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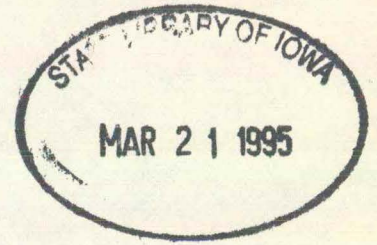
*The State Hygienic
Laboratory*

MEDICAL LABORATORIES BUILDING

THE UNIVERSITY OF IOWA

IOWA CITY, IOWA 52240





MISSISSIPPI RIVER WATER QUALITY
SURVEY
BURLINGTON, IOWA
RIVER MILES 397 - 404
#70-41

Submitted to the Iowa Water Pollution Control Commission
by the
State Hygienic Laboratory
April 24, 1970

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The City of Burlington is located near the upper end of pool 19 on the Mississippi River between Muscatine, which is 50 miles upstream, and Ft. Madison, which is about 20 miles down-river. Unlike the other six Iowa Mississippi River cities, Burlington has no large organic waste producing industry, subsequently the municipal sewage treatment plant receives primarily domestic wastes from a population of 31,000 and discharges an estimated waste load to the river of 16,000 P.E. after pre-chlorination and primary treatment. To put the significance of this discharge into perspective, Dubuque will have a discharge of approximately 50,000 P.E. after its secondary treatment plant begins operation in the fall of this year.

This report summarized a study of the Mississippi in the Burlington area during April 7-9 and April 14. River flows during this period were relatively high. Estimated discharge rates at dam 18 were 64,900, 65,400 and 61,000 cfs for April 7, 8 and 9 respectively. Discharge rates for April 13 through 17 were 72,400, 85,700, 91,000 90,500 and 88,800 respectively.

The initial report on the limnology of the Mississippi River in the Burlington area was submitted to the Iowa Water Pollution Control Commission by the State Hygienic Laboratory on October 28, 1969. That report summarized existing conditions in early October and also included water quality data collected during February of 1969. During both the February and October sampling periods, the river flows were relatively low with approximate discharge rates at Clinton of 35,000 cfs and 28,000 cfs respectively. To summarize the first report, it demonstrated that all measurable effects from the Burlington discharge were restricted to a narrow strip of water along the Iowa bank. A slight degradation in water chemistry was observed in this strip immediately below the outfall, however, these effects disappeared within 1.4-2.4 miles downstream. Similarly there was a slight elevation in contamination by Fecal Coliform organisms but this also disappeared within the reach described above. Biologically, some localized degradation was observed just downstream from the storm sewer discharges above the sewage plant outfall. Downstream from the sewage treatment plant, significant biological degradation was present along the shoreline for the first 0.5 mile approximately but below this zone, although there was still evidence of the waste influence, degradation was relatively minor.

METHODS

Chemical, bacteriological, and biological samples were collected both upstream and downstream from the sewage treatment plant outfall and also across the river. As in previous studies, primary emphasis was placed on collecting samples along the Iowa shoreline since it had been established that wastes discharged from or near the bank mix very slowly with the main flow of the river. Temperature and pH were measured in the field and dissolved oxygen samples were fixed immediately but titrated in the laboratory. Chemical and bacteriological samples were preserved by refrigeration until the analyses could be performed. All chemical analyses were conducted according to Standard Methods For The Examination Of Water and Wastewater, 12th edition.

Benthos samples were collected with a Ponar dredge and were sieved through a number 30 mesh screen to separate the organisms from the mud and other debris. The specimens were preserved in 70% ethanol until they could be counted and identified in the laboratory.

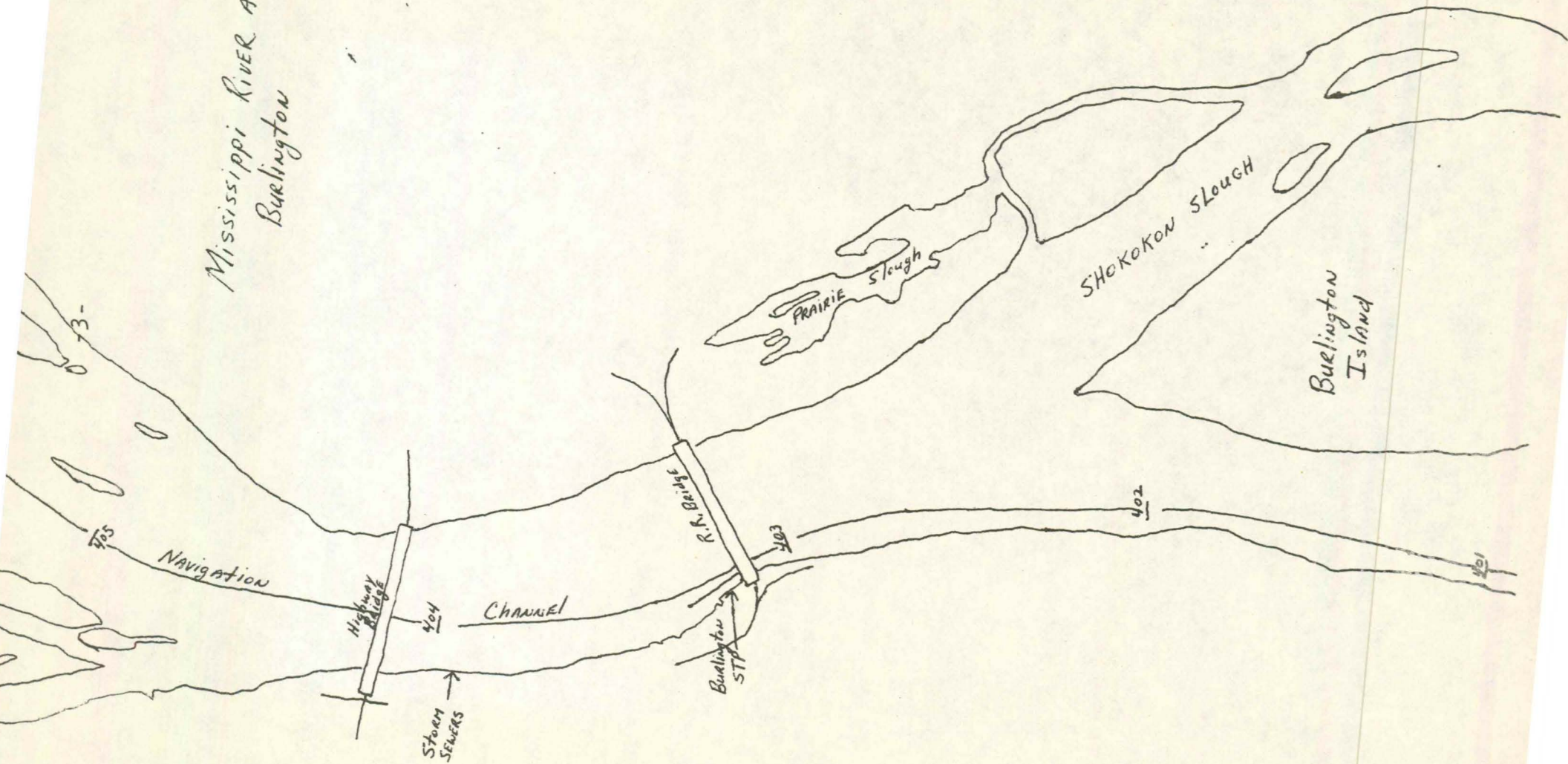
Due to the problems of fragmentation of tubificids and other related Oligochaetes in alcohol, no attempt was made to count these organisms. Instead, the worms and worm fragments were picked from the samples, dried overnight at 103° C and weighed to compare the relative dry weights of worms at significant stations. No attempts were made to correlate dry weight with numbers of worms in each sample.

