

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

A BIOLOGICAL SURVEY OF THE TITTABAWASSEE RIVER BASIN
INCLUDING THE TITTABAWASSEE, CHIPPEWA, AND PINE RIVERS
AND SELECTED TRIBUTARIES
CLARE, GLADWIN, GRATIOT, ISABELLA, MECOSTA, MIDLAND, MONTCALM,
OGEMAW, AND SAGINAW COUNTIES
JUNE 2012

Qualitative biological sampling of the Tittabawassee River watershed was conducted by staff of the Surface Water Assessment Section (SWAS) in June 2012, as part of a five-year watershed monitoring cycle. Surveys were conducted on all major tributaries (Tittabawassee, Pine, and Chippewa Rivers) of the watershed (Figure 1). This is a vast watershed that falls within the Southern Michigan Northern Indiana Till Plain (SMNITP), Huron and Lake Erie Till Plain (HELP), and Northern Lakes and Forests (NLAF) ecoregions (Omernik and Gallant, 1988). Land use is predominantly agriculture and forested with portions also being urban. The Tittabawassee River is a major tributary to the Saginaw River/Bay ecosystem.

OBJECTIVES

This biological survey was conducted to:

- Assess the current status condition of individual waters to determine attainment of Michigan Water Quality Standards (WQS).
- Evaluate potential impacts from National Pollutant Discharge Elimination System (NPDES)-regulated sources to water quality in the watersheds.
- Identify potential nonpoint sources (NPS) of water quality impairment.
- Satisfy monitoring requests submitted by internal and external customers.

The surveyed locations are illustrated in Figure 1 and Table 1.

WATERSHED DESCRIPTION

The Tittabawassee River watershed drains approximately 2,100 square miles in east central Michigan and is the largest tributary to the Saginaw River; Michigan's largest river basin (Creal and Johnson, 1980). This watershed is comprised of three primary subwatersheds: the Tittabawassee, Chippewa, and Pine Rivers. The Pine River is tributary to the Chippewa River, which joins the Tittabawassee River near Midland.

The Tittabawassee River subwatershed lies within the NLAF, SMNITP, and HELP ecoregions (Omernik and Gallant, 1988). The Tittabawassee River contains four sizeable impoundments including impoundments on the Tobacco, Cedar, and Sugar Rivers. Approximately 44 percent of land use in the Tittabawassee River subwatershed is classified as agricultural and contains

miles of channelized waterways. The Tittabawassee River basin, exclusive of the Chippewa/Pine subwatershed, drains approximately 1,446 square miles in seven counties.

The Chippewa River and Pine River subwatersheds lie within the SMNITP and HELP ecoregions (Omernik and Gallant, 1988). Approximately 53 percent and 79 percent of the Chippewa and Pine Rivers subwatersheds, respectively, are used for agricultural production and there are many tributary miles that have been channelized to support agricultural drainage. The Chippewa River subwatershed, exclusive of the Pine River subwatershed, drains approximately 605 square miles in five counties. The Pine River subwatershed is approximately 60 miles long and drains approximately 420 square miles in five counties.

HISTORY

Previous water quality and biological surveys in the Chippewa River subwatershed have reported good conditions in the headwaters, but impairment from storm water and industrial waste from the city of Mt. Pleasant downstream. Nutrient loading from the North Branch Chippewa River (NBCR) has also been noted in previous surveys (Morse, 1994). The NBCR has been highly modified (straightened, dredged, and defoliated) to facilitate agricultural drainage in many areas.

Previous studies in the Pine River subwatershed found severely degraded water quality in the lower reaches of the river from the communities of Alma and St. Louis to the confluence with the Chippewa River (Walker, 2012). While the upper reaches and headwaters of the Pine River support good water quality, the lower reaches remain on the 2010 Clean Water Act Section 303(d) list (LeSage and Smith, 2010) due to mercury found in the water column and restrictions on fish consumption due to PCB contamination.

