N. Br. Pigeon River.
Pigeon River
W.Q.E.

Marion Pre-Operation Survey

By: Dennis C. Weisensel

Introduction

A pre-operation survey was conducted at Marion on August 7, 1978. The purpose of the survey was to determine the effect of the publically owned treatment works on the North Branch Pigeon River before reconstruction and upgrading of the plant. Water quality above and below the outfall was documented by chemical, macroinvertebrate and periphyton sampling. Stream flows were taken throughout the study area. The study area consisted of above the discharge, the mixing zone, sag area and recovery zone.

Background

Marion wastewater treatment facility began operation in 1951. The design flow was 218,400 g.p.d. The facility experienced overloading conditions.

The present plant operates a primary settling system with anaerobic digestor and sludge drying beds.

The new plant construction is scheduled to begin in September, 1979. The plant system will consist of primary settling, biodisc, final settling, anaerobic digestor, and sludge drying beds. The facility will continue to discharge to the North Branch of the Pigeon River.

Summary

Chemical monitoring: The chemical monitoring results are contained in Table 1. Increases in BOD, Suspended Solids, and NH_3-N can be noted in stations 2 and 3 (mixing zone and sag area). Decrease in Dissolved Oxygen is noted in the sag area.

Macroinvertebrate: The macroinvertebrate data is contained in Table 2. A decline in water quality is noted below the discharge.

Station 1	-	2.077	- Good
Station 2	-	2.999	- Fair
Station 3	-	3.15	- Poor
Station 4	-	3.8	- Very Poor

Macroinvertebrate data indicates that the river is not recovered at station 4.

Periphyton: Comparison of the periphyton community above and below the discharge revealed a decrease in Chlorophyll a as well as total population and an increase in the percent of pollution tolerant organism as indicated by the following table:

	Chl a	% of Tolerent Algae	Tot. Pop. #/M^2
Station 1	13.32 Ca/M^2	8.6%	21,750
Station 3	1.574 Ca/M^2	23.8%	758
Station 4	.238 Ca/M^2	18.7%	4,950

Results

Chemical monitoring was conducted at 6 stations. Standard Methods sampling procedures were followed in collecting the samples. The analytical work was conducted by the Wisconsin State Laboratory of Hygiene, Madison, Wisconsin. Stations 1 through 4 locations are described in the macroinvertebrate section. Samples at stations 5 and 6 were collected on two different tributaries which are intersected by Pella Swamp Road. Samples at both stations were collected midstream directly above the bridges.

Chemical parameters were B.O.D. (Biochemical Oxygen Demand), Total SS (Suspended Solids), NH_3-N (Ammonia), D.O. (Dissolved Oxygen), Lab pH, Temperature and physical flows in cubic feet per second (C.F.S.). Table 1 is the chemical results.

TABLE #1 - CHEMICAL RESULTS

STATION #	1	2	3	4	5	6
BOD	3.3	12.0	6.8	4.1	2.9	2.9
TOTAL SS	4	13	5	2	23	3
NH_3-N	.11	.64	.88	<0.02	<0.02	<0.02
LAB pH	7.8	7.6	7.6	8.1	8.3	8.4
D.O.	5.8	5.8	4.4	9.8	8.8	11.1
TEMPERATURE	20	20	21	22	21	21
FLOW/CFS	6.29	6.94	7.97	8.02	.73	3.5

Biological Monitoring

Macroinvertebrate samples were collected at four stations on the North Branch of the Pigeon River, above the Marion treatment works, mixing zone, sag area, and recovery zone. Sampling was conducted using a surber stream sampler. Gravel or debris and vegetation was washed by hand in the current above the sampler. The samples were preserved in 70% alcohol and returned to the lab for later identification. Sorting the macroinvertebrates from debris was done on a time basis. The sample was first rinsed with clear water. It was placed in a 9" x 14" white porcelain pan and a sufficient amount of water added to cover the debris. Organisms were then picked randomly from the pan for a 10 minute period. The samples were placed in 70% alcohol for later identification. Standard identification procedures were followed. The Chironomid group was placed in concentrated NaOH to provide clearing of the heads and the heads were mounted for microscopic viewing. The macroinvertebrates were tabulated and Hilsenhoff's biotic index applied.

