

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
SURFACE WATER QUALITY DIVISION
MAY 2002

STAFF REPORT

A BIOLOGICAL SURVEY OF THE LOWER ST. JOSEPH
RIVER WATERSHED, BERRIEN AND CASS COUNTIES,
JUNE AND JULY 2001

As part of the watershed surveillance activity of the Surface Water Quality Division, staff of the Great Lakes and Environmental Assessment Section (GLEAS) conducted a qualitative, biological survey of tributaries to the lower St. Joseph River in Berrien and Cass Counties. The biological survey was conducted according to GLEAS Procedure #51 (GLEAS, 1997). Sediment and water samples were collected, preserved, and transported to the Michigan Department of Environmental Quality (MDEQ) Laboratory for chemical analyses (MDNR, 1994). The survey objectives were to document current conditions and assess stream quality through biological, physical, and chemical evaluations.

SUMMARY

Locations of macroinvertebrate community sampling, physical habitat evaluations, and chemical sampling are indicated in Figure 1. The macroinvertebrate community sampling results, physical habitat evaluations, and chemical data from both water and sediment are presented in Tables 1 through 4, respectively. A summary of the sampling locations are presented in Appendix A. The overall metric evaluations for the 14 sampling locations are summarized in Appendix B.

Scoring of the macroinvertebrate communities was conducted using a scoring system, which rated the communities on a scale from +9 to -9. Stations with a score greater than or equal to +5 would be considered excellent. Stations with a score less than or equal to -5 would be classified as poor. Stations with a score of -4 through +4 would be classified as acceptable (moderately impaired). Stream habitat was evaluated at each station using a scoring system, which ranged in values from 0 to 135 (Appendix B).

Hickory Creek

Hickory Creek is a coldwater stream originating in the western portion of Berrien County. The stream flows in a northerly direction until it converges with the St. Joseph River in the vicinity of St. Joseph, Michigan. Agricultural impacts to the stream are common in the headwaters of the system, while the lower reaches of the stream are more impacted by residential and urban development (Roush, 2001). The Bosch Braking manufacturing facility discharges wastewater to Hickory Creek at Maiden Lane. The survey conducted in 1996 at Maiden Lane documented a macroinvertebrate community that would be rated as fair (Roush, 2001). The survey documented few impacts to Hickory Creek from the point source discharge (Roush, 2001).

Hickory Creek had been dredged at both stations surveyed. Therefore, the stream tended to be extremely straight with little variation in channel morphology. The biological community was rated as acceptable and the habitat was rated as fair at both stations surveyed. The biological community and physical habitat documented in 2001 was very similar to the conditions documented in 1996. The substrate was dominated by sand, with very little stable substrate available for colonization by macroinvertebrates. The point source discharge from Bosch

Braking did not appear to be negatively impacting the biological community present in Hickory Creek. In March 1999, the Aquatic Toxicity Laboratory of the MDEQ conducted whole effluent toxicity testing with effluent collected from the Bosch Braking facility. The effluent was not acutely toxic to *Ceriodaphnia dubia* and did not exhibit excessive chronic toxicity to *Ceriodaphnia dubia* (Butler, 1999).

Previous sediment samples collected at this location in 1996 had identified arsenic, barium, manganese, and vanadium at elevated levels (Roush, 2001). However, a base, neutral, acid (BNA) scan was not conducted on the sediment from this location. Therefore, the elevated levels of contamination identified in this survey were not previously documented. Sediment samples were collected from Hickory Creek, just downstream from the point source discharge. The sediments were analyzed for multiple pollutants to characterize the quality of the sediment. The sediments contained quantifiable levels of polynuclear aromatic hydrocarbons such as naphthalene, 2-methylnaphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. Tables 4A through 4C presents the sediment data gathered during this survey.

Big Meadow Creek

Big Meadow Creek is a coldwater tributary to the St. Joseph River. The ditched headwaters of this stream flow through predominantly agricultural land. According to a local resident, who is also a trout angler, the Berrien County Drain Commissioner recently removed the large woody debris from the downstream portions of the stream, including the station where the stream was evaluated, to facilitate the drainage of water.

The biological community in Big Meadow Creek is rated as acceptable, and the habitat was rated as fair, moderately impaired. The combined effects of dredging, canopy removal, and the removal of instream structure severely limits the amount of suitable, stable, habitat available for macroinvertebrate colonization. The stream banks were relatively unstable due to a lack of stream bank vegetation. The removal of nearly all of the large woody debris from the stream channel has allowed storm flow velocities to increase, thereby causing bank erosion problems and creating a uniform flow pattern that has eliminated deep pool habitat.

Pipestone Creek

Pipestone Creek is a coldwater tributary to the St. Joseph River. Previous work on this stream has identified fish communities that would be rated as good. Rainbow trout and brown trout were identified during the survey (Heaton, 1995). The macroinvertebrate community was rated as fair at two locations and good at another location (Heaton, 1995).

Pipestone Creek was evaluated at two stations in 2001. The macroinvertebrate community was rated as acceptable at stations 4 and 5. The habitat was rated as good at station 4 and fair at station 5. The biological community and physical habitat documented during this survey was very similar to the conditions documented in 1994. Station 5 had previously been dredged and the lack of riffles and shallow pools was obvious. The stream at station 5 could be characterized as a deep run/pool; bottom contours provided some habitat. Station 4 had not been dredged and the channel sinuosity was considerably improved when compared to station 5.

Love Creek

The Love Creek evaluated during this survey is a warmwater tributary to the St. Joseph River and is located downstream from Farmer's Creek. There is another Love Creek located upstream from Farmer's Creek; however, this Love Creek is designated as a coldwater stream.

In 2001, Love Creek was evaluated just prior to the confluence with the St. Joseph River. The habitat was rated as fair, and the macroinvertebrate community was rated as acceptable. At the survey location, the stream flowed through a deep ravine in a mature woods. The variable flows of the stream, unstable, steep banks, and sandy soils combine to create a situation where sediments are entering the stream. The existing instream substrates are frequently shifting, thereby limiting the amount of stable habitat available for macroinvertebrate colonization.

Lemon Creek

Lemon Creek is a relatively small coldwater tributary to the St. Joseph River. The stream was surveyed near the Andrews University Apartments. The habitat at this location was rated as fair, and the macroinvertebrate community was rated as acceptable. Highly variable flows and the relatively steep gradient at the sample location produce substrates that frequently migrate downstream limiting stable habitat. Upstream visual reconnaissance documented a dredged stream channel through a predominantly agricultural watershed. The lower reaches of Lemon Creek receives the storm water discharges from Berrien Springs.

