IOLA PHOSPHORUS BAN IMPACT STUDY

1979-1981

BY:

LAURA HERMAN

ABSTRACT

A three year Detergent Phosphorus Ban Impact Study was conducted at Iola from July 1979 through August 1981. This study was done in correlation with the Detergent Phosphorus Ban Legislation. The study program developed will allow the Department of Natural Resources to report the Ban Impacts to the Legislature in January 1982.

Acknowledgements:

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OBJECTIVE

To evaluate data from Wisconsin's ambient water quality monitoring network to determine if any loading reduction is occurring coincidental to the limitation of detergent phosphorus.

INTRODUCTION

In 1978, Assembly Bill 881 was inacted to prohibit the sale "... of cleaning agents and water conditioners with specific phosphorus concentrations..." in the State of Wisconsin.

Beginning on July 1, 1978, and running until June 30, 1981, a limited ban on phosphorus in cleaning agents will be in effect. The Legislature has directed the Department of Natural Resources to conduct a study to determine the effects the detergent phosphorus ban may have on surface waters in the State.

Iola has a secondary-treatment wastewater facility. Periphyton and phosphorus loading was looked at above and below the outfall. Twenty-four hour monitoring periods were set up for sample collection.

The first part of the study was conducted in July of 1979 with the water samples having been taken on the 23rd and 24th, the second part was conducted in July of 1980 with the water samples having been taken on the 23rd and 24th, and the final part was conducted in July of 1981 with the water samples having been taken on the 29th and 30th.

Periphytometers were placed in the South Branch of the Little Wolf River on July 23, 1979 and removed for examination on August 14, 1979. This was also done for the time periods of July 23, 1980 - August 7, 1980 and July 29, 1981 - August 12, 1981. When I went to recover the July 29, 1981 samples, I found that two sets had been removed. I thus replaced them on August 17, 1981 and collected them on August 31, 1981.

PHYSICAL SETTING OF THE STUDY PLAN (Figure 1)

The Iola monitoring area consists of a 1/2 mile reach of the South Branch of the Little Wolf River in Waupaca County. The study reach consists of five sampling stations (A through E): (Figure 2)

Station A - located 100 feet above the Iola STP outfall;
Station B - located at the outfall;
Station C - located 100 feet below the outfall;
Station D - located 1/4 river miles below the outfall;
Station E - located 1/2 river miles below the outfall.

Station A

Station A consists of a 50% riffle-50% pool section with a sand and gravel substrate. The area near the river is a fallow sedge marsh type area. (Above Mill Road.)

Station B

Station B consists of the STP outfall. (At the base of Mill Road bridge.)

Station C

Station C consists of a 100% deep run section with a sand, rock and gravel substrate. The area near the river is a fallow sedge marsh type area. (100' below Mill Road bridge.)

Station D

Station D consists of a 50% riffle-50% pool section with a sand and small gravel substrate. The area near the river is a fallow field. Highway 61 is approximately 250 feet away from a bend in the river.

Station E

Station E consists of a deep fast run with 20% riffles. The substrate is made up of rocks and sand. The adjacent area if partial agricultural with a fallow wooded buffer zone near the river. Above site E, a tributary empties in to the River. This tributary may help to increase the flow and decrease the phosphorus concentrations.

MATERIALS AND METHODS

Five sites were selected on the South Branch of the Little Wolf according to their distance relationship with the Iola STP outfall. They were: above the outfall, at the outfall, at the mix zone, at the sag zone, and at the recovery zone. Expected mix, sag and recovery zones were calculated from previous studies. These five sites were established to look at the river before and after the discharge and to see how long it takes the river to absorb the discharged material and to recover.