DISCUSSION (CHEMISTRY AND BACTERIOLOGY)

Rather than describing the water quality observed at Burlington on a station to station basis, the significant points and trends will be discussed here. Those interested in the details should refer to Tables 1 through 10 which itemize the data by stations.

Upstream from the Burlington outfall, water quality was very good and was similar from the Iowa to the Illinois side of the river with the exception of nitrate-nitrogen concentrations. These concentrations were 1 to 1.5 mg/l higher on the Iowa side than at mid-river or on the Illinois side. This was probably due to the effects of the Iowa tributary streams (specifically the Iowa River), all

Mississippi River at
Burlington



Burlington

STATE HYGIENIC LABORATORY

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 Table 1

Town or Station	Burlington			
Source	Mississippi River			STP
Specific Location	Mile 403.4	Mile 403.4	Mile 403.4	Mile 403.2
	30 yds from Iowa	Mid-channel	40 yds from	Effluent
Date Collected	7 Apr 70		Illinois bank	
Date Received	8 Apr 70			
Bottle Number				
Laboratory Number	4753	4754	4755	4756
Bacterial: Exam. By				
M.P.N. Coliform/100 ml.	100	20	< 10	< 1000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	8.1	8.3	8.35	7.85
Alkalinity P	8.0	12.0	10.0	None
T	168	147	154	220
Spec Cond at 25°C x 10 ⁻⁵	44	37	40	88
Turbidity (Est)	150	110	120	160
Organic Nitrogen As N	1.5	1.7	1.7	9.6
Ammonia Nitrogen As N	0.01	0.04	0.05	6.9
Nitrite Nitrogen As N	0.023	0.012	0.017	0.12
Nitrate Nitrogen As N	1.9	0.4	0.9	1.5
Total Nitrogen As N				
Total Solids	332	300	339	664
Fixed Solids	219	200	229	447
Volatile Solids	113	100	110	217
Total Suspended Solids	79	87	99	61
Fixed Suspended Solids	56	69	86	31
Volatile Suspended Solids	23	18	13	30
Total Dissolved Solids	253	213	240	603
Fixed Dissolved Solids	163	131	143	416
Volatile Dissolved Solids	90	82	97	187
Soluble Phosphate (PO ₄)	0.1	< 0.1	< 0.1	7.6
Total Phosphate (PO ₄)	0.5	0.5	0.5	20
Dissolved Oxygen	14.0	15.7	15.3	9.4
B. O. D. 5-day 20° C.	7	9	9	95
COD	31.1	45.6	45.6	214
Total Hardness mg/l	198	184	194	246
" " gpg	11.6	10.7	11.3	14.4
Field Data:				
Temperature °C	8.5	8.5	8.5	11.7
Remarks: Time	11:10 am	11:15 am	11:25 am	11:35 am
pH	8.6			

