2.1
Ammonia N	2.2	0.92	0.01
Nitrite N	0.067	0.098	0.096
Nitrate N	0.1	0.2	0.5
Nitrate as NO <sub>3</sub>			
RESIDUE: Total			732
Fixed			509
Volatile			223
Filtrable Residue T			661
F			471
V			190
Nonfiltrable Residue T			71
F			38
V			33
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.59	0.29	0.18
Total P	0.74	0.46	0.30
Dissolved Oxygen			
BOD	15	11	11
COD	60.7	60.7	56.7
Grease or Oil			
Turbidity (JTU)	56	88	88
Total Hardness (as CaCO <sub>3</sub> )			
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )			
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

COLLECTOR  
REPORT TO Limnology

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

JHG 31 August 1971 jb



Table 3A  
WATER QUALITY REPORT

-7-

STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Estherville	Estherville	Estherville
Source	West Fork Des Moines		
Specific Location	Emmet Co. Rd. N-26 North of Estherville	Emmet Co. Rd. N-26 Bridge in Estherville	100 yards below Hwy 9 bridge
Date Collected	11 January 1972		
Date Received	12 January 1972		
Lab Number	3285	3286	3287
Collection Time	9:15 a	FIELD DATA 9:50 a	10:15 a
pH			
Temperature	0	0	0
Dissolved Oxygen	6.9	7.2	7.6
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	20	< 10	10
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)	1180		
MBAS (as LAS)			
pH (units)	7.6		
Alkalinity: P	None		
T	318		
NITROGEN: Organic N	0.79	0.79	0.83
Ammonia N	0.63	0.61	0.59
Nitrite N	0.031	0.036	0.036
Nitrate N	0.9	0.9	0.9
Nitrate as NO <sub>3</sub>			
RESIDUE: Total	859		849
Fixed	629		597
Volatile	230		252
Filtrable Residue T	838		847
F	616		597
V	222		250
Nonfiltrable Residue T	21		2
F	13		0
V	8		2
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.22	0.20	0.20
Total P	0.22	0.20	0.20
Dissolved Oxygen			
BOD	2	2	2
COD	14.1	14.1	14.1
Grease or Oil			
Turbidity (JTU)	2	3	2
Total Hardness (as CaCO <sub>3</sub> )	590		
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )	43		
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

COLLECTOR  
REPORT TO

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

Table 3B  
WATER QUALITY REPORT

-8-

STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town Source Specific Location	Estherville STP Effluent of Final Clarifier	Estherville W Fork, Des Moines Hwy 4 bridge SE Estherville	Estherville W Fork, Des Moines Emmet Co. Rd. A-33
Date Collected	11 January 1972		
Date Received	12 January 1972		
Lab Number	3288	3289	3290
Collection Time	10:20 a	FIELD DATA 11:00 a	11:15 a
pH			
Temperature	0	0	0
Dissolved Oxygen		6.9	3.7
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	420,000	98,000	40,000
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)	2360	1590	1620
MBAS (as LAS)			
pH (units)	7.4	7.6	7.6
Alkalinity: P	None	None	None
T	530	348	352
NITROGEN: Organic N	8.8	1.6	2.9
Ammonia N	20	2.1	3.6
Nitrite N	0.019	0.043	0.070
Nitrate N	0.1	0.7	0.7
Nitrate as NO <sub>3</sub>			
RESIDUE: Total	1852	1103	1110
Fixed	1509	829	830
Volatile	343	274	280
Filtrable Residue T	1787	1099	1110
F	1454	825	830
V	333	274	280
Nonfiltrable Residue T	65	4	0
F	55	4	0
V	10	0	0
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	6.9	0.75	1.3
Total P	8.0	0.76	1.3
Dissolved Oxygen			
BOD	160	14	17
COD	306	40.3	50.4
Grease or Oil			
Turbidity (JTU)	88	8	10
Total Hardness (as CaCO <sub>3</sub> )		660	
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )		160	
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