Farmers Creek

Farmers Creek is a coldwater tributary to the St. Joseph River. In 1991, the macroinvertebrate community in Farmers Creek was rated as fair at the two locations surveyed (Heaton, 1992). The most recent survey found a biological community that was rated as acceptable, and the habitat was rated as fair. Approximately 2% of the stream reach surveyed had rooted, emergent vegetation, but nuisance conditions were not observed. The highly variable flows of the stream along with the relatively unstable banks and naturally sandy soils are combining to produce limited stable habitat.

Water samples were collected from Farmers Creek to assess ambient water quality. Results from water sampling were compared to water quality data from reference sites within the Southern Michigan Northern Indiana Till Plains (SMNITP) ecoregion (Lundgren, 1994). Arsenic, magnesium, and nickel were present at levels that exceeded the range of values documented at reference sites within the SMNITP ecoregion. However, none of the parameters were present at levels that exceeded the Michigan Water Quality Standards. All other parameters evaluated were within the range of values documented for this ecoregion.

Eau Claire Extension Drain

The Eau Claire Extension Drain is a coldwater tributary to Farmer's Creek. Past surveys have documented the impacts of point source discharges and the storm water from the village of Eau Claire (Heaton, 1992). Toxicity testing was conducted on the effluent from Hoffman Industries-Michigan Tube Division in 1996. All three samples of effluent collected exhibited acute toxicity to the aquatic organisms used in the testing (Dimond, 1996).

During the survey in 2001, the macroinvertebrate community was rated as acceptable at both survey locations, and the habitat was rated as fair at both locations. The biological community at station 9 has improved from poor in 1996 to acceptable in 2001. The improvement may be attributed to the termination of two point source discharges (Heaton, 1992). The relatively

unstable banks of the stream are contributing sediments to the stream. Sources of potential non point source pollution includes: the storm water from the village of Eau Claire and a park with deer located on a hillside adjacent to the stream.

Water samples were collected from the Eau Claire Extension Drain to assess ambient water quality. Results from water sampling were compared to water quality data from reference sites within the SMNITP ecoregion (Lundgren, 1994). Magnesium, nickel, and ammonia were present at levels that exceeded the range of values expected for this ecoregion. However, none of these values were present at levels that would violate the Michigan Water Quality Standards. All other parameters evaluated were either within or below the expected range of values for this ecoregion.

McCoy Creek

McCoy Creek is a designated coldwater stream originating near the Indiana/Michigan border. The stream flows in a northerly direction until converging with the St. Joseph River in Buchanan, Michigan. Two stations were surveyed on McCoy Creek. Station 12 was located upstream of Buchanan, while station 11 was located downstream of Buchanan, just prior to the stream's convergence with the St. Joseph River.

The biological community was rated as excellent at station 12, and the physical habitat was rated as fair. Dredging activities at station 12 have created a stream that lacks bends, riffles, and pools. The stream is dominated by a straight run with banks densely vegetated with shrubs. Downstream at station 11 the biological community was rated as acceptable, and the habitat was rated as good. Station 11 on McCoy Creek has maintained an unaltered stream channel at the survey station; however, the highly variable flows of the stream cause erosion of the stream bank and the substrate is frequently disturbed by the variable flows.

Brandywine Creek

Brandywine Creek is a coldwater tributary to the St. Joseph River, located in southwestern Cass County and southeastern Berrien County. The stream is designated as a top quality trout stream and has been managed as a trout fishery since at least 1933 by the Michigan Department of Natural Resources, Fisheries Division (Dexter, 1991). The land use in the upper portion of the watershed is dominated by farming, while the lower reaches are more influenced by the urban area of Niles.

During a survey of the upper portion of Brandywine Creek in 1994 (Heaton, 1995), impacts to the stream were observed and documented. Farming practices, including farming up to the edge of the stream, and a lack of buffer strips contributed to the input of sediments to the creek (Heaton, 1995). Stream bank erosion, from slumping banks, also appeared to contribute a large amount of sediments to the system. The biological community and habitat was rated as fair during this survey. The increased sediments caused an increase in the stream width and a decrease in stream depth (Heaton, 1995).

The survey in 2001 documented a macroinvertebrate community that would be considered acceptable at the two stations surveyed. The habitat was rated as good at the survey locations. Brandywine Creek, at station 13, had historically been dredged. The stream modifications have destroyed the riffle, run sequence common to unmodified streams. The majority of the stable habitat present was provided by overhanging brush. Station 14 was located on Brandywine Creek in the town of Niles, just upstream from the convergence with the St. Joseph River. The majority of the stable habitat at this station was provided by the substrate. There was a noticeable lack of large woody debris present in the stream. The gradient of Brandywine Creek at this station prevented excessive embeddedness of the substrate.

Sediments

Sediments were collected from several locations to be analyzed for multiple pollutants. The level of pollutants present in the sediments was compared to reference site sediments collected from within the SMNITP ecoregion (Jones, 1999). Sediments collected from station 1 on Hickory Creek and station 9 on the Eau Claire Extension Drain had levels of copper that exceeded the typical range of values for the SMNITP ecoregion. Station 9 also had levels of zinc in the sediment that exceeded the typical range for this ecoregion. Multiple other pollutants were present in the sediments from Hickory Creek and the Eau Claire Drain that were not identified in the sediments collected from reference sites in the SMNITP ecoregion. Further sediment data is presented in Tables 4A through 4C.

The pollutant levels within the sediments were also compared to the sediment quality guidelines (SQGs) (MacDonald et al., 2000). The pollutant levels were compared to the threshold effect concentration (TEC) and the probable effect concentration (PEC). The TEC describes a level of contamination in the sediment below which adverse effects are not expected to occur. The PEC describes a level of contamination in the sediment above which adverse effects are expected to occur more often than not (MacDonald et al., 2000).

Sediment collected from station 10 on the Eau Claire Extension Drain had levels of 4,4'-DDE that exceeded the TEC for this parameter. The sediment collected from station 9 on the Eau Claire Extension Drain had the following contaminants present at levels that exceeded the TEC but were below the PEC: 4,4'-DDD, fluoranthene, pyrene, benz(a)anthracene, and chrysene.

The station surveyed on Hickory Creek was located just downstream from a site of environmental contamination. Sediment collected from this site was contaminated. The following contaminants were present at levels that greatly exceeded the PEC: phenanthrene, anthracene, fluoranthene, pyrene, benz(a)anthracene, chrysene, and benzo(a)pyrene. This station also had levels of naphthalene and fluorene that exceeded the TEC but were below the PEC. It is likely that sediments from this site had been contaminated by petroleum products.