Each Detergent Phosphorus Ban study was conducted over a 24-hour period. Parameters taken at each site are:

Sample Location	Parameters	Sampling Frequency
Above STP Outfall	Flow	once in 24 hours
	Total Phosphorus	1 every 4 hours
	Dis. Phosphorus	1 every 4 hours
	D.O.	1 every 4 hours
	pH	1 every 4 hours
	Temperature	1 every 4 hours
	Periphyton	2 week period
Outfall	Flow	once in 24 hours
	Total Phosphorus	1 every 4 hours
	Dis. Phosphorus	1 every 4 hours
	D.O.	1 every 4 hours
	pH	1 every 4 hours
	Temperature	1 every 4 hours
Downstream A	Flow	once in 24 hours
	Total Phosphorus	1 every 4 hours
	Dis. Phosphorus	1 every 4 hours
	D.O.	1 every 4 hours
	pH	1 every 4 hours
	Temperature	1 every 4 hours
	Periphyton	2 week period
Downstream B	Total Phosphorus	1 every 4 hours
	Dis. Phosphorus	1 every 4 hours
	D.O.	1 every 4 hours
	pH	1 every 4 hours
	Temperature	1 every 4 hours
Downstream C	Flow	once in 24 hours
	Total Phosphorus	1 every 4 hours
	Dis. Phosphorus	1 every 4 hours
	D.O.	1 every 4 hours
	pH	1 every 4 hours
	Temperature	1 every 4 hours
	Periphyton	2 week period

Flows, D.O.'s and temperatures were taken at the sites. Water grab samples were taken for total phosphorus, dissolved phosphorus, and pH. These samples were placed on ice and shipped to the State Lab of Hygiene in Madison.

Our analysis will mainly be limited to the total and dissolved phosphorus data that Madison has sent back to us.

Our monitoring took place at the end of the summer because the flows are considerably lower during this period, thus, we have a decrease in the dilution rate of the STP effluent. Also, we have optimum periphyton growth at this time.

RESULTS AND DISCUSSION

Vallisneria was found throughout all three years. This growth may have affected the flow, but since it was at all stations at approximately the same level, it was assumed that it affected each flow equally.

Table 1 contains the periphyton data for the three year period of the study. Periphytometers were placed in the stream then removed two weeks later. No listings were obtained for 1980 due to lab errors. However, we can compare 1979 with 1981 and we can also compare data variance among stations A, C and E. 1981 stations A and C chlorophyll went up as compared to 1979's, but when we look at station E (below another tributary inlet) we see that there is no significance variance between these two years. When comparing stations A-E see an increase below the outfall. In 1979 this variance is greatly increased below the tributary and in 1981 this variance shows up above the tributary. Our data shows that there was more phosphorus in 1981 than in 1979.

Because of the lack of periphyton data, a stronger emphasis will be placed on phosphorus data.

Table 2 contains the flow data for 1979-1981. This table shows a slight 1981 increase in flow over 1979. In 1980, the lake was lowered for dam repairs and the boards were placed back in the lake before we took the flows.

Table 3 contains the onsite data collection along with Madison's data. The total and dissolved phosphorus loadings were then calculated for each day and put in Table 4, the total phosphorus loading (lbs/day) was put in graphic form in Figure 3. From our data we can see that there was a significant phosphorus decrease in 1980, but that it went back up in 1981. This drop coincides a water flow decline. In 1981, we are almost back up to the 1979 phosphorus load. In looking at the station averages, we can see an increase in total phosphorus up to the mix zone, but this decreases in the sag and recovery zones. This is expected because the river is naturally diluting and breaking down the phosphorus.