In 2002, biological surveys were conducted at 19 sites in the Chippewa River, and 15 sites in the Pine River, subwatersheds. In total, only one location was rated as having a poor macroinvertebrate community; the remaining locations were rated as having acceptable to excellent macroinvertebrate communities.

Previous studies (1997 and 2007) on the Tittabawassee River showed similar patterns in macroinvertebrate community assessments where a majority of sites were rated as excellent or acceptable. Of the 32 sites surveyed in the 1997 study (including the Pine and Chippewa Rivers subwatersheds), none were rated as having a poor macroinvertebrate community. Results for the 2007 biological survey of the Tittabawassee River watershed (including the Pine and Chippewa Rivers subwatersheds) showed 49 of the 52 surveyed sites supported an acceptable to excellent macroinvertebrate community. The three locations that were rated as poor were located in and near the city of Midland and had highly modified stream channels.

METHODS

Qualitative macroinvertebrate and habitat surveys were performed according to the SWAS Procedure 51 (MDEQ, 1990; Creal et al., 1996). Site selection was made based on the need to gather information on a watershed-wide basis to determine attainment of WQS, identify NPS of water quality impairment, provide information for review of the NPDES permits, and to satisfy outside monitoring requests, where possible. Fourteen sampling locations were randomly selected from a pool of valley segment types represented within the Tittabawassee River watershed to satisfy status monitoring requirements. To develop long-term trend monitoring,

10 survey locations from the previous survey (2007) were also sampled in the current survey. In total, 23 locations were surveyed for status and trend monitoring (one location that was randomly selected, by chance, was also a trend site).

To satisfy targeted monitoring requests for specific concerns, additional locations were sampled. On the NBCR and Beal City Drain, Procedure 51 analysis and water chemistry samples were performed/collected at two locations. Water chemistry samples were also collected at two other locations on the NBCR. A separate site (Pony Creek at Rolland Road) outside of the planned locations was sampled for water chemistry based on in-the-field concerns.

In total, 28 sites were investigated for macroinvertebrates, habitat, and/or water chemistry in this study.

RESULTS

The locations of the biological sampling stations, habitat observations, and water samples are shown in Figure 1. Table 1 contains a summary of station locations and qualitative ratings for the habitat and biological community for each station. Macroinvertebrate community, physical habitat, and water chemistry data are presented in Tables 2A and 2B; 3A and 3B; and 4, respectively.

