

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

BIOLOGICAL ASSESSMENT OF THE BETSIE AND PLATTE RIVERS WATERSHEDS
BENZIE, MANISTEE, GRAND TRAVERSE, AND LEELANAU COUNTIES, MICHIGAN
JULY-SEPTEMBER 2008

INTRODUCTION

Staff of the Michigan Department of Environmental Quality (MDEQ), Surface Water Assessment Section (SWAS), conducted qualitative biological and habitat surveys in the Betsie and Platte Rivers watersheds from July to September 2008. This assessment was designed to qualitatively characterize the biotic integrity of macroinvertebrate communities with respect to existing habitat conditions at selected sites throughout the Betsie and Platte Rivers watersheds. Surveys were performed according to the MDEQ rapid bioassessment protocol, Procedure 51 (MDEQ, 1990; Creal et al., 1996), at 11 stations in wadeable segments of the mainstem, and tributaries to, the Betsie and Platte Rivers, as well as coastal tributaries to Lake Michigan in the Northwest Lower Peninsula (Table 1).

Two site selection methods were used to assess northwest Lower Peninsula streams in 2008: stratified random and targeted. A probabilistic monitoring approach, using stratified random site selection to address statewide and regional questions about water quality, was used to select stations within the northwest Lower Peninsula region (MDEQ, 2006 draft). For the purposes of probabilistic site selection, the northwest Lower Peninsula consists of the Betsie River, Platte River, Boardman River, and Elk River watersheds, and the many small watersheds that flow to Lake Michigan and Grand Traverse Bay. The biosurveys east of the Betsie and Platte Rivers (including coastal tributaries north to Mackinaw) were conducted separately from the Betsie and Platte Rivers watersheds and are addressed in a separate report (Holden, 2009). Nine probabilistic sites are described in this report. In addition to probabilistic monitoring, 2 sites within the watershed group were selected for targeted monitoring to fulfill specific monitoring requests, assess known or potential areas of concern, collect information and assess attainment of water quality standards (WQS) from areas where historic survey information was lacking, or collect information related to National Pollutant Discharge Elimination System (NPDES) permits.

OBJECTIVES

The specific objectives of this survey were to:

- Assess the current status/condition of individual waters and determine attainment of Michigan WQS.
- Support water quality-based effluent limit development for NPDES permits.
- Identify potential nonpoint source pollution problems.
- Evaluate general water quality trends in the watershed.
- Satisfy monitoring requests submitted by external and internal customers.

WATERSHED DESCRIPTIONS

Betsie River

The Betsie River watershed is located in Grand Traverse, Manistee, and Benzie Counties

(Figure 1), and drains roughly 155,026 acres (Tonello, 2004). The watershed lies in the North Central Hardwood Forests (NCHF) ecoregion (Omernik and Gallant, 1988). The Betsie River originates at Green Lake in Grand Traverse County and flows for nearly 50 miles to Betsie Lake and Lake Michigan near Elberta and Frankfort in Benzie County. The two largest tributaries to the Betsie River are the Little Betsie River and Dair Creek. These two streams have cold, stable flow and, along with a few smaller cold water tributaries, produce roughly half of the wild salmonid smolts in the watershed (Tonello, 2004). The Betsie River has been a state-designated Natural River since 1973 (Michigan Department of Natural Resources [MDNR], 1973). A Natural Rivers zoning board oversees development and other projects that are proposed within 400 feet of the riverbank on either side (Tonello, 2004).

Platte River

The Platte River watershed is located primarily in Benzie County (Figure 1), and drains roughly 123,200 acres including lakes. The river is a designated cold water system in the NCHF ecoregion (Omernik and Gallant, 1988) and originates from a series of lakes in western Grand Traverse County. The river flows for about 20 miles before it reaches Platte Lake and then another 5 miles to the confluence with Lake Michigan. The river mouth is located in Sleeping Bear Dunes National Lakeshore and much of the river proper lies within in the Pere Marquette State Forest.

The MDNR, Platte River State Fish Hatchery, is located on the river at Platte Creek, Michigan. This facility raises coho and chinook salmon and is the main egg take station for coho salmon in the upper Great Lakes. The area is a very popular destination for paddle sports, fishing, and camping.

HISTORICAL SAMPLING EFFORTS

Platte and Betsie River Watersheds

Recent MDEQ surveys of the Betsie and Platte Rivers watersheds were conducted in 2003 and 1998. In July 2003, the Platte and Betsie Rivers, and their respective tributaries, were assessed using Procedure 51. The habitat and macroinvertebrate communities of the two watersheds were assessed at 10 stations. All stations were found to have acceptable macroinvertebrate communities (scores ranged from 0 to +4) and good to excellent habitat conditions (scores ranged from 147 to 179). The full results of these assessments can be found in Zbytowski (2007a; 2007b).

Unnamed Tributary to Platte Lake

In 2003, staff from the SWAS and Cadillac District Office conducted a chemical and biological survey of an unnamed tributary to Platte Lake in response to a water quality complaint. The complainant reported strong odors and a change in the color of the stream. It was determined that one branch of this groundwater-fed stream was being impacted by contaminated groundwater venting from an illicit fruit waste disposal to an upgradient gravel pit. Macroinvertebrate and habitat conditions were determined to be degraded in comparison to other nearby streams and subsequently, not meeting Michigan's WQS. Chemical analyses revealed elevated conductivity, total phosphorus and metals concentrations, biochemical oxygen demand, chemical oxygen demand, and total organic carbon. Two reports were produced as a result of this investigation: Walker (2003) and Smith (2003).