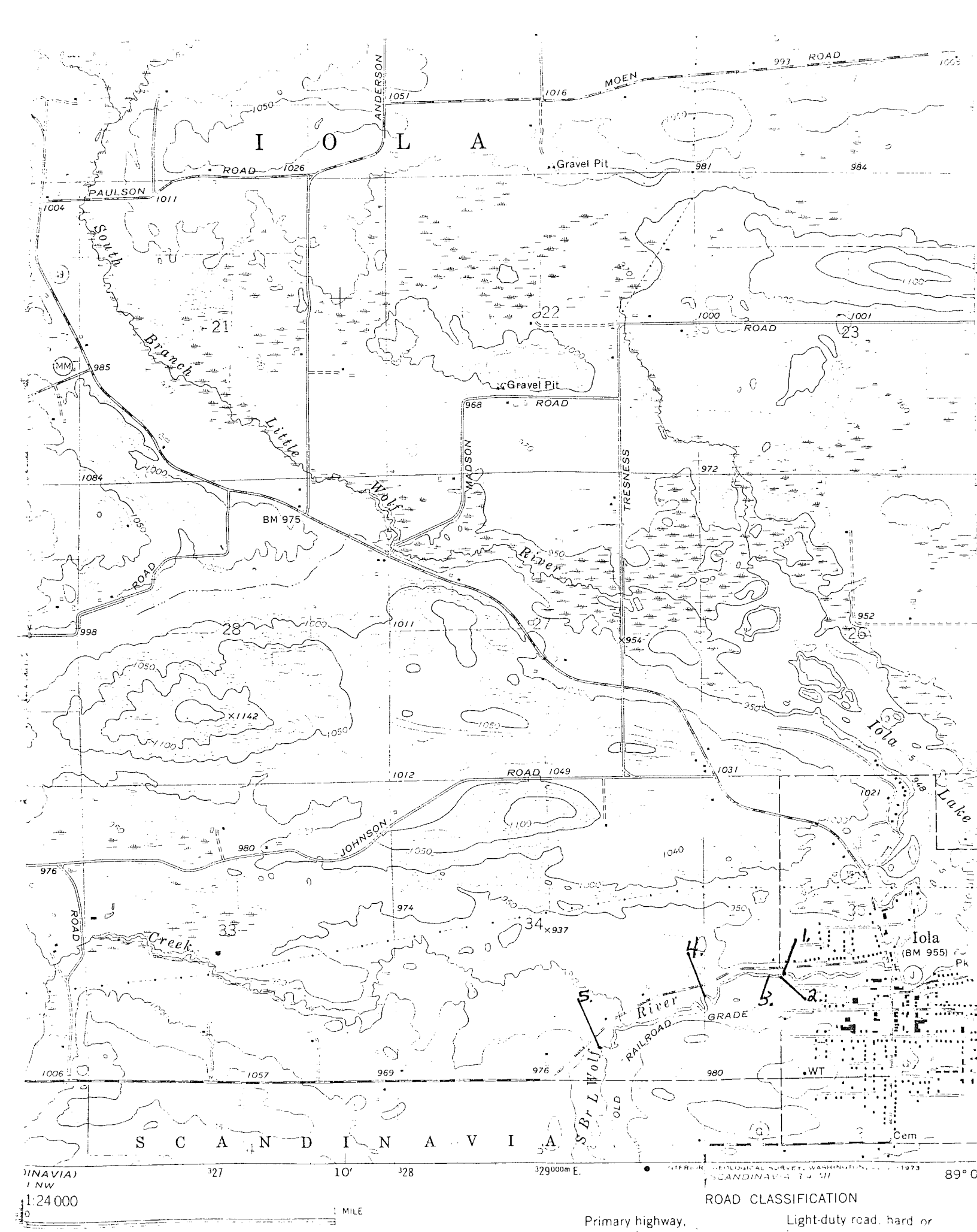
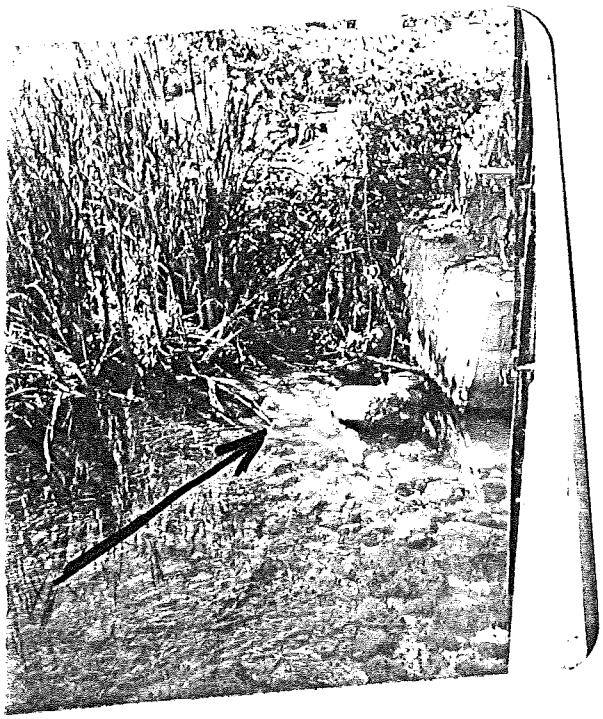