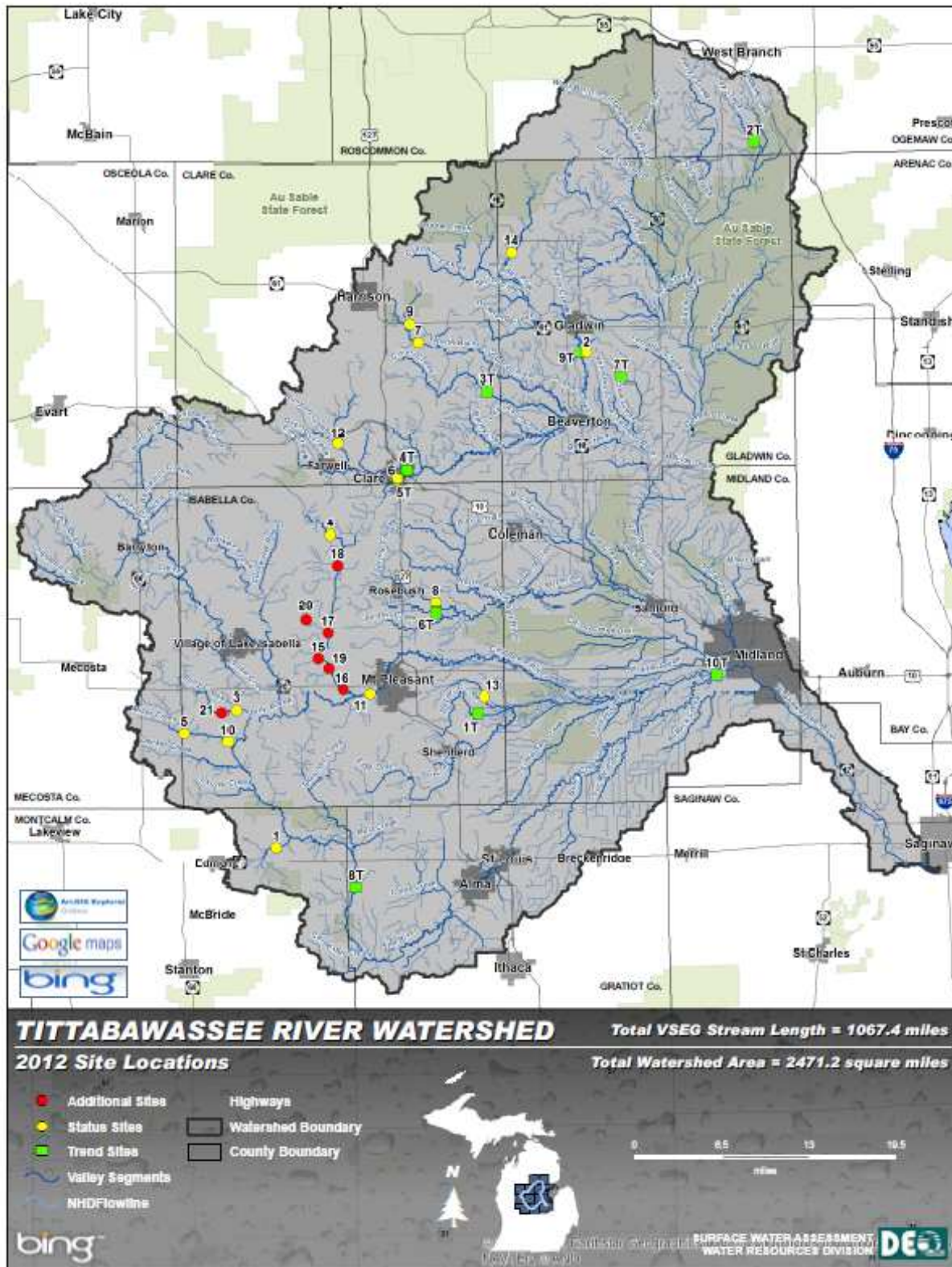


Figure 1. Map of survey sites for the 2012 Tittabawassee River watershed survey.

Status

The 2012 Tittabawassee River basin assessment included 14 randomly selected sites for probabilistic monitoring needs where Procedure 51 was conducted. All of the randomly selected sites rated as having acceptable to excellent macroinvertebrate communities. Canham Drain off River Road (Station 2; Figure 2) was rated as having poor habitat while the remaining random sites rated as having marginal to excellent habitat. Canham Drain is a small tributary to the Cedar River near Gladwin, Michigan. Canham Drain appeared to have been dredged and channelized a number of years ago but lack of flowing water appears to be the biggest habitat concern.

An interesting situation was found while evaluating a site on Pony Creek near the village of Lake Isabella where the stream crosses Brinton Road. Upon arrival at the site, cattle were observed entering and crossing the stream (Figure 3). Further investigation revealed that cattle had full access to Pony Creek at this location, as the stream was flowing through the middle of a cattle pasture. District staff worked with Department of Agriculture and Rural Development staff to collaborate with the landowner to resolve the issue. Water chemistry samples were collected both at the station and one mile upstream off Rolland Road (Table 4). The macroinvertebrate community for this station scored excellent while habitat was rated as being marginal (Table 1).



Figure 2. Canham Drain at River Road (Station 2).

Trend

For this study, ten sites from the 2007 survey were revisited for trend analysis.

