MI/DEQ/WRD-12/035

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
NOVEMBER 2012

STAFF REPORT

BIOLOGICAL ASSESSMENT OF THE MUSKEGON RIVER WATERSHED CLARE, MECOSTA, MISSAUKEE, MONTCALM, MUSKEGON, NEWAYGO, OSCEOLA, AND ROSCOMMON COUNTIES, MICHIGAN JUNE - SEPTEMBER 2011

INTRODUCTION

Staff of the Michigan Department of Environmental Quality (MDEQ), Surface Water Assessment Section (SWAS), conducted biological and physical habitat surveys during the summer of 2011 throughout the Muskegon River watershed (Figure 1). The goals of the 2011 monitoring were to: (1) assess the current status and condition of individual water bodies and determine whether Michigan Water Quality Standards (WQS) are being met; (2) evaluate biological integrity temporal trends; (3) satisfy monitoring requests submitted by external and internal customers; and (4) identify potential nonpoint source (NPS) pollution problems.

The primary objective of this survey was to qualitatively characterize the biotic integrity of macroinvertebrate communities with respect to existing habitat conditions at randomly selected sites throughout the Muskegon River watershed. These results are used by SWAS's Status and Trends Program to estimate the percentage of the watershed that is supporting the other indigenous aquatic life designated use component of R 323.1100(1)(e) of the Part 4 rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Other biological and water chemistry sampling efforts conducted recently within the Muskegon River watershed region (i.e., efforts to support Total Maximum Daily Load development in Ruddiman Creek) are reported separately in Lipsey (2011) and Knoll and Lipsey (2012).

WATERSHED DESCRIPTION AND BACKGROUND INFORMATION

The Muskegon River is located in the north-central and western portions of the Lower Peninsula and incorporates over 2,350 square miles of land. The river is 212 miles long, with a 575-foot drop in elevation between its sources (Higgins Lake and Houghton Lake) to the mouth at Lake Michigan. Most of the watershed is contained within eight counties: Roscommon, Missaukee, Clare, Osceola, Mecosta, Montcalm, Newaygo, and Muskegon. Approximately 94 tributaries flow directly into the main stem of the Muskegon River, and primary tributaries include the West Branch of the Muskegon River, Clam River, Middle Branch River, Hersey River, Little Muskegon River, Bigelow Creek, Brooks Creek, and Cedar Creek (O'Neal, 1997). The watershed is included in the Southern Michigan Northern Indiana Till Plains and Northern Lakes and Forests ecoregions (Omernik and Gallant, 1988).

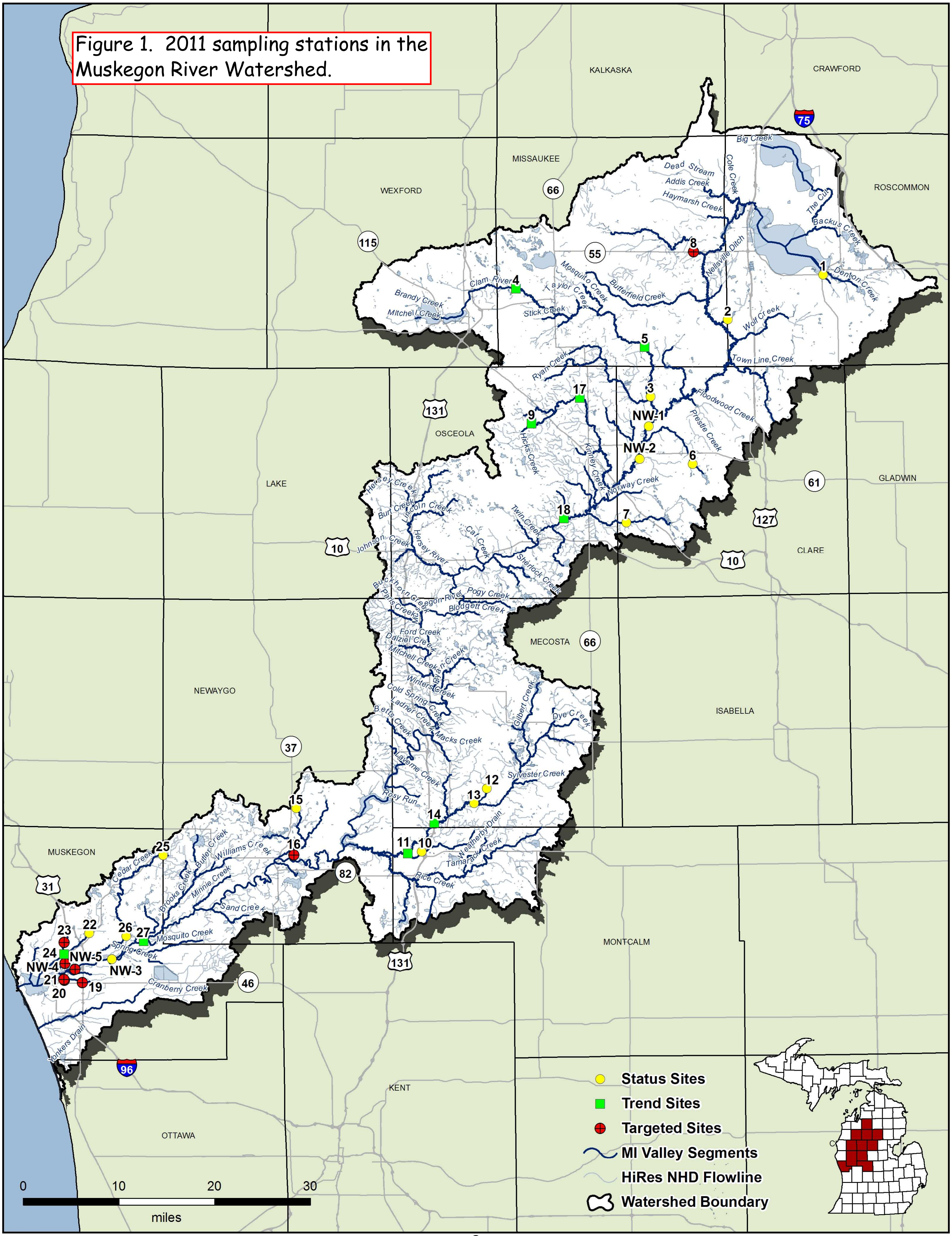
Figure 1. 2011 sampling stations in the Muskegon River Watershed.
KALKASKA
CRAWFORD
MISSAUKEE
WEXFORD
ROSCOMMON
OSCEOLA
LAKE
GLADWIN
CLARE
MECOSTA
NEWAYGO
ISABELLA
MUSKEGON
MONTCALM
KENT
OTTAWA
Status Sites
Trend Sites
Targeted Sites
MI Valley Segments
HiRes NHD Flowline
Watershed Boundary
0
10
20
30
miles

According to O'Neal (1997), human settlement began in the region in the early to late 1800s continuing through today and has had numerous effects on watershed conditions. Lumbering had significant effects on river habitat through log transport down the river and deforestation of the uplands (including riparian areas). The development of large hydroelectric dams began in the late 1800s, and many smaller dams have been established on the tributaries. These dams have resulted in the conversion of most of the moderate and high gradient reaches into impoundments.

While agricultural and urban development in the watershed has been moderate, erosion of sediment into streams from the watershed's uplands has been significant. Also, drainage systems have been established on many tributary streams, and many have been dredged and straightened. Nutrient and chemical pollution peaked in the mid-1900s and had significant effects, especially in Muskegon Lake. The introduction or invasion of pest animals also had notable effects on aquatic communities in the river. For additional details about the river system and its watershed, see O'Neal (1997).

Recent MDEQ biological assessments done on numerous sites throughout the Muskegon River watershed were reported in Schmitt (2005 a – c) and Wesener (2010 a – c). These reports divided the watershed into three main regions: (1) the Upper Muskegon River watershed, (2) the Middle Muskegon River watershed, and (3) the Lower Middle River watershed, as described below. These reports also summarize earlier monitoring and studies in the area.

The Upper Muskegon River watershed extends from Higgins Lake down to M-115 (just upstream of where the Middle Branch River joins with the Muskegon River main stem). This portion of the Muskegon River covers Clare, Missaukee, and Roscommon counties. There are over 25 registered dams in this portion of the watershed, and many water bodies, or defined sections of them, are classified as designated trout streams. These include portions or all of the Clam River, Middle Branch Clam River, Butterfield Creek, Dead Stream, Wolf Creek, Cole Creek, Haymarsh Creek, Townline Creek, Big Creek, and all tributaries to Higgins Lake (MDNR, 1997). Macroinvertebrate communities at sites sampled in this region were rated as acceptable or excellent in both 2001 (Schmitt, 2005 c) and 2006 (Wesener, 2010 a).

The Middle Muskegon River watershed extends from M-115 down to Croton Dam. This portion of the Muskegon River covers Clare, Mecosta, Montcalm, Newaygo, and Osceola counties. There are approximately 40 registered dams in this portion of the watershed and many water bodies, or defined sections of them, are classified as designated trout streams. These include portions or all of the Little Muskegon River, Tamarack Creek, Handy Creek, Quigley Creek, Muskegon River (from Paris upstream to Hersey), Pogy Creek, Hersey River, Franz Creek, Twin Creek, Whetstone Creek, Middle Branch River, Clam River, Townline Creek, Wolf Creek, and Butterfield Creek (MDNR, 1997). Macroinvertebrate communities at sites sampled in this region were mostly rated as acceptable or excellent in both 2001 (Schmitt, 2005 b) and 2006 (Wesener, 2010 b). One exception in 2006 was Weatherby Drain, downstream of North Bailey Road, which had a community rated as poor (Wesener, 2010 b).

The Lower Muskegon River watershed extends from Croton Dam down to the mouth at Lake Michigan. This portion of the Muskegon River covers all of Muskegon County and part of Newaygo County. There are approximately 17 registered dams in this portion of the watershed and many water bodies are classified as designated trout streams. These include the Muskegon River and all tributaries from T10N, R16W, Section 18 to T12N, R11W, Section 18 (MDNR, 1997). Macroinvertebrate communities at sites sampled in this region were rated as acceptable or excellent in both 2001 (Schmitt, 2005 a) and 2006 (Wesener, 2010 c).

The present report includes results from sites located throughout the entire Muskegon River watershed.