I O L A
S C A N D I N A V I A
ANDERSON
MOEN
ROAD
PAULSON
South Branch
Little Wolf River
MADSON
TRESNESS
JOHNSON
Gravel Pit
BM 975
Iola
(BM 955)
Lake
Creek
RAILROAD GRADE
OLD
S Br L Wolf River
WT
Cem
Pk
1:24 000
1 MILE
ROAD CLASSIFICATION
Primary highway,
Light-duty road, hard or

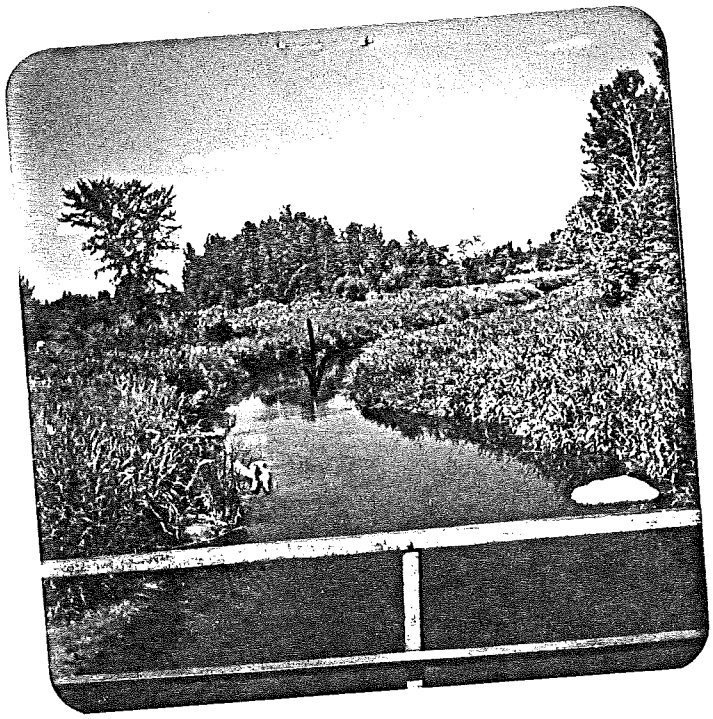
FIGURE 1

Figure 2

Above STP Outfall (Station A)



STP Outfall (Station B)



Mix Zone (Station C)

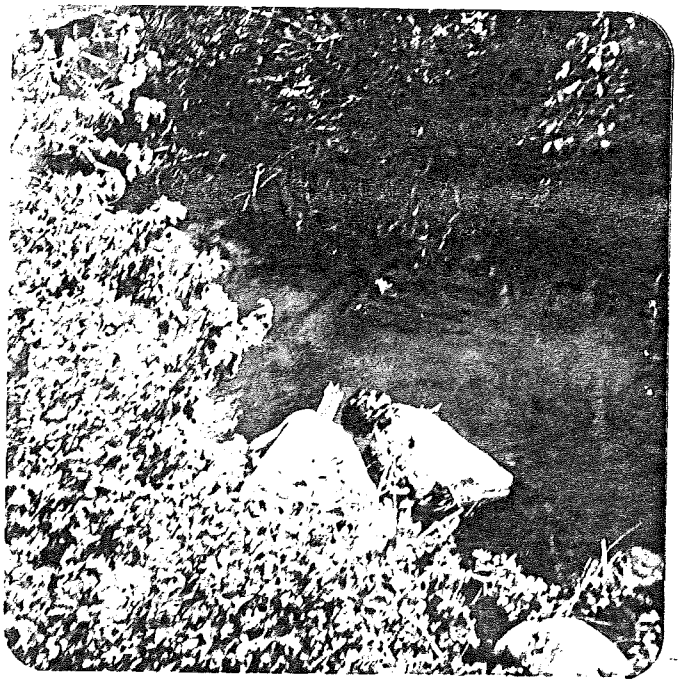
Figure 2 continued

Station - Looking Upstream

Station - Looking Downstream

Sag Zone (Station D)