Of the ten trend sites, all were found to have acceptable to excellent macroinvertebrates except for Vernon City Creek (Station 5T; Figure 4), which rated poor. Vernon City Creek lies within the city limits of Clare, and has undergone heavy habitat alterations (channelization/straightening, dredging, riparian removal). This site was surveyed following a rain event



Figure 3. Cattle Crossing in Pony Creek (Station 3).

and petroleum sheen/odor was observed throughout. Overall quality of this stream was quite dismal and habitat was rated as being marginal. Instream substrate observed in the stream, however, was depauperate of macroinvertebrates. This site was visited during the 2007 survey where it had scored on the low end of acceptable.



Figure 4. Vernon City Creek in the city of Clare, Michigan (Station 5T).

Other than the Vernon City Creek trend site, the remaining trend locations had similar scores between the 2007 and 2012 sampling. Two sites were rated as having excellent macroinvertebrate communities versus acceptable communities in the previous study. However, it should be noted that these differences were subtle when looking at the numerical points on the rating scale. With only two sampling events, it is premature to make any determination about long-term trends at these sites. Future studies will provide a much better understanding of trends within the watershed.

Targeted

The NBCR was the focus of additional monitoring due to suspected illicit septic discharges resulting in elevated nutrient conditions. Concerns from a local watershed monitoring organization prompted further investigation into the suspected issues. Two additional surveys were conducted on the NBCR and found acceptable macroinvertebrate communities at both sites. Results from water chemistry sampling are discussed below.

Water Chemistry

Samples were collected at three locations on the NBCR and a single sample was taken from Beal City Drain (a tributary to the NBCR). Based on concerns from local stakeholders of nutrient and *E. coli* additions through suspected illicit discharges within the vicinity of Beal City, SWAS staff collected nutrient samples above and below the confluence of Beal City Drain with the NBCR. Overall concentrations of phosphorus increased from upstream to downstream in the NBCR with Beal City Drain having the lowest observed values. Total Kjeldahl Nitrogen was similar among all NBCR sites and was observed to be lower in Beal City Drain. Results can be found in Table 4. A more comprehensive study (including wet weather sampling) would be needed to accurately address the concerns of local stakeholders.

Water chemistry samples were also collected at two locations on Pony Creek at the location where cattle were observed entering the stream and upstream approximately one mile off Rolland Road. Both Total Phosphorus and Total Kjeldahl Nitrogen were higher upstream of the cattle crossing while Nitrate + Nitrite were higher below the cattle crossing (Table 4).

NPS Sampling

Follow-up/post-implementation monitoring for a cattle exclusion project on a Sugar River tributary was planned for this study, but due to landowner availability and staff sampling time, this site visited, but not sampled. Cattle were not observed in the water body by SWAS staff while adjacent to the location. This site should be investigated in future studies for post-exclusion monitoring.

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Table 1.