REFERENCES

- Butler, D. 1999. Chronic Toxicity Assessment of Bosch Braking. Report No. MI/DEQ/SWQ-99/073.
- Dexter, James, L., Jr. 1991. Status of the Fishery Resource Report. Michigan Department of Natural Resources, Fisheries Division. Report No. 91-11, 1991.
- Dimond, W. 1996. Acute Toxicity Assessment of Hofmann Ind-Michigan Tube Division Outfall 001 Effluent. Report No. MI/DEQ/SWQ-96/120.
- GLEAS Procedure #51. 1997. Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers. MDEQ, Surface Water Quality Division, Great Lakes and Environmental Assessment Section.
- Heaton, S. 1992. A Biological Survey of Eau Claire Extension Drain and Farmer's Creek, Berrien County, Michigan, July 29-30, 1991. Report No. MI/DNR/SWQ-92/264.
- Heaton, S. 1995. A Biological Survey of Brandywine Creek, Cass County, Michigan, September 20, 1994. Report No. MI/DNR/SWQ-95/031.
- Heaton, S. 1995. Biological Survey of Blue Creek, Yellow Creek and Pipestone Creek, Berrien County, Michigan, September 19-21, 1994. Report No. MI/DNR/SWQ-95/032.

Jones, R. 1999. Reference Site Sediment Chemistry Report for Wadable Streams 1994, 1997, and 1998. Report No. MI/DEQ/SWQ-99/060.

Lundgren, R. 1994. Reference Site Monitoring Report, 1992-1993. Report No. MI/DNR/SWQ-94/048.

MDNR. 1994. Quality Assurance Manual for Water, Sediment, and Biological Sampling. Michigan Department of Natural Resources, Surface Water Quality Division.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. Archives of Environmental Contamination and Toxicology. 39, 20-31 (2000).

Omernik, J.M. and A.L. Gallant. 1988. Ecoregions of the Upper Midwest States. United States Environmental Protection Agency, Environmental Research Laboratory, EPA/600/3-88/037.

Roush, D. 2001. Biological Assessment of Hickory Creek, Berrien County, August 6, 1996. Report No. MI/DEQ/SWQ-01/127.

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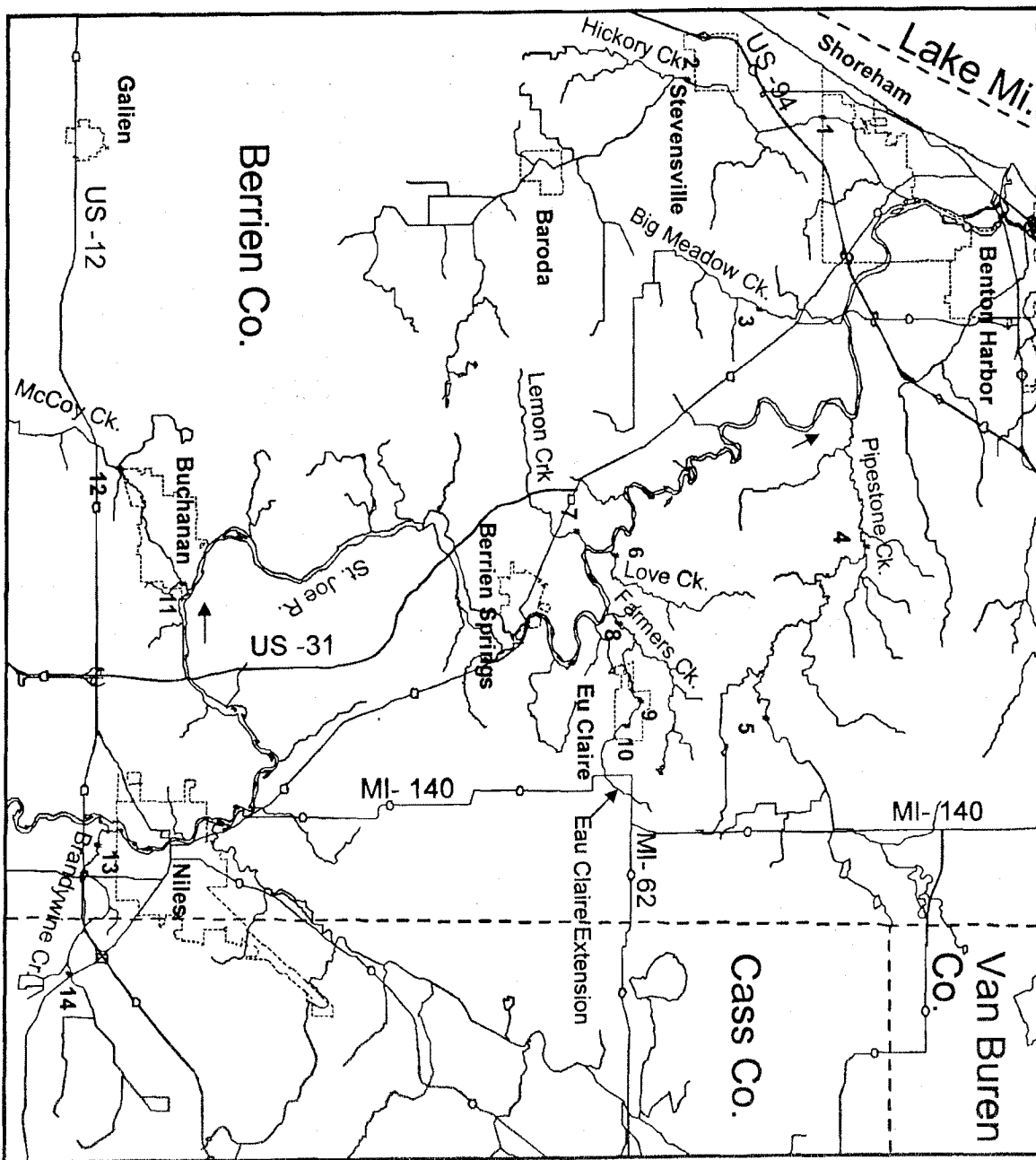


Figure 1. Biological Survey of Selected Lower St. Joseph River Tributaries, 2001.