Station - Looking Downstream



Station E

Recovery Zone (Station E)

TABLE 1

Periphyton Analysis

South Branch Little Wolf River at Iola

	1979	1980*	1981
Station A			
Periphyton Chlorophyll a mg/m^2	0.9	Data	3.0**
Pheophyton Chlorophyll a mg/m^2	0.6	Inaccur-	1.0
Chlorophyll a corrected mg/m^2	0.6	ate	3.0
Station C			
Periphyton Chlorophyll a mg/m^2	1.6	Data	13.0
Pheophyton Chlorophyll a mg/m^2	0.6	Inaccur-	1.0
Chlorophyll a corrected mg/m^2	1.3	ate	12.0
Station E			
Periphyton Chlorophyll a mg/m^2	17.4	Data	17.0**
Pheophyton Chlorophyll a mg/m^2	1.5	Inaccur-	2.0
Chlorophyll a corrected mg/m^2	16.4	ate	16.0

*1980 samples were inaccurate due to lab error or poor packaging for shipment.

**1981-Station A and E were redone because first samplers were washed out.

TABLE 2

Flow Data (cfs)[1]

	1979	1980[2]	1981
Station A	10.70	3.644	12.73
Station B[3]	0.127	0.101	0.233
Station C	13.58	3.95	15.54
Station E		10.36	18.34

[1]Flow may have been effected by vallisneria growth. The growth seems to be consistant and was present in all 3 years.

[2]Lake levels were lowered for dam repairs, boards were replaced before flows were taken. Station E is below a tributary and was not as noticeably effected by the repairs.

[3]Flows taken from effluent recorded at STP.

TABLE 3

CHEMICAL RESULTS
IOLA PHOSPHORUS BAN STUDY

Station A (100 feet above STP outfall)

July 1979

Station		Time	D.O. (mg/l)	Temp. (C)	PH (su)	Tot-P (mg/l)	Sol-P (mg/l)
IA1	7-23	11:11	9.5	25	8.4	0.02	<0.004
IA2		15:00	9.5	26	8.4	0.02	<0.004
IA3		19:50	8.5	25	8.1	0.02	<0.004
IA4	7-24	00:04	7.8	22	8.0	0.03	<0.004
IA5		04:01	7.0	24	8.1	0.02	<0.004
IA6		08:20	9.0	25	8.5	0.03	<0.004

July 1980

IA1	7-23	10:00	7.1	24	8.0	0.03	0.005
IA2		13:00	9.1	27	8.1	0.06	<0.004
IA3		16:00	9.2	27	8.1	0.07	<0.004
IA4		19:45	5.5	23	7.9	0.06	0.018
IA5		23:50	4.8	20	7.8	0.04	0.012
IA6	7-24	04:00	5.5	18	7.7	0.03	0.006
IA7		08:30	6.4	20	8.0	0.04	0.004

July 1981

IA1	7-29	10:00	9.0	20	8.7	0.02	<0.004
IA2		13:50	11.0	22.5	8.8	0.02	0.004
IA3		18:00	9.4	22	8.8	0.02	0.004
IA4		21:50	9.0	20	8.7	0.02	<0.004
IA5	7-30	01:32	11.6	20	8.7	0.02	<0.004
IA6		05:55	11.2	19	8.6	0.02	<0.004

Table 3 continued

Station B (STP outfall)

July 1979

Station		Time	D.O. (mg/l)	Temp. (C)	PH (su)	Tot-P (mg/l)	Sol-P (mg/l)
IB1	7-23	11:10	6.0	21	8.4	4.6	3.8
IB2		15:01	7.5	22	8.2	5.0	4.1
IB3		20:00	6.5	20	8.3	6.6	5.9
IB4	7-24	00:09	6.1	18	8.2	7.6	6.6
IB5		04:05	5.6	19	7.9	5.1	4.5
IB6		08:25	6.0	18	8.4	6.8	6.1