METHODS

Two site selection methods were used to assess the Muskegon River watershed in 2011: (1) random and (2) targeted. A probabilistic monitoring approach (MDEQ a, draft), using random site selection to address statewide and regional questions about water quality, was used to select 24 stations throughout the watershed. In addition to being summarized in the present report, the data from these sites will be used by SWAS's Status and Trend Program to estimate the watershed attainment status for the "other indigenous aquatic life" designated use component of R 323.1100(e) of the Michigan WQS, and as a baseline to measure biointegrity temporal trends. In this watershed, 15 stations were "status" sites, 10 were "trend" sites, with 1 location serving as both a status and trend site. For targeted monitoring, 8 stations within the watershed were selected to fulfill specific monitoring requests, assess known or potential areas of concern, and assess attainment of WQS from areas where historic survey information was lacking.

The biological and physical habitat surveys described in this report were conducted, at wadeable sites, according to the guidelines of SWAS Procedure 51 (MDEQ, 1990). The macroinvertebrate communities were scored with metrics that rate water bodies from excellent (+5 to +9) to poor (-9 to -5). Macroinvertebrate ratings from (-4 to +4) are considered acceptable. Negative ratings that are acceptable are indicative of water bodies that are strongly tending toward poor, while positive ratings that are acceptable indicate slight impairment (Creal et al., 1996). Stream habitat at wadeable sites was qualitatively evaluated at each station using a scoring system, which ranged in value from 0 to 135. Additionally, five stations were assessed using the SWAS qualitative biological survey procedure for nonwadeable rivers (MDEQ b, draft). In this nonwadeable procedure, the range of scores possible for macroinvertebrate community metrics is 0 - 100, with scores from 26 - 100 representing communities meeting WQS.

Digital photographs were taken upstream and downstream at each of the sites that were surveyed during this investigation, and some representative photographs are included in this report for illustrative purposes. Other photographs are available upon request.

SAMPLING RESULTS AND DISCUSSION

Biological (i.e., macroinvertebrate community) and physical habitat surveys were conducted at 32 stations throughout the watershed. In addition to 5 stations on the main stem Muskegon River, 19 tributaries were assessed in 2011 (2 tributaries to Bear Lake, 16 tributaries to the Muskegon River, and 1 tributary to Muskegon Lake [not including the Muskegon River]). Survey location maps are presented in Figure 1. A summary of the station locations, macroinvertebrate community ratings, and habitat evaluations is presented in Table 1. Detailed macroinvertebrate community sampling results and habitat evaluations for the wadeable stream and river sites are provided in Tables 2 and 3, respectively. Detailed macroinvertebrate community sampling results for nonwadeable sites are provided in Table 4.

For comparative purposes with past biosurvey reports, sampling station ID numbers from the present study are grouped in the following table into the Upper, Middle, and Lower Muskegon River watershed area categories as described in past reports (Schmitt, 2005 a - c; Wesener, 2010 a - c):

Geographic Regions Delineated in Past Reports*	Sampling Station ID Numbers from the Present Study
Upper Muskegon River Watershed	1, 2, 3, 4, 5, 6, 8, 17, NW1, NW2
Middle Muskegon River Watershed	7, 9, 10, 11, 12, 13, 14, 18,
Lower Muskegon River Watershed	15, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, NW3, NW4, NW5

* Past reports: Schmitt (2005 a - c) and Wesener (2010 a - c).

Macroinvertebrate Communities

Wadeable Sites

The majority (24) of the 27 wadeable sites evaluated throughout the watershed had acceptable or excellent macroinvertebrate communities, with scores ranging from -3 to 7 (Table 1). Of these 24 sites, four had negative scores (i.e., tending towards poor, which would be considered moderately impaired) including Bear Creek at Barney Lake Road (Station 2), Ryerson Creek at Homes Street (Station 19), Little Bear Creek at River Road (Station 23), and Cedar Creek downstream of the River Road bridge (Station 26).

Three sites rated as poor, indicative of not meeting the designated use for other indigenous aquatic life and wildlife. Those sites were Ryerson Creek upstream of Clay Avenue (Station 20), Ryerson Creek near Shoreline Drive (Station 21), and Markle Drain (Cedar Creek) at Maple Island Road (Station 25) (Table 1).

Sites that had been scheduled, but which were not sampled, included (a) Cold Creek at Polar Avenue (in Everett Township, Newaygo County), which was dry, and (b) an unnamed tributary to Little Bear Creek upstream of River Road (Dalton Township, Muskegon County) which had intermittent flow, was dammed in multiple locations in the valley forming a wooded wetland, and was covered with duckweed.

Nonwadeable Sites

Five nonwadeable sites were sampled in the Muskegon River watershed and had marginal to good macroinvertebrate communities, with scores ranging from 43 to 74, indicating the attainment of WQS at these sites (Table 1).

Summary

Overall, the abundance of sites throughout the watershed that support macroinvertebrate communities (i.e., that rate either excellent or acceptable with minimal impairment) demonstrates the attainment of WQS throughout much of the watershed (Table 1). Based on the probabilistic monitoring aspect of this watershed survey, 93 percent $\pm$ 14 percent of the randomly selected “status” sites supported the other indigenous aquatic life and wildlife designated use component of R 323.1100(1)(e) of the Michigan WQS using Procedure 51. Percent attainment was calculated by dividing the number of random “status” sites that met

WQS by the total number of random "status" locations (14 / 15 = 0.93). This value is coupled with a 95 percent confidence interval to provide our estimation of certainty, meaning there is 95 percent certainty that the true proportion of attainment in the Muskegon River watershed is within ± 14 percent of the 93 percent result.

Habitat

Wadeable Sites

Overall stream habitat scores, which consider in-stream habitat as well as the adjacent stream banks and riparian habitat at the 27 wadeable sites in the Muskegon River watershed ranged from 68 (marginal) to 155 (excellent). Glide/pool metrics were used to evaluate habitat at 19 of the sites, while riffle/run metrics were used at the remaining 8 sites. Figure 2 presents representative photographs of sites monitored during the present study.

The three sites that had macroinvertebrate communities rated as poor (Stations 20, 21, and 25), are located in an agricultural watershed. All three sites appeared to have been dredged, at least historically, and had riparian vegetation conditions that rated as either marginal or poor. (The only other monitoring site in this survey that appeared to have possibly been dredged was Green Creek at Jackson Avenue [Station 6], which had a macroinvertebrate community that rated as acceptable.) Thus, stream corridor modifications such as channel dredging and riparian vegetation disturbance are likely factors limiting the health of these sites' macroinvertebrate communities.

Other factors, such as pollutants in storm water runoff, may also be playing a role in degrading stream health at the sites having poor macroinvertebrate communities. For example, monitoring in Ryerson Creek by Wuycheck (1989) found that stream sediment concentrations of a number of heavy metals (arsenic, cadmium, copper, mercury, nickel, lead, and zinc) generally increased as one moved in a downstream direction from Getty Street to Wood Street and then Yuba Avenue. (Chromium, an exception, had its highest concentration at Wood Street – the middle location.) Wuycheck (1989) concluded that urban runoff was the most probable anthropogenic source of these contaminants since there were no permitted point dischargers to Ryerson Creek. The author noted that by 1989 stream conditions appeared to have improved slightly relative to conditions observed in 1972 by Evans (ca. 1973) due to installation of the Muskegon County Wastewater Management System No. 1 facility, which would have eliminated most, if not all, sanitary waste discharges to Ryerson Creek (Wuycheck, 1989).

Nonwadeable Sites

Habitats at nonwadeable sites were also assessed qualitatively. However, each nonwadeable site was comprised of 11 transects distributed longitudinally along a stretch of river, which resulted in multiple habitat observations that were quite variable within a given "site/station". In general, all of the nonwadeable sites had a variety of dominant substrate, riparian zone width, and streambank stability conditions, as well as some evidence of human impact, included within their multi-transect sampling areas. It is worth noting that the Muskegon River 0.3 miles upstream of Milliron Road boat launch (Station NW-3) did not have any coarse gravel or cobble substrates observed in its transects; the Muskegon River off the end of Cook Road (Station NW-1) had a relatively larger amount of high-end (good) riparian zone width/condition and streambank stability scores; and the Muskegon River off Thornapple Trail (Station NW-2) had a relatively larger amount of low-end riparian width/condition and streambank stability scores relative to the other nonwadeable sites.

Summary of NPS Problems and Other Impacts

The relatively small number of sites in the present survey having macroinvertebrate communities that rated as poor (3 out of 27 wadeable sites), and habitat conditions that rated as less than good (i.e., marginal) (2 out of 27), were confined to Ryerson Creek (urban watershed) and Markle Drain (agricultural watershed). Limitations to these biological communities appear to be primarily attributed to habitat limitations created by historic and current efforts to quickly drain water from both urban and agricultural portions of the watershed via dredging activities, large woody debris removal, and either urban storm water or agricultural tile drainage systems. Additionally, floodplain and riparian corridor disturbance (e.g., encroachment of urban development or agricultural activities; vegetation disturbance or removal) can impair stream biological communities.

While many sites in the present survey were flagged as having some potential sources of NPS pollution and/or moderate local watershed erosion issues, no sites were flagged as having obvious significant sources of NPS pollution or recent heavy watershed erosion.

a

b

d

Figure 2. Representative photographs from sites monitored throughout the Muskegon River watershed in July 2011: (a) Muskegon River, downstream (d/s) of Holton Duck Lake Road ramp (Station 27); (b) Bigelow Creek, facing upstream (u/s) off of Bigelow Creek Trail (Station 16); (c) Clam River, u/s of Stoney Corners Road (Station 5); and (d) Handy Creek, u/s off of North Daggett Road (Station 11).

e

f

g

h

Figure 2 (continued). Representative photographs from sites monitored throughout the Muskegon River watershed in July 2011: (e) Little Bear Creek, d/s of River Road (Station 23); (f) Markle Drain (Cedar Creek), d/s of Maple Island Road (Station 25); (g) Ryerson Creek, u/s of Clay Avenue (Station 20); and (h) Ryerson Creek, facing d/s from Shoreline Drive and bike path (Station 21).

CONCLUSION

Some general recommendations for improving biological and habitat conditions in sections of streams, drains, and rivers in this watershed impacted by intensive urban (e.g., Ryerson Creek) and agricultural (e.g., Markle Drain) land uses include:

1) Where riparian buffer strips are absent (or degraded), property owners can allow trees and shrubs to re-grow on stream banks because they provide shade and in-stream cover help stabilize stream banks, and serve as a source for large woody debris (i.e., habitat diversity) in the future.
2) Adopting best management practices that are designed to reduce upland erosion and water quality impacts and slow the rate of stream flow, thus benefitting the aquatic biota residing in streams and rivers throughout the watershed.

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LITERATURE CITED

Creal, W., S. Hanshue, S. Kosek, M. Oemke, and M. Walterhouse. 1996. Update of GLEAS Procedure 51 Metric Scoring and Interpretation. MDEQ Report No. MI/DEQ/SWQ-96/068,(revised May 1998).