Collector Dr Gakstatter, Dr Shobe, P Briedis

Report To _____

R. L. Morris, Ph.D.

JHG Assistant Director & Principal Chemist

20 Apr 70 bj

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Table 2

Town or Station	Burlington			
Source	Mississippi River			
Specific Location	Mile 403.15	Mile 403	Mile 402.7	Mile 402.2
Under RR bridge, 10 yds from shore	20 yds from	20 yds from	20 yds from	20 yds from
Date Collected	7 Apr 70	Iowa shore	Iowa shore	Iowa
Date Received	8 Apr 70			
Bottle Number				
Laboratory Number	4757	4758	4759	4760
Bacterial: Exam. By				
M. coli Coliform/100 ml.	200	60	30	10
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	8.2	8.2	8.2	8.15
Alkalinity P	2.0			
T	168			
Spec Cond at 25°C x 10 ⁻⁵	45	45	44	44
Turbidity (Est)	140	100	130	150
Organic Nitrogen As N	1.7	1.7	1.5	1.5
Ammonia Nitrogen As N	0.20	0.12	0.11	0.08
Nitrite Nitrogen As N	0.029	0.028	0.021	0.028
Nitrate Nitrogen As N	1.9	2.0	1.8	1.8
Total Nitrogen As N				
Total Solids	358			
Fixed Solids	282			
Volatile Solids	76			
Total Suspended Solids	84			
Fixed Suspended Solids	67			
Volatile Suspended Solids	17			
Total Dissolved Solids	274			
Fixed Dissolved Solids	215			
Volatile Dissolved Solids	59			
Soluble Phosphate (PO ₄)	0.5	0.2	0.2	0.1
Total Phosphate (PO ₄)	1.0	0.7	0.6	0.6
Dissolved Oxygen	13.8	13.4	14.0	13.6
B. O. D. 5-day 20° C.	8	7	7	7
COD	43.6	45.6	39.4	41.5
Total Hardness mg/l	212			
gpg	12.4			
Field Data:				
Temperature °C	8.5	8.5	8.5	8.5
Remarks: Time	11:45 am	11:50 am	12:00 pm	12:10 pm

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JHG Assistant Director & Principal Chemist

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 Table 3

Town or Station	Burlington			
Source	Mississippi River			
Specific Location	Mile 401.7	Mile 400.8	Mile 400.8	Mile 400.8
	20 yds from Iowa shore	20 yds from	Mid-River	50 yds from
Date Collected	7 Apr 70	Iowa		Burlington
Date Received	8 Apr 70			Island
Bottle Number				
Laboratory Number	4761	4762	4763	4764
Bacterial: Exam. By				
M.P.N. Coliform/100 ml.	10	70	< 10	< 10
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	8.1	8.2	8.4	8.45
Alkalinity P		4.0	10.0	14.0
T		162	142	144
Sec Cond at 25°C x 10 ⁻⁵	44	44	36	36
Turbidity (Est)	120	110	110	130
Organic Nitrogen As N	1.4	1.5	1.7	1.8
Ammonia Nitrogen As N	0.05	0.04	0.08	0.03
Nitrite Nitrogen As N	0.029	0.028	0.024	0.019
Nitrate Nitrogen As N	1.8	1.8	0.6	0.3
Total Nitrogen As N				
Total Solids		330	300	298
Fixed Solids		243	184	178
Volatile Solids		87	116	120
Total Suspended Solids		69	85	77
Fixed Suspended Solids		69	68	59
Volatile Suspended Solids		0	17	18
Total Dissolved Solids		261	215	221
Fixed Dissolved Solids		174	116	119
Volatile Dissolved Solids		87	99	102
Soluble Phosphate (PO ₄)	0.1	0.1	< 0.1	< 0.1
Total Phosphate (PO ₄)	0.5	0.1	0.3	0.2
Dissolved Oxygen	14.2	13.6	15.7	16.1
B.O.D. 5-day 20° C.	7	7	9	9
COD	41.5	31.1	39.4	39.4
Total Hardness mg/l		204	172	
gpg		11.9	10.1	
Field Data:				
Temperature °C	8.5	8.5	8.5	8.5
Remarks: Time	12:15 pm	12:25 pm	12:30 pm	12:40 pm
pH				8.6

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 Table 4

Town or Station	Burlington			
Source	Mississippi River STP			
Specific Location	Mile 403.4	Mile 403.2	Mile 403	Mile 402.7
	30 yds from Iowa	Effluent	25 yds from Iowa shore	20 yds from Iowa shore
Date Collected	8 Apr 70			
Date Received	8 Apr 70			
Bottle Number				
Laboratory Number	4765	4766	4767	4768
Bacterial: Exam. By				
F M R X Coliform/100 ml.	< 10	< 1000	< 100	< 10
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	8.2	7.55	8.15	8.2
Alkalinity P	6.0			
T	164			
Spec Cond at 25°C x 10 ⁻⁵	41	98	43	42
Turbidity (Est)	130	93	130	110
Organic Nitrogen As N	1.6	4.9	1.6	1.6
Ammonia Nitrogen As N	0.01	4.2	0.03	0.07
Nitrite Nitrogen As N	0.018	0.055	0.023	0.025
Nitrate Nitrogen As N	1.8	1.9	1.8	1.6
Total Nitrogen As N				
Total Solids	315	661		
Fixed Solids	193	471		
Volatile Solids	122	190		
Total Suspended Solids	74	34		
Fixed Suspended Solids	60	7		
Volatile Suspended Solids	14	27		
Total Dissolved Solids	241	627		
Fixed Dissolved Solids	133	464		
Volatile Dissolved Solids	108	163		
Soluble Phosphate (PO ₄)	< 0.1	4.0	< 0.1	< 0.1
Total Phosphate (PO ₄)	0.2	6.9	0.5	0.4
Dissolved Oxygen	13.2	9.9	13.3	13.2
B. O. D. 5-day 20° C.	6	55	7	6
COD	35.3	83.0	37.3	35.3
Total Hardness mg/l				
gpg				
Field Data:				
Temperature °C	9		9	9
Remarks: Time	8:40 am	8:50 am	9:00 am	9:05 am

Collector Dr Gakstatter, Dr Shobe, P Briedis

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JHG

Assistant Director & Principal Chemist

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Des Moines Branch
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 Table 5