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REPORT TO

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

JHG 24 Jan 1972 jb

Table 3C  
WATER QUALITY REPORT

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STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town Source Specific Location	Wallingford W Fork, Des Moines Emmet Co. Rd. A-34	Graettinger W Fork, Des Moines Palo Alto Co. Rd. B-14, E of town	Emmetsburg W Fork, Des Moines Hwy 18 bridge NW of town
Date Collected	11 January 1972		
Date Received	12 January 1972		
Lab Number	3291	3292	3293
Collection Time	11:15 a	FIELD DATA 12:20 p	1:20 p
pH			
Temperature	0	0	0
Dissolved Oxygen	3.1	2.0	5.8
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	7100	540	30
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)	1310		1140
MBAS (as LAS)			
pH (units)	7.6		7.7
Alkalinity: P	None		None
T	340		324
NITROGEN: Organic N	1.3	0.97	1.0
Ammonia N	2.4	1.8	1.7
Nitrite N	0.074	0.053	0.061
Nitrate N	0.9	0.8	0.9
Nitrate as NO <sub>3</sub>			
RESIDUE: Total	983		809
Fixed	739		601
Volatile	244		208
Filtrable Residue T	979		797
F	736		596
V	243		201
Nonfiltrable Residue T	4		12
F	3		5
V	1		7
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.78	0.45	0.37
Total P	0.78	0.47	0.38
Dissolved Oxygen			
BOD	6	2	3
COD	22.2	14.1	14.1
Grease or Oil			
Turbidity (JTU)	3	2	2
Total Hardness (as CaCO <sub>3</sub> )			
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )			
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

COLLECTOR  
REPORT TO

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

JHG 24 Jan 1972 jb

Table 3D  
WATER QUALITY REPORT

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STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Emmetsburg	Rodman	West Bend
Source	W Fork, Des Moines	W Fork, Des Moines	W Fork, Des Moines
Specific Location	Hwy 4 South of town	Palo Alto Co. Rd. B-55	Pocahontas Co. Hwy 15
Date Collected	11 January 1972		
Date Received	12 January 1972		
Lab Number	3294	3295	3296
Collection Time	1:40 p	FIELD DATA 2:05 p	2:15 p
pH			
Temperature	0	0	0
Dissolved Oxygen	9.1	9.9	8.4
BACTERIOLOGICAL EXAMINATION			
Fecal Coliform/100 ml	1610	60	300
CHEMICAL ANALYSIS (as mg/l unless designated otherwise)			
Conductance (micromhos)	1040		
MBAS (as LAS)			
pH (units)	7.7		
Alkalinity: P	None		
T	316		
NITROGEN: Organic N	0.88	0.88	0.81
Ammonia N	1.6	1.2	1.0
Nitrite N	0.065	0.055	0.061
Nitrate N	1.1	1.1	1.3
Nitrate as NO <sub>3</sub>			
RESIDUE: Total	746		
Fixed	522		
Volatile	224		
Filtrable Residue T	745		
F	522		
V	223		
Nonfiltrable Residue T	1		
F	0		
V	1		
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.36	0.27	0.22
Total P	0.37	0.27	0.22
Dissolved Oxygen			
BOD	3	3	2
COD	10.1	10.1	2.0
Grease or Oil			
Turbidity (JTU)	4	3	2
Total Hardness (as CaCO <sub>3</sub> )			
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )			
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

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REPORT TO

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

JHG 24 Jan 1972 jb

Table 3E  
WATER QUALITY REPORT

- 11 -

STATE HYGIENIC LABORATORY, Des Moines Branch  
The University of Iowa  
E 7th & Court, Rm 405, Des Moines, Iowa 50309