Hilsenhoff's biotic index was calculated by using the formula:

$$B.I = \frac{\sum n_i a_i}{N}$$

where n_i is the number of each species, a_i is the value for that species (Append. I), and N is the total number of arthropods in the sample (usually 100).

Water Quality Determination From Biotic Index Values

Biotic Index	Water Quality	State of the Stream
1.75	Excellent	Clean undisturbed
1.75-2.25	Good	Some enrichment or disturbance
2.25-3.00	Fair	Moderate enrichment or disturbance
3.00-3.75	Poor	Significant enrichment or disturb.
3.75	Very Poor	Gross enrichment or disturbance

The macroinvertebrate samples are tabulated in the following tables with calculations of Biotic Indexes. Index values are not available for some organisms. That will account for missing value numbers in the table.

TABLE #2

Sample No. M-1
Date: 8-7-78

Stream: Pigeon River
Station Location: Marion
Sample Location: 50' above Marion STP mid-stream
Sample Depth: 1' Stream Characteristics: W 19' D 1'
Current: Fast Sampler Type: Qual.
Substrate: Rock, C. gravel, C. sand, - riffle area

Macroinvertebrates

FAMILY	GENUS	SPECIES	No.'s (n_i)	Spp. Index Value (a_i)	Biotic Index Value Cal.
Heptageniidae	Stenonema	exiguum	19	3	1.117
Baetidae	Baetis	phoebus	6	2	.235
Leptoceridae	Ceraclea		1	2	.039
Sisyridae	Sisyra	vicaria	1		
Gammaridae	Gammarus		4	2	.157
Hydropsychidae	Macronema		19	1	.372
	Hydropsyche		2		
	Cheumatopsyche		49		
Simulidae	Simulium	vittatum	2	4	.157
			51		2.077

Biotic Index:
2.077 - Good - Some enrichment or disturbance

Sample No. M-2
Date: 8-7-78

Stream: Pigeon River
Station Location: 100' below O.F. - Mixing zone
Sample Location: Mid-stream
Sample Depth: 1 Stream Characteristics: W 20' D 6" to 1'
Current: Slow Flat Area Sampler Type: Qual.
Substrate: C. gravel, C. sand

Macroinvertebrates

FAMILY	GENUS	SPECIES	No.'s (n_i)	Spp. Index Value (a_i)	Biotic Index Value Cal.
Limnephilidae	Pysnopsyche		1	2	.125
Hydropsychidae	Diplectrona		1	0	.000
Baetiidae	✓Baetis	phoebus	6	3	1.125
Talitridae	✓Hyalella	aztecca	1	4	.250
Hydropsychidae	✓Cheumatopsyche		28		
Simuliidae	✓Simulium	vittatum	2	4	.500
Chironomidae	✓Polypedilum		1	3	.187
	✓Tribelos		3		
	✓Ablabesmyia		14		
	✓Psectrocladius		1	2	.125
	✓Cricotopus		2	4	.500
	✓Cryptochironomus		1	3	.187
	✓Stenochironomus		1		
			16		2.999

Biotic Index:
2.999 - Fair - Moderate enrichment or disturbance

Sample No. M-3
Date: 8-7-78

Stream: Pigeon River
Station Location: STH 45 - Sag area
Sample Location: Mid-stream - sand wash area - 20' below bridge
Sample Depth: 1' Stream Characteristics: W 15' D 3'
Current: Moderately Slow Sampler Type: Qual.
Substrate: C. sand, silt loam

Macroinvertebrates

FAMILY	GENUS	SPECIES	No.'s (n_i)	Spp. Index Value (a_i)	Biotic Index Value Cal.
Caenidae	Caenis		1		
Chironomiidae	Ablabesmyia		40		
	Cricotopus		1	4	.200
	Glyptotendipes		2	5	.500

Periphyton: Above and below the Marion wastewater treatment facility by Tim Rasman.