Evans, E. (ca. 1973). Final report of Michigan Bureau of Water Management's Investigation of the Sediments and Benthic Communities of Mona, White, and Muskegon Lakes, Muskegon County, Michigan 1972. MDNR Report No. 02540. Lansing, Michigan.

Knoll, M. and T. Lipsey. 2012. Biological and sediment chemistry surveys of selected stations in the Ruddiman Creek Watershed, Muskegon County, Michigan, July 2011. MDEQ Report No. MI/DEQ/WRD-12/030. Michigan Department of Environmental Quality, Water Resources Division, Lansing, Michigan.

Lipsey, T. 2011. Biological and water chemistry surveys of selected stations in the Ruddiman Creek Watershed, Muskegon County, Michigan, June 2009. MDEQ Report No. MI/DEQ/WRD-11/012. Michigan Department of Environmental Quality, Water Resources Division, Lansing, Michigan.

Michigan Department of Environmental Quality (MDEQ). 1990. SWAS Procedure 51 – Qualitative Biological and Habitat Survey Protocols for Wadeable Streams and Rivers, April 24, 1990. Revised June 1991, August 1996, January 1997, May 2002, and December 2008.

MDEQ a. Draft. Macroinvertebrate Community Status and Trend Monitoring Procedure. Michigan Department of Environmental Quality, Water Resources Division, Lansing, Michigan.

MDEQ b. Draft. Qualitative Biological and Habitat Survey Protocols for Nonwadeable Rivers. Michigan Department of Environmental Quality, Water Resources Division, Lansing, Michigan.

MDNR. 1997. Designated Trout Streams for the State of Michigan. Director's Order No. DFI-101.97. Michigan Department of Natural Resources, Fisheries Division, Lansing, Michigan.

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

O'Neal, R. P. 1997. Muskegon River Watershed Assessment. Fisheries Special Report 19. Michigan Department of Natural Resources (MDNR), Fisheries Division, Lansing, Michigan. http://www.michigandnr.com/PUBLICATIONS/PDFS/ifr/ifrlibra/Special/Reports/sr19.pdf

Schmitt, G. 2005 a. Biological Survey of the Lower Muskegon River Watershed, Muskegon and Newaygo Counties, July 7-11, 2001. MDEQ Report No. MI/DEQ/WB-05/054. Michigan Department of Environmental Quality, Water Bureau, Lansing, Michigan.

Schmitt, G. 2005 b. Biological Survey of the Middle Muskegon River Watershed, Clare, Mecosta, Newaygo, and Osceola Counties, July 11-12 and August 1-2, 2001. MDEQ Report No. MI/DEQ/WB-05/070. Michigan Department of Environmental Quality, Water Bureau, Lansing, Michigan.

Schmitt, G. 2005 c. Biological Survey of the Upper Muskegon River Watershed, Clare, Missaukee, Osceola, and Roscommon Counties, August 3 and August 20-22, 2001. MDEQ Report No. MI/DEQ/WB-05/071. Michigan Department of Environmental Quality, Water Bureau, Lansing, Michigan.

Wesener, M. 2010 a. Biological Assessment of the Upper Muskegon River Watershed, Clare, Missaukee, and Roscommon Counties, Michigan, July-September 2006. MDEQ Report No. MI/DNRE/WB-10/012. Michigan Department of Natural Resources and Environment, Water Bureau, Lansing, Michigan.

Wesener, M. 2010 b. Biological Assessment of the Middle Muskegon River Watershed, Montcalm, Mecosta, Osceola, and Clare Counties, Michigan, July-September 2006. MDEQ Report No. MI/DNRE/WB-10/013. Michigan Department of Natural Resources and Environment, Water Bureau, Lansing, Michigan.

Wesener, M. 2010 c. Biological Assessment of the Lower Muskegon River Watershed, Muskegon and Newaygo Counties, Michigan, July-September 2006. MDEQ Report No. MI/DNRE/WB-10/014. Michigan Department of Natural Resources and Environment, Water Bureau, Lansing, Michigan.

Wuycheck, J. 1989. Biological and sediment contaminant surveys of Ryerson Creek, Muskegon County, Michigan, 17 August 88 and 1 August 89. MDNR Report No. MI/DNR/SWQ-89/127. Michigan Department of Natural Resources, Great Lakes and Environmental Assessment Section, Lansing, Michigan.

Table 1. Survey locations and sampling activities for sites in the Muskegon River watershed, 2011.

Station #	Stream	Survey Location	Macroinvertebrate Community Rating & Score	Habitat Rating & Score (Riffle/Run, Glide/Pool)	County	Lat	Long	Site Type	Channel Modifications	Other Comments
1	Knappen Creek	Main Street	Acceptable (1)	Good (142) (G/P)	ROSCOMMON	44.29843	-84.64933	S	None	
2	Bear Creek	Barney Lake Rd	Acceptable (-3)	Good (141) (G/P)	ROSCOMMON	44.23228	-84.85197	S	None	
3	Clam River	Haskell Lake Rd	Acceptable (3)	Good (146) (G/P)	CLARE	44.11761	-85.01585	S (alt)	None	
4	Clam River	La Chance Rd	Acceptable (2)	Good (126) (G/P)	MISSAUKEE	44.28329	-85.29662	TRD	Bnk Stbl	
5	Clam River	Stoney Corners Rd	Excellent (7)	Good (137) (G/P)	MISSAUKEE	44.19245	-85.02729	TRD	None	
6	Green Creek	Jackson Avenue	Acceptable (1)	Good (115) (G/P)	CLARE	44.01489	-84.92928	S	Dredged (probably)	
7	Doc and Tom Creek	Garfield Avenue	Excellent (5)	Good (152) (R/R)	CLARE	43.92766	-85.06985	S	None	
8	West Branch Muskegon River	M-55	Acceptable (0)	Good (132) (R/R)	MISSAUKEE	44.33596	-84.92176	T	None	
9	Franz Creek	90th Ave	Acceptable (3)	Good (139) (G/P)	OSCEOLA	44.07925	-85.26663	TRD	None	
10	Handy Creek	Amy School Road	Excellent (6)	Good (142) (R/R)	MONTCALM	43.43189	-85.50255	S	None	
11	Handy Creek	off N Daggett Rd	Excellent (7)	Good (141) (R/R)	MONTCALM	43.42922	-85.53135	TRD	None	
12	Quigley Creek	4 Mile Road	Acceptable (4)	Excellent (155) (G/P)	MECOSTA	43.52752	-85.36600	S	None	
13	Little Muskegon River	155th Avenue	Excellent (6)	Good (148) (G/P)	MECOSTA	43.50439	-85.39285	S	None	
14	Little Muskegon River	Washington Rd	Excellent (5)	Good (138) (R/R)	MECOSTA	43.47524	-85.47567	TRD	None	
15	Bigelow Creek	Walnut Ave	Acceptable (2)	Good (148) (G/P)	NEWAYGO	43.49830	-85.76270	S,TRD	None	
16	Bigelow Creek	S. Basswood Dr (a.k.a. Bigelow Creek Trail) (2-Track u/s Croton Dr)	Acceptable (2)	Good (130) (R/R)	DELTA	43.42778	-85.76784	T	None	This is also a WCMP site.
17	Middle Branch River	21 Mile Rd (east xing)	Acceptable (3)	Good (145) (G/P)	OSCEOLA	44.11697	-85.16451	TRD	None	
18	Muskegon River	off Logging Trail Dr	Acceptable (3)	Good (134) (G/P)	OSCEOLA	43.93501	-85.20051	TRD	Bnk Stbl	
19	Ryerson Creek	u/s Home St	Acceptable (-3)	Good (114) (G/P)	MUSKEGON	43.23528	-86.20640	T	None	AOC support
20	Ryerson Creek	u/s Clay Ave	Poor (-5)	Marginal (94) (G/P)	MUSKEGON	43.23866	-86.24357	T	Dredged; Bnk Stbl	AOC support
21	Ryerson Creek	Shoreline Drive (d/s Bike Path)	Poor (-6)	Good (109) (G/P)	MUSKEGON	43.24005	-86.24433	T	Dredged	AOC support
22	Bear Creek	McMillan Road	Acceptable (4)	Good (114) (G/P)	MUSKEGON	43.30955	-86.19247	S	None	
23	Little Bear Creek	d/s River Road	Acceptable (-2)	Good (149) (R/R)	MUSKEGON	43.29572	-86.24427	T	None	AOC support
24	Little Bear Creek	Giles Rd	Acceptable (0)	Good (137) (G/P)	MUSKEGON	43.27795	-86.24443	TRD	None	
25	Markle Drain (Cedar Creek)	Maple Island Road	Poor (-5)	Marginal (68) (G/P)	NEWAYGO	43.42785	-86.03923	S	Dredged	
26	Cedar Creek	d/s River Road bridge	Acceptable (-1)	Good (146) (G/P)	MUSKEGON	43.30512	-86.11581	S	None	
27	Muskegon River	d/s Holton Duck Lake Rd	Excellent (6)	Good (139) (R/R)	MUSKEGON	43.29776	-86.07954	TRD	None	

Macroinvertebrate Rating System (Wadeable Stations):
Poor: -9 to -5 Acceptable: -4 to +4 Excellent: +5 to +9
Macroinvertebrate Rating System (Non-Wadeable Stations):
Poor: < 26 Marginal: 26 to 50 Good: 51 to 74 Excellent: 75 to 100
Habitat Rating System (Wadeable Stations):
Poor: < 56 Marginal: 56 to 104 Good: 105 to 154 Excellent: > 154

Site Type and Other Comments:
T - Targeted
TRD - Trend
S - Status
WCMP - Water Chemistry Monitoring Program
AOC - Area of Concern (Program)

Other:
N/A - Not Available
u/s - Upstream
d/s - Downstream
Bnk Stbl - Bank Stabilization
NW - Non-Wadeable

Table 1. Survey locations and sampling activities for sites in the Muskegon River watershed, 2011.