Town	Bradgate	Humboldt	
Source	W Fork Des Moines	W Fork, Des Moines	
Specific Location	Humboldt Co. Rd. c-29, SE of town	Hwy 169 Bridge at State Hatchery	
Date Collected	11 January 1972		
Date Received	12 January 1972		
Lab Number	3297	3298	
Collection Time	3:15 p	FIELD DATA 3:45 p	
pH			
Temperature	0	0	
Dissolved Oxygen	10.2	13.2	
	BACTERIOLOGICAL EXAMINATION		
Fecal Coliform/100 ml	90	2530	
	CHEMICAL ANALYSIS (as mg/l unless designated otherwise)		
Conductance (micromhos)		930	
MBAS (as LAS)			
pH (units)		7.8	
Alkalinity: P		None	
T		296	
NITROGEN: Organic N	0.57	0.49	
Ammonia N	0.59	0.48	
Nitrite N	0.051	0.045	
Nitrate N	1.9	2.8	
Nitrate as NO <sub>3</sub>			
RESIDUE: Total		633	
Fixed		424	
Volatile		209	
Filtrable Residue T		633	
F		424	
V		209	
Nonfiltrable Residue T		0	
F		0	
V		0	
Settleable Matter (ml/l)			
PHOSPHATE: Filtrable P	0.22	0.22	
Total P	0.22	0.22	
Dissolved Oxygen			
BOD	2	3	
COD	< 1.0	10.1	
Grease or Oil			
Turbidity (JTU)	1	1	
Total Hardness (as CaCO <sub>3</sub> )			
Calcium (Ca <sup>++</sup> )			
Magnesium (Mg <sup>++</sup> )			
Chloride (Cl <sup>-</sup> )			
Sulfate (SO <sub>4</sub> <sup>-</sup> )			

REMARKS:

COLLECTOR  
REPORT TO

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

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JHG 24 January 1972 1h

During the January survey substantial (28%) increases were noted in total solids and conductivity in the river due to the Estherville effluent. Biochemical oxygen demand (BOD) increased from 2 ppm above Estherville to 14 ppm and 17 ppm respectively at the first two sampling stations below the treatment plant.

Ammonia-nitrogen concentrations were greater than the 2 ppm water quality standard for more than seven miles below Estherville during the January survey. Other parameters of water quality were correspondingly changed by the waste input.

The January sample taken at the Emmet County Road A-33 bridge about 3.7 miles downstream from the Estherville outfall obviously indicated the presence of a waste slug. Water quality parameters were significantly poorer in this sample than the one taken immediately downstream from the outfall.

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As depicted by Figures 2, 3 and 4 wastes from the Estherville Sewage Treatment Plant consistently depleted dissolved oxygen concentrations in the river to levels below the minimum required by Iowa Water Quality Standards (4.0 ppm). During the August surveys the lowest dissolved oxygen concentrations occurred at the Highway 4 bridge which is only about 1/2 miles downstream from the Estherville STP discharge. Recovery of dissolved oxygen concentrations to levels exceeding the minimum required by water quality standards generally occurred by the time the river reached Wallingford or shortly beyond, a distance of about 7 miles. The lowest observed oxygen concentration was 1.3 ppm and this occurred at the Highway 4 bridge on the morning of August 24.

The January survey demonstrated that the winter oxygen sag occurred in the vicinity of Graettinger, a distance of about 14 miles below the Estherville discharge. Recovery to acceptable dissolved oxygen levels occurred between Graettinger and Emmetsburg. The lowest oxygen concentration observed during the January survey was 2.0 ppm near Graettinger.

Dissolved oxygen concentrations upstream from the Estherville area were often substantially lower than saturation values and in one instance were lower than the minimum water quality standard of 4.0 ppm. During the August surveys dissolved oxygen concentrations during the early morning ranged from 3.7 - 5.7 ppm. During that period the river was obviously experiencing a plankton bloom which could at least partially be responsible for the low dissolved oxygen concentrations which occurred in the early morning above Estherville. We have no explanation for the fact that dissolved oxygen concentrations were usually lower at the power plant foot-bridge (above power plant) and the Highway 9 bridge than at the Emmet County Road N-26 bridge north of Estherville. We did not travel this entire river reach by foot so there was the possibility that a waste discharge in that area could have been responsible for the drop in dissolved oxygen.

Figure 2. Dissolved oxygen concentrations in the West Fork Des Moines River August 19 and 20, 1971.