METHODS

The habitat, fish community, and macroinvertebrate community were evaluated qualitatively using Procedure 51 at 11 sites. The macroinvertebrate community was evaluated based on the total of 9 individual metric scores. Cumulative macroinvertebrate scores can range from -9 to +9. Community ratings are based on the cumulative score as follows: poor (-9 to -5), acceptable (-4 to +4), and excellent (+5 to +9). Habitat evaluations are based on 10 individual metrics, with a possible maximum total score of 200. Individual habitat metrics include both instream and surrounding riparian habitat conditions in determining cumulative scores and ratings. Habitat is rated as excellent with a cumulative habitat score >154, good with a score between 105 and 154, marginal with a score between 56-104, and poor with a score <56.

SAMPLING RESULTS

Table 1 lists all sites visited and the type of work done at each site. Survey and site visit locations are presented in Figure 1. Macroinvertebrate community ratings and habitat evaluations are given in Tables 2a and 2b, and Table 3, respectively.

Betsie River

- The most downstream site in the Betsie River watershed was at River Road (Station 1). The site is a popular canoe and kayak access point with an unimproved launch and gravel parking lot on the upstream side of River Road. The river is relatively wide (170 feet) at this location and nearly 100 percent of the substrate is loose sand. Other than limited wood and fringing emergent vegetation, there is very little instream habitat available for macroinvertebrate colonization. Despite these limitations, the macroinvertebrate community scored acceptable (+1) and habitat rated good (141).
- The Betsie River at Old Grade Road (Station 2) in Manistee County was found to have excellent instream and riparian habitat conditions (171). The macroinvertebrate community was well represented by mayfly, caddisfly, and dipteran families. The overall macroinvertebrate community was rated acceptable with a score of +1.
- Station 3 at King Road was found to have excellent habitat (174) and an acceptable macroinvertebrate community (+2). Instream habitat features included submerged logs and snags, cobble, and undercut banks. Pool habitats were somewhat variable in size and were found to have slight sand and sediment deposition. One family of stonefly (Perlidae) was collected as well as 6 families of mayfly and 8 families of caddisfly. Other dominant taxa include beetles in the family Elmidae and 6 families of mollusks.
- The most upstream site in the Betsie River was at Reynolds Road (Station 4). This station, which is 2.5 miles downstream of the Grass Lake Flooding, had two distinct habitat types present. A few yards downstream of the Reynolds Road Bridge there is a dramatic gradient change creating an abrupt transition from a low gradient, glide/pool stream to a high gradient, riffle/run stream. Habitat features upstream of the bridge are typical of lake outlets having abundant macrophytes and wetland vegetation in the riparian zone. Substrate was composed of sand and gravel overlain with some organic silts and attached algae. Habitat features downstream of the gradient break transition to more coarse particles of gravel and cobble. Riffles and fast, deep pools were prevalent in this section of the stream. Our macroinvertebrate survey included all habitats above and below the bridge. The macroinvertebrate community scored acceptable (+1) at Reynolds Road. The macroinvertebrate score was slightly depressed due, primarily, to the lack of stonefly taxa and the abundance of isopods, snails, and leeches. This station had the highest number of taxa (37) among all sites sampled, which is not surprising

given the diversity of habitats available above and below the bridge. Habitat at this site scored excellent (183), which can be attributed to the wide variety of instream habitat features available as well as a relatively undisturbed riparian upstream. Fish were not surveyed at this site but spawning salmon were observed at the time of our macroinvertebrate and habitat survey.

Little Betsie River

The Little Betsie River is a cold water designated tributary to the Betsie River in Benzie County. One station was assessed on the Little Betsie River at Nessen Road (Station 5). This station was found to have excellent habitat (170) and an acceptable macroinvertebrate community (+1). This site was typical of cold headwater streams in this region, having a complex mix of large woody debris, deep pools, undercut banks, and overhanging riparian alders. The surrounding forest is composed primarily of cedar and maple. Sand is the dominant substrate in both the glide and pool habitats. The macroinvertebrate community was dominated by caddisfly families (primarily Brachycentridae) and the dipteran, Chironomidae.

Unnamed Tributary to Platte Lake

Station 6 was located just upstream of US-131 on an unnamed cold water tributary to Platte Lake. This water body was assessed more thoroughly in 2003 (Walker, 2003) in response to contamination due to illicit fruit waste disposal (see Historical Sampling Efforts section above). Since the initial survey in 2003, the disposal pit was remediated and, in response to a Consent Judgment, a groundwater and surface water monitoring program was initiated by the responsible party. In 2008, the stream was found to be in the same condition as it was in 2003. Biochemical oxygen demand was about 30 times higher than would be expected in a similar stream. A thick layer of ferric iron bacterial slime still covers the anoxic stream bottom, inhibiting organic matter processing. The macroinvertebrate survey conducted in 2008 revealed a poor community (-6) with both low abundance and diversity. Intolerant macroinvertebrate taxa, including Ephemeroptera, Plecoptera, and Trichoptera families, were not present in 2008. The community was dominated by Chironomidae and Oligochaeta. Since the surrounding riparian area is relatively undisturbed, the overall habitat at this site was rated good (149). The instream metrics (e.g., epifaunal substrate, available cover, and embeddedness) scored the lowest of all metrics due to the bacterial slimes and accumulated organic matter. An additional site visit was made in 2009 to this site. A formal Procedure 51 macroinvertebrate survey was not conducted due to the persistence of thick bacterial slimes, accumulated unprocessed leaf litter, and anoxic conditions observed previously in 2008.



Cobble from Station 6 demonstrates presence of anoxic sediments (black layer) beneath bacterial slime (orange layer).