July 1980

IB1	7-23	10:10	5.6	24	7.7	0.96	0.460
IB2		13:10	5.6	24	7.9	0.86	0.166
IB3		16:10	6.0	19	7.9	0.89	0.175
IB4		19:55	4.6	23	7.7	3.70	0.440
IB5		23:59	4.2	19	7.7	2.30	0.440
IB6	7-24	04:05	6.0	19	7.7	1.54	0.520
IB7		08:35	6.4	19	7.8	0.78	0.370

July 1981

IB1	7-29	10:10	5.8	17	7.6	4.4	3.0
IB2		13:52	5.4	17	7.5	4.6	2.3
IB3		18:05	5.1	18	7.6	4.8	2.6
IB4		21:55	5.0	17.5	7.6	4.6	3.4
IB5	7-30	01:34	6.2	17	7.8	3.6	3.1
IB6		06:00	5.5	18	7.8	2.9	2.7

Table 3 continued

Station C (100 feet below outfall)

July 1979

Station		Time	D.O. (mg/l)	Temp. (C)	PH (su)	Tot-P (mg/l)	Sol-P (mg/l)
IC1	7-23	11:15	8.8	25	8.3	0.11	0.064
IC2		15:04	8.9	26	8.6	0.09	0.043
IC3		20:05	6.0	24	8.3	0.10	0.064
IC4	7-24	00:13	5.7	21	8.1	0.15	0.085
IC5		04:10	6.9	22	8.0	0.14	0.101
IC6		08:30	8.0	24	8.5	0.12	0.089

July 1980

IC1	7-23	10:15	8.0	24	8.1	0.12	0.048
IC2		13:15	8.6	26	8.1	0.11	0.017
IC3		16:20	8.7	26	8.2	0.10	0.020
IC4		20:00	5.3	22	7.8	0.28	0.068
IC5	7-24	00:05	4.5	19	7.8	0.26	0.041
IC6		04:10	3.8	19	7.8	0.12	0.045
IC7		08:40	6.3	20	7.8	0.10	0.037

July 1981

IC1	7-29	10:15	9.8	21	8.6	0.12	0.093
IC2		14:00	11.2	22.5	8.8	0.09	0.066
IC3		18:10	9.5	22	8.7	0.10	0.072
IC4		22:05	7.8	20	8.7	0.10	0.065
IC5	7-30	01:40	10.0	19	8.7	0.12	0.086
IC6		06:05	8.9	19.5	8.6	0.06	0.030

Table 3 continued

Station D* (1/4 river miles below outfall)

July 1979

Station		Time	D.O. (mg/l)	Temp. (C)	PH (su)	Tot-P (mg/l)	Sol-P (mg/l)
ID1	7-23	11:45	9.6	26	8.4	0.10	0.065
ID2		15:20	10.4	26	8.5	0.10	0.064
ID3		20:21	6.5	25	8.4	0.11	0.073
ID4	7-24	00:23	5.9	20	8.3	0.12	0.070
ID5		04:15	7.1	24	8.2	0.08	0.050
ID6		08:40	9.5	22	8.6	0.12	0.087
				July 1980			
ID1	7-23	10:30	9.5	24	8.1	0.09	0.044
ID2		13:20	8.3	27	8.3	0.18	0.034
ID3		16:25	8.4	28	8.2	0.14	0.033
ID4		20:20	6.5	24	8.0	0.10	0.038
ID5	7-24	00:25	5.7	19	7.8	0.06	0.016
ID6		04:14	3.5	17	7.8	0.08	0.032
ID7		08:45	7.8	20	8.0	0.08	0.031
				July 1981			
ID1	7-29	10:38	11.6	21	8.7	0.09	0.063
ID2		14:10	11.6	23	8.8	0.09	0.058
ID3		18:20	9.5	22	8.7	0.08	0.052
ID4		22:15	6.9	20	8.5	0.10	0.045
ID5	7-30	01:50	9.0	20	8.6	0.08	0.033
ID6		06:12	7.8	19	8.5	0.06	0.030

*Flows from Station C are used for PO_4 load.