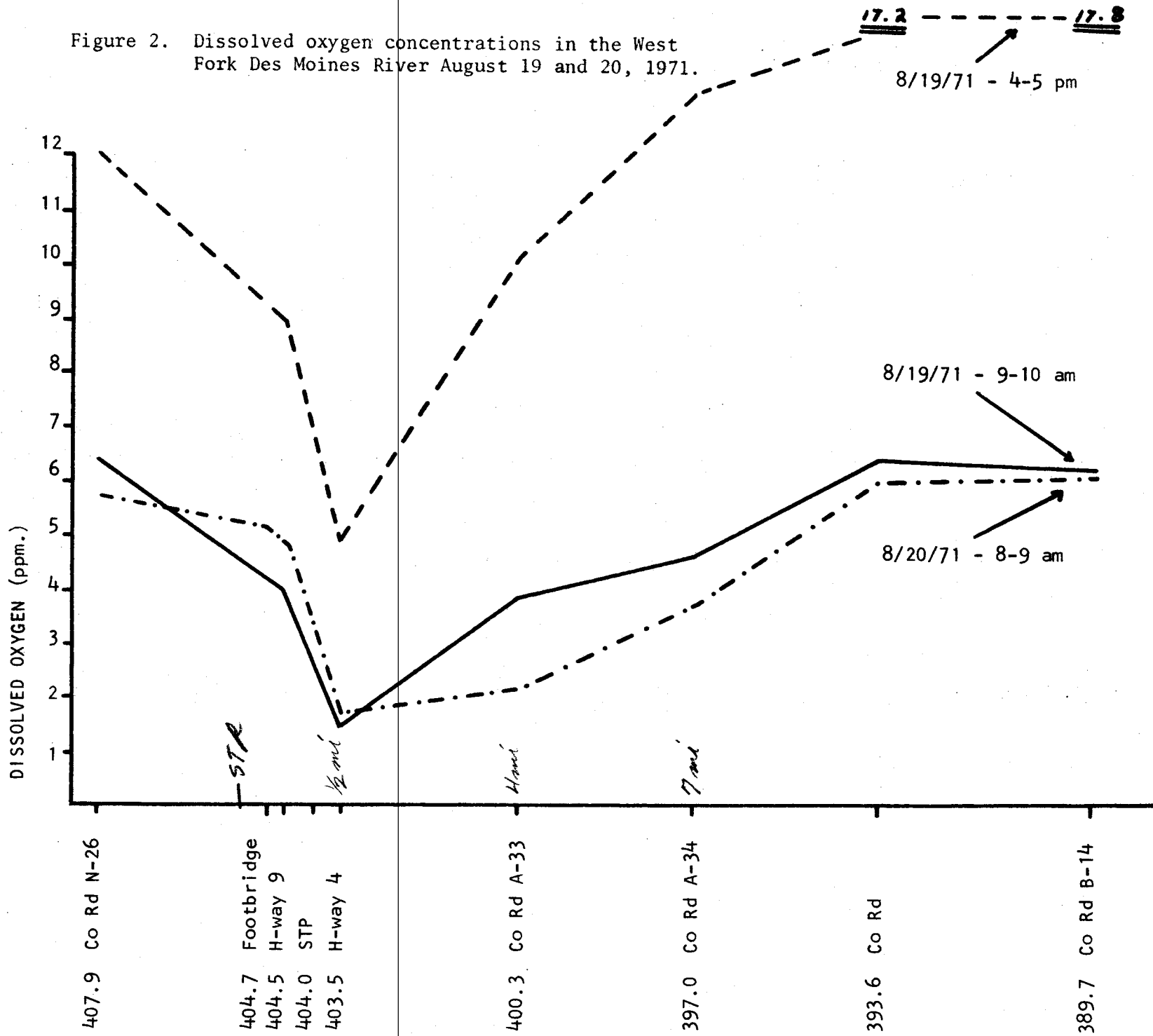