STATION	STORET	SITE NAME	LOCATION	LATITUDE	LONGITUDE	MACROS	HABITAT	WATER CHEMISTRY
1	590348	Wolf Creek	Pine Grove Road	43.42304	-84.95026	Excellent	Excellent	
2	260140	Canham Drain	River Road	43.95196	-84.47676	Acceptable	Poor	
3	370142	Pony Creek	Brinton Road	43.57235	-85.0065	Excellent	Marginal	x
4	370143	North Branch Chippewa River	Glass Road	43.75982	-84.8636	Excellent	Excellent	
5	370144	Pine River	Chapman Road	43.54772	-85.08267	Acceptable	Good	
7	180001	North Branch Tobacco River	Cornwell Road	43.96723	-84.727782	Excellent	Excellent	
8	370145	Spring Creek	Leaton Road	43.68593	-84.70792	Acceptable	Marginal	
9	180188	Mostellar Creek	M-61	43.98711	-84.74039	Excellent	Excellent	
10	370146	Pine River	Walton Road	43.53823	-85.01846	Acceptable	Good	
11	370147	Chippewa River	Lincoln Road	43.58782	-84.80756	Excellent	Good	
12	180189	Newton Creek	Surrey Road	43.85764	-84.85015	Excellent	Good	
13	370148	Onion Creek	Broomfield Road	43.58267	-84.638	Acceptable	Good	
14	260141	North Branch Cedar River	Bard Road	44.06271	-84.58599	Excellent	Good	
17	370149	North Branch Chippewa River	Jordan Road	43.65461	-84.868648	Acceptable	Good	x
18	370150	North Branch Chippewa River	Vernon Road	43.72718	-84.853235	Acceptable	Marginal	x
19	370095	North Branch Chippewa River	Nottawa Road	43.61616	-84.86804			x
20		Beal City Drain	Beal City Road	43.66922	-84.90105			x
21		Pony Creek	Rolland Road	43.5695	-85.0261			x
1T	370125	Potter Creek	Downstream Wise Road	43.56527	-84.64774	Acceptable	Good	
2T	650111	Lake George Outlet	Upstream Greenwood Road	44.17619	-84.21976	Excellent	Good	
3T	180172	Middle Branch Tobacco River	Upstream Hoover Road	43.91223	-84.62653	Excellent	Excellent	
4T	180171	South Branch Tobacco	Eberhart Avenue	43.82917	-84.74816	Excellent	Good	
5T	180170	Vernon City Creek	6th Street	43.82037	-84.76207	Poor	Marginal	
6T	370132	Lewis Drain	Upstream Leaton Road	43.67425	-84.70823	Acceptable	Marginal	
7T	260122	Pete Drain	Upstream Hockaday Road	43.92446	-84.42602	Acceptable	Good	
8T	290186	Pine River	Lincoln Road (Montcalm Road)	43.3791	-84.8328	Excellent	Good	
9T	260123	Cedar River	End of Woods Road East side on 2 Track	43.95193	-84.48535	Excellent	Excellent	
10T	560208	Chippewa River	Chippewa Nature Center	43.60246	-84.29224	Excellent	Excellent	

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012.

TAXA	Onion Creek Broomfield Rd 6/26/2012 STATION 13	Spring Creek Leaton Rd 6/14/2012 STATION 8	Pete Drain u/s Hockaday Rd 6/13/2012 STATION 7T	Chippewa River Chippewa Nature Center 6/26/2012 STATION 10T
PLATYHELMINTHES (flatworms)				
Turbellaria		54		
ANNELIDA (segmented worms)				
Hirudinea (leeches)		30		
Oligochaeta (worms)	5	37		4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	70		251	10
Decapoda (crayfish)	16	1		1
Isopoda (sowbugs)	11	73		
Arachnoidea				
Hydracarina	1	11	1	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae		1	20	55
Caenidae	1	1		2
Ephemerellidae				3
Heptageniidae				16
Isonychiidae				1
Potamanthidae				2
Tricorythidae	1			46
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	13	1	1	
Gomphidae	4			
Zygoptera (damselflies)				
Calopterygidae	9	1		1
Coenagrionidae	10	18		1
Plecoptera (stoneflies)				
Perlidae				1
Perlodidae				2
Pteronarcyidae				3
Hemiptera (true bugs)				
Corixidae	6	1		2
Gerridae	3			
Mesoveliidae			1	
Nepidae				1
Veliidae	2			
Megaloptera				
Sialidae (alder flies)				1
Trichoptera (caddisflies)				
Brachycentridae			10	56
Helicopsychidae				1
Hydropsychidae	3	1		22
Hydroptilidae		1		3
Leptoceridae			1	14
Limnephilidae	8		3	1
Philopotamidae				1
Polycentropodidae				10
Uenoidae			1	1
Coleoptera (beetles)				
Dytiscidae (total)		1		
Gyrinidae (adults)			1	1
Haliplidae (adults)		1		
Hydrophilidae (total)	1		1	1
Dryopidae		3		
Elmidae	123	20		21
Psephenidae (larvae)				1
Diptera (flies)				
Chironomidae	12	91	81	6
Simuliidae		1	1	
Stratiomyidae	1			