Town or Station	Burlington		
Source	Mississippi River		
Specific Location	Mile 402.2	Mile 402.2	Mile 402.2
	20 yds from Iowa	150 yds from Iowa	150 yds from Burlington Island
Date Collected	8 Apr 70	8 Apr 70	8 Apr 70
Date Received	8 Apr 70		
Bottle Number			
Laboratory Number	4769	4770	4771
Bacterial: Exam. By			
M.P.O. Coliform/100 ml.	10	< 10	20
Chemical: (MG/L) Exam. By			
Fluoride DMB			
Local			
Detergents (ABS)			
CSCFE			
pH Value	8.3	8.35	8.5
Alkalinity P	8.0		
T	160		
Sec Cond at 25°C x 10 ⁻⁵	41	40	35
Turbidity (Est)	130	140	130
Organic Nitrogen As N	1.6	1.7	1.8
Ammonia Nitrogen As N	0.03	0.03	0.03
Nitrite Nitrogen As N	0.025	0.020	0.013
Nitrate Nitrogen As N	1.6	1.2	0.4
Total Nitrogen As N			
Total Solids			312
Fixed Solids			220
Volatile Solids			92
Total Suspended Solids			94
Fixed Suspended Solids			75
Volatile Suspended Solids			19
Total Dissolved Solids			218
Fixed Dissolved Solids			145
Volatile Dissolved Solids			73
Soluble Phosphate (PO ₄)	< 0.1	< 0.1	< 0.1
Total Phosphate (PO ₄)	0.5	0.4	0.3
Dissolved Oxygen	13.4	13.4	14.2
B. O. D. 5-day 20° C.	6	7	9
COD	37.3	41.5	51.9
Field Data:			
Temperature °C	9	9	9
Remarks: Time	9:10 am	9:15 am	9:20 am

Collector Dr Gakstatter, Dr Shobe, P Briedis

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R. L. Morris, Ph.D.

JHG Assistant Director & Principal Chemist
 20 Apr 70 bj

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 Table 6

Town or Station	Burlington			
Source	Mississippi River Mile 403.4			
Specific Location	Iowa side - 50 yds from shore			Mid-River
	4' deep	8' deep	12' deep	
Date Collected	14 Apr 70			
Date Received	15 Apr 70			
Bottle Number				
Bottle Number				
Laboratory Number	4849	4850	4851	4852
Bacterial: Exam. By				
M.P.O. Coliform/100 ml.	20	70	10	360
total Coliform/100ml	800	3500	600	11,000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	8.8	8.5	8.45	
Alkalinity P				
T				
Spec Cond at 25°C x 10 ⁻⁵	38	39	40	
turbidity (Est)	130	130	130	
Organic Nitrogen As N	1.5	1.5	1.5	
Ammonia Nitrogen As N	< 0.01	0.04	0.04	
Nitrite Nitrogen As N	0.022	0.023	0.024	
Nitrate Nitrogen As N	1.2	1.3	1.3	
Total Nitrogen As N				
Total Solids	327	345	350	
Fixed Solids	205	228	236	
Volatile Solids	122	117	114	
Total Suspended Solids	95	108	109	
Fixed Suspended Solids	71	98	96	
Volatile Suspended Solids	24	10	13	
Total Dissolved Solids	232	237	241	
Fixed Dissolved Solids	134	130	140	
Volatile Dissolved Solids	98	107	101	
Soluble Phosphate (PO ₄)	0.1	0.1	0.1	
Total Phosphate (PO ₄)	0.4	0.5	0.5	
Dissolved Oxygen	11.1	11.0	11.0	11.0
B. O. D. 5-day 20° C.	6	6	6	
COD	37.2	35.1	39.5	
Field Data:				
Time	10:30 am	10:35 am	10:35 am	10:45 am

Remarks:

Collector Dr Shobe, P Briedis

Report To _____

R. L. Morris, Ph.D.

JHG Assistant Director & Principal Chemist
 22 Apr 70 bj

STATE HYGIENIC LABORATORY

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Table 7

Town or Station	Burlington			
Source	Mississippi River			
Specific Location	Mile 403.4	Mile 403.2	Mile 403.15	Mile 403.0
	Illinois side-	STP outfall		
Date Collected	60 yds from shore			
Date Received Recd.	14 Apr 70			
Bottle Number Collected	15 Apr 70			
Bottle Number				
Laboratory Number	4853	4854	4855	4856
Bacterial: Exam. By				
IF XXXX Coliform/100 ml.	800	200	20	2400
Total Coliform/100ml	16,000	9000	3000	30,000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value				
Alkalinity P				
T				
Organic Nitrogen As N				
Ammonia Nitrogen As N				
Nitrite Nitrogen As N				
Nitrate Nitrogen As N				
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)				
Total Phosphate (PO ₄)				
Dissolved Oxygen	11.0	9.2	11.5	11.1
B. O. D. 5-day 20° C.				
COD				
Field Data:				
Time	10:50 am	11:15 am	12:50 pm	
Remarks:				

Collector Dr Shobe, P Briedis

Report To _____

R. L. Morris, Ph.D.

JHG Assistant Director & Principal Chemist
22 Apr 70 bj

STATE HYGIENIC LABORATORY

Des Moines Branch
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 East 7th & Court
 Des Moines 9, Iowa
 Table 8

Town or Station	Burlington			
Source	Mississippi River			
Specific Location	Mile 402.7			Mile 402.2
	4' deep	8' deep	12' deep	
Date Collected	14 Apr 70			
Date Received	15 Apr 70			
Bottle Number				
Bottle Number				
Laboratory Number	4857	4858	4859	4860
Bacterial: Exam. By				
XXXX Coliform/100 ml.	690	1000	540	50
Total Coliform/100ml	1000	17,000	26,000	3000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value	8.5	8.5	8.5	
Alkalinity P				
T				
Spec Cond at 25°C x 10 ⁻⁵	40	41	41	
Turbidity (Est)	120	120	120	
Organic Nitrogen As N	1.5	1.5	1.5	
Ammonia Nitrogen As N	0.03	0.01	0.04	
Nitrite Nitrogen As N	0.024	0.022	0.017	
Nitrate Nitrogen As N	1.3	1.3	1.1	
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)	0.2	0.2	0.1	
Total Phosphate (PO ₄)	0.5	0.5	0.6	
Dissolved Oxygen	11.6	11.5	11.5	11.5
B ₅ O ₂ D ₅ 5-day 20° C.	7	7	6	
COD	35.1	37.2	37.2	
Field Data:				
Time	3:25 pm	3:35 pm	3:45 pm	1:20 pm

Remarks:

Collector Dr Shobe, P Briedis

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R. L. Morris, Ph.D.