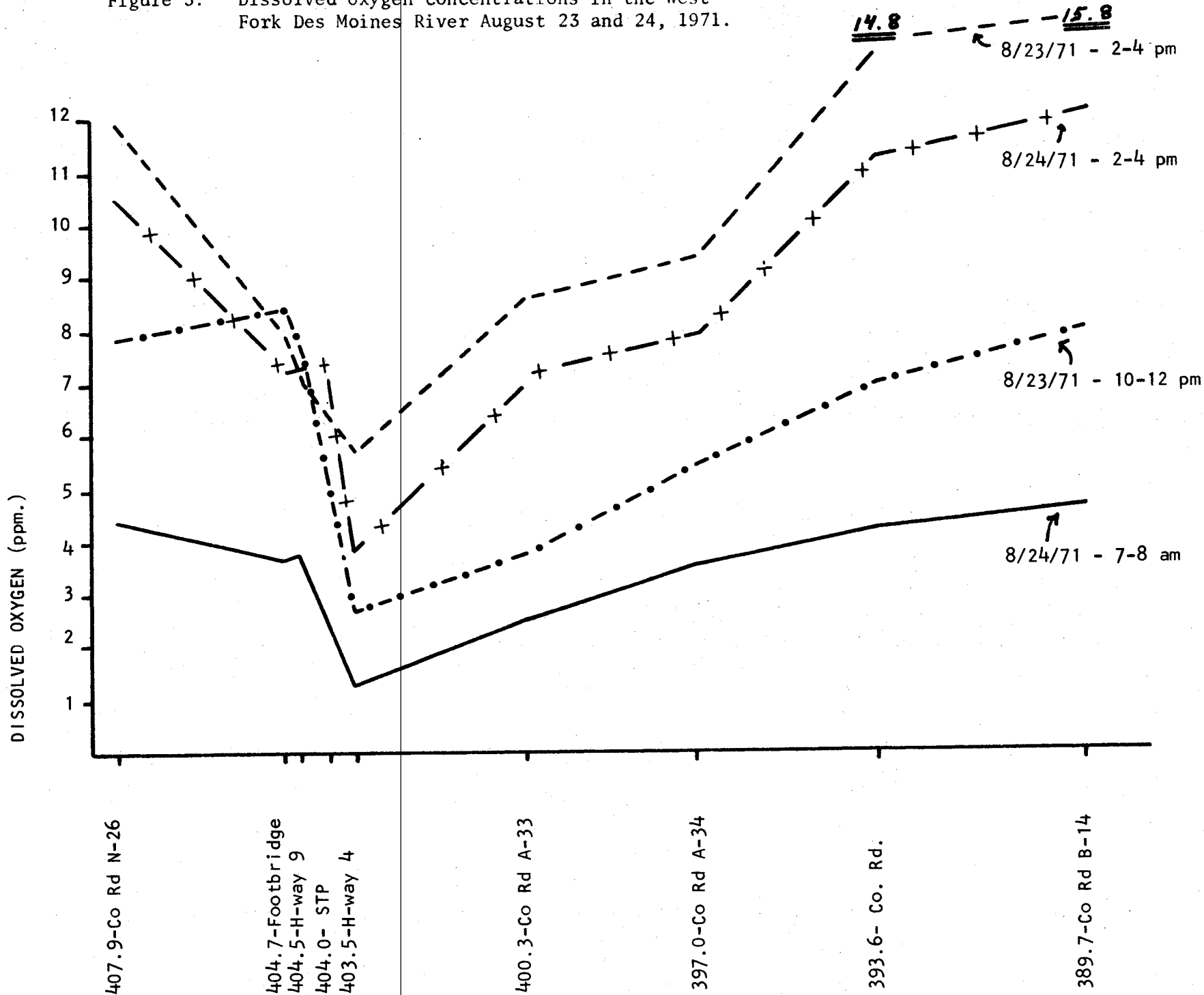