Introduction:

Periphyton substrate were placed in the Pigeon River above and below the Marion wastewater treatment facility effluent outfall. Quantification and qualification of the biological community was made after 29 days of colorization, with emphasis on the algae. The results were correlated with C. Mervin Palmer's 1968 "Composite Rating of Algae Tolerating Organic Pollution".

Objective:

The objective was to determine the impact of the wastewater treatment plant discharge on the periphyton community.

Methods and Procedure:

Glass slides attached to 12 or 14 inch long sections of two by fours, suspended just below the surface by styrafoam, were used. Samplers were placed above the discharge, in the sag area, and in the recovery zone. Dissolved oxygen concentrations were used to determine the different zones. Two slides per site were used in most instances; one or two for identification and quantification, and one for chlorophyll a analysis. Chlorophyll a is an indication of the density of algae.

Palmer's Index was used to rate the algae identified in this study. Palmer's lists 60 Genera in decreasing order of emphasis by 165 authorities; the lower the number from 1 to 60 the more tolerant the organism is to organic pollution.

Chlorophyll a units are reported in Ca/M^2, where Ca is in mg/l of chlorophyll a

Results:

The number next to the taxa indicates where the Genera falls on Palmer's Index; the lower the number the more tolerant the algae is to organic pollution.

Marion - Pigeon Creek - Control Sample

Volume 100 ml.
Chlorophyll a 13.32 Ca/M^2

Placed: August 7, 1978
Retrieved: September 5, 1978
Observed: January 30, 1979

Taxa	#/ml	% of Tot. Pop.	$\#/mm^2$
Anacystis - 19	6,000		157.5
Chroococcus	150		3.9
Tot. Cynanophyta (blue-green)	5,160	22%	161.4
Gomphomema - 14	2,150		56.4

Baetidae	Baetis	brunneicolor	1	2	.100
		vagans	1	1	.050
Assellidae	Asellus		6	4	1.200
Talitridae	Hyalella	aztecca	2	4	.400
Gammaridae	Gammarus		2	2	.200
Calopterygidae	Calopteryx		1	1	.050
Gyrinidae	Gyrinus		3	2	.300
Elmidae	Dubiraphia		1	3	.150
Hydropsychidae	Cheumatopsyche		16		
			20		3.15

Biotic Index:
3.15 - Poor - Significant enrichment or disturbance

Sample No. M-4
Date: 8-7-78

Stream: Pigeon River
Station Location: Ramsdall Road - below recovery area
Sample Location: Mid-stream - 100' above bridge
Sample Depth: 1' Stream Characteristics: W 12' D 2'
Current: Shallow Pool Sampler Type: Qual.
Area - Slow
Substrate: C. sand, sandy loam

Macroinvertebrates

FAMILY	GENUS	SPECIES	No.'s (n_i)	Spp. Index Value (a_i)	Biotic Index Value Cal.
Simuliidae	Simulium	vittatum	119	4	2.867
Baetidae	Pseudocloeon		4	2	.048
	Baetis	pygmaeus	1	3	.018
	B.	phoebus	1	2	.012
	B.	vagans	1	1	.006
	B.	brunneicolor	7	2	.084
Assellidae	Asellus		5	5	.151
Talitridae	Hyalella	azteca	24	4	.578
Gyrinidae	Gyrinus		1	2	.012
Hydropsychidae	Cheumatopsyche		8		
Tabanidae	Chrysops		1	2	.012
Chironomiidae	Ablabesmyia		2		
	Stictochironomus		2	1	.012
			166		3.8

Biotic Index:
3.8 - Very Poor - Gross enrichment or disturbance

Cocconeis - 52	19,300		506.6
Fragillaria - 29	50		1.3
Navicula - 7	150		3.9
Nitzschia - 6	100		2.6
Tot. Bacillariophyceae (diatoms)	21,750	78%	570.8