Orange ferric-iron bacterial slime covered substrate of small cascade in unnamed tributary to Platte Lake upstream of US-31.

Platte River

The Platte River was assessed at Goose Road (Station 7) in Benzie County. The river at this point is classified as a medium-sized cold water stream. There is extensive plant growth at this site, both in abundance and diversity of plant taxa, represented primarily by several *Potamogeton* species, *Chara* sp., *Elodea* sp., *Sparganium* sp., *Ludwigia* sp., and *Scirpus* sp. Attached algae were also present (*Cladophora* sp.). The habitat at this station scored excellent (169) with only two individual habitat metrics scoring less than excellent (pool variability and channel sinuosity). The substrate was dominated by sand and cobble. Other stable habitat included aquatic vegetation, snags, and submerged logs. The macroinvertebrate community, dominated by the mayfly family Leptohyphidae (formerly Trichorythidae) and the Isopoda, scored acceptable (+1). This station was revisited in 2009 for trend analysis and similar macroinvertebrate community and habitat conditions were found.

North Branch Platte River

The habitat and macroinvertebrate community of the North Branch Platte River was assessed at Indian Hill Road (Station 8) in Benzie County. The North Branch Platte River is a small, cold water tributary to the Platte River. The stream at this location is less than a foot deep and is about 10 feet wide. The substrate is wholly composed of loose sand with undercut banks, overhanging vegetation, and sparse woody debris and macrophytes being the primary sources of stable habitat. Despite the lack of cobble or gravel, habitat scored good (150). The macroinvertebrate community scored acceptable (+3) and was dominated by blackfly (Simuliidae) and midge (Chironomidae) larvae. Two families of stonefly (Nemouridae and Perlodidae) were collected in addition to several taxa of intolerant organisms in the orders Ephemeroptera and Trichoptera. Fish were not actively targeted for collection in this survey; however, sculpin and trout were observed during the assessment.

Crystal River

The fish community of the Crystal River was assessed to determine if it is meeting its cold water fishery designated use. The river at Crystal View Road is about 70 feet wide and about 1.5 feet deep on average. The river drains three large inland lakes (Glen Lake, Fisher Lake, and Tucker Lake) and winds its way through coastal sand dunes on its way to Lake Michigan. The fish community is dominated by Centrarchidae (smallmouth bass, rock bass, green sunfish, and pumpkinseed) and Cyprinid minnows (emerald and common shiners); taxa commonly found in warmwater lake outlets. While no resident salmonids were collected in the 30 minutes of backpack shocking, several potamodromous king and coho salmon were collected.

Weaver Creek

Weaver Creek (Station 10) is a small, coastal tributary to Omena Bay (West Arm of Grand Traverse Bay) located in Leelanau County on the Leelanau peninsula. The stream was found to have an acceptable (0) macroinvertebrate community with families of Ephemeroptera, Plecoptera, and Trichoptera present. Habitat scored excellent (179) with the lowest individual metric scores relating to the low water conditions and slight sediment deposition. The riparian area was composed of beech, maple, and hemlock. Young-of-the-year trout and small sculpin were collected during the macroinvertebrate survey.

Leo Creek

Leo Creek (Station 11) is classified as a coastal stream and flows for a short distance before reaching Sutton's Bay just south of the town of Sutton's Bay located on the Leelanau peninsula. The stream was accessed upstream of M-22 and was found to have good habitat (152) and a

poor macroinvertebrate community (-5). The substrate was almost entirely sand with some small areas of gravel. Woody debris was available for colonization, cover habitat, and creating pool habitat. It was apparent that this stream receives a substantial spring melt pulse but has stable, groundwater-fed flow the rest of the year. Banks were found to be stable despite the sand-dominated local soil and proximity to homes and a major road. The macroinvertebrate community reflects the small, groundwater-fed nature of the stream in its sparse taxa richness and low taxa diversity. Thus, the poor rating likely has more to do with the fact Procedure 51 metrics were not developed using small, groundwater-fed coastal streams. Additional monitoring of the macroinvertebrate community of this stream should occur before it is determined that it is not attaining the 'other indigenous wildlife and aquatic life' designated use.

DISCUSSION

Macroinvertebrate Community Assessment

Macroinvertebrate communities rated acceptable at 8 stations in the lower portion of the watershed and poor at 2 stations. Total number of taxa for all stations ranged from 12 to 37 (Table 2a). Overall macroinvertebrate community scores for these sites ranged from -6 to +3 (Table 2b).

Habitat Assessment

Overall stream habitat scores, which consider in-stream habitat as well as the adjacent stream banks and riparian habitat at the 10 sites in the Betsie and Platte Rivers watersheds ranged from 141 (good) to 183 (excellent) (Table 3). Glide/pool metrics were used to evaluate habitat at eight of the sites and riffle/run metrics were used at the remaining two sites. Overall, stream habitat at 6 of the sites was rated as excellent and 4 were rated as good. The sites where habitat scores were better tended to have higher riparian and bank structure scores. Also notable is that the good sites tended to score much lower than excellent sites on the flashiness, sediment deposition, and pool variability metrics (Table 3).

Habitat conditions throughout these watersheds are highly influenced by past land use. Virgin timber was logged from much of northern lower Michigan in the late 1800s and has contributed to much of the sand bedload and bank scour in the lower watershed reducing available habitat and habitat complexity. Poorly constructed road/stream crossings and undersized culverts are additional stressors to these rivers.