Figure 3. Dissolved oxygen concentrations in the West Fork Des Moines River August 23 and 24, 1971.





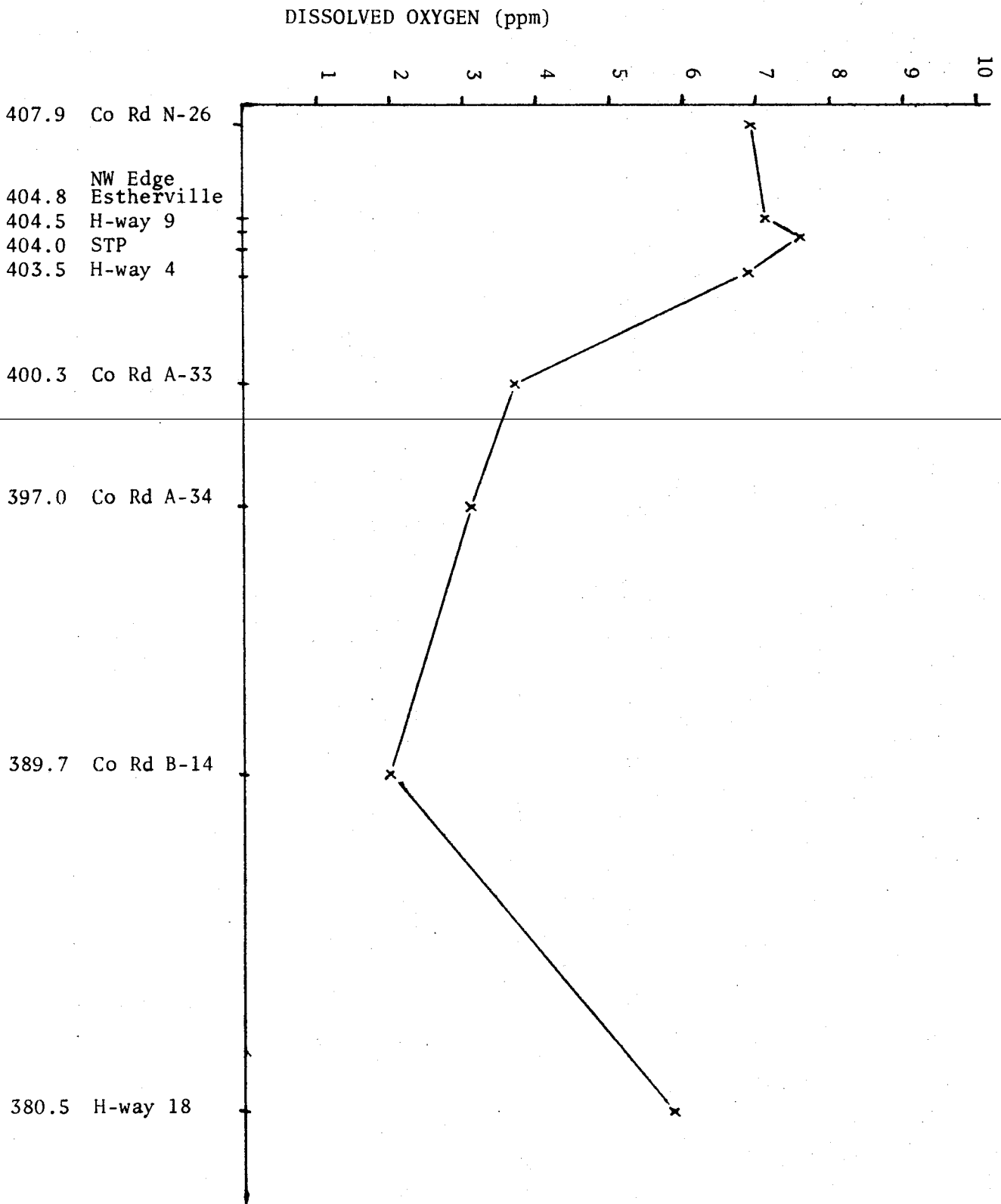


Figure 4. Dissolved oxygen concentrations in the West Fork Des Moines River on January 11, 1972.

During the January survey no decrease in dissolved oxygen was observed in the first three stations all of which are above the Estherville Sewage Treatment Plant. Dissolved oxygen concentrations at the control stations were running at about 50% saturation which is about average in a small river during a period of ice cover.

If dissolved oxygen concentrations above the Estherville STP had been at saturation during the early morning hours of the summer, the treated wastes from Estherville would still have caused unacceptably low dissolved oxygen concentrations in the River. Oxygen depletions attributable to the Estherville discharge ranged from 2.5 - 4.9 ppm. If a saturation value of 8.0 ppm at nominal summer temperatures were assumed the resulting stream values would have ranged from 3.1 - 5.5 ppm.

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### Biological Results

Three artificial substrate samplers of the multiple plate variety were placed in the river during the period from July 1 to August 17, 1971. One of these samplers was placed upstream from influence of Estherville and two were located downstream from the Estherville STP outfall. The following genera of benthic organisms colonized those samplers during the exposure period.

Station 1: River mile 407.9 near Emmet County Road N-26 bridge north of Estherville.