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

TAXA	Hickory Ck at Maiden Lane 7/5/2001 STATION 1	Hickory Ck @ Stevensville Rd 7/5/2001 STATION 2	Big Meadow Ck @ Marquette Woods 7/5/2001 STATION 3	Pipestone Ck Hillandale Rd 6/27/2001 STATION 4
BRYOZOA (moss animals)		1		
ANNELIDA (segmented worms)				
Hirudinea (leeches)				1
Oligochaeta (worms)		1		
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	15	20	5	20
Decapoda (crayfish)	1	1	1	1
Isopoda (sowbugs)	15	10	15	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	15	10	15	10
Heptageniidae	2	3	2	5
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	2	2	2
Gomphidae		1		
Zygoptera (damselflies)				
Calopterygidae	2	2	2	3
Coenagrionidae				1
Hemiptera (true bugs)				
Corixidae				1
Gerridae	1	1	1	1
Mesoveliidae		1		1
Pleidae	1			
Trichoptera (caddisflies)				
Brachycentridae		1		
Hydropsychidae	5	5	20	10
Leptoceridae	2			
Limnephilidae	1	2	1	1
Polycentropodidae	1			
Coleoptera (beetles)				
Hydrophilidae (total)		1	1	
Psephenidae (adults)				1
Elmidae	2	3	3	1
Halplidae (larvae)				1
Diptera (flies)				
Chironomidae	30	30	25	20
Simuliidae	5	2	5	15
Tipulidae			2	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				1
Physidae	1	1	1	1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	1		1
TOTAL INDIVIDUALS	102	99	101	99

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

METRIC	Hickory Ck at Maiden Lane 7/5/2001 STATION 1		Hickory Ck @ Stevensville Rd 7/5/2001 STATION 2		Big Meadow Ck @ Marquette Woods 7/5/2001 STATION 3		Pipestone Ck Hillandale Rd 6/27/2001 STATION 4	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	18	0	21	0	16	0	21	0
NUMBER OF MAYFLY TAXA	2	0	2	0	2	0	2	0
NUMBER OF CADDISFLY TAXA	4	0	3	0	2	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	17	0	13	0	17	0	15	0
PERCENT CADDISFLY COMP.	9	0	8	0	21	0	11	0
PERCENT CONTR. DOM. TAXON	29	0	30	0	25	0	20	0
PERCENT ISOPOD, SNAIL, LEECH	16	-1	11	-1	16	-1	3	1
PERCENT SURF. AIR BREATHERS	2	1	3	1	2	1	4	1
TOTAL SCORE		-1		-1		-1		1
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.	

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

TAXA	Pipestone Ck Old Pipestone Rd 6/27/2001 STATION 5	Love Ck Hipps Hollow 6/26/2001 STATION 6	Lemon Ck @ Andrews University Apts 6/26/2001 STATION 7	Farmers Ck Hipps Hollow Rd 6/26/2001 STATION 8
PORIFERA (sponges)	1			
PLATYHELMINTHES (flatworms)				
Turbellaria	1			
BRYOZOA (moss animals)	1			
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	1
Oligochaeta (worms)	1	2	1	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	5	5	35	10
Decapoda (crayfish)	1	2	1	1
Isopoda (sowbugs)			1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	3	10	5	10
Heptageniidae				1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	3	5	1	5
Corduliidae		1		
Gomphidae	1			
Zygoptera (damselflies)				
Calopterygidae	3	3	3	5
Coenagrionidae	1			
Hemiptera (true bugs)				
Corixidae	1	1	1	2
Gerridae	1	1	1	1
Mesoveliidae		1		
Trichoptera (caddisflies)				
Hydropsychidae	20	5	5	5
Limnephilidae	1	1	1	1
Coleoptera (beetles)				
Dytiscidae (total)			1	
Halplidae (adults)	1	1	1	
Hydrophilidae (total)				1
Elmidae	2	5	2	5
Gyrinidae (larvae)			1	
Diptera (flies)				
Athericidae	1	1	1	1
Chironomidae	25	30	30	25
Culicidae	1			
Simuliidae	25	25	10	25
Tabanidae				1
Tipulidae	5			1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1		1	
Physidae	1	1	1	1
Planorbidae	1			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1			1
TOTAL INDIVIDUALS	108	100	104	104

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

METRIC	Pipestone Ck Old Pipestone Rd 6/27/2001 STATION 5		Love Ck Hipps Hollow 6/26/2001 STATION 6		Lemon Ck @ Andrews University Apts 6/26/2001 STATION 7		Farmers Ck Hipps Hollow Rd 6/26/2001 STATION 8	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	26	1	18	1	20	0	21	0
NUMBER OF MAYFLY TAXA	1	-1	1	0	1	0	2	0
NUMBER OF CADDISFLY TAXA	2	0	2	0	2	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	3	-1	10	0	5	0	11	0
PERCENT CADDISFLY COMP.	19	0	6	0	6	0	6	0
PERCENT CONTR. DOM. TAXON	23	0	30	0	34	0	24	0
PERCENT ISOPOD, SNAIL, LEECH	3	1	1	1	4	1	2	1
PERCENT SURF. AIR BREATHERS	4	1	4	1	4	1	4	1
TOTAL SCORE		0		2		1		1
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.	

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

TAXA	Eau Claire Extension @ Park off 5th St 6/26/2001	Eau Claire Drain Keigley Rd 6/26/2001	McCoy Ck Sinclair 6/12/2001	McCoy Ck Bakertown Rd 6/12/2001
	STATION 9	STATION 10	STATION 11	STATION 12
PLATYHELMINTHES (flatworms)				
Turbellaria	2	15	1	
BRYOZOA (moss animals)		1		
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1	1	
Oligochaeta (worms)	2	3		1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	20	1	25	20
Decapoda (crayfish)		1	4	1
Isopoda (sowbugs)			2	1
Arachnoidea				
Hydracarina			1	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	10	10	3	15
Heptageniidae			5	10
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	5	5	2	
Gomphidae			1	
Zygoptera (damselflies)				
Calopterygidae	10	3	2	
Coenagrionidae				1
Plecoptera (stoneflies)				
Perlodidae			5	15
Hemiptera (true bugs)				
Corixidae	1	2	1	
Gerridae	1	1	1	1
Mesoveliidae				1
Trichoptera (caddisflies)				
Brachycentridae			1	
Hydropsychidae			10	15
Leptoceridae			1	
Limnephilidae			1	2
Phryganeidae			1	1
Coleoptera (beetles)				
Halplidae (adults)	1			
Elmidae	5	5	5	2
Gyrinidae (larvae)		1		
Halplidae (larvae)		1		
Diptera (flies)				
Athericidae	1			1
Chironomidae	20	35	25	20
Simuliidae	20	10	5	1
Tipulidae			1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				
Physidae	1	1		1
Planorbidae			1	
Valvatidae			1	
Pelecypoda (bivalves)				
Corbiculidae			1	
Sphaeriidae (clams)	1	1		
TOTAL INDIVIDUALS	101	97	107	110

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

METRIC	Eau Claire Extension @ Park off 5th St 6/26/2001		Eau Claire Drain Keigley Rd 6/26/2001		McCoy Ck Sinclair 6/12/2001		McCoy Ck Bakertown Rd 6/12/2001	
	STATION 9 Value	Score	STATION 10 Value	Score	STATION 11 Value	Score	STATION 12 Value	Score
TOTAL NUMBER OF TAXA	16	1	16	1	26	1	19	0
NUMBER OF MAYFLY TAXA	1	0	1	0	2	0	2	0
NUMBER OF CADDISFLY TAXA	0	-1	0	-1	5	1	3	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	1	1	1	1
PERCENT MAYFLY COMP.	10	0	10	0	7	0	23	1
PERCENT CADDISFLY COMP.	0	-1	0	-1	13	0	16	0
PERCENT CONTR. DOM. TAXON	20	1	36	0	23	0	18	1
PERCENT ISOPOD, SNAIL, LEECH	2	1	2	1	5	0	2	1
PERCENT SURF. AIR BREATHERS	3	1	3	1	2	1	2	1
TOTAL SCORE		1		0		4		5
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.		EXCELLENT	

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass County, 2001.