JHG Assistant Director & Principal Chemist
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STATE HYGIENIC LABORATORY

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

Town or Station	Burlington			
Source	Mississippi River			
Specific Location	Mile 401.7	Mile 400.8		
		Iowa side -	20 yds from shore	
Date Collected	14 Apr 70	4' deep	8' deep	12' deep
Date Received	15 Apr 70			
Bottle Number				
Laboratory Number	4861	4862	4863	4864
Bacterial: Exam. By				
M.P.N. Coliform/100 ml.	100	70	40	110
Total Coliform/100ml	3100	3000	13,000	10,000
Chemical: (MG/L) Exam. By				
Fluoride DMB				
Local				
Detergents (ABS)				
CSCFE				
pH Value		8.5	8.5	8.5
Alkalinity P				
T				
Spec Cond at 25°C x 10 ⁻⁵		40	40	40
Turbidity (Est)		120	120	140
Organic Nitrogen As N		1.4	1.5	1.5
Ammonia Nitrogen As N		< 0.01	0.01	< 0.01
Nitrite Nitrogen As N		0.023	0.021	0.023
Nitrate Nitrogen As N		1.2	1.2	1.2
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)		< 0.1	< 0.1	< 0.1
Total Phosphate (PO ₄)		0.5	0.5	0.5
Dissolved Oxygen	11.5	11.5	11.5	11.5
B. O. D. 5-day 20° C.		7	7	7
COD		39.2	37.2	33.0
Field Data:				
Time	1:30 pm	2:10 pm	2:30 pm	2:45 pm

Remarks:

Collector Dr Shobe, P Briedis

Report To _____

R. L. Morris, Ph.D.

Assistant Director & Principal Chemist

JHG

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STATE HYGIENIC LABORATORY

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Des Moines 9, Iowa
Table 10

Town or Station	Burlington		
Source	Mississippi River		
Specific Location	Mile 400.8		
Date Collected	Midway between Burlington Island and Iowa side	Near (40 yds)	Burlington Island
Date Received	14 Apr 70		
Bottle Number Collected	15 Apr 70		
Bottle Number			
Laboratory Number	4865	4866	
Bacterial: Exam. By			
M.P.N. Coliform/100 ml.	70	320	
Total Coliform/100ml	7000	9000	
Chemical: (MG/L) Exam. By			
Fluoride DMB			
Local			
Detergents (ABS)			
CSCFE			
pH Value			
Alkalinity P			
T			
Organic Nitrogen As N			
Ammonia Nitrogen As N			
Nitrite Nitrogen As N			
Nitrate Nitrogen As N			
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)			
Total Phosphate (PO ₄)			
Dissolved Oxygen	11.2	11.2	
B. O. D. 5-day 20° C.			
COD			
Field Data:			
Time	3:00 pm	3:10 pm	
Remarks:			

Collector Dr Shobe, P Briedis

Report To _____

R. L. Morris, Ph.D.

JHG Assistant Director & Principal Chemist
22 Apr 70 bj

of which generally carry substantially greater nitrate-nitrogen loads than the Mississippi. Upstream waste discharges could also contribute to the observed concentrations to some extent.

The spring phytoplankton pulse was occurring at the time this study was made and this condition was reflected by the water chemistry. Dissolved oxygen concentrations were greater than saturation, pH levels as high as 8.8 were observed and organic nitrogen concentrations were unusually high. A total plankton count made on April 14 indicated that 82,300 organisms per milliliter were present which is a substantial phytoplankton population. April 7 and 8 were both bright, clear days which resulted in maximum photosynthetic activity by these organisms.

During the three days of sample collection (April 7, 8 and 14), the effect of the Burlington sewage treatment plant discharge on the river was very slight. The only measurable effect on water chemistry was observed on ammonia-nitrogen and phosphate concentrations. The maximum observed ammonia-nitrogen increase was 0.15 mg/l and this occurred approximately 50 yards below the waste outfall. Increases in soluble and total phosphate at this same station were in the order of 0.5 mg/l over upstream concentrations. One-half mile below the outfall, ammonia-nitrogens and phosphates were very close to values observed upstream and beyond this point water quality was essentially identical to that observed above the Burlington discharge.

An increase of approximately 20 mg/l total solids was also observed 50 yards below the waste outfall and this can be attributed to the dissolved solids content of the waste. A similar situation would be expected with secondary treatment also.

On April 7 and 8 fecal coliform numbers in the Mississippi at Burlington were extremely low. With the exception of the station 50 yards below the waste outfall, all fecal coliform levels were 100 organisms per 100 ml. or less. The station 50 yards below the outfall had 200 fecal coliforms per 100 ml. Other than at this station immediately below the outfall, there were no increases in fecal coliforms attributable to the Burlington wastes on April 7 and 8. A similar situation existed on April 14 although fecal coliform levels in general were higher than on the previous dates. One station, 0.2 mile downstream from the Burlington

outfall, had an increased fecal coliform count which was possibly due to the waste discharge. Generally speaking, however, the Burlington waste had no effect on fecal coliform levels in the river.