Syrphidae	2			
Tipulidae		1	7	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			
Hydrobiidae	1			
Physidae	10	1	1	41
Pleuroceridae				1
Viviparidae	3			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	31	1		1
Unionidae (mussels)				1
TOTAL INDIVIDUALS	348	351	381	336

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012

METRIC	Onion Creek Broomfield Rd 6/26/2012 STATION 13		Spring Creek Leaton Rd 6/14/2012 STATION 8		Pete Drain u/s Hockaday Rd 6/13/2012 STATION 7T		Chippewa River Chippewa Nature Center 6/26/2012 STATION 10T	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	26	1	23	0	15	1	37	1
NUMBER OF MAYFLY TAXA	2	1	2	0	1	1	7	1
NUMBER OF CADDISFLY TAXA	2	1	2	0	4	1	9	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	3	1
PERCENT MAYFLY COMP.	0.57	-1	0.57	-1	5.25	-1	37.20	1
PERCENT CADDISFLY COMP.	3.16	0	0.57	-1	3.94	0	32.44	1
PERCENT DOMINANT TAXON	35.34	-1	25.93	-1	65.88	-1	16.67	0
PERCENT ISOPOD, SNAIL, LEECH	7.47	0	29.63	-1	0.26	1	12.50	0
PERCENT SURF. AIR BREATHERS	4.31	1	0.85	1	0.79	1	1.49	1
TOTAL SCORE		1		-4		2		7
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		EXCELLENT

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012 .

TAXA	Potter Creek d/s Wise Rd 6/26/2012 STATION 1T
ANNELIDA (segmented worms)	
Oligochaeta (worms)	8
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	177
Decapoda (crayfish)	14
Isopoda (sowbugs)	1
Insecta	
Ephemeroptera (mayflies)	
Baetidae	1
Ephemerellidae	1
Heptageniidae	1
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	1
Zygoptera (damselflies)	
Calopterygidae	2
Coenagrionidae	1
Hemiptera (true bugs)	
Corixidae	27
Gerridae	1
Veliidae	3
Trichoptera (caddisflies)	
Hydropsychidae	1
Limnephilidae	2
Coleoptera (beetles)	
Elmidae	26
Diptera (flies)	
Chironomidae	52
MOLLUSCA	
Gastropoda (snails)	
Hydrobiidae	1
Physidae	5
Viviparidae	1
Pelecypoda (bivalves)	
Sphaeriidae (clams)	15
TOTAL INDIVIDUALS	341

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012

Potter Creek

d/s Wise Rd

6/26/2012

STATION 1T

METRIC	Value	Score			
TOTAL NUMBER OF TAXA	21	0			
NUMBER OF MAYFLY TAXA	3	1			
NUMBER OF CADDISFLY TAXA	2	0			
NUMBER OF STONEFLY TAXA	0	-1			
PERCENT MAYFLY COMP.	0.88	-1			
PERCENT CADDISFLY COMP.	0.88	-1			
PERCENT DOMINANT TAXON	51.91	-1			
PERCENT ISOPOD, SNAIL, LEECH	2.35	1			
PERCENT SURF. AIR BREATHERS	9.09	1			
TOTAL SCORE		-1			
MACROINV. COMMUNITY RATING	ACCEPT.	ACCEPT.	ACCEPT.	ACCEPT.	ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012.