TAXA	Brandywine Ck Bond St in Niles Twp Pk 6/12/2001		Brandywine Ck US-12 6/13/2001	
	STATION 13		STATION 14	
BRYOZOA (moss animals)	1			
ANNELIDA (segmented worms)				
Oligochaeta (worms)	1		1	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	20		20	
Decapoda (crayfish)	1		1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	15		10	
Ephemeridae	1			
Heptageniidae	10		1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae			1	
Zygoptera (damselflies)				
Calopterygidae			1	
Plecoptera (stoneflies)				
Perlodidae			2	
Hemiptera (true bugs)				
Corixidae			10	
Trichoptera (caddisflies)				
Brachycentridae			10	
Hydropsychidae	20		5	
Limnephilidae	5		5	
Uenoidae	1			
Coleoptera (beetles)				
Haliplidae (adults)			1	
Elmidae	1			
Gyrinidae (larvae)			1	
Diptera (flies)				
Chironomidae	20		20	
Culicidae			1	
Simuliidae	2		10	
Tipulidae	3			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				
Planorbidae			1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1			
TOTAL INDIVIDUALS	102		101	

Table 1A. Qualitative macroinvertebrate sampling results for sites on selected tributaries to the St Joseph River, Berrien and Cass County, 2001.

METRIC	Brandywine Ck Bond St in Niles Twp Pk 6/12/2001		Brandywine Ck US-12 6/13/2001	
	STATION 13		STATION 14	
	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	15	0	17	0
NUMBER OF MAYFLY TAXA	3	0	2	0
NUMBER OF CADDISFLY TAXA	3	0	3	0
NUMBER OF STONEFLY TAXA	0	-1	1	1
PERCENT MAYFLY COMP.	25	1	11	0
PERCENT CADDISFLY COMP.	25	0	20	0
PERCENT CONTR. DOM. TAXON	20	1	20	1
PERCENT ISOPOD, SNAIL, LEECH	0	1	1	1
PERCENT SURF. AIR BREATHERS	0	1	12	0
TOTAL SCORE		3		3
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.	

Table 2. Habitat evaluation for selected tributaries to the St. Joseph River, Berrien and Cass counties, 2001.

HABITAT METRIC (MAX)	Hickory Ck @ Maiden Lane STATION 1	Hickory Ck @ Stevensville Rd STATION 2	Big Meadow Ck @ Marquette Woods STATION 3	Pipestone Ck @ Hillandale Rd STATION 4	Pipestone Ck @ Old Pipestone Rd STATION 5
Bottom Substrate					
Avail. Cover (20):	6	8	5	11	10
Embeddedness (20):	8	8	10	10	6
Velocity:Depth (20):	10	12	11	16	10
Flow Stability (15):	7	7	6	7	4
Bottom Depos. (15):	3	4	8	4	7
Pools-Riffles- Runs-Bends (15):	7	7	7	8	4
Bank Stability (10):	6	5	3	6	6
Bank Vegetative Stability (10):	7	7	2	6	6
Stream Cover (10):	9	7	7	7	7
TOTAL SCORE (135):	63	65	59	75	60

HABITAT RATING:	FAIR (MODERATELY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	FAIR (MODERATELY IMPAIRED)
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Date:	7/5/2001	7/5/2001	7/5/2001	6/27/2001	6/27/2001
Weather:	Sunny	Sunny	Sunny	Sunny	Sunny
Air Temperature:	65 Deg. F.	70 Deg. F.	65 Deg. F.	68 Deg. F.	70 Deg. F.
Water Temperature:	66 Deg. F.	0 Deg. F.	62 Deg. F.	64 Deg. F.	66 Deg. F.
Ave. Stream Width:	22 Feet	25 Feet	10 Feet	18 Feet	15 Feet
Ave. Stream Depth:	0.5 Feet	2 Feet	0.25 Feet	1.5 Feet	0.5 Feet
Surface Velocity:	0.75 Ft./Sec.	0.25 Ft./Sec.	0.75 Ft./Sec.	0.75 Ft./Sec.	0.5 Ft./Sec.
Estimated Flow:	8.25 CFS	12.5 CFS	1.875 CFS	20.25 CFS	3.75 CFS
Stream Modifications:	Dredged	Dredged	Dredged	None	Dredged
Nuisance Plants (Y/N):	No	No	No	No	No
Report Number:					

STORET No.:	110675	110106	110676	110641	110669
Stream Name:	Hickory Ck	Hickory Ck	Big Meadow Ck	Pipestone Ck	Pipestone Ck
Road Crossing/Location:	@ Maiden Lane	@ Stevensville Rd	@ Marquette Woods	@ Hillandale Rd	@ Old Pipestone Rd
County Code:	11	11	11	11	11
TRS:	05S19W10	05S19W28	05S18W19	05S18W01	05S17W16
Latitude (dd):	42.0502532	42.02544	42.02907	42.06519	42.03146
Longitude (dd):	-86.505508	-86.50448	-86.43998	-86.35858	-86.29999
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001	4050001

COMMENTS:

Table 2. Habitat evaluation for selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