Station #	Stream	Survey Location	Macroinvertebrate Community Rating & Score	Habitat Rating & Score (Riffle/Run, Glide/Pool)	County	Lat	Long	Site Type	Channel Modifications	Other Comments
NW-1	Muskegon River	off end of Cook Road	Marginal (43)	N/A	CLARE	44.07326	-85.02073	S	N/A	
NW-2	Muskegon River	off Thornapple Trail (Main St)	Marginal (50)	N/A	CLARE	44.02320	-85.04048	S	N/A	
NW-3	Muskegon River	0.3 miles u/s Milliron Road boat launch	Good (64)	N/A	MUSKEGON	43.27021	-86.14506	S	N/A	
NW-4	North Branch Muskegon River	Upstream from Muskegon Lake mouth	Good (53)	N/A	MUSKEGON	43.26384	-86.24231	T	N/A	AOC support
NW-5	South Branch Muskegon River	Teldyne	Good (74)	N/A	MUSKEGON	43.25527	-86.22179	T	N/A	AOC support

Macroinvertebrate Rating System (Wadeable Stations):
Poor: -9 to -5 Acceptable: -4 to +4 Excellent: +5 to +9
Macroinvertebrate Rating System (Non-Wadeable Stations):
Poor: < 26 Marginal: 26 to 50 Good: 51 to 74 Excellent: 75 to 100
Habitat Rating System (Wadeable Stations):
Poor: < 56 Marginal: 56 to 104 Good: 105 to 154 Excellent: > 154

Site Type and Other Comments:
T - Targeted
TRD - Trend
S - Status
WCMP - Water Chemistry Monitoring Program
AOC - Area of Concern (Program)

Other:
N/A - Not Available
u/s - Upstream
d/s - Downstream
Bnk Stbl - Bank Stabilization
NW - Non-Wadeable

Table 2A. Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Knappen Creek Main Street 7/22/2011 STATION 1	Bear Creek Barney Lake Road 7/22/2011 STATION 2	Clam River Haskell Lake Road 7/21/2011 STATION 3	Clam River LaChance Road 7/21/2011 STATION 4
PORIFERA (sponges)		1		
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1		
Oligochaeta (worms)	3	1		
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	54	101	15	48
Decapoda (crayfish)	5		3	6
Isopoda (sowbugs)	20			
Arachnoidea				
Hydracarina		6		1
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae				1
Baetidae		3	3	10
Caenidae	1	2		
Ephemeridae	1			26
Heptageniidae	5		7	7
Isonychiidae			1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	8	11	3	3
Gomphidae	9	3		1
Libellulidae		3		
Zygoptera (damselflies)				
Calopterygidae	19	1		1
Coenagrionidae		7		
Plecoptera (stoneflies)				
Perlidae			1	
Perlodidae			3	
Pteronarcyidae			1	
Hemiptera (true bugs)				
Corixidae	2		7	44
Gerridae	10	1	2	1
Veliidae	1	1	1	
Megaloptera				
Corydalidae (dobson flies)	2		1	1
Sialidae (alder flies)	4	1		
Trichoptera (caddisflies)				
Brachycentridae			131	29
Helicopsychidae			10	5
Hydropsychidae	15	13	47	31
Leptoceridae	25	19	1	6
Limnephilidae	11	6	8	4
Molannidae	2	1		
Phryganeidae		1	6	28
Uenoidae				2
Coleoptera (beetles)				
Gyrinidae (adults)		1	1	1
Hydrophilidae (total)		1		1
Elmidae	28	3	1	1
Diptera (flies)				
Athericidae				1
Chironomidae	25	37	14	22
Simuliidae	12	3		3
Tabanidae		1	1	4
Tipulidae				1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		6	5	6
Hydrobiidae	1	31		1
Physidae	7	2	9	6
Planorbidae		3		
Pleuroceridae		2		
Viviparidae		8	2	
Pelecypoda (bivalves)				
Sphaeriidae (clams)		21	13	3
TOTAL INDIVIDUALS	270	302	297	305

Table 2B. Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Knappen Creek Main Street 7/22/2011 STATION 1		Bear Creek Barney Lake Road 7/22/2011 STATION 2		Clam River Haskell Lake Road 7/21/2011 STATION 3		Clam River LaChance Road 7/21/2011 STATION 4	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	24	1	33	1	27	0	32	1
NUMBER OF MAYFLY TAXA	3	1	2	-1	3	0	4	0
NUMBER OF CADDISFLY TAXA	4	0	5	0	6	1	7	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	3	1	0	-1
PERCENT MAYFLY COMP.	2.59	-1	1.66	-1	3.70	0	14.43	0
PERCENT CADDISFLY COMP.	19.63	0	13.25	0	68.35	1	34.43	1
PERCENT DOMINANT TAXON	20.00	0	33.44	-1	44.11	-1	15.74	1
PERCENT ISOPOD, SNAIL, LEECH	10.37	0	17.55	-1	5.39	0	4.26	0
PERCENT SURF. AIR BREATHERS	4.81	1	1.32	1	3.70	1	15.41	-1
TOTAL SCORE		1		-3		3		2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A (cont'd). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Clam River Stoney Corners Road 7/21/2011 STATION 5	Green Creek Jackson Avenue 7/15/2011 STATION 6	Doc and Tom Creek Garfield Avenue 7/15/2011 STATION 7	W B Muskegon River M-55 7/21/2011 STATION 8
PLATYHELMINTHES (flatworms)				
Turbellaria	2			
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	
Oligochaeta (worms)	2			
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	41	1	3	101
Decapoda (crayfish)	13	1	2	8
Isopoda (sowbugs)	6			13
Arachnoidea				
Hydracarina		1	10	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	14		8	1
Caenidae	2		3	
Ephemerellidae	1			
Ephemeridae	1	6		4
Heptageniidae	83	1	13	8
Isonychiidae	21			
Tricorythidae	1			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		4	3	1
Gomphidae	4		1	
Zygoptera (damselflies)				
Calopterygidae		21	2	1
Coenagrionidae	1			
Plecoptera (stoneflies)				
Perlidae	2		1	
Perlodidae	2		3	1
Hemiptera (true bugs)				
Corixidae	4			54
Gerridae	1	14	1	1
Pleidae				3
Megaloptera				
Corydalidae (dobson flies)	3	2		1
Sialidae (alder flies)		21		1
Trichoptera (caddisflies)				
Brachycentridae	11	6	22	
Helicopsychidae	1		12	3
Hydropsychidae	51	1	82	13
Leptoceridae		2	9	1
Limnephilidae	5	12	9	6
Molannidae		1	1	
Philopotamidae			1	
Phryganeidae	36	2		2
Uenoidae	13		8	13
Coleoptera (beetles)				
Gyrinidae (adults)	1	1	1	
Elmidae	4		4	23
Diptera (flies)				
Athericidae	9		1	
Chironomidae	12	56	37	21
Simuliidae	2		13	13
Tabanidae			1	
Tipulidae	2		1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	13		4	1
Hydrobiidae	1		5	10
Physidae	9	2	5	3
Planorbidae				1
Pleuroceridae				5
Viviparidae	1		3	2
Pelecypoda (bivalves)				
Sphaeriidae (clams)		4	40	2
Unionidae (mussels)			1	
TOTAL INDIVIDUALS	375	159	311	317

Table 2B. Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Clam River Stoney Corners Road 7/21/2011 STATION 5		Green Creek Jackson Avenue 7/15/2011 STATION 6		Doc and Tom Creek Garfield Avenue 7/15/2011 STATION 7		W B Muskegon River M-55 7/21/2011 STATION 8	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	35	1	20	1	34	1	30	1
NUMBER OF MAYFLY TAXA	7	1	2	0	3	0	3	0
NUMBER OF CADDISFLY TAXA	6	1	6	1	8	1	6	1
NUMBER OF STONEFLY TAXA	2	1	0	-1	2	1	1	0
PERCENT MAYFLY COMP.	32.80	1	4.40	0	7.72	0	4.10	0
PERCENT CADDISFLY COMP.	31.20	1	15.09	0	46.30	1	11.99	0
PERCENT DOMINANT TAXON	22.13	0	35.22	-1	26.37	0	31.86	-1
PERCENT ISOPOD, SNAIL, LEECH	8.00	0	1.26	1	5.79	0	11.04	0
PERCENT SURF. AIR BREATHERS	1.60	1	9.43	0	0.64	1	18.30	-1
TOTAL SCORE		7		1		5		0
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		EXCELLENT		ACCEPT.

Table 2A (cont'd). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Franz Creek 90th Avenue 7/20/2011 STATION 9	Handy Creek Amy School Road 7/20/2011 STATION 10	Handy Creek Daggett Road 7/20/2011 STATION 11	Quigley Creek 4 Mile Road 7/14/2011 STATION 12
PORIFERA (sponges)		1		
ANNELIDA (segmented worms)				
Oligochaeta (worms)	3	1	2	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	77	23	44	73
Decapoda (crayfish)		2		
Isopoda (sowbugs)	1			1
Arachnoidea				
Hydracarina		2		
Insecta				
Ephemeroptera (mayflies)				
Baetidae	3	11	13	21
Caenidae		2	3	9
Ephemerellidae			1	6
Ephemeridae				1
Heptageniidae	1	13	24	3
Isonychiidae		12		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		13	6	2
Corduliidae				4
Gomphidae			1	
Libellulidae		2		3
Zygoptera (damselflies)				
Calopterygidae		1	1	8
Plecoptera (stoneflies)				
Perlidae		1	3	
Perlodidae		1	1	
Pteronarcyidae		1		
Hemiptera (true bugs)				
Gerridae	1	1		2
Saldidae				1
Veliidae				1
Megaloptera				
Corydalidae (dobson flies)	1	1	3	1
Sialidae (alder flies)	1			
Trichoptera (caddisflies)				
Brachycentridae	24	18	45	22
Glossosomatidae	48	21	17	5
Helicopsychidae		1	1	
Hydropsychidae	11	61	32	15
Leptoceridae	59			23
Limnephilidae	12	10	20	9
Molannidae	1	1	1	1
Philopotamidae	11		15	
Uenoidae		2	26	5
Coleoptera (beetles)				
Gyrinidae (adults)				2
Hydrophilidae (total)	1	2	2	
Elmidae	1	25	6	2
Diptera (flies)				
Athericidae	1	7	5	
Chironomidae	21	44	11	28
Dixidae				1
Simuliidae	21	14	23	49
Tabanidae			1	10
Tipulidae	1			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1	1	
Physidae	1	1	2	4
Planorbidae	1			2
Pelecypoda (bivalves)				
Sphaeriidae (clams)		1	1	9
TOTAL INDIVIDUALS	302	297	311	324

Table 2B. Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Franz Creek 90th Avenue 7/20/2011 STATION 9		Handy Creek Amy School Road 7/20/2011 STATION 10		Handy Creek Daggett Road 7/20/2011 STATION 11		Quigley Creek 4 Mile Road 7/14/2011 STATION 12	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	23	1	32	1	29	1	32	1
NUMBER OF MAYFLY TAXA	2	0	4	0	4	0	5	1
NUMBER OF CADDISFLY TAXA	7	1	7	1	8	1	7	1
NUMBER OF STONEFLY TAXA	0	-1	3	1	2	1	0	-1
PERCENT MAYFLY COMP.	1.32	-1	12.79	0	13.18	0	12.35	0
PERCENT CADDISFLY COMP.	54.97	1	38.38	1	50.48	1	24.69	0
PERCENT DOMINANT TAXON	25.50	0	20.54	0	14.47	1	22.53	0
PERCENT ISOPOD, SNAIL, LEECH	0.99	1	0.67	1	0.96	1	2.16	1
PERCENT SURF. AIR BREATHERS	0.66	1	1.01	1	0.64	1	1.85	1
TOTAL SCORE		3		6		7		4
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		EXCELLENT		ACCEPT.