Total coliform counts were also made on the April 14 samples in addition to fecal coliforms. As expected, total coliform numbers were much greater and bore no particular relationship to fecals. As with fecal coliforms, the Burlington waste discharge had little or no effect on the downstream total coliform contamination.

The bacteriological results were somewhat unusual in that one would normally expect some measurable fecal coliform contamination from a domestic waste discharge. After contacting one of the Burlington Sewage Plant employees, it was learned that the city pre-chlorinates its raw waste, presumably to suppress obnoxious odors since the plant is located only a short distance from the downtown area. An inspection of the samples collected from the effluent indicated that a chlorine residual was present in one of these after 2 days of refrigeration.

In three samples taken directly from the Burlington outfall, fecal coliforms were always less than 1000 organisms per 100 milliliters. It can therefore be concluded that the pre-chlorination process, at least during the study period, was also doing a good job of disinfection.

DISCUSSION (BIOLOGY)

Seventeen stations were sampled in the Burlington area to determine the effects of storm water and the sewage treatment plant discharge on the Mississippi. All of the samples except one were taken by a 9 by 9 inch Ponar dredge which restricted sampling, by necessity, to the softer substrates, i.e. mud, sand, detritus or combinations of these. This type of bottom substrate typically supports a fauna which is facultative with respect to its water quality requirement or in other words can tolerate a wide range of oxygen concentrations and still carry on normal life cycles. When detritus such as sticks or leaves are present in the mud to provide a more stable surface, clean water loving organisms such as mayfly nymphs, stonefly nymphs and caddis larvae will also be found if the surrounding water is of suitably high quality.

In a situation such as Burlington, where at any given time only very small changes in water chemistry can be

detected, one would expect that any biological effects from the wastes would be restricted to areas where sedimentation occurs with the subsequent accumulation of organic debris. Areas of the river bed, which are scoured by the current, would be relatively unaffected and would support the same variety of organisms found in similar upstream areas.

Each station sampled is listed below in sequential order beginning at the upstream station and proceeding down-river. The organisms found at each location are tabulated and thus population densities per square foot are given. The notation of C, F or P beside each name designates the tolerance of the organism. C indicates that high quality water is required and those organisms bearing this notation (in this report) are also typically associated with a firm substrate. F indicates that the organism has a wide tolerance for water quality and may be found in clean water or semi-polluted situations. P indicates that the organism has a preference for polluted conditions and may be found when all of the F (facultative) and C (clean-water) organisms have been eliminated.

There is one correction to be made regarding the October, 1969, report. The caddis larvae reported as Hydropsyche sp. was most probably Cheumatopsyche sp. which is the predominant caddis in the Burlington area.

Mile 404.1: 20 yards from the Iowa bank just upstream from the River Terminal Warehouse and dock and above the large storm sewers. Bottom consisted of mud and detritus.

		Organisms/ft ²
<u>Cheumatopsyche sp.</u>	C	4
<u>Stenonema sp.</u>	C	5
<u>Caenis sp.</u>	C	2
<u>Hexagenia sp.</u>	F	192
<u>Procladius sp.</u>	F	27
<u>Coelotanypus sp.</u>	F	94
Tribe Pentaneurini	F	66
Ceratopogonidae	F	36
<u>Stenelmis sp.</u>	F	21
<u>Sphaeriidae</u>	F	73
<u>Campeloma sp.</u>	F	9
<u>Physa sp.</u>	F	2

		Organisms/ft ²
Hirudinea	F	2
Turbellaria	F	4
<u>Chaoborus sp.</u>	P	2
<u>Chironomus sp.</u>	P	131
<u>Oligochaetes</u>	P	52.7 mg

Mile 404.1: 15 yards from the Iowa bank upstream from the storm sewers, mud bottom.

<u>Cheumatopsyche sp.</u>	C	5
<u>Hexagenia sp.</u>	F	153
<u>Procladius sp.</u>	F	27
<u>Coelotanypus sp.</u>	F	9
Tribe Pentaneurini	F	37
<u>Cryptochironomus sp.</u>	F	2
<u>Ceratopogonidae</u>	F	2
<u>Stenelmis sp.</u>	F	11
<u>Sphaeriidae</u>	F	25
<u>Gomphus sp.</u>	F	2
<u>Chaoborus sp.</u>	P	5
<u>Chironomus sp.</u>	P	68
<u>Oligochaetes</u>	P	8.9 mg

The first two stations have a normal and abundant fauna for this type of substrate.

Mile 403.8: Near Iowa bank about 150 yards downstream from storm sewer discharges, mud bottom.

		Organisms/ft ²
<u>Hexagenia sp.</u>	F	21
<u>Procladius sp.</u>	F	100
<u>Coelotanypus sp.</u>	F	4
Tribe Pentaneurini	F	4
<u>Ceratopogonidae</u>	F	4
<u>Unionidae</u>	F	2
<u>Chaoborus sp.</u>	P	2
<u>Chironomus sp.</u>	P	69
<u>Oligochaetes</u>	P	253.6 mg

Mile 403.6: 15 yards from the Iowa shore between the grain loading dock and the Rutherford Potato Company, mud bottom.

		Organisms/ft ²
<u>Hexagenia</u> sp.	F	12
<u>Procladius</u> sp.	F	18
<u>Coelotanypus</u> sp.	F	2
Tribe Pentaneurini	F	5
Ceratopogonidae	F	2
Sphaeriidae	F	2
<u>Campeloma</u> sp.	F	2
<u>Chironomus</u> sp.	P	2
<u>Oligochaetes</u>	P	181.4 mg

Stations 403.8 and 403.6 are mildly polluted due to the storm sewer discharges.

Mile 403.3: 15 yards from the Iowa bank, mud bottom.