Stratified Random Sample Results

Beyond determining the designated use support of streams in the Betsie and Platte Rivers watersheds (HUC 4060104), sites were selected in a manner to determine the general status of streams in the greater Northwest Lower Peninsula region. Nine of the 11 stations sampled during this survey are considered status stations, which were chosen with a randomized design. These 9 stations, along with 25 additional stations in the Boardman, Elk, and Boyne Rivers watersheds (HUC 4060105), were analyzed to answer questions about the regional water quality of both HUC regions. In the Northwest Lower Peninsula, all but two sites (Bear River at Evergreen Trail [as described in Holden (2009) and Leo Creek at M-22 [Station 11]] were found to have acceptable or excellent macroinvertebrate communities.

In 2008, 94 ± 9 percent (using a 95 percent confidence interval) of Northwest Lower Peninsula streams were estimated to be supporting the "other indigenous wildlife and aquatic life" designated use component of R 323.1100(1)(e) of the Michigan WQS. This estimate is based on 34 stratified random sites selected within the region. The 34 sampling locations were stratified by the percentage of the total wadeable stream miles each respective classification

represented (e.g., 45 percent of the streams were classified as small warm, 45 percent of the total sampling effort would be used for small warm streams, 45 percent of 40 total sampling locations equals about 18 locations in small, warm streams).

The Northwest Lower Peninsula classification percentages, followed by an estimate of the number of sampling stations to proportionately represent the entire region, are presented below.

Classification	River Miles	Percent of Total	Number of Sites	Percent Attaining
Coastal	105	23.2	7	86
Small Cold	187	41.4	15	100
Medium Cold	91	20.1	7	86
Medium Warm	33	7.3	3	100
Large Cold	18	4	1	100
Large Warm	18	4	1	100
TOTAL	452	100	34	

Summary statistics were calculated from the probabilistic monitoring results (N=34) to address regional attainment status for Northwest Lower Peninsula streams. The probabilistic monitoring results can be extrapolated to the entire region. The average Procedure 51 macroinvertebrate score for the Northwest Lower Peninsula streams was 2.0, with a 95 percent confidence level of +/- 1.0.

CONCLUSION

Results of the macroinvertebrate community and habitat assessments indicate that, overall, Michigan WQS are being met in the Northwest Lower Peninsula and specific to this report, the Betsie and Platte Rivers watersheds. However, two small streams, the unnamed tributary to Platte Lake (Station 6) and Leo Creek (Station 11), were surveyed and found to be not attaining WQS for the 'other indigenous aquatic life and wildlife' designated use. In spite of this overall good or attaining condition, considerable potential remains for protection and enhancement of biological communities in the watershed. Poor historic and current land use practices in the watershed have, and will continue to cause habitat degradation in the form of bank erosion, stream morphology changes (widening, aggradation of sediments, loss of habitat diversity, etc.), increased embeddedness, and will reduce indigenous aquatic life metric scores. While habitat is generally good throughout the Northwest Lower Peninsula, biological communities will benefit from continued protection and rehabilitation of instream habitats and riparian zones.

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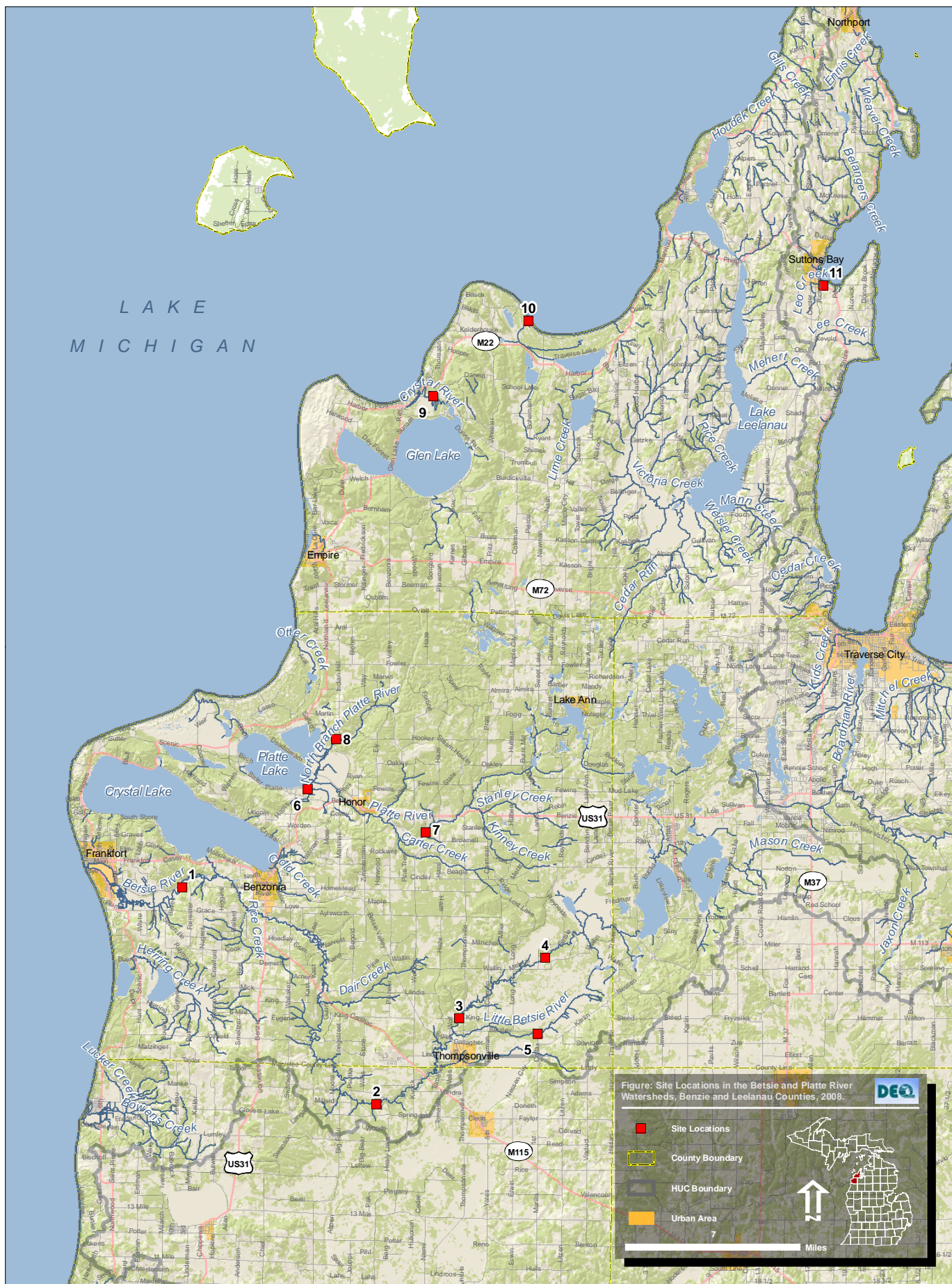