Table 2A (cont'd). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Little Muskegon River 155th Avenue 7/14/2011 STATION 13	Little Muskegon River Washington Road 7/20/2011 STATION 14	Bigelow Creek Walnut Avenue 7/19/2011 STATION 15	Bigelow Creek S. Basswood Dr (2-Track u/s Croton Dr) 7/14/2011 STATION 16
PLATYHELMINTHES (flatworms)				
Turbellaria	1			
ANNELIDA (segmented worms)				
Hirudinea (leeches)	5			
Oligochaeta (worms)	9	2		3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	13	4	100	82
Decapoda (crayfish)	5	5	9	1
Arachnoidea				
Hydracarina	1	1	1	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	4	6	6	1
Caenidae	2	1		1
Ephemerellidae	2	5	4	29
Ephemeridae	23	17	6	
Heptageniidae	9	15	4	6
Isonychiidae	8	3		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1	4	3
Gomphidae	2	3	2	
Libellulidae			5	
Zygoptera (damselflies)				
Calopterygidae	6		12	
Coenagrionidae			1	
Plecoptera (stoneflies)				
Perlidae		8		1
Perlodidae	7	2		
Pteronarcyidae	1	20		
Hemiptera (true bugs)				
Corixidae	1			
Gerridae		1	4	
Veliidae			2	
Megaloptera				
Corydalidae (dobson flies)	2	1	3	4
Trichoptera (caddisflies)				
Brachycentridae	78	3	65	58
Glossosomatidae			1	8
Helicopsychidae	1	5		
Hydropsychidae	14	52	40	36
Leptoceridae	1			
Limnephilidae	1	1	6	3
Molannidae			1	
Philopotamidae				1
Phryganeidae	36			
Uenoidae	1	25	5	
Coleoptera (beetles)				
Elmidae	7	18	5	9
Psephenidae (larvae)	2	13		
Diptera (flies)				
Athericidae	1	9		1
Chironomidae	23	30	22	12
Simuliidae		1	2	30
Tabanidae			1	2
Tipulidae				1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1	1		
Hydrobiidae		5		
Physidae	11		4	1
Planorbidae				1
Pleuroceridae	1	4		
Viviparidae		3		
Pelecypoda (bivalves)				
Sphaeriidae (clams)	2	2	9	
Unionidae (mussels)	1	1		
TOTAL INDIVIDUALS	284	268	324	295

Table 2B (cont'd). Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Little Muskegon River 155th Avenue 7/14/2011 STATION 13		Little Muskegon River Washington Road 7/20/2011 STATION 14		Bigelow Creek Walnut Avenue 7/19/2011 STATION 15		Bigelow Creek S. Basswood Dr - 2-Track u/s Croton Dr 7/14/2011 STATION 16	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	35	1	33	1	27	0	24	0
NUMBER OF MAYFLY TAXA	6	1	6	1	4	0	4	0
NUMBER OF CADDISFLY TAXA	7	1	5	0	6	1	5	0
NUMBER OF STONEFLY TAXA	2	1	3	1	0	-1	1	0
PERCENT MAYFLY COMP.	16.90	0	17.54	0	6.17	0	12.54	0
PERCENT CADDISFLY COMP.	46.48	1	32.09	1	36.42	1	35.93	1
PERCENT DOMINANT TAXON	27.46	0	19.40	0	30.86	-1	27.80	-1
PERCENT ISOPOD, SNAIL, LEECH	6.34	0	4.85	0	1.23	1	0.68	1
PERCENT SURF. AIR BREATHERS	0.35	1	0.37	1	1.85	1	0.00	1
TOTAL SCORE		6		5		2		2
MACROINV. COMMUNITY RATING		EXCELLENT		EXCELLENT		ACCEPT.		ACCEPT.

Table 2A (cont'd). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Middle Branch River 21 Mile Road 7/21/2011 STATION 17	Muskegon River off Logging Trail Drive 7/20/2011 STATION 18
ANNELIDA (segmented worms)		
Hirudinea (leeches)		1
Oligochaeta (worms)	2	1
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	21	7
Decapoda (crayfish)	1	3
Arachnoidea		
Hydracarina	1	1
Insecta		
Ephemeroptera (mayflies)		
Baetidae	19	11
Ephemerellidae		1
Ephemeridae		3
Heptageniidae	4	28
Isonychiidae	5	3
Tricorythidae	21	
Odonata		
Anisoptera (dragonflies)		
Gomphidae		1
Libellulidae		1
Zygoptera (damselflies)		
Calopterygidae	3	
Plecoptera (stoneflies)		
Perlidae		5
Perlodidae		3
Pteronarcyidae		8
Hemiptera (true bugs)		
Corixidae	18	1
Pleidae	21	
Megaloptera		
Corydalidae (dobson flies)	4	
Sialidae (alder flies)		1
Trichoptera (caddisflies)		
Brachycentridae	26	19
Helicopsychidae	1	
Hydropsychidae	40	22
Lepidostomatidae	1	
Leptoceridae		3
Limnephilidae	6	3
Phryganeidae	8	1
Uenoidae	1	15
Coleoptera (beetles)		
Gyrinidae (adults)	1	
Haliplidae (adults)	1	
Elmidae	8	3
Diptera (flies)		
Athericidae	17	2
Chironomidae	38	12
Simuliidae	46	8
Tabanidae	19	
MOLLUSCA		
Gastropoda (snails)		
Ancylidae (limpets)	2	3
Hydrobiidae		16
Physidae	3	1
Pleuroceridae		23
Viviparidae		7
Pelecypoda (bivalves)		
Sphaeriidae (clams)		121
Unionidae (mussels)		1
TOTAL INDIVIDUALS	338	339

Table 2B (cont'd). Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Middle Branch River 21 Mile Road 7/21/2011 STATION 17		Muskegon River off Logging Trail Drive 7/20/2011 STATION 18	
METRIC	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	28	1	34	1
NUMBER OF MAYFLY TAXA	4	0	5	1
NUMBER OF CADDISFLY TAXA	7	1	6	1
NUMBER OF STONEFLY TAXA	0	-1	3	1
PERCENT MAYFLY COMP.	14.50	0	13.57	0
PERCENT CADDISFLY COMP.	24.56	0	18.58	0
PERCENT DOMINANT TAXON	13.61	1	35.69	-1
PERCENT ISOPOD, SNAIL, LEECH	1.48	1	15.04	-1
PERCENT SURF. AIR BREATHERS	12.13	0	0.29	1
TOTAL SCORE		3		3
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.

Table 2A (con'td). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Ryerson Creek Home Street 7/13/2011 STATION 19	Ryerson Creek u/s of Clay Avenue 7/13/2011 STATION 20	Ryerson Creek d/s of Shoreline Drive 7/12/2011 STATION 21	Bear Creek McMillan Road 7/13/2011 STATION 22
PORIFERA (sponges)			1	
PLATYHELMINTHES (flatworms)				
Turbellaria		1	2	
ANNELIDA (segmented worms)				
Hirudinea (leeches)		39	10	1
Oligochaeta (worms)	18	9	10	2
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	110	106	66	90
Decapoda (crayfish)			1	1
Isopoda (sowbugs)	80	85	143	3
Arachnoidea				
Hydracarina	1			
Insecta				
Ephemeroptera (mayflies)				
Baetidae	15	1		16
Ephemeridae				1
Heptageniidae				1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1		2	11
Corduliidae				1
Libellulidae			1	1
Zygoptera (damselflies)				
Calopterygidae				22
Coenagrionidae		1	1	
Hemiptera (true bugs)				
Corixidae			3	
Gerridae	1	1	1	2
Veliidae				1
Megaloptera				
Corydalidae (dobson flies)				3
Sialidae (alder flies)				1
Trichoptera (caddisflies)				
Brachycentridae				81
Glossosomatidae				1
Hydropsychidae				5
Limnephilidae				10
Philopotamidae				1
Phryganeidae				1
Coleoptera (beetles)				
Dytiscidae (total)	1			1
Gyrinidae (adults)				1
Haliplidae (adults)			10	
Hydrophilidae (total)	1			1
Elmidae				2
Gyrinidae (larvae)		1	1	
Diptera (flies)				
Athericidae				1
Chironomidae	93	52	47	16
Simuliidae	2	26		26
Stratiomyidae		1		
Tabanidae				3
Tipulidae	1			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		7	1	
Hydrobiidae		19	3	
Physidae	4	6		7
Planorbidae		19	14	
Viviparidae			1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)		1		1
TOTAL INDIVIDUALS	328	375	318	315

Table 2B (cont'd). Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Ryerson Creek Home Street 7/13/2011 STATION 19		Ryerson Creek u/s of Clay Avenue 7/13/2011 STATION 20		Ryerson Creek d/s of Shoreline Drive 7/12/2011 STATION 21		Bear Creek McMillan Road 7/13/2011 STATION 22	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	13	0	17	0	19	0	32	1
NUMBER OF MAYFLY TAXA	1	0	1	-1	0	-1	3	0
NUMBER OF CADDISFLY TAXA	0	-1	0	-1	0	-1	6	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	4.57	0	0.27	-1	0.00	-1	5.71	0
PERCENT CADDISFLY COMP.	0.00	-1	0.00	-1	0.00	-1	31.43	1
PERCENT DOMINANT TAXON	33.54	0	28.27	0	44.97	-1	28.57	0
PERCENT ISOPOD, SNAIL, LEECH	25.61	-1	46.67	-1	54.09	-1	3.49	1
PERCENT SURF. AIR BREATHERS	0.91	1	0.53	1	4.40	1	1.90	1
TOTAL SCORE		-3		-5		-6		4
MACROINV. COMMUNITY RATING		ACCEPT.		POOR		POOR		ACCEPT.