HABITAT METRIC (MAX)	Love Ck Hipps Hollow STATION 6	Lemon Ck @ Andrews University Apts STATION 7	Farmers Ck Hipps Hollow Rd STATION 8	Eau Claire Extension @ Park off 5th St STATION 9	Eau Claire Drain Keigley Rd STATION 10
Bottom Substrate					
Avail. Cover (20):	6	10	10	10	10
Embeddedness (20):	6	10	8	11	8
Velocity:Depth (20):	15	15	15	11	8
Flow Stability (15):	4	4	4	6	5
Bottom Depos. (15):	3	3	4	7	7
Pools-Riffles- Runs-Bends (15):	8	8	8	8	7
Bank Stability (10):	3	5	5	4	6
Bank Vegetative Stability (10):	3	5	5	6	4
Stream Cover (10):	7	7	7	5	7
TOTAL SCORE (135):	55	67	66	68	62
HABITAT RATING:	FAIR (MODERATELY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	FAIR (MODERATELY IMPAIRED)
Date:	6/26/2001	6/26/2001	6/26/2001	6/26/2001	6/26/2001
Weather:	Sunny	Sunny	Sunny	Sunny	Sunny
Air Temperature:	85	Deg. F. 86	Deg. F. 85	Deg. F. 85	Deg. F. 85
Water Temperature:	66	Deg. F. 59	Deg. F. 0	Deg. F. 0	Deg. F. 0
Ave. Stream Width:	5	Feet 10	Feet 20	Feet 4	Feet 4
Ave. Stream Depth:	0.25	Feet 0.333	Feet 0.333	Feet 0.25	Feet 0.25
Surface Velocity:	0.5	Ft./Sec. 0.75	Ft./Sec. 0.75	Ft./Sec. 0.5	Ft./Sec. 0.75
Estimated Flow:	0.625	CFS 2.4975	CFS 4.995	CFS 0.5	CFS 0.75
Stream Modifications:	None	None	None	None	Dredged
Nuisance Plants (Y/N):	No	No	No	No	No
Report Number:					
STORET No.:	110047	110668	110634	110667	110635
Stream Name:	Love Ck	Lemon Ck	Farmers Ck	Eau Claire Extension	Eau Claire Drain
Road Crossing/Location:	Hipps Hollow	@ Andrews University Apts	Hipps Hollow Rd	@ Park off 5th St	Keigley Rd
County Code:	11	11	11	11	11
TRS:	06S18W01	06S18W11	06S17W06	05S17W32	06s17w04
Latitude (dd):	41.97923	41.96583	41.98054	41.98814	41.98322
Longitude (dd):	-86.35623	-86.365	-86.33296	-86.30669	-86.29821
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001	4050001
COMMENTS:					

Table 2. Habitat evaluation for selected tributaries to the St Joseph River, Berrien and Cass Counties, 2001.

HABITAT METRIC (MAX)	McCoy Ck Sinclair STATION 11	McCoy Ck Bakertown Rd STATION 12	Brandywine Ck Bond St in Niles Twp Pk STATION 13	Brandywine Ck US-12 STATION 14
Bottom Substrate				
Avail. Cover (20):	10	10	8	10
Embeddedness (20):	13	6	16	10
Velocity:Depth (20):	15	5	15	10
Flow Stability (15):	7	8	7	10
Bottom Depos. (15):	8	4	11	4
Pools-Riffles- Runs-Bends (15):	11	1	11	4
Bank Stability (10):	6	9	6	9
Bank Vegetative Stability (10):	7	9	6	9
Stream Cover (10):	7	9	7	9
TOTAL SCORE (135):	84	61	87	75
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	FAIR (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
Date:	6/12/2001	6/12/2001	6/12/2001	6/13/2001
Weather:	Sunny	Sunny	Sunny	Rainy
Air Temperature:	85 Deg. F.	83 Deg. F.	75 Deg. F.	80 Deg. F.
Water Temperature:	0 Deg. F.	69 Deg. F.	0 Deg. F.	57 Deg. F.
Ave. Stream Width:	22 Feet	25 Feet	18 Feet	14 Feet
Ave. Stream Depth:	0.666 Feet	1 Feet	0.5 Feet	3 Feet
Surface Velocity:	1 Ft./Sec.	0.5 Ft./Sec.	1.5 Ft./Sec.	0.5 Ft./Sec.
Estimated Flow:	14.652 CFS	12.5 CFS	13.5 CFS	21 CFS
Stream Modifications:	None	Dredged	None	Dredged
Nuisance Plants (Y/N):	No	No	No	No
Report Number:				
STORET No.:	110662	110663	110664	140111
Stream Name:	McCoy Ck	McCoy Ck	Brandywine Ck	Brandywine Ck
Road Crossing/Location:	Sinclair	Bakertown Rd	Bond St in Niles Twp Pk	US-12
County Code:	11	11	11	14
TRS:	07S18W25	07S18W34	08S17W02	08S16W06
Latitude (dd):	41.83364	41.81293	41.80615	41.79694
Longitude (dd):	-86.34794	-86.3877	-86.25886	-86.21472
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001

COMMENTS:

Table 3. Water chemistry data for Farmers Creek and Eau Claire Drain, Berrien County, Michigan, June, 2001.				
		Station 8	Station 9	Station 10
		Farmers Crk	Eau Claire Ext.	Eau Claire Drain
		@ Hipps Hollow Rd	@ Park off 5th St.	@ Keigley Rd.
PARAMETER	UNITS			
Potassium	mg/L	2.1	4.5	1.3
Sodium	mg/L	14.8	27.3	15.3
pH of water	pH	8.18 HT	7.91 HT	8.11 HT
Total Suspended Solids	mg/L	4	K 4	K 4
Hardness	mg/L	319	326	309
Conductivity	umho/cm	648	735	623
Nitrite	mg N/L	0.018	0.096	0.006
Nitrate + Nitrite	mg N/L	0.56	1.74	0.63
Ammonia	mg N/L	0.035	0.21	0.024
Kjeldahl Nitrogen	mg N/L	0.24	0.69	0.38
Ortho Phosphorus	mg P/L	0.092	0.094	0.044
Total Phosphorus	mg P/L	0.132	0.137	0.062
Total Silver	ug/L	K 0.5	K 0.5	K 0.5
Total Aluminum	ug/L	265	54	K 50
Total Antimony	ug/L	K 1.0	K 1.0	K 1.0
Total Arsenic	ug/L	2.7	2.2	1.5
Total Barium	ug/L	69	44	30
Total Beryllium	ug/L	K 1.0	K 1.0	K 1.0
Total Boron	ug/L	38	48	35
Total Calcium	mg/L	74.9	80.5	74.7
Total Cadmium	ug/L	K 0.2	K 0.2	K 0.2
Total Chromium	ug/L	K 1.0	K 1.0	K 1.0
Hex Chromium	ug/L	K 5 HT	K 5 HT	K 5 HT
Total Cobalt	ug/L	K 15	K 15	K 15
Total Copper	ug/L	1.5	2.3	K 1.0
Total Iron	ug/L	410	430	180
Total Lead	ug/L	K 1.0	K 1.0	1.2
Total Lithium	ug/L	K 10	K 10	K 10
Total Mercury	ug/L	K 0.2	K 0.2	K 0.2
Total Magnesium	mg/L	32	30.2	29.6
Total Manganese	ug/L	54	67	51
Total Molybdenum	ug/L	K 25	K 25	K 25
Total Nickel	ug/L	5.2	5.9	4.7
Total Selenium	ug/L	K 1.0	K 1.0	K 1.0
Total Strontium	ug/L	124	105	85
Total Thallium	ug/L	K 2.0	K 2.0	K 2.0
Total Titanium	ug/L	K 10	K 10	K 10
Total Vanadium	ug/L	K 5	K 5	K 5
Total Zinc	ug/L	K 10	10	K 10
K= actual value is known to be less than the given value				
HT= holding time was exceeded				

Michigan, 2001.