Figure 1. Site locations in the Betsie and Platte Rivers watersheds, July-September 2008.

Table 1. Betsie and Platte Rivers watersheds station locations and Procedure 51 macroinvertebrate and habitat scores and ratings.

<i>Station</i>	<i>Waterbody Name</i>	<i>Location</i>	<i>County</i>	<i>Latitude</i>	<i>Longitude</i>	<i>P51 Bugs</i>	<i>Bug Score</i>	<i>Bug Rating</i>	<i>P51 Habitat</i>	<i>Habitat Score</i>	<i>Habitat Rating</i>	<i>P51 Fish</i>	<i>Fish Score</i>	<i>Fish Rating</i>
1	Betsie River	River Rd	Benzie	44.6180	-86.1670	X	1	Accept.	X	141	Good			
2	Betsie River	off Old Grade Rd	Manistee	44.4920	-86.0090	X	1	Accept.	X	171	Excellent			
3	Betsie River	King Rd	Benzie	44.5420	-85.9420	X	2	Accept.	X	174	Excellent			
4	Betsie River	Reynolds Rd	Benzie	44.5770	-85.8720	X	1	Accept.	X	183	Excellent			
5	Little Betsie River	Nessen Rd	Benzie	44.5330	-85.8780	X	0	Accept.	X	170	Excellent			
6	Unnamed Trib to Platte Lk	US-131	Benzie	44.6750	-86.0649	X	-6	Poor	X	149	Good			
7	Platte River	2-track off Goose Rd	Benzie	44.6500	-85.9690	X	1	Accept.	X	169	Excellent			
8	N B Platte River	Indian Hill Rd	Benzie	44.7040	-86.0420	X	3	Accept.	X	150	Good			
9	Crystal River	Lk. MI to Fisher Lk	Leelanau	44.9180	-85.9710							X	*	*
10	Weaver Creek	M-22	Leelanau	44.9470	-85.8850	X	0	Accept.	X	179	Excellent			
11	Leo Creek	M-22	Leelanau	44.9670	-85.6440	X	-5	Poor	X	152	Good			

Bold/Italic = Targeted Sites

* Metrics not developed for this ecoregion

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	Betsie River River Road 7/17/2008 STATION 1	Betsie River Old Grade Road 7/17/2008 STATION 2	Betsie River King Road 9/10/2008 STATION 3	Betsie River Reynolds Road 9/10/2008 STATION 4
PORIFERA (sponges)	1	1		1
PLATYHELMINTHES (flatworms)				
Turbellaria		3		3
ANNELIDA (segmented worms)				
Oligochaeta (worms)	1	1	3	2
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	52	5	6	24
Decapoda (crayfish)	1	3	2	1
Isopoda (sowbugs)	11		1	15
Arachnoidea				
Hydracarina		4		5
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae			3	
Baetidae	21	2	12	5
Caenidae				1
Ephemerellidae	1	7	1	1
Ephemeridae	7			1
Heptageniidae	10	4	16	20
Isonychiidae	3	3	7	
Leptophlebiidae				6
Tricorythidae		2	17	1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		1	1	
Gomphidae		1	2	16
Macromiidae				1
Zygoptera (damselflies)				
Calopterygidae		5	7	2
Coenagrionidae				2
Plecoptera (stoneflies)				
Perlidae	1		1	
Pteronarcyidae	1			
Hemiptera (true bugs)				
Corixidae	9			
Gerridae	1	1	1	1
Naucoridae	1			
Pleidae			1	
Veliidae			1	1
Megaloptera				
Corydalidae (dobson flies)				1
Sialidae (alder flies)				1
Neuroptera (spongilla flies)				
Sisyridae		1		
Trichoptera (caddisflies)				
Brachycentridae	3	1	2	
Glossosomatidae		3		
Helicopsychidae	1		18	5
Hydropsychidae	10	75	7	65
Hydroptilidae			3	
Leptoceridae	6	11	2	5
Limnephilidae	3		1	2
Philopotamidae			1	21
Polycentropodidae	1			
Uenoidae			1	
Coleoptera (beetles)				
Gyrinidae (adults)	1			1
Haliplidae (adults)	1			
Elmidae	1	13	62	9
Diptera (flies)				
Athericidae		43	21	
Chironomidae	7	18	26	39
Empididae			1	
Simuliidae	19	20	3	1
Tipulidae		3		1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	6		5	
Hydrobiidae			1	2
Physidae	65	3	2	
Planorbidae	1			1
Pleuroceridae	11	1	45	22
Viviparidae			1	1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	8	10	3
TOTAL INDIVIDUALS	258	243	294	289