Table 2A (cont'd). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Little Bear Creek d/s of River Road 7/13/2011 STATION 23	Little Bear Creek Giles Road 7/19/2011 STATION 24	Markle Drain (Cedar Creek) u/s Maple Island Rd (M120) 7/13/2011 STATION 25	Cedar Creek d/s of River Road 7/14/2011 STATION 26
PLATYHELMINTHES (flatworms)				
Turbellaria			171	
ANNELIDA (segmented worms)				
Hirudinea (leeches)			8	1
Oligochaeta (worms)	2	1	20	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	35	127	15	71
Decapoda (crayfish)			1	3
Isopoda (sowbugs)	42	17	2	24
Arachnoidea				
Hydracarina	4	1	1	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	41	24	1	74
Caenidae		1		
Ephemerellidae	1			
Ephemeridae				5
Heptageniidae	2	4		1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		2	1	2
Zygoptera (damselflies)				
Calopterygidae		18		
Coenagrionidae			5	
Hemiptera (true bugs)				
Corixidae				43
Gerridae		1		1
Pleidae				1
Megaloptera				
Corydalidae (dobson flies)		3		
Sialidae (alder flies)		1		1
Trichoptera (caddisflies)				
Brachycentridae	5	1		2
Hydropsychidae	2	55		2
Leptoceridae	2	3		1
Limnephilidae	11	8		2
Philopotamidae		2		
Coleoptera (beetles)				
Dytiscidae (total)				1
Gyrinidae (adults)	1	2		
Hydrophilidae (total)		2		
Elmidae		1		1
Diptera (flies)				
Athericidae	6			
Ceratopogonidae				1
Chaoboridae	112			
Chironomidae		37	28	31
Simuliidae	43	8		44
Tabanidae		3		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				1
Hydrobiidae				2
Physidae			22	7
Planorbidae			1	
Pleuroceridae				1
Viviparidae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)		5	1	1
TOTAL INDIVIDUALS	309	327	277	326

Table 2B (cont'd). Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Little Bear Creek d/s of River Road 7/13/2011 STATION 23		Little Bear Creek Giles Road 7/19/2011 STATION 24		Markle Drain (Cedar Creek) u/s Maple Island Rd (M120) 7/13/2011 STATION 25		Cedar Creek d/s of River Road 7/14/2011 STATION 26	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	15	0	24	0	14	0	28	1
NUMBER OF MAYFLY TAXA	3	1	3	0	1	0	3	0
NUMBER OF CADDISFLY TAXA	4	0	5	1	0	-1	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	14.24	0	8.87	0	0.36	-1	24.54	1
PERCENT CADDISFLY COMP.	6.47	0	21.10	0	0.00	-1	2.15	-1
PERCENT DOMINANT TAXON	36.25	0	38.84	-1	61.73	-1	22.70	0
PERCENT ISOPOD, SNAIL, LEECH	13.59	-1	5.20	0	11.91	-1	11.35	-1
PERCENT SURF. AIR BREATHERS	36.57	-1	1.53	1	0.00	1	14.11	0
TOTAL SCORE		-2		0		-5		-1
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		POOR		ACCEPT.

Table 2A (cont'd). Qualitative macroinvertebrate sampling results for wadeable sites in the Muskegon River Watershed, 2011.

TAXA	Muskegon River d/s Holton Duck Lake Rd 7/19/2011 STATION 27
ANNELIDA (segmented worms)	
Oligochaeta (worms)	1
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	10
Decapoda (crayfish)	1
Isopoda (sowbugs)	1
Insecta	
Ephemeroptera (mayflies)	
Baetidae	4
Ephemeridae	2
Heptageniidae	2
Isonychiidae	2
Tricorythidae	1
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	1
Gomphidae	1
Zygoptera (damselflies)	
Calopterygidae	1
Plecoptera (stoneflies)	
Perlodidae	19
Pteronarcyidae	2
Hemiptera (true bugs)	
Gerridae	1
Veliidae	1
Trichoptera (caddisflies)	
Brachycentridae	258
Hydropsychidae	5
Leptoceridae	1
Limnephilidae	1
Phryganeidae	4
Polycentropodidae	1
Coleoptera (beetles)	
Gyrinidae (adults)	1
Hydrophilidae (total)	1
Elmidae	2
Diptera (flies)	
Athericidae	1
Chironomidae	4
Simuliidae	12
Tabanidae	2
MOLLUSCA	
Pelecypoda (bivalves)	
Dreissenidae	1
Unionidae (mussels)	1
TOTAL INDIVIDUALS	345

Table 2B (cont'd). Macroinvertebrate metric evaluation of wadeable sites in the Muskegon River Watershed, 2011.

	Muskegon River d/s Holton Duck Lake Rd 7/19/2011 STATION 27	
METRIC	Value	Score
TOTAL NUMBER OF TAXA	31	1
NUMBER OF MAYFLY TAXA	5	1
NUMBER OF CADDISFLY TAXA	6	1
NUMBER OF STONEFLY TAXA	2	1
PERCENT MAYFLY COMP.	3.19	0
PERCENT CADDISFLY COMP.	78.26	1
PERCENT DOMINANT TAXON	74.78	-1
PERCENT ISOPOD, SNAIL, LEECH	0.29	1
PERCENT SURF. AIR BREATHERS	1.16	1
TOTAL SCORE		6
MACROINV. COMMUNITY RATING		EXCELLENT

Table 3. Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Knappen Creek Main Street GLIDE/POOL STATION 1	Bear Creek Barney Lake Road GLIDE/POOL STATION 2	Clam River Haskell Lake Road GLIDE/POOL STATION 3	Clam River LaChance Road GLIDE/POOL STATION 4
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	10	10	8	10
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	11	11	9	13
Pool Variability (20)**	10	3	13	8
Channel Morphology				
Sediment Deposition (20)	10	13	14	11
Flow Status - Maint. Flow Volume (10)	8	8	8	8
Flow Status - Flashiness (10)	9	9	8	9
Channel Alteration (20)	15	16	16	15
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	15	13	15	15
Riparian and Bank Structure				
Bank Stability (L) (10)	9	9	9	9
Bank Stability (R) (10)	9	9	9	9
Vegetative Protection (L) (10)	9	10	9	2
Vegetative Protection (R) (10)	9	10	9	9
Riparian Veg. Zone Width (L) (10)	9	10	10	2
Riparian Veg. Zone Width (R) (10)	9	10	9	6
TOTAL SCORE (200):	142	141	146	126
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s)

Date:	7/22/2011	7/22/2011	7/21/2011	7/21/2011
Weather:	Partly Cloudy	Partly Cloudy	Sunny	Sunny
Air Temperature:	80 Deg. F.	83 Deg. F.	90 Deg. F.	80 Deg. F.
Water Temperature:	68 Deg. F.	71 Deg. F.	70 Deg. F.	70 Deg. F.
Ave. Stream Width:	6 Feet	20 Feet	48 Feet	45 Feet
Ave. Stream Depth:	0.3 Feet	0.8 Feet	1.8 Feet	1.1 Feet
Surface Velocity:	0.3 Ft./Sec.	0.2 Ft./Sec.	0.9 Ft./Sec.	0.9 Ft./Sec.
Estimated Flow:	0.54 CFS	3.2 CFS	77.76 CFS	44.55 CFS
Stream Modifications:	None	None	None	Bank Stabilization
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	720169	720170	180128	570012
Stream Name:	Knappen Creek	Bear Creek	Clam River	Clam River
Road Crossing/Location:	Main Street	Barney Lake Road	Haskell Lake Road	LaChance Road
County Code:	72	72	18	57
TRS:	22N03W14	21N04W07	20N06W15	22N08W20
Latitude (dd):	44.29843	44.2324	44.11761	44.28329
Longitude (dd):	-84.64933	-84.85197	-85.01585	-85.29662
Ecoregion:	NLAF	NLAF	NLAF	NLAF
Stream Type:	Warmwater	Warmwater	Coldwater	Coldwater
USGS Basin Code:	4060102	4060102	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Clam River Stoney Corners Road RIFFLE/RUN STATION 5	Green Creek Jackson Avenue GLIDE/POOL STATION 6	Doc and Tom Creek Garfield Avenue RIFFLE/RUN STATION 7	W B Muskegon River M-55 RIFFLE/RUN STATION 8
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	13	5	11	13
Embeddedness (20)*	15		13	11
Velocity/Depth Regime (20)*	16		15	10
Pool Substrate Characterization (20)**		6		
Pool Variability (20)**		6		
Channel Morphology				
Sediment Deposition (20)	13	5	11	11
Flow Status - Maint. Flow Volume (10)	9	8	8	8
Flow Status - Flashiness (10)	9	8	8	7
Channel Alteration (20)	16	11	18	15
Frequency of Riffles/Bends (20)*	11		10	11
Channel Sinuosity (20)**		8		
Riparian and Bank Structure				
Bank Stability (L) (10)	9	9	9	8
Bank Stability (R) (10)	9	9	9	8
Vegetative Protection (L) (10)	6	10	10	10
Vegetative Protection (R) (10)	3	10	10	6
Riparian Veg. Zone Width (L) (10)	6	10	10	10
Riparian Veg. Zone Width (R) (10)	2	10	10	4
TOTAL SCORE (200):	137	115	152	132
HABITAT RATING	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (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:	7/21/2011	7/15/2011	7/15/2011	7/21/2011
Weather:	Sunny	Sunny	Partly Cloudy	Partly Cloudy
Air Temperature:	90 Deg. F.	Deg. F.	Deg. F.	85 Deg. F.
Water Temperature:	69 Deg. F.	60 Deg. F.	68 Deg. F.	78 Deg. F.
Ave. Stream Width:	52 Feet	5 Feet	16 Feet	30 Feet
Ave. Stream Depth:	1.3 Feet	0.3 Feet	0.6 Feet	1 Feet
Surface Velocity:	0.8 Ft./Sec.	0.2 Ft./Sec.	0.7 Ft./Sec.	0.4 Ft./Sec.
Estimated Flow:	54.08 CFS	0.3 CFS	6.72 CFS	12 CFS
Stream Modifications:	None	Dredged	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	570099	180187	180143	570065
Stream Name:	Clam River	Green Creek	Doc and Tom Creek	W B Muskegon River
Road Crossing/Location:	Stoney Corners Road	Jackson Avenue	Garfield Avenue	M-55
County Code:	57	18	18	57
TRS:	21N06W22	19N05W28	18N06W29	23N05W33
Latitude (dd):	44.19244	44.01489	43.92824	44.33596
Longitude (dd):	-85.02722	-84.92928	-85.06355	-84.92176
Ecoregion:	NLAF	NLAF	NLAF	NLAF
Stream Type:	Coldwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4060102	4060102	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Franz Creek 90th Avenue GLIDE/POOL STATION 9	Handy Creek Amy School Road RIFFLE/RUN STATION 10	Handy Creek Daggett Road RIFFLE/RUN STATION 11	Quigley Creek 4 Mile Road GLIDE/POOL STATION 12
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	10	13	12	11
Embeddedness (20)*		16	13	
Velocity/Depth Regime (20)*		11	11	
Pool Substrate Characterization (20)**	6			16
Pool Variability (20)**	6			11
Channel Morphology				
Sediment Deposition (20)	13	10	11	13
Flow Status - Maint. Flow Volume (10)	8	8	8	8
Flow Status - Flashiness (10)	8	4	5	9
Channel Alteration (20)	16	15	16	16
Frequency of Riffles/Bends (20)*		15	13	
Channel Sinuosity (20)**	16			13
Riparian and Bank Structure				
Bank Stability (L) (10)	9	6	7	9
Bank Stability (R) (10)	9	8	7	9
Vegetative Protection (L) (10)	9	9	9	10
Vegetative Protection (R) (10)	9	9	9	10
Riparian Veg. Zone Width (L) (10)	10	8	10	10
Riparian Veg. Zone Width (R) (10)	10	10	10	10
TOTAL SCORE (200):	139	142	141	155
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON-IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s)