Marion - Pigeon Creek - Sag

Volume 124 ml.
Chlorophyll a 1.574 Ca/M^2

Placed: August 7, 1978
Retrieved: September 5, 1978
Observed: February 1, 1979

Taxa	#/ml	% of Tot. Pop.	#/mm^2
Anacystis - 19	116.7		3.8
Tot. Cyanophyta (blue-green)	116.7	12.8%	3.8
Characiopsis	16.7		0.5
Cladophora - 42	16.7		0.5
Tot. Chrysophyta (greens)	33.4	3.7%	1.0
Gomphonema - 14	158.3		5.2
Cocconeis - 52	466.7		15.2
Mastogolia	75.0		2.4
Nitzschia - 6	25.0		0.8
Navicula - 7	33.3		1.1
Tot. Bacillariophyceae (diatoms)	758.3	83.5%	24.7

Marion - Pigeon Creek - Recovery

Volume 113 ml.
Chlorophyll a - 0.238 Ca/M^2

Placed: August 7, 1978
Retrieved: September 5, 1978
Observed: February 1, 1979

Taxa	#/ml	% of Tot. Pop.	#/mm^2
Anacystis - 19	33.3		1.0
Oscillatoria - 2	16.7		0.5
Tot. Cyanophyta (blue-green)	50.0	1%	1.5
Mastogolia	216.7		6.4
Nitzschia - 6	83.3		2.5
Cymbella - 39	16.7		0.5
Cocconeis - 52	3783.7		112.2
Gomphonema - 14	583.3		17.3
Stephandiscus - 32	16.7		0.5
Navicula - 7	250.0		7.4
Tot. Bacillariophyceae	4950.0	99%	146.8

Discussion and Conclusion:

All three substrates placed in the river were recovered intact.

At Marion the greatest concentration of algae was found above the discharge in the control area. Included are those Genera from one to fifteen on Palmer's Index as indicators of high organic pollution. 8.6% of the total population of algae observed fell within the top 15. The rest of the Genera range from 19 to 52 with 69% of the total being Cocconeis number 52. This would indicate a low level of organic pollution based on Genera diversity.

A reduction of 8.5 times in chlorophyll a occurred between the control and the sag area, dissolved oxygen also decreased from 5.8 mg/1 to 4.4 mg/1. Algae highly tolerant of organic pollution made up 23.8% of the total population observed. The effect below the discharge was a dramatic decrease in the total number of algae, with a slight increase in those Genera most tolerant of high organics.

A 97% reduction in the total periphyton algae population occurred from the control to the sag area. Insufficient data, particularly chemistry data, limits the ability to account for the reduction in algae biomass.

In the recovery area, the chlorophyll a reading was unrealistically low compared to the numbers obtained in identification and quantification. The increase in numbers obtained through identification would suggest that chlorophyll a levels should also have increased. Algae tolerant of organic pollution made up 18.7% of the total population. The total population in the recovery area increased 18.2% from the sag area.

The discharge from the Marion wastewater treatment facility has a significant effect on the density of algae in the Pigeon River.

An initial reduction in total population of 97% from the control to the sag area confirm this. Limited chemistry data doesn't allow a correlation between toxic substances and algae biomass.

Although green and blue-green algae are included in this report that inclusion may be misleading, since glass is a poor substrate for sampling the total greens and blue-greens population. Certain species are selected for by the use of glass. The numbers for them would therefore be expected to be considerably higher. Those greens and blue-greens observed in the study area and listed on Palmer's Index were all highly tolerant of organic pollution. It is not known whether the highly tolerant species are more likely to be selected for by the use of glass slides.

A map is included designating the stations involved in the study.

Conclusion:

The purpose of this survey was to record water quality conditions before upgrading of the Marion treatment works takes place. A post-operational survey will be scheduled after the upgraded treatment works becomes operational and the river stabilizes under upgraded effluent conditions.