Table 2B. Macroinvertebrate metric evaluation of

	Betsie River		Betsie River		Betsie River		Betsie River	
	River Road		Old Grade Road		King Road		Reynolds Road	
	7/17/2008		7/17/2008		9/10/2008		9/10/2008	
	STATION 1		STATION 2		STATION 3		STATION 4	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	31	1	28	1	36	1	37	1
NUMBER OF MAYFLY TAXA	5	1	5	1	6	1	7	1
NUMBER OF CADDISFLY TAXA	6	1	4	0	8	1	5	0
NUMBER OF STONEFLY TAXA	2	1	0	-1	1	0	0	-1
PERCENT MAYFLY COMP.	16.28	0	7.41	-1	19.05	0	12.11	0
PERCENT CADDISFLY COMP.	9.30	-1	37.04	0	11.90	-1	33.91	0
PERCENT DOMINANT TAXON	25.19	0	30.86	0	21.09	1	22.49	1
PERCENT ISOPOD, SNAIL, LEECH	36.43	-1	1.65	0	18.71	-1	14.19	-1
PERCENT SURF. AIR BREATHERS	5.04	-1	0.41	1	1.02	0	1.04	0
TOTAL SCORE		1		1		2		1
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

	Little Betsie River	Unnamed Trib to Platte Lake	Platte River	N. Br. Platte River
	Nessen Road	US 31	2 Track Off Goose Road	Indian Hill Road
	9/10/2008	9/9/2008	7/16/2008	9/9/2008
TAXA	STATION 5	STATION 6	STATION 7	STATION 8
PLATYHELMINTHES (flatworms)				
Turbellaria	2		3	
NEMATOMORPHA (roundworms)				1
ANNELIDA (segmented worms)				
Hirudinea (leeches)			4	1
Oligochaeta (worms)	4	20	20	30
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	29	4	1	23
Decapoda (crayfish)			1	
Isopoda (sowbugs)		2	68	1
Arachnoidea				
Hydracarina	2			1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	24		9	32
Ephemerellidae	2		7	1
Heptageniidae			3	
Isonychiidae	1			
Leptophlebiidae	4			7
Tricorythidae			89	
Odonata				
Zygoptera (damselflies)				
Calopterygidae	4			
Plecoptera (stoneflies)				
Nemouridae				4
Perlidae				2
Hemiptera (true bugs)				
Belostomatidae	1			
Gerridae	2	1	1	
Veliidae	2	6		
Megaloptera				
Corydalidae (dobson flies)	1		1	
Sialidae (alder flies)	1	1		1
Trichoptera (caddisflies)				
Brachycentridae	44		22	9
Glossosomatidae			9	1
Helicopsychidae	18		5	
Hydropsychidae	15		3	3
Lepidostomatidae			6	1
Leptoceridae	1			
Limnephilidae	3		2	1
Molannidae	9			
Philopotamidae				1
Phryganeidae	1			
Coleoptera (beetles)				
Dytiscidae (total)	1	1		
Gyrinidae (adults)	1			
Hydrophilidae (total)	1			
Elmidae			2	
Diptera (flies)				
Athericidae	2		1	
Ceratopogonidae		1		6
Chironomidae	48	245	25	59
Dixidae	2			
Empididae				4
Psychodidae		1		
Simuliidae	8		29	103
Tabanidae	2		3	
Tipulidae		8		4
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)			1	
Hydrobiidae			2	
Physidae	11		3	2
Planorbidae		1	2	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	10		8	5
TOTAL INDIVIDUALS	256	291	330	303

Table 2B. Macroinvertebrate metric evaluation of

METRIC	Little Betsie River		Unnamed Trib to Platte Lake		Platte River		N. Br. Platte River	
	Nessen Road		US 31		2 Track Off Goose Road		Indian Hill Road	
	9/10/2008		9/9/2008		7/16/2008		9/9/2008	
	STATION 5		STATION 6		STATION 7		STATION 8	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	31	1	12	1	28	1	25	1
NUMBER OF MAYFLY TAXA	4	0	0	-1	4	0	3	0
NUMBER OF CADDISFLY TAXA	7	1	0	-1	6	1	6	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	2	1
PERCENT MAYFLY COMP.	12.11	0	0.00	-1	32.73	1	13.20	0
PERCENT CADDISFLY COMP.	35.55	0	0.00	-1	14.24	-1	5.28	-1
PERCENT DOMINANT TAXON	18.75	1	84.19	-1	26.97	0	33.99	0
PERCENT ISOPOD, SNAIL, LEECH	4.30	-1	1.03	0	24.24	-1	1.32	0
PERCENT SURF. AIR BREATHERS	3.13	-1	2.75	-1	0.30	1	0.00	1
TOTAL SCORE		0		-6		1		3
MACROINV. COMMUNITY RATING		ACCEPT.		POOR		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