Table 3 continued

Station E (1/2 river miles below outfall)

July 1979*

Station		Time	D.O. (mg/l)	Temp. (C)	PH (su)	Tot-P (mg/l)	Sol-P (mg/l)
IE1	7-23	12:00	10.8	23	8.5	0.09	0.052
IE2		15:59	12.0	25	8.5	0.07	0.044
IE3		20:35	7.0	23	8.4	0.08	0.038
IE4	7-24	00:39	6.6	21	8.3	0.12	0.071
IE5		04:30	7.5	22	8.1	0.07	0.043
IE6		09:01	7.1	23	8.5	0.08	0.048
			July 1980				
IE1	7-23	10:16	10.4	18	8.0	0.08	0.034
IE2		13:30	9.6	22	8.2	0.19	0.047
IE3		16:30	9.2	27	8.3	0.07	0.037
IE4		20:30	4.5	19	8.2	0.08	0.043
IE5	7-24	00:0:30	5.1	17	7.9	0.06	0.020
IE6		04:20	5.4	15	8.0	0.07	0.037
IE7		08:50	7.6	17	8.2	0.06	0.034
			July 1981				
IE1	7-29	10:50	12.0	18	8.6	0.06	0.044
IE2		14:20	17.0	22	8.8	0.07	0.051
IE3		18:30	3.6	22	8.7	0.06	0.044
IE4		22:20	7.8	20	8.4	0.07	0.040
IE5	7-30	01:55	7.9	17	8.3	0.07	0.036
IE6		06:20	7.0	16.5	8.3	0.05	0.027

*Flow from Station C is used for Phosphorus load.

24 HOUR AVERAGE

Station	D.O. (mg/l)	Temp. (C)	PH (su)	Tot-P (mg/l)	Sol-P (mg/l)
Station A					
1979	8.8	24.5	8.2	0.023	<0.004
1980	6.8	22.7	7.9	0.047	0.008
1981	10.2	20.6	8.7	0.020	< 0.004
Station B					
1979	6.3	19.7	8.2	5.950	5.20
1980	5.5	21.0	7.8	1.580	0.367
1981	5.5	17.4	7.6	4.400	2.850
Station C					
1979	7.4	24.0	8.3	0.12	0.074
1980	6.5	22.3	7.9	0.16	0.039
1981	9.5	20.7	8.7	0.10	0.069
Station D					
1979	8.2	24.0	8.4	0.11	0.068
1980	7.1	23.0	8.0	0.10	0.033
1981	9.4	21.0	8.6	0.08	0.047
Station E					
1979	8.5	23.0	8.4	0.09	0.049
1980	7.4	19.0	8.1	0.09	0.036
1981	9.2	19.0	8.5	0.06	0.040