Michigan, 2001.									
		Station 1		Station 8		Station 9		Station 10	
		Hickory Crk		Farmers Crk		Eau Claire Ext		Eau Claire Dr	
		@ Maiden Lane		@ Hipps Hollow Rd		@ Park off 5th St		@ Keigley Rd.	
			Reporting	Reporting			Reporting		Reporting
		Result	Limit	Result	Limit	Result	Limit	Result	Limit
Compound	Units								
a-BHC	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
b-BHC	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
g-BHC (lindane)	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
d-BHC	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
Heptachlor	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
Aldrin	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
Heptachlor epoxide	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
g-Chlordane	ug/Kg (dry)	ND	94	ND	5	ND	5	ND	5
Endosulfan I	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
a-Chlordane	ug/Kg (dry)	ND	94	ND	5	ND	5	ND	5
Dieldrin	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
4,4'-DDE	ug/Kg (dry)	ND	38	ND	3.3	3.5	3.3	8	3.3
Endrin	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
Endosulfan II	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
4,4'-DDD	ug/Kg (dry)	ND	38	ND	3.3	5.8	3.3	ND	3.3
Endrin Aldehyde	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
Endosulfan Sulfate	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
4,4'-DDT	ug/Kg (dry)	ND	38	ND	3.3	ND	3.3	ND	3.3
Endrin Ketone	ug/Kg (dry)	ND	38	ND	2.3	ND	2.7	ND	3
Hexabromobenzene	ug/Kg (dry)	ND	190	ND	100	ND	100	ND	100
Methoxychlor	ug/Kg (dry)	ND	94	ND	50	ND	50	ND	50
Mirex	ug/Kg (dry)	ND	94	ND	50	ND	50	ND	50
BP-6 (PBB)	ug/Kg (dry)	ND	470	ND	50	ND	50	ND	50
Aroclor 1016 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1221 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1232 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1242 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1248 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1254 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1260 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1262 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Aroclor 1268 (PCB)	ug/Kg (dry)	ND	47	ND	100	ND	100	ND	100
Toxaphene	ug/Kg (dry)	ND	320	ND	170	ND	170	ND	170

ND = Not detected at the specified reporting limit

Table 4B. Sediment chemistry data for selected tributaries to the lower St. Joseph River, Berrien County, Michigan, 2001.									
		Station 1		Station 8		Station 9		Station 10	
		Hickory Crk		Farmers Crk		Eau Claire Ext		Eau Claire Dr	
		@ Maiden Lane		@ Hipps Hollow Rd		@ Park off 5th St		@ Keigley Rd.	
		Reporting		Reporting		Reporting		Reporting	
Compound	Units	Result	Limit	Result	Limit	Result	Limit	Result	Limit
N-Nitrosodimethylamine	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
Phenol	ug/kg (ppb)	850	620	ND	330	ND	330	ND	330
Bis(2-chloroethyl)ether	ug/kg (ppb)	ND	190	ND	100	ND	100	ND	100
2-Chlorophenol	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
1,3-Dichlorobenzene	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
1,4-Dichlorobenzene	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
1,2-Dichlorobenzene	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
2-Methylphenol (o-cresol)	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
Bis(2-chloroisopropyl)ether	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
3/4-Methylphenol (m/p-cresol)	ug/kg (ppb)	ND	1200	ND	330	ND	330	ND	330
N-Nitrosodi-n-propylamine	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
Hexachloroethane	ug/kg (ppb)	ND	190	ND	100	ND	100	ND	100
Nitrobenzene	ug/kg (ppb)	ND	380	ND	200	ND	200	ND	200
Isophorone	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
2-Nitrophenol	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
2,4-Dimethylphenol	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
Bis(2-chloroethoxy)methane	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
2,4-Dichlorophenol	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
1,2,4-Trichlorobenzene	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
Naphthalene	ug/kg (ppb)	340	190	ND	200	ND	200	ND	200
Hexachlorobutadiene	ug/kg (ppb)	ND	380	ND	200	ND	200	ND	200
4-Chloro-3-methylphenol	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
2-Methylnaphthalene	ug/kg (ppb)	570	470	ND	330	ND	330	ND	330
Hexachlorocyclopentadiene	ug/kg (ppb)	ND	3800	ND	330	ND	330	ND	330
2,4,6-Trichlorophenol	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
2,4,5-Trichlorophenol	ug/kg (ppb)	ND	620	ND	1700	ND	1700	ND	1700
2-Chloronaphthalene	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
2-Nitroaniline	ug/kg (ppb)	ND	3200	ND	1700	ND	1700	ND	1700
Acenaphthylene	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
Dimethyl phthalate	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
2,6-Dinitrotoluene	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
3-Nitroaniline	ug/kg (ppb)	ND	3200	ND	1700	ND	1700	ND	1700
Acenaphthene	ug/kg (ppb)	410	190	ND	330	ND	330	ND	330
2,4-Dinitrophenol	ug/kg (ppb)	ND	3200	ND	1700	ND	1700	ND	1700
Dibenzofuran	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
4-Nitrophenol	ug/kg (ppb)	ND	3200	ND	1700	ND	1700	ND	1700
2,4-Dinitrotoluene	ug/kg (ppb)	ND	620	ND	330	ND	330	ND	330
Fluorene	ug/kg (ppb)	450	190	ND	330	ND	330	ND	330
Diethyl phthalate	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
4-Nitroaniline	ug/kg (ppb)	ND	3200	ND	1700	ND	1700	ND	1700
2-Methyl-4,6-dinitrophenol	ug/kg (ppb)	ND	3200	ND	1700	ND	1700	ND	1700
4-Chlorophenyl phenylether	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
N-Nitrosodiphenylamine	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
Azobenzene	ug/kg (ppb)	ND	380	-	-	-	-	-	-