	Weaver Creek	Leo Creek
	M22	Upstream M22
	9/8/2008	9/8/2008
TAXA	STATION 10	STATION 11
PLATYHELMINTHES (flatworms)		
Turbellaria		4
ANNELIDA (segmented worms)		
Oligochaeta (worms)	20	7
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	98	1
Isopoda (sowbugs)	2	50
Arachnoidea		
Hydracarina		1
Insecta		
Ephemeroptera (mayflies)		
Baetidae	1	16
Odonata		
Anisoptera (dragonflies)		
Aeshnidae	1	
Cordulegastridae	7	
Plecoptera (stoneflies)		
Nemouridae	7	
Perlidae	1	
Hemiptera (true bugs)		
Gerridae	1	1
Megaloptera		
Sialidae (alder flies)	1	
Trichoptera (caddisflies)		
Glossosomatidae	17	
Hydropsychidae	15	40
Limnephilidae		2
Philopotamidae	32	
Phryganeidae	4	
Coleoptera (beetles)		
Hydrophilidae (total)	1	
Dryopidae	1	
Elmidae	6	1
Diptera (flies)		
Ceratopogonidae	2	3
Chironomidae	19	70
Ptychopteridae	1	
Simuliidae	7	26
Tabanidae	5	5
Tipulidae	6	4
MOLLUSCA		
Pelecypoda (bivalves)		
Sphaeriidae (clams)	1	35
TOTAL INDIVIDUALS	256	266

Table 2B. Macroinvertebrate metric evaluation of

METRIC	Weaver Creek		Leo Creek	
	M22		Upstream M22	
	9/8/2008		9/8/2008	
	STATION 10		STATION 11	
	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	24	1	16	0
NUMBER OF MAYFLY TAXA	1	-1	1	-1
NUMBER OF CADDISFLY TAXA	4	0	2	-1
NUMBER OF STONEFLY TAXA	2	1	0	-1
PERCENT MAYFLY COMP.	0.39	-1	6.02	-1
PERCENT CADDISFLY COMP.	26.56	0	15.79	-1
PERCENT DOMINANT TAXON	38.28	-1	26.32	0
PERCENT ISOPOD, SNAIL, LEECH	0.78	1	18.80	-1
PERCENT SURF. AIR BREATHERS	1.17	0	0.38	1
TOTAL SCORE		0		-5
MACROINV. COMMUNITY RATING		ACCEPT.		POOR

Table 3. Habitat evaluation for	Betsie River		Betsie River		Betsie River		Betsie River		Little Betsie River
	River Road		Old Grade Road		King Road		Reynolds Road		Nessen Road
	GLIDE/POOL		GLIDE/POOL		GLIDE/POOL		RIFFLE/RUN		GLIDE/POOL
	STATION 1		STATION 2		STATION 3		STATION 4		STATION 5
HABITAT METRIC									
Substrate and Instream Cover									
Epifaunal Substrate/ Avail Cover (20)	3		16		18		17		15
Embeddedness (20)*							16		
Velocity/Depth Regime (20)*							14		
Pool Substrate Characterization (20)**	7		15		14				10
Pool Variability (20)**	13		15		16				18
Channel Morphology									
Sediment Deposition (20)	11		15		15		16		15
Flow Status - Maint. Flow Volume (10)	10		10		10		10		10
Flow Status - Flashiness (10)	10		9		10		10		10
Channel Alteration (20)	20		20		20		20		20
Frequency of Riffles/Bends (20)*							20		
Channel Sinuosity (20)**	7		14		11				12
Riparian and Bank Structure									
Bank Stability (L) (10)	10		10		10		10		10
Bank Stability (R) (10)	10		9		10		10		10
Vegetative Protection (L) (10)	10		10		10		10		10
Vegetative Protection (R) (10)	10		10		10		10		10
Riparian Veg. Zone Width (L) (10)	10		8		10		10		10
Riparian Veg. Zone Width (R) (10)	10		10		10		10		10
TOTAL SCORE (200):	141		171		174		183		170
HABITAT RATING:	GOOD		EXCELLENT		EXCELLENT		EXCELLENT		EXCELLENT
	(SLIGHTLY IMPAIRED)		(NON-IMPAIRED)		(NON-IMPAIRED)		(NON-IMPAIRED)		(NON-IMPAIRED)
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).									
Date:	7/17/2008		7/17/2008		9/10/2008		9/10/2008		9/10/2008
Weather:	Sunny		Cloudy		Sunny		Sunny		Sunny
Air Temperature:	75 Deg. F.		75 Deg. F.		50 Deg. F.		60 Deg. F.		50 Deg. F.
Water Temperature:	72 Deg. F.		71 Deg. F.		54 Deg. F.		60 Deg. F.		49 Deg. F.
Ave. Stream Width:	170 Feet		45 Feet		55 Feet		75 Feet		15 Feet
Ave. Stream Depth:	2 Feet		2 Feet		1 Feet		1.5 Feet		0.5 Feet
Surface Velocity:	1.5 Ft./Sec.		2 Ft./Sec.		1 Ft./Sec.		0.75 Ft./Sec.		0.75 Ft./Sec.
Estimated Flow:	510 CFS		180 CFS		55 CFS		84.375 CFS		5.625 CFS
Stream Modifications:	None		None		None		None		None
Nuisance Plants (Y/N):	N		N		N		N		N
Report Number:									
STORET No.:	100239		510255		100243		100244		100242
Stream Name:	Betsie River		Betsie		Betsie River		Betsie River		Little Betsie River
Road Crossing/Location:	River Road		Off Old Grade Road (Pri		King Road		Reynolds Road		Nessen Road
County Code:	10		51		10		10		10
TRS:	26N16W31		24N14W09		25N14W24		25N13W10		25N13W27
Latitude (dd):	44.618		44.492		44.5424		44.5745		44.5331
Longitude (dd):	-86.167		-86.009		-85.9425		-85.8777		-85.8782
Ecoregion:	NCHF		NCHF		NCHF		NCHF		NCHF
Stream Type:	Coldwater		Coldwater		Coldwater		Coldwater		Coldwater
USGS Basin Code:	4060104		4060104		4060104		4060104		4060104
* Applies only to Riffle/Run stream Surveys									
** Applies only to Glide/Pool stream Surveys									