Date:	7/20/2011	7/20/2011	7/20/2011	7/14/2011
Weather:	Sunny	Partly Cloudy	Partly Cloudy	Sunny
Air Temperature:	95 Deg. F.	80 Deg. F.	85 Deg. F.	78 Deg. F.
Water Temperature:	59 Deg. F.	62 Deg. F.	57 Deg. F.	65 Deg. F.
Ave. Stream Width:	8 Feet	13 Feet	15 Feet	11 Feet
Ave. Stream Depth:	0.5 Feet	0.4 Feet	0.5 Feet	0.4 Feet
Surface Velocity:	0.5 Ft./Sec.	0.8 Ft./Sec.	0.7 Ft./Sec.	0.8 Ft./Sec.
Estimated Flow:	2 CFS	4.16 CFS	5.25 CFS	3.52 CFS
Stream Modifications:	None	None	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	670234	590294	590316	540203
Stream Name:	Franz Creek	Handy Creek	Handy Creek	Quigley Creek
Road Crossing/Location:	90th Avenue	Amy School Road	Daggett Road	4 Mile Road
County Code:	67	59	59	54
TRS:	20N08W33	12N10W15	12N10W17	13N09W10
Latitude (dd):	44.07927	43.433555	43.42897	43.52752
Longitude (dd):	-85.26688	-85.5023846	-85.53139	-85.366
Ecoregion:	NLAF	NLAF	NLAF	NLAF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060102	4060102	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Little Muskegon River 155th Avenue GLIDE/POOL STATION 13	Little Muskegon River Washington Road RIFFLE/RUN STATION 14	Bigelow Creek Walnut Avenue GLIDE/POOL STATION 15	Bigelow Creek S. Basswood Dr - 2-Track u/s Croton Dr RIFFLE/RUN STATION 16
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	15	15	11	11
Embeddedness (20)*		15		11
Velocity/Depth Regime (20)*		16		16
Pool Substrate Characterization (20)**	16		11	
Pool Variability (20)**	11		10	
Channel Morphology				
Sediment Deposition (20)	13	11	13	10
Flow Status - Maint. Flow Volume (10)	7	7	9	9
Flow Status - Flashiness (10)	8	6	9	9
Channel Alteration (20)	18	18	18	18
Frequency of Riffles/Bends (20)*		15		11
Channel Sinuosity (20)**	16		16	
Riparian and Bank Structure				
Bank Stability (L) (10)	8	9	9	9
Bank Stability (R) (10)	8	6	6	8
Vegetative Protection (L) (10)	4	2	9	6
Vegetative Protection (R) (10)	10	8	9	6
Riparian Veg. Zone Width (L) (10)	4	2	9	3
Riparian Veg. Zone Width (R) (10)	10	8	9	3
TOTAL SCORE (200):	148	138	148	130
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s).

Date:	7/14/2011	7/20/2011	7/19/2011	7/14/2011
Weather:	Sunny	Partly Cloudy	Sunny	Sunny
Air Temperature:	80 Deg. F.	85 Deg. F.	93 Deg. F.	72 Deg. F.
Water Temperature:	73 Deg. F.	72 Deg. F.	66 Deg. F.	63 Deg. F.
Ave. Stream Width:	75 Feet	65 Feet	10 Feet	15 Feet
Ave. Stream Depth:	1 Feet	1.2 Feet	0.5 Feet	0.6 Feet
Surface Velocity:	0.8 Ft./Sec.	0.9 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	60 CFS	70.2 CFS	2.5 CFS	9 CFS
Stream Modifications:	None	None	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	540137	540180	620213	620215
Stream Name:	Little Muskegon River	Little Muskegon River	Bigelow Creek	Bigelow Creek
Road Crossing/Location:	155th Avenue	Washington Road	Walnut Avenue	S. Basswood Dr - 2-Track u/s Croton Dr
County Code:	54	54	62	62
TRS:	13N09W21	13N10W35	13N12W16	12N13W17
Latitude (dd):	43.504346	43.47526	43.4983	43.428333
Longitude (dd):	-85.392686	-85.47548	-85.7627	-85.768333
Ecoregion:	NLAF	NLAF	NLAF	NLAF
Stream Type:	Coldwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4060102	4060102	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Middle Branch River 21 Mile Road GLIDE/POOL STATION 17	Muskegon River off Logging Trail Drive GLIDE/POOL STATION 18
Substrate and Instream Cover		
Epifaunal Substrate/ Avail Cover (20)	13	10
Embeddedness (20)*		
Velocity/Depth Regime (20)*		
Pool Substrate Characterization (20)**	16	16
Pool Variability (20)**	13	15
Channel Morphology		
Sediment Deposition (20)	11	11
Flow Status - Maint. Flow Volume (10)	8	8
Flow Status - Flashiness (10)	7	5
Channel Alteration (20)	16	16
Frequency of Riffles/Bends (20)*		
Channel Sinuosity (20)**	15	15
Riparian and Bank Structure		
Bank Stability (L) (10)	8	5
Bank Stability (R) (10)	8	9
Vegetative Protection (L) (10)	8	2
Vegetative Protection (R) (10)	8	10
Riparian Veg. Zone Width (L) (10)	7	2
Riparian Veg. Zone Width (R) (10)	7	10
TOTAL SCORE (200):	145	134
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s)

Date:	7/21/2011	7/20/2011
Weather:	Sunny	Sunny
Air Temperature:	95 Deg. F.	92 Deg. F.
Water Temperature:	65 Deg. F.	76 Deg. F.
Ave. Stream Width:	35 Feet	275 Feet
Ave. Stream Depth:	0.7 Feet	2.5 Feet
Surface Velocity:	0.7 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	17.15 CFS	687.5 CFS
Stream Modifications:	None	Bank Stabilization
Nuisance Plants (Y/N):	N	N
STORET No.:	670232	670229
Stream Name:	Middle Branch River	Muskegon River
Road Crossing/Location:	21 Mile Road	off Logging Trail Drive
County Code:	67	67
TRS:	20N07W16	18N07W19
Latitude (dd):	44.11708	43.93433
Longitude (dd):	-85.16472	-85.20208
Ecoregion:	NLAF	NLAF
Stream Type:	Coldwater	Warmwater
USGS Basin Code:	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Ryerson Creek Home Street GLIDE/POOL STATION 19	Ryerson Creek upstream Clay Avenue GLIDE/POOL STATION 20	Ryerson Creek d/s of Shoreline Drive GLIDE/POOL STATION 21	Bear Creek McMillan Road GLIDE/POOL STATION 22
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	10	10	11	6
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	10	11	11	6
Pool Variability (20)**	8	11	10	6
Channel Morphology				
Sediment Deposition (20)	8	10	15	8
Flow Status - Maint. Flow Volume (10)	8	7	9	6
Flow Status - Flashiness (10)	6	7	9	6
Channel Alteration (20)	11	8	8	11
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	11	6	6	13
Riparian and Bank Structure				
Bank Stability (L) (10)	7	7	7	8
Bank Stability (R) (10)	7	7	7	8
Vegetative Protection (L) (10)	8	3	5	9
Vegetative Protection (R) (10)	8	3	5	9
Riparian Veg. Zone Width (L) (10)	6	2	3	9
Riparian Veg. Zone Width (R) (10)	6	2	3	9
TOTAL SCORE (200):	114	94	109	114
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s)

Date:	7/13/2011	7/13/2011	7/12/2011	7/13/2011
Weather:	Sunny	Sunny	Partly Cloudy	Sunny
Air Temperature:	70 Deg. F.	75 Deg. F.	83 Deg. F.	78 Deg. F.
Water Temperature:	61 Deg. F.	69 Deg. F.	76 Deg. F.	67 Deg. F.
Ave. Stream Width:	9 Feet	15 Feet	15 Feet	15 Feet
Ave. Stream Depth:	0.3 Feet	0.5 Feet	0.5 Feet	0.5 Feet
Surface Velocity:	0.75 Ft./Sec.	0.5 Ft./Sec.	0.25 Ft./Sec.	0.75 Ft./Sec.
Estimated Flow:	2.025 CFS	3.75 CFS	1.875 CFS	5.625 CFS
Stream Modifications:	None	Dredged	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	610664	610780	610779	610527
Stream Name:	Ryerson Creek	Ryerson Creek	Ryerson Creek	Bear Creek
Road Crossing/Location:	Home Street	upstream Clay Avenue	d/s of Shoreline Drive	McMillan Road
County Code:	61	61	61	61
TRS:	10N16W21	10N16W19	10N16W19	11N16W26
Latitude (dd):	43.23528	43.23866	43.24005	43.309566
Longitude (dd):	-86.2064	-86.24357	-86.24433	-86.192401
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4060102	4060102	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Little Bear Creek downstream River Road RIFFLE/RUN STATION 23	Little Bear Creek Giles Road GLIDE/POOL STATION 24	Markle Drain (Cedar Cr) u/s of Maple Island Rd (M120) GLIDE/POOL STATION 25	Cedar Creek downstream River Road GLIDE/POOL STATION 26
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	13	10	8	10
Embeddedness (20)*	10			
Velocity/Depth Regime (20)*	13			
Pool Substrate Characterization (20)**		6	11	11
Pool Variability (20)**		8	5	10
Channel Morphology				
Sediment Deposition (20)	10	10	5	11
Flow Status - Maint. Flow Volume (10)	7	8	5	8
Flow Status - Flashiness (10)	9	8	3	9
Channel Alteration (20)	16	16	6	16
Frequency of Riffles/Bends (20)*	13			
Channel Sinuosity (20)**		15	3	15
Riparian and Bank Structure				
Bank Stability (L) (10)	9	9	6	9
Bank Stability (R) (10)	9	9	6	9
Vegetative Protection (L) (10)	10	10	3	9
Vegetative Protection (R) (10)	10	10	3	9
Riparian Veg. Zone Width (L) (10)	10	9	2	10
Riparian Veg. Zone Width (R) (10)	10	9	2	10
TOTAL SCORE (200):	149	137	68	146
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s)