<u>Trichoptera</u> (Caddis Flies)	# of Organisms	Designation
<u>Cheumatopsyche</u> sp.	1670	C
<u>Hydropsyche</u> sp.	343	C
<u>Neureclipsis</u> sp.	38	C
<u>Ephemeroptera</u> (May Flies)		
<u>Ameletus</u> sp.	25	C
<u>Caenis</u> sp.	62	C
<u>Heptagenia</u> sp.	21	C
<u>Isonychia</u> sp.	56	C
<u>Stenonema</u> sp.	33	C
<u>Plecoptera</u> (Stone Flies)		
<u>Pteronarcys</u> sp.	1	C
<u>Diptera</u> (Midges)		
Tendipedidae	155	F
<u>Coleoptera</u> (Beetles)		
<u>Stenelmis</u> sp.	3	F

Station 6: River miles 400.3, Emmet County Road A-33 bridge south of Estherville.

<u>Trichoptera</u>		
<u>Cheumatopsyche sp.</u>	8	C
<u>Hydropsyche sp.</u>	23	C
<u>Ephemeroptera</u>		
<u>Heptagenia sp.</u>	2	C
<u>Stenonema sp.</u>	1	C
<u>Diptera (Midges)</u>		
<u>Tendipedidae</u>	40	F

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Station 8: River mile 393.6, first Emmet County Road bridge below Wallingford.

<u>Trichoptera</u>		
<u>Cheumatopsyche sp.</u>	139	C
<u>Hydropsyche sp.</u>	31	C
<u>Ephemeroptera</u>		
<u>Ameletus sp.</u>	9	C
<u>Baetisca sp.</u>	1	C
<u>Caenis sp.</u>	61	C
<u>Heptagenia sp.</u>	5	C
<u>Stenonema sp.</u>	8	C
<u>Plecoptera</u>		
<u>Pteronarcys sp.</u>	1	C
<u>Diptera</u>		
<u>Tendipedidae</u>	110	F
<u>Simulium sp.</u>	4	F
<u>Coleoptera</u>		
<u>Stenelmis sp.</u>	1	F
<u>Crustacea</u>		
<u>Hyalella Azteca</u>	1	F

The biological results reflected in general the same trends as the physico-chemical data. A diverse and abundant population of benthic organisms were present at the control station above Estherville even though that area occasionally had dissolved oxygen concentrations near the lower limits specified by Iowa Water Quality Standards.

The first biological sampler below the Estherville outfall (3.7 miles) was obviously affected by that waste discharge. Both the diversity and numbers of organisms were substantially less than the control station.

A good deal of biological recovery had occurred at the point ten miles below Estherville (Station 8), however, the number of benthic organisms present were still far less than above the Estherville discharge.

## Discussion

The Limnology Division studies have demonstrated that the effluent from the Estherville Sewage Treatment Plant has caused pollution in the West Fork Des Moines River for a distance of 10-20 miles below Estherville. Violations of water quality standards for ammonia-nitrogen and dissolved oxygen have occurred and a corresponding damage to the benthic inhabitants (fish-food organisms) of the river was also demonstrated.

Although the city of Estherville has secondary waste treatment facilities consisting of trickling filters and sludge digestion, the effluent quality has been relatively poor according to the mail-order BOD results and the monthly operation reports submitted to the State Department of Health. The relatively high BOD's of the plant effluent can be attributed to the industrial wastes which are treated by the Estherville facility. In addition to the high organic loading to the plant, the industrial wastes also create a grease problem which hinders plant efficiency.

The seven day, ten year low flow in the West Fork at Estherville is less than 0.1 cfs or in other words the river is practically a dry run during the extreme condition. To meet water quality standards then, the Estherville plant would have to achieve a very high degree of treatment as the river flow below Estherville would consist primarily of treated sewage with little or no dilution. In all but the extreme years, however, a flow is maintained in the river of sufficient magnitude to support aquatic life within the river reach below Estherville. For example, in the water years of 1969, 1970 and 1971 the minimum one day flows recorded at Estherville were 54, 21 and 11 cfs respectively.

There has been some discussion of changing the stream classification at Estherville so that the specific water quality criteria for aquatic life use would no longer apply. Rather than employing this negative approach, it would seem more desirable to first achieve the highest degree of secondary treatment available at Estherville before evaluating additional needs.

It would not be unreasonable to expect a higher quality secondary effluent than the Estherville plant has been producing, particularly if the industries minimized their organic and grease loadings to the city plant.