Table 3. Habitat evaluation for	Unnamed Trib to Platte Lake		Platte River		N. Br. Platte River	
	US 31		2 Track Off Goose Road		Indian Hill Road	
	RIFFLE/RUN		GLIDE/POOL		GLIDE/POOL	
	STATION 6		STATION 7		STATION 8	
HABITAT METRIC						
Substrate and Instream Cover						
Epifaunal Substrate/ Avail Cover (20)	6		16		11	
Embeddedness (20)*	6					
Velocity/Depth Regime (20)*	10					
Pool Substrate Characterization (20)**			18		8	
Pool Variability (20)**			8		10	
Channel Morphology						
Sediment Deposition (20)	14		18		8	
Flow Status - Maint. Flow Volume (10)	10		10		10	
Flow Status - Flashiness (10)	10		10		10	
Channel Alteration (20)	20		20		20	
Frequency of Riffles/Bends (20)*	15					
Channel Sinuosity (20)**			9		13	
Riparian and Bank Structure						
Bank Stability (L) (10)	10		10		10	
Bank Stability (R) (10)	10		10		10	
Vegetative Protection (L) (10)	10		10		10	
Vegetative Protection (R) (10)	10		10		10	
Riparian Veg. Zone Width (L) (10)	10		10		10	
Riparian Veg. Zone Width (R) (10)	8		10		10	
TOTAL SCORE (200):	149		169		150	
HABITAT RATING:	GOOD		EXCELLENT		GOOD	
	(SLIGHTLY IMPAIRED)		(NON-IMPAIRED)		(SLIGHTLY IMPAIRED)	
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).						
Date:	9/9/2008		7/16/2008		9/9/2008	
Weather:	Sunny		Sunny		Sunny	
Air Temperature:	65 Deg. F.		74 Deg. F.		70 Deg. F.	
Water Temperature:	56 Deg. F.		64 Deg. F.		51 Deg. F.	
Ave. Stream Width:	4 Feet		80 Feet		10 Feet	
Ave. Stream Depth:	0.25 Feet		1 Feet		0.8 Feet	
Surface Velocity:	1 Ft./Sec.		1.25 Ft./Sec.		0.75 Ft./Sec.	
Estimated Flow:	1 CFS		100 CFS		6 CFS	
Stream Modifications:	None		None		None	
Nuisance Plants (Y/N):	Y		N		N	
Report Number:						
STORET No.:	100240		100238		100241	
Stream Name:	Unnamed Trib to Platte Lake		Platte River		North Branch Platte River	
Road Crossing/Location:	US 31		2 Track Off Goose Road		Indian Hill Road	
County Code:	10		10		10	
TRS:	26N14W07		26N14W14		27N14W31	
Latitude (dd):	44.6638		44.65		44.7041	
Longitude (dd):	-86.0542		-85.969		-86.0413	
Ecoregion:	NCHF		NCHF		NCHF	
Stream Type:	Warmwater		Coldwater		Coldwater	
USGS Basin Code:	4060104		4060104		4060104	
* Applies only to Riffle/Run stream Surveys						
** Applies only to Glide/Pool stream Surveys						

Table 3. Habitat evaluation for	Weaver Creek		Leo Creek			
	M22		Upstream M22			
	GLIDE/POOL		GLIDE/POOL			
	STATION 10		STATION 11			
HABITAT METRIC						
Substrate and Instream Cover						
Epifaunal Substrate/ Avail Cover (20)	17		10			
Embeddedness (20)*						
Velocity/Depth Regime (20)*						
Pool Substrate Characterization (20)**	18		10			
Pool Variability (20)**	15		10			
Channel Morphology						
Sediment Deposition (20)	13		11			
Flow Status - Maint. Flow Volume (10)	8		7			
Flow Status - Flashiness (10)	10		8			
Channel Alteration (20)	20		20			
Frequency of Riffles/Bends (20)*						
Channel Sinuosity (20)**	18		16			
Riparian and Bank Structure						
Bank Stability (L) (10)	10		10			
Bank Stability (R) (10)	10		10			
Vegetative Protection (L) (10)	10		10			
Vegetative Protection (R) (10)	10		10			
Riparian Veg. Zone Width (L) (10)	10		10			
Riparian Veg. Zone Width (R) (10)	10		10			
TOTAL SCORE (200):	179		152			
HABITAT RATING:	EXCELLENT		GOOD			
	(NON-		(SLIGHTLY			
	IMPAIRED)		IMPAIRED)			
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).						
Date:	9/8/2008		9/8/2008			
Weather:	Cloudy		Cloudy			
Air Temperature:	65 Deg. F.		65 Deg. F.			
Water Temperature:	56 Deg. F.		55 Deg. F.			
Ave. Stream Width:	10 Feet		12 Feet			
Ave. Stream Depth:	0.33 Feet		0.5 Feet			
Surface Velocity:	0.75 Ft./Sec.		0.5 Ft./Sec.			
Estimated Flow:	2.475 CFS		3 CFS			
Stream Modifications:	None		None			
Nuisance Plants (Y/N):	N		N			
Report Number:						
STORET No.:	450229		450228			
Stream Name:	Weaver Creek		Leo Creek			
Road Crossing/Location:	M22		Upstream M22			
County Code:	45		45			
TRS:	31N11W35		30N11W28			
Latitude (dd):	45.0473		44.9673			
Longitude (dd):	-85.5938		-85.6443			
Ecoregion:	NCHF		NCHF			
Stream Type:	Coldwater		Coldwater			
USGS Basin Code:	4060104		4060104			
* Applies only to Riffle/Run stream Surveys						
** Applies only to Glide/Pool stream Surveys						