Date:	7/13/2011	7/19/2011	7/13/2011	7/14/2011
Weather:	Sunny	Sunny	Sunny	Sunny
Air Temperature:	78 Deg. F.	85 Deg. F.	78 Deg. F.	60 Deg. F.
Water Temperature:	61 Deg. F.	68 Deg. F.	71 Deg. F.	60 Deg. F.
Ave. Stream Width:	9 Feet	18 Feet	5 Feet	45 Feet
Ave. Stream Depth:	0.5 Feet	0.3 Feet	0.4 Feet	2 Feet
Surface Velocity:	0.8 Ft./Sec.	0.7 Ft./Sec.	0.3 Ft./Sec.	0.5 Ft./Sec.
Estimated Flow:	3.6 CFS	3.78 CFS	0.6 CFS	45 CFS
Stream Modifications:	None	None	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	610781	610325	620324	610782
Stream Name:	Little Bear Creek	Little Bear Creek	Markle Drain (Cedar Cr)	Cedar Creek
Road Crossing/Location:	downstream River Road	Giles Road	u/s of Maple Island Rd (M120)	downstream River Road
County Code:	61	61	62	61
TRS:	10N16W6	10N16W06	12N14W18	11N15W33
Latitude (dd):	43.29554	43.278089	43.42785	43.30512
Longitude (dd):	-86.24423	-86.244424	-86.03923	-86.11581
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060102	4060102	4060102	4060102

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3 (cont'd). Habitat evaluation for wadeable sites in the Muskegon River Watershed, 2011.

HABITAT METRIC	Muskegon River downstream Holton Duck Lake Road RIFFLE/RUN STATION 27
Substrate and Instream Cover	
Epifaunal Substrate/ Avail Cover (20)	8
Embeddedness (20)*	13
Velocity/Depth Regime (20)*	16
Pool Substrate Characterization (20)**	
Pool Variability (20)**	
Channel Morphology	
Sediment Deposition (20)	10
Flow Status - Maint. Flow Volume (10)	8
Flow Status - Flashiness (10)	2
Channel Alteration (20)	18
Frequency of Riffles/Bends (20)*	10
Channel Sinuosity (20)**	
Riparian and Bank Structure	
Bank Stability (L) (10)	8
Bank Stability (R) (10)	8
Vegetative Protection (L) (10)	9
Vegetative Protection (R) (10)	9
Riparian Veg. Zone Width (L) (10)	10
Riparian Veg. Zone Width (R) (10)	10
TOTAL SCORE (200):	139
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s)

Date:	7/19/2011	
Weather:	Sunny	
Air Temperature:	95	Deg. F.
Water Temperature:	78	Deg. F.
Ave. Stream Width:	37.5	Feet
Ave. Stream Depth:	2.5	Feet
Surface Velocity:	0.9	Ft./Sec.
Estimated Flow:	84.375	CFS
Stream Modifications:	None	
Nuisance Plants (Y/N):	N	
STORET No.:	610662	
Stream Name:	Muskegon River	
Road Crossing/Location:	downstream Holton Duck Lake Road	
County Code:	61	
TRS:	11N15W34	
Latitude (dd):	43.29776	
Longitude (dd):	-86.07954	
Ecoregion:	SMNITP	
Stream Type:	Coldwater	
USGS Basin Code:	4060102	

* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 4A. Qualitative macroinvertebrate sampling results for nonwadeable sites in the Muskegon River Watershed, 2011.

TAXA	Muskegon River off end of Cook Rd. 6/28/2011 STATION NW-1	Muskegon River off Thornapple Tr. 9/9/2011 STATION NW-2	Muskegon River 0.3 mi u/s Milliron Rd. boat launch 9/8/2011 STATION NW-3	N B Muskegon River u/s Muskegon L. mouth 6/29/2011 STATION NW-4
PLATYHELMINTHES (flatworms)				
Turbellaria		1		
ANNELIDA (segmented worms)				
Oligochaeta (worms)		7		
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	55	94	219	236
Decapoda (crayfish)	3	1		1
Isopoda (sowbugs)			5	1
Arachnoidea				
Hydracarina	5	12		1
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae		17		
Baetidae	475	127	237	48
Caenidae	2			
Ephemeridae		4		
Heptageniidae	56	6	6	79
Isonychiidae	18	15		2
Leptophlebiidae		1		
Polymitarcyidae	1			
Leptohyphidae (Trico.)			2	
Odonata				
Anisoptera (dragonflies)				
Gomphidae	4	11	1	
Zygoptera (damselflies)				
Calopterygidae		20	1	
Coenagrionidae		1	85	
Plecoptera (stoneflies)				
Perlidae	25			15
Pteronarcyidae		4		
Hemiptera (true bugs)				
Belostomatidae	1	1		
Corixidae	14	183	5	20
Gerridae	1		5	1
Naucoridae			2	1
Nepidae		1		
Trichoptera (caddisflies)				
Brachycentridae	1	1	22	1
Hydropsychidae	2	2	6	
Leptoceridae	5		5	13
Limnephilidae	1	2		1
Molannidae		1		
Polycentropodidae				1
Coleoptera (beetles)				
Dytiscidae (total)			1	
Gyrinidae (adults)			1	
Hydrophilidae (total)	3			
Elmidae (total)		4	4	
Diptera (flies)				
Athericidae		6		
Ceratopogonidae		10	2	
Chironomidae	7	43	51	20
Simuliidae	14	7	18	
Tabanidae	1	24		
Tipulidae			1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		2		
Hydrobiidae	2			4
Lymnaeidae		1		1
Physidae	6	2	6	2
Planorbidae			1	
Pleuroceridae	2			
Pelecypoda (bivalves)				
Sphaeriidae (fingernail clams)	2	13		

Table 4B. Macroinvertebrate community metric evaluation for nonwadeable sites in the Muskegon River Watershed, 2011.

METRIC	Muskegon River off end of Cook Rd. 6/28/2011 STATION NW-1		Muskegon River off Thornapple Tr. 9/9/2011 STATION NW-2		Muskegon River 0.3 mi u/s Milliron Rd. boat launch 9/8/2011 STATION NW-3		N B Muskegon River u/s Muskegon L. mouth 6/29/2011 STATION NW-4	
TOTAL ABUNDANCETOTAL ABUNDANCE	706		624		686		448	
TOTAL RICHNESS	25		32		23		19	
NUMBER OF EPHEMEROPTERA FAMILIES	5		6		3		3	
NUMBER OF PLECOPTERA FAMILIES	1		1		0		1	
NUMBER OF TRICHOPTERA FAMILIES	4		4		3		4	
NUMBER OF DIPTERA TAXA	3		5		4		1	
TRICHOPTERA ABUNDANCE	9		6		33		16	
ABUNDANCE OF DOMINANT TAXON	475		183		237		236	
SHREDDER ABUNDANCE	61		100		229		251	
SCRAPER ABUNDANCE	66		12		13		86	
COLL-FILTERER ABUNDANCE	37		38		46		3	
COLL-GATH ABUNDANCE	502		388		300		89	
PREDATOR ABUNDANCE	40		86		98		19	

Metric Calculations (possible points)	**Metric Score**			
FFG Diversity (25)	16	16	25	16
Habitat Stability FFG Surrogate (25)	8	8	8	8
% Trichoptera (20)	0	0	14	14
EPT Richness (8)	8	8	3	6
Total Richness (7)	7	7	5	5
Diptera Richness (5)	2	4	4	0
Plecoptera Richness (5)	2	2	0	2
% Dominance (5)	0	5	5	2
TOTAL SCORE:	43	50	64	53
Rating:	MARGINAL	MARGINAL	GOOD	GOOD

Table 4A (cont'd). Qualitative macroinvertebrate sampling results for nonwadeable sites in the Muskegon River Watershed, 2011.

TAXA	S B Muskegon River Teldyne 6/30/2011 STATION NW-5
PLATYHELMINTHES (flatworms)	
Turbellaria	2
ANNELIDA (segmented worms)	
Hirudinea (leeches)	1
Oligochaeta (worms)	13
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	336
Decapoda (crayfish)	1
Isopoda (sowbugs)	31
Arachnoidea	
Hydracarina	9
Insecta	
Ephemeroptera (mayflies)	
Baetidae	7
Caenidae	3
Heptageniidae	27
Isonychiidae	1
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	2
Zygoptera (damselflies)	
Calopterygidae	1
Coenagrionidae	2
Plecoptera (stoneflies)	
Perlidae	54
Hemiptera (true bugs)	
Corixidae	4
Gerridae	2
Mesoveliidae	8
Nepidae	1
Pleidae	3
Trichoptera (caddisflies)	
Brachycentridae	63
Hydropsychidae	17
Polycentropodidae	3
Coleoptera (beetles)	
Elmidae (total)	1
Diptera (flies)	
Ceratopogonidae	1
Chironomidae	19
Simuliidae	6
Stratiomyidae	1
MOLLUSCA	
Gastropoda (snails)	
Hydrobiidae	5
Lymnaeidae	1
Physidae	18
Pelecypoda (bivalves)	
Sphaeriidae (fingernail clams)	11

Table 4B (cont'd). Macroinvertebrate community metric evaluation for nonwadeable sites in the Muskegon River Watershed, 2011.

METRIC	S B Muskegon River Teldyne 6/30/2011 STATION NW-5							
TOTAL ABUNDANCETOTAL ABUNDANCE	654							
TOTAL RICHNESS	32							
NUMBER OF EPHEMEROPTERA FAMILIES	4							
NUMBER OF PLECOPTERA FAMILIES	1							
NUMBER OF TRICHOPTERA FAMILIES	3							
NUMBER OF DIPTERA TAXA	4							
TRICHOPTERA ABUNDANCE	83							
ABUNDANCE OF DOMINANT TAXON	336							
SHREDDER ABUNDANCE	367							
SCRAPER ABUNDANCE	51							
COLL-FILTERER ABUNDANCE	98							
COLL-GATH ABUNDANCE	51							
PREDATOR ABUNDANCE	87							

Metric Calculations (possible points)	**Metric Score**
FFG Diversity (25)	25
Habitat Stability FFG Surrogate (25)	8
% Trichoptera (20)	20
EPT Richness (8)	6
Total Richness (7)	7
Diptera Richness (5)	4
Plecoptera Richness (5)	2
% Dominance (5)	2
TOTAL SCORE:	74
Rating:	GOOD