		Organisms/ft ²
<u>Hexagenia</u> sp	F	91
<u>Procladius</u> sp.	F	5
<u>Coelotanypus</u> sp.	F	5
Tribe Pentaneurini	F	4
Ceratopogonidae	F	7
Sphaeriidae	F	2
<u>Pleurocera</u> sp.	F	2
<u>Hirudinea</u>	F	9
<u>Chironomus</u> sp.	P	4
<u>Oligochaetes</u>	P	19.0 mg

Recovery from the storm water discharges is indicated at this station.

Mile 403.3: 50 yards from the Illinois bank, mud bottom.

		Organisms/ft ²
<u>Hexagenia</u> sp.	F	82
<u>Procladius</u> sp.	F	5
<u>Chironomus</u> sp.	P	2
<u>Oligochaetes</u>	P	4

This is typical of detritus-free mud substrate.

Mile 403.2: Burlington sewage treatment plant outfall.

Mile 403.05: Approximately 100 yards downstream from the Chicago, Burlington and Quincy Railroad Bridge and 25 yards from shore. The river bed was hard with a thin layer of mud and bacterial growth overlaying it.

		Organisms/ft ²
<u>Cheumatopsyche</u> sp.	C	2
<u>Isoperla</u> sp.	C	2
<u>Hexagenia</u> sp.	F	12
<u>Procladius</u> sp.	F	3
Tribe Pentaneurini	F	1
Ceratopogonidae	F	1
<u>Chromagrion</u> sp.	F	1
<u>Hyalella azteca</u>	F	1
Hirudinea	F	2
<u>Chironomus</u> sp.	P	6
<u>Psychoda</u> sp.	P	3
<u>Pericoma</u> sp.	P	1
Oligochaetes	P	17.1 mg

The bacterial coating on the rocks and the odor from the sample indicated that this station was strongly influenced by the waste discharge. Because the location is scoured by the current there is still a wide variety of organisms including a few stonefly nymphs and caddis larvae.

Mile 403.0: 275 yards downstream from the railroad bridge and 20 yards from shore, mud bottom.

		Organisms/ft ²
<u>Hexagenia</u> sp.	F	11
<u>Procladius</u> sp.	F	9
<u>Polypedilum</u> sp.	F	2
<u>Erioptera</u> sp.	F	2
<u>Chironomus</u> sp.	P	11
<u>Psychoda</u> sp.	P	2
<u>Periocoma</u> sp.	P	2
Oligochaetes	P	329.7 mg

This station is affected by settleable materials from the waste outfall as evidenced by the numbers of pollutional organisms and paucity of Hexagenia nymphs and would have to be classified as polluted.

Mile 402.6: 20 yards from the Iowa bank, mud bottom.

		Organisms/ft ²
<u>Cheumatopsyche</u> sp.	C	2
<u>Hexagenia</u> sp.	F	9
<u>Procladius</u> sp.	F	12
Tribe Pentaneurini	F	2
<u>Cricotopus</u> sp.	F	2
Ceratopogonidae	F	12
<u>Chironomus</u> sp.	P	5
<u>Psychoda</u> sp.	P	4
<u>Pericoma</u> sp.	P	2
OTigochaetes	P	310.3 mg

Station is affected by settleable materials from the Burlington outfall and is classified as polluted.

Mile 402.6: 70 yards from the Iowa bank, mud and detritus bottom.

		Organisms/ft ²
<u>Cheumatopsyche</u> sp.	C	5
<u>Isoperla</u> sp.	C	5
<u>Hexagenia</u> sp.	F	166
<u>Procladius</u> sp.	F	59
Tribe Pentaneurini	F	39
Ceratopogonidae	F	7
<u>Stenelmis</u> sp.	F	2
<u>Pericoma</u> sp.	P	2
<u>Chironomus</u> sp.	P	23
<u>Proptera</u> sp.	P	2
OTigochaetes	P	24.4 mg

Visual evidence indicated that this station is in the path of the waste, yet the biological condition was excellent as evidenced by large numbers of Hexagenia and the presence of caddis and stonefly nymphs.

Mile 402.6: 100 yards from the Iowa bank, bottom consists of sand with detritus.

		Organisms/ft ²
<u>Cheumatopsyche</u> sp.	C	16
<u>Isoperla</u> sp.	C	4
<u>Stenonema</u> sp.	C	2

		Organisms/ft ²
<u>Hexagenia sp.</u>	F	27
<u>Polypedilum sp.</u>	F	2
<u>Cricotopus sp.</u>	F	2
<u>Sphaeriidae</u>	F	2
<u>Unionidae</u>	F	4
<u>Chironomus sp.</u>	P	2
<u>Oligochaetes</u>	P	2

This station is not in the waste flow and is also in excellent condition.

Mile 402.4: 75 yards from the Iowa bank, hard bottom with some shells and detritus.

		Organisms/ft ²
<u>Cheumatopsyche sp.</u>	C	6
<u>Neureclipsis sp.</u>	C	1
<u>Isoperla sp.</u>	C	15
<u>Stenonema sp.</u>	C	2
<u>Chironomus sp.</u>	P	1

Stonefly nymphs were abundant and the biological condition was excellent.

Mile 402.3: 20 yards from the Iowa bank. Bottom consisted of a thin layer of mud and detritus overlaying a hard substrate.

		Organisms/ft ²
<u>Cheumatopsyche sp.</u>	C	7
<u>Isoperla sp.</u>	C	4
<u>Hexagenia sp.</u>	F	39
<u>Coelotanypus sp.</u>	F	2
<u>Turbellaria</u>	F	2
<u>Hirudinea</u>	F	5
<u>Chironomus sp.</u>	P	4
<u>Oligochaetes</u>	P	21.7 mg

Stonefly nymphs, caddis larvae and relatively abundant Hexagenia indicate a good condition for this substrate type.