TABLE 4

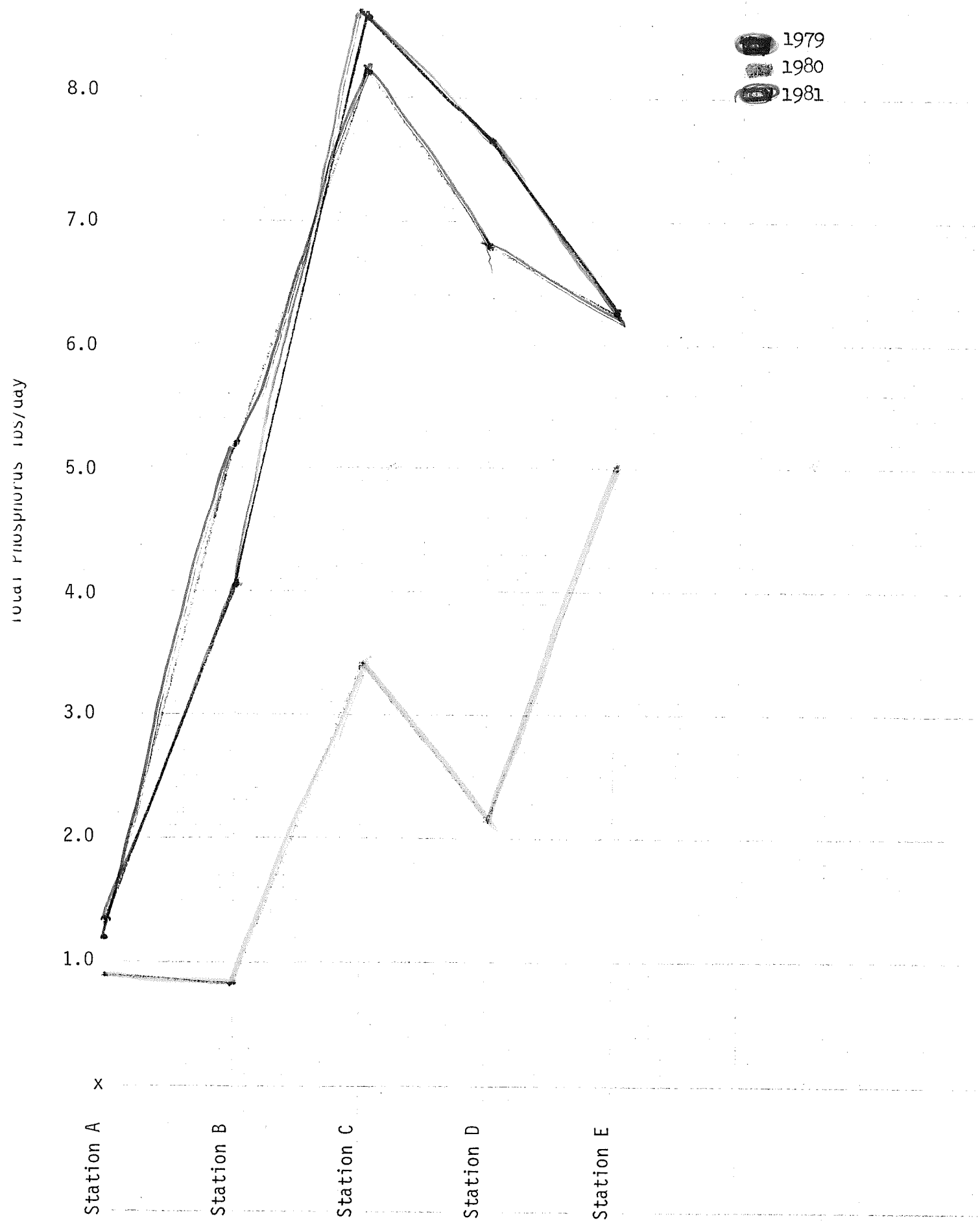
Total & Dissolved Phosphorus
24 Hour Averages

Station	Total Phosphorus Load (lbs/day)	Total Phosphorus Load (lbs/4 hrs)	Dissolved Phosphorus Load (lbs/day)	Dissolved Phosphorus Load (lbs/4 hrs)
Station A				
1979	1.32	0.22	.23	0.04
1980	.92	.15	.16	0.03
1981	1.38	0.23	.27	0.05
Station B				
1979	4.08	0.68	3.57	0.59
1980	0.86	0.14	0.20	0.03
1981	5.23	0.92	3.59	0.60
Station C				
1979	8.68	1.47	5.42	.90
1980	3.41	0.57	0.83	0.14
1981	8.26	1.40	5.79	0.97
Station D				
1979*	7.68	1.34	4.99	0.83
1980*	2.13	0.36	0.70	0.11
1981*	6.86	1.12	3.94	0.65
Station E				
1979*	6.25	1.10	3.59	0.60
1980*	5.03	0.84	3.57	0.59
1981*	6.24	.99	3.96	0.66

*Flows from Station C is used for phosphorus load.

FIGURE 3

1979-1981 Phosphorus Monitoring (Total Loading for 24-hours)



Based on Grab Samples Collected Over a 24-hour Period

CONCLUSION

From the data that we have collected, there was a decline in total phosphorus between the years of 1979 and 1980 then an increase between 1980 and 1981. There is a slight decline between 1979 and 1981 but it is not significant. The periphyton showed an increase between 1979 and 1981. Much of the 1980 data cannot be used because Lake Iola dam was removed for repair and this coincided with the time of our sampling.

Apparently, the ban on high phosphorus concentrations in household detergents has resulted in no effect on the phosphorus level of the South Branch of the Wolf River due to the Iola Wastewater Facility.