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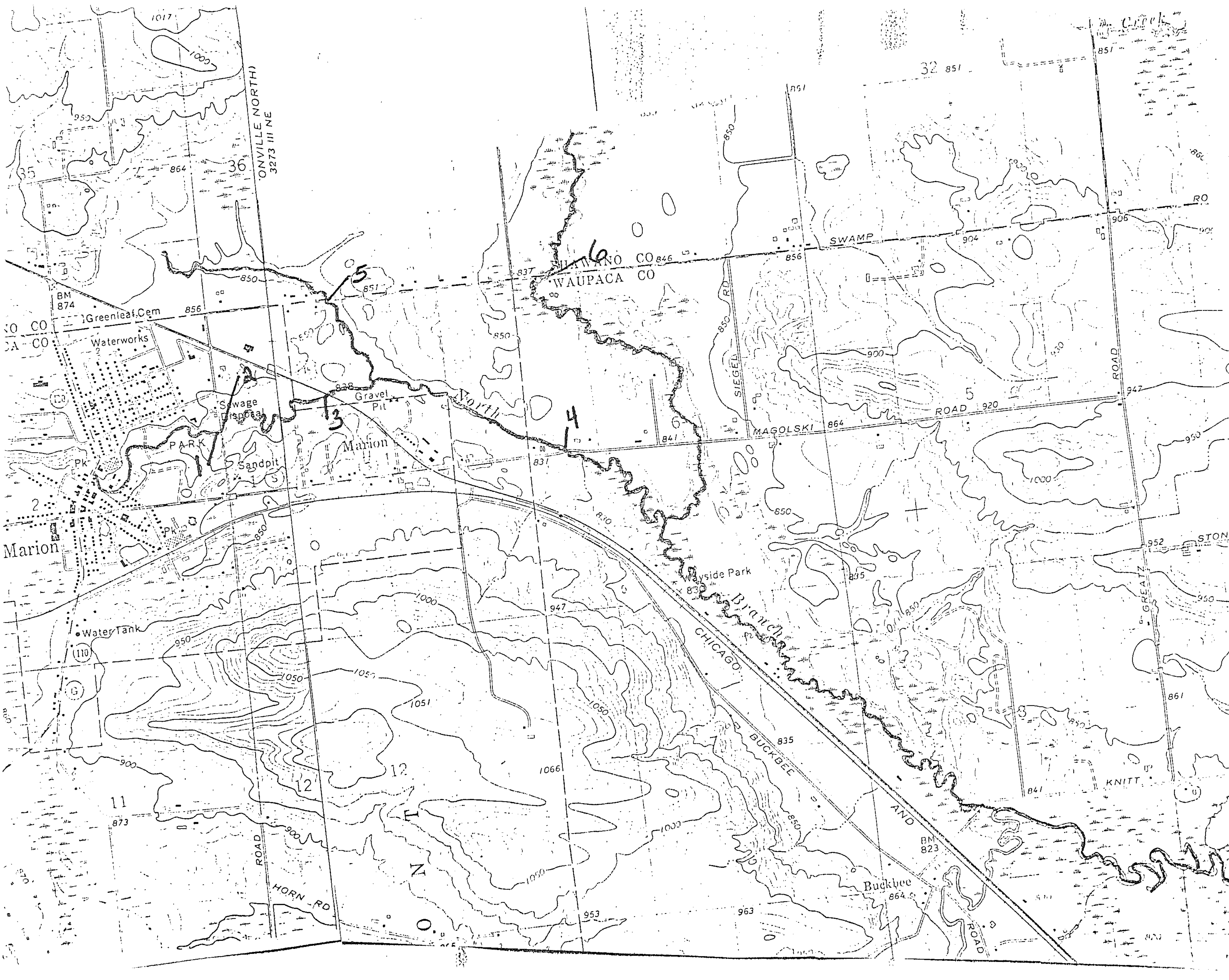
Marion
Greenleaf Cem
Waterworks
BM 874
Sewage Disposal
Sandpit
PARK
Pk
Gravel Pit
Marion
North Branch
Wayside Park
Water Tank
SHAWANO CO
WAUPACA CO
SWAMP
ROAD
SIEGEL RD
MAGOLSKI ROAD
GREATZ
KNITT
STON
CHICAGO BUCKBEE AND
Buckbee
BM 823
HORN RD
ROAD
ONVILLE NORTH)
3273 III NE
Creek

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