Mile 402.2: 15 yards from the Iowa bank, mud bottom.

		Organisms/ft ²
<u>Hexagenia sp.</u>	F	27
<u>Procladius sp.</u>	F	4
<u>Coelotanypus sp.</u>	F	2
Tribe Pentaneurini	F	12
Ceratopogonidae	F	14
Sphaeriidae	F	4
Hirudinea	F	2
<u>Proptera sp.</u>	P	2
<u>Chaoborus sp.</u>	P	2
<u>Chironomus sp.</u>	P	2
<u>Oligochaetes</u>	P	378.8 mg

The abundance of oligochaetes indicates this station is affected by the waste discharge, however, the usual diversity of benthos are present and the effect would have to be considered mild pollution.

Mile 401: A few minutes of qualitative collecting from the rocks along the bank produced 59 mayfly nymphs of the genus Stenonema and 1 specimen of Gammarus sp.

Mile 399.8: 20 feet from the Iowa bank in a small bay, mud and detritus substrate.

		Organisms/ft ²
<u>Cheumatopsyche sp.</u>	C	2
<u>Hexagenia sp.</u>	F	14
<u>Procladius sp.</u>	F	4
<u>Polypedilum sp.</u>	F	2
Ceratopogonidae	F	5
Corixidae	F	2
<u>Chaoborus sp.</u>	F	4
<u>Chironomus sp.</u>	P	2
<u>Oligochaetes</u>	P	112.3 mg

This station was located very near the shore and the relative paucity of organisms is probably a localized condition. A sample taken in this area in the fall of 1969 contained many more midge larvae and Hexagenia nymphs.

Mile 397: 20 yards from Iowa bank, sandy mud and detritus.

		Organisms/ft ²
<u>Cheumatopsyche</u> sp.	C	2
<u>Leptocera</u> sp.	C	1
<u>Hexagenia</u> sp.	F	26
<u>Procladius</u> sp.	F	4
Tribe Pentaneurini	F	1
<u>Coelotanypus</u> sp.	F	1
<u>Ceratopogonidae</u>	F	6
<u>Stenelmis</u> sp.	F	1
<u>Sphaeriidae</u>	F	2
Hirudinea	F	2
<u>Chironomus</u> sp.	P	12
<u>Oligochaetes</u>	P	137 mg

Relatively few organisms were present at this station but it is doubtful that the effect is entirely the result of the Burlington wastes. Samples collected in this area in October of 1969 contained more organisms than the above sample while a collection on the Illinois side of the river was similar to the above sample.

Storm sewer discharges from Burlington in the area of river mile 403.9 to 404 have caused a localized degradation of benthic organisms along the shoreline. This is probably the result of settleings from the storm water as conditions were considerably improved at mile 403.3 which is just above the sewage treatment plant outfall. These findings are verified by both the October 1969 report and this report.

The biological effects of the Burlington waste outfall were primarily limited to quiet water areas along the shoreline and immediately downstream where sedimentation occurred. No areas were found to be degraded to the degree where only pollution tolerant organisms were present. Stonefly nymphs, which require extremely high water quality, were found at three stations within the first 0.15-0.6 miles below the outfall.

At mile 402.6 (about 0.6 mile below the outfall), three samples were taken at approximate distances of 20, 70, and 100 yards from the Iowa bank. The sample nearest the bank, taken from a mud bottom, was degraded by the wastes

and, although a variety of organisms was present, the pollution tolerant forms dominated. Moving 70 yards out from the bank where there was a stronger current but still a soft substrate, the biological condition was extremely good even though there was physical evidence of the waste in the sample. 100 yards from the bank at mile 402.6 the biological condition was also good and there was no physical evidence of the waste.

In the area of mile 402.2 to 402.4 there was still some evidence of pollution but there were also samples with a normal diversity of organisms.

Inspection of the submerged rocks along the Iowa bank revealed a heavy aufwuchs (attached growth) consisting of a bacterial slime and periphyton for a distance of about 2 1/2 miles downstream from the outfall. Many mayfly nymphs (Stenonema sp.) were found on these rocks at mile 401 but organisms were generally sparse in this area. Inspection of similar conditions on the Illinois side revealed an absence of aufwuchs but also an absence of rock-associated organisms. The general absence of organisms in this type of situation was probably related to the rising water levels.

This aufwuchs growth was further downstream than had been observed last fall, probably as a result of cooler water temperatures. It would be expected to recede back toward the sewage treatment plant outfall as the water warms and metabolic rates increase. The aufwuchs growths mentioned above should not be confused with the luxuriant Sphaerotilus growths which have been recorded in other areas of the river. Slime traps placed below the Burlington outfall revealed no drifting Sphaerotilus at all.

CONCLUSIONS

This report, which covers data collected in early April of this year, both supplements and substantiates data and conclusions which resulted from the October 1969 study.

The effects of Burlington wastes on the chemistry of the Mississippi River during this study were very small and were limited to the narrow strip of water along the Iowa bank for approximately 0.5 mile below the Burlington outfall.

The bacteriology of the river with respect to both

total and fecal coliforms was essentially unaffected by the Burlington discharges as a result of the chlorination of incoming raw wastes by the Burlington Sewage Treatment Plant.

Biologically there was some degradation localized below the point of storm sewer discharges (mile 403.9-404) however by mile 403.3 recovery was evident. Below the treatment plant outfall (mile 403.2) there was some biological degradation in the soft substrate resulting from the long term accumulation of organic debris. No areas were degraded to the degree where only pollution tolerant organisms were present. Stonefly nymphs, which require high quality water, were collected at three stations in the first 0.15-0.6 miles below the outfall. The total observed biological effect was limited to the area immediately along the Iowa bank and represented an extremely small percentage of the total cross section of the river in that area.

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