Recommendations

The Limnology Division recommends that the Water Pollution Control Commission find that a condition pollution exists in the West Fork Des Moines River downstream from the city of Estherville and that the city be called in for negotiations to correct that problem.



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Principal Limnologist

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APPENDIX

Values of Dissolved Oxygen  
Concentrations Depicted in Figures  
2, 3 and 4

Dissolved Oxygen Concentrations  
West Fork Des Moines River  
Estherville, Iowa

August 23, 1971

	<u>Station</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>
RM 407.9	Co. Rd. N-26	3:30 pm	29°C	11.9	10:30 pm	28.5°C	7.8
404.7	Power Plant Footbridge	3:10	28	7.8	10:40	28.5	8.4
404.5	Highway 9	3:05	28	7.0	10:45	28	7.5
403.5	Highway 4	2:55	28	5.7	10:50	26.5	2.7
400.3	Co. Rd. A-33	2:45	29	8.6	11:00	27	3.7
397.0	Wallingford	2:35	28.5	9.4	11:05	27	5.4
393.6	1st Br. below Wallingford	2:24	29	14.8	11:20	27	6.9
389.7	Graetinger	2:10	28	15.8	11:35	26.5	7.9

August 24, 1971

	<u>Station</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>
RM 407.9	Co. Rd. N-26	7:00 am	24.5°C	4.4	3:15 pm	25°C	10.5
404.7	Power Plant Footbridge	7:10	25.5	3.7	3:30	25	7.3
404.5	Highway 9	7:15	25.5	3.8	3:35	25	7.4
403.5	Highway 4	7:19	25.5	1.3	3:45	26	3.7
400.3	Co. Rd. A-33	7:26	24	2.5	3:55	26	7.2
397.0	Wallingford	7:34	24	3.5	4:03	26.5	7.9
393.6	1st Br. below Wallingford	7:42	24	4.2	4:12	25.5	11.3
389.7	Graetinger	7:55	24	4.6	4:25	26	12.2



August 19, 1971

	<u>Station</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>
RM 407.9	Co. Rd. N-26	10:05 am	23°C	6.4	5:20 pm	25.4°C	12.0
404.7	Power Plant Footbridge	---	---	---	---	---	---
404.5	Highway 9	9:55	23.8	4.0	5:26	25.4	8.8
403.5	Highway 4	9:45	23.6	1.5	5:02	25.4	4.8
400.3	Co. Rd. A-33	9:35	22.6	3.8	4:55	26.1	10.2
397.0	Wallingford	9:20	22.4	4.7	4:45	25.0	13.2
393.6	1st Br. below Wallingford	9:10	22.8	6.4	4:25	25.7	17.2
389.7	Graetinger	8:55	22.6	6.2	4:20	24.5	17.8

August 20, 1971

	<u>Station</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>
RM 407.9	Co. Rd. N-26	8:15 am	22.5°C	5.7
404.7	Power Plant Footbridge	8:30	23	5.2
404.5	Highway 9	7:58	23.0	4.8
403.5	Highway 4	7:50	23.4	1.7
400.3	Co. Rd. A-33	7:45	22.3	2.2
397.0	Wallingford	7:35	22.2	3.7
393.6	1st Br. below Wallingford	8:45	22.0	6.0
389.7	Graetinger	8:55	21.9	6.2

WINTER SURVEY

Dissolved Oxygen Concentrations  
West Fork Des Moines River  
Estherville, Iowa

January 11, 1972

	<u>Station</u>	<u>Time</u>	<u>Temp.</u>	<u>D.O.</u>
RM 407.9	Co. Rd. N-26	9:15 am	0°	6.9
404.8	NW edge of Estherville	9:50	0	7.2
404.5	Highway 9	10:15	0	7.6
403.5	Highway 4	11:00	0	6.9
400.3	Co. Rd. A-33	11:15	0	3.7
397.0	Co. Rd. A-34	11:45	0	3.1
389.7	Co. Rd. B-14	12:20 pm	0	2.0
380.5	Highway 18-NW Emmetsburg	1:20	0	5.8
375.5	Highway 4 - S Emmetsburg	1:40	0	9.1
367.0	Co. Rd. B-55	2:05	0	9.9
356.0	Highway 15	2:15	0	8.4
343.5	Co. Rd. C-29	3:15	0	10.2
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