		Station 1		Station 8		Station 9		Station 10	
		Hickory Crk		Farmers Crk		Eau Claire Ext		Eau Claire Dr	
		@ Maiden Lane		@ Hipps Hollow Rd		@ Park off 5th St		@ Keigley Rd.	
			Reporting		Reporting		Reporting		Reporting
Compound	Units	Result	Limit	Result	Limit	Result	Limit	Result	Limit
1,2-Diphenylhydrazine	ug/kg (ppb)	-	-	ND	330	ND	330	ND	330
4-Bromophenyl phenylether	ug/kg (ppb)	ND	380	ND	330	ND	330	ND	330
Hexachlorobenzene	ug/kg (ppb)	ND	380	ND	200	ND	200	ND	200
Pentachlorophenol	ug/kg (ppb)	ND	6400	ND	1700	ND	1700	ND	1700
Phenanthrene	ug/kg (ppb)	5700	190	ND	330	ND	330	ND	330
Anthracene	ug/kg (ppb)	870	190	ND	330	ND	330	ND	330
Carbazole	ug/kg (ppb)	1300 J	620	ND	330	ND	330	ND	330
Di-n-butyl phthalate	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
Fluoranthene	ug/kg (ppb)	12000	190	ND	330	740	330	ND	330
Pyrene	ug/kg (ppb)	7800	190	ND	330	660	330	ND	330
Butyl benzyl phthalate	ug/kg (ppb)	ND	190	ND	330	ND	330	ND	330
Benz(a)anthracene	ug/kg (ppb)	3700	190	ND	330	350	330	ND	330
Chrysene	ug/kg (ppb)	4700	190	ND	330	400	330	ND	330
Bis(2-ethylhexyl)phthalate	ug/kg (ppb)	570	380	ND	330	ND	330	ND	330
Di-n-octyl phthalate	ug/kg (ppb)	1100	380	ND	330	ND	330	ND	330
Benzo(b)fluoranthene	ug/kg (ppb)	6500	380	ND	330	480	330	ND	330
Benzo(k)fluoranthene	ug/kg (ppb)	3600	380	ND	330	ND	330	ND	330
Benzo(a)pyrene	ug/kg (ppb)	4900	380	ND	330	ND	330	ND	330
Indeno(1,2,3-cd)pyrene	ug/kg (ppb)	2100	380	ND	330	ND	330	ND	330
Dibenz(a,h)anthracene	ug/kg (ppb)	870	380	ND	200	ND	200	ND	200
Benzo(g,h,i)perylene	ug/kg (ppb)	1700	380	ND	330	ND	330	ND	330
ND = Not detected at the specified reporting limit									
J = Estimated value									
- = Parameter not evaluated									

Table 4C. Sediment chemistry data for selected tributaries to the lower St. Joseph River, Berrien County, Michigan, 2001.					
		Station 1	Station 8	Station 9	Station 10
		Hickory Crk	Farmers Crk	Eau Claire Ext	Eau Claire Dr
		@ Maiden Ln	@ Hipps Hollow Rd	@ Park off 5th St	@ Keigley Rd
PARAMETER	UNITS	Result	Result	Result	Result
Silver	mg/kg (dry)	K 0.25	K 0.25	K 0.25	K 0.25
Aluminum	mg/kg (dry)	2500	1000	2880	2600
Arsenic	mg/kg (dry)	5.6	1.6	3.8	3.6
Barium	mg/kg (dry)	59	11	30	30
Beryllium	mg/kg (dry)	0.24	K 0.25	K 0.2	K 0.2
Cadmium	mg/kg (dry)	K 2	K 2	K 2	K 2
Calcium	mg/kg (dry)	-	8840	12900	11800
Cobalt	mg/kg (dry)	4	K 2	3	2
Chromium	mg/kg (dry)	9	3	17	5
Copper	mg/kg (dry)	26	3	16	9
Iron	mg/kg (dry)	13000	3080	6700	6400
Mercury	mg/kg (dry)	K 0.1 DM	K 0.05	K 0.1	K 0.1
Lithium	mg/kg (dry)	4	2	3	3
Magnesium	mg/kg (dry)	-	4140	5230	3850
Manganese	mg/kg (dry)	500	123	270	257
Molybdenum	mg/kg (dry)	K 5	K 5	K 5	K 5
Nickel	mg/kg (dry)	7	K 5	K 5	5
Lead	mg/kg (dry)	20	5	19	12
Potassium	mg/kg (dry)	-	122	267	197
Selenium	mg/kg (dry)	K 0.5	K 0.5	K 0.5	K 0.5
Sodium	mg/kg (dry)	-	K 50	60	K 50
Strontium	mg/kg (dry)	20	5	10	8
Titanium	mg/kg (dry)	39	60	64	45
Thallium	mg/kg (dry)	K 1.0	K 1.0	K 1.0	K 1.0
Vanadium	mg/kg (dry)	7	4	7	7
Zinc	mg/kg (dry)	127	23	180	38
Total Solids - Inorganic	%TS	52.3	76.9	63.2	55.6
K= actual value is known to be less than the given value					
DM= Dilution required due to matrix problems					
- = parameter not measured					

Appendix A

Station locations for the St. Joseph River Watershed survey, June and July 2001

<u>Station #</u>	<u>County (TRS)</u>	<u>Location</u>
1	Berrien (5S,19W,S10)	Hickory Creek @ Maiden Lane
2	Berrien (5S,19W,S28)	Hickory Creek @ Stevensville Rd.
3	Berrien (5S,18W,S19)	Big Meadow Creek @ Marquette Woods
4	Berrien (5S,18W,S1)	Pipestone Creek @ Hillendale Rd.
5	Berrien (5S,17W,S16)	Pipestone Creek @ Old Pipestone Rd.
6	Berrien (6S,18W,S1)	Love Creek @ Hipps Hollow Rd.
7	Berrien (6S,18W,S11)	Lemon Creek @ Andrews Univ. Apts.
8	Berrien (6S,17W,S6)	Farmers Creek @ Hipps Hollow Rd.
9	Berrien (5S,17W,S32)	Eau Claire Extension @ Park off 5 th St.
10	Berrien (6S,17W,S4)	Eau Claire Extension @ Keigley Rd.
11	Berrien (7S,18W,S25)	McCoy Creek @ Sinclair Rd.
12	Berrien (7S,18W,S34)	McCoy Creek @ Bakertown Rd.
13	Berrien (8S,17W,S2)	Brandywine Creek @ Bond St. in Twp Park
14	Cass (8S,16W,S6)	Brandywine Creek @ US 12

Appendix B

Summary of biological and habitat ratings for the St. Joseph River Watershed, Berrien and Cass Counties, June and July 2001

<u>Station</u>	<u>Macro Score</u>	<u>Habitat Score</u>
1	-1 (Acceptable)	63 (Fair, Moderately Impaired)
2	-1 (Acceptable)	65 (Fair, Moderately Impaired)
3	-1 (Acceptable)	59 (Fair, Moderately Impaired)
4	1 (Acceptable)	75 (Good, Slightly Impaired)
5	0 (Acceptable)	60 (Fair, Moderately Impaired)
6	2 (Acceptable)	55 (Fair, Moderately Impaired)
7	1 (Acceptable)	67 (Fair, Moderately Impaired)
8	1 (Acceptable)	66 (Fair, Moderately Impaired)
9	1 (Acceptable)	68 (Fair, Moderately Impaired)
10	0 (Acceptable)	62 (Fair, Moderately Impaired)
11	4 (Acceptable)	84 (Good, Slightly Impaired)
12	5 (Excellent)	61 (Fair, Moderately Impaired)
13	3 (Acceptable)	87 (Good, Slightly Impaired)
14	3 (Acceptable)	75 (Good, Slightly Impaired)