TAXA	Mostellar Creek M-61 6/20/2012 STATION 9	N B Tobacco River Cornwell Rd 6/20/2012 STATION 7	N B Cedar River Bard Rd 6/20/2012 STATION 14	Canham Drain River Rd 6/13/2012 STATION 2
ANNELIDA (segmented worms)				
Hirudinea (leeches)				3
Oligochaeta (worms)	3	3	9	68
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	55	14	15	
Decapoda (crayfish)			1	2
Isopoda (sowbugs)	1			7
Arachnoidea				
Hydracarina		4	1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	2	33	16	4
Caenidae		5	13	
Ephemerellidae	18	3	7	
Ephemeridae	7	1		
Heptageniidae	25	2	36	
Isonychiidae			2	
Tricorythidae	58			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae			1	2
Cordulegastridae	3	1	1	
Gomphidae				1
Libellulidae				6
Zygoptera (damselflies)				
Calopterygidae	2		3	
Plecoptera (stoneflies)				
Chloroperlidae			9	
Perlidae	2	6	11	
Perlodidae		1		
Taeniopterygidae				3
Hemiptera (true bugs)				
Gerridae				4
Mesoveliidae		1		
Megaloptera				
Corydalidae (dobson flies)	3	2	2	
Trichoptera (caddisflies)				
Brachycentridae	1	37	45	1
Glossosomatidae	2	39	1	
Helicopsychidae	1			
Hydropsychidae	2	49	9	
Hydroptilidae	1	2		
Lepidostomatidae	19	16	1	
Leptoceridae	7	1	14	
Limnephilidae	2	1	1	10
Philopotamidae	1	4	1	
Phryganeidae	1			
Polycentropodidae	1	3	1	
Uenoidae	3	1		
Coleoptera (beetles)				
Dytiscidae (total)	1			
Gyrinidae (adults)			1	1
Hydrophilidae (total)		1	4	1
Dryopidae				1
Elmidae	21	52	15	
Diptera (flies)				
Athericidae		3	1	
Ceratopogonidae			1	1
Chironomidae	12	55	32	76
Dixidae				1
Simuliidae	1	16	2	1

Tabanidae	1		1	1
Tipulidae		2	4	1
MOLLUSCA				
Gastropoda (snails)				
Lymnaeidae				1
Physidae		1		15
Planorbidae				4
Pelecypoda (bivalves)				
Sphaeriidae (clams)				16
<hr/> <hr/> TOTAL INDIVIDUALS	256	359	261	231

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012

METRIC	Mostellar Creek		N B Tobacco River		N B Cedar River		Canham Drain	
	M-61		Cornwell Rd		Bard Rd		River Rd	
	6/20/2012		6/20/2012		6/20/2012		6/13/2012	
	STATION 9		STATION 7		STATION 14		STATION 2	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	29	1	30	1	32	1	25	1
NUMBER OF MAYFLY TAXA	5	1	5	1	5	1	1	-1
NUMBER OF CADDISFLY TAXA	12	1	10	1	8	1	2	-1
NUMBER OF STONEFLY TAXA	1	0	2	1	2	1	1	1
PERCENT MAYFLY COMP.	42.97	1	12.26	0	28.35	1	1.73	-1
PERCENT CADDISFLY COMP.	16.02	0	42.62	1	27.97	0	4.76	0
PERCENT DOMINANT TAXON	22.66	0	15.32	1	17.24	0	32.90	-1
PERCENT ISOPOD, SNAIL, LEECH	0.39	1	0.28	1	0.00	1	12.99	0
PERCENT SURF. AIR BREATHERS	0.39	1	0.56	1	1.92	1	2.60	1
TOTAL SCORE		6		8		7		-1
MACROINV. COMMUNITY RATING		EXCELLENT		EXCELLENT		EXCELLENT		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012 .

TAXA	W B Tittabawassee River	N B Chippewa River	N B Chippewa River	N B Chippewa River
	u/s Fitzwater Rd 6/20/2012 Min. Impact site	Glass Rd 6/27/2012 STATION 4	Jordan Rd 6/27/2012 STATION 17	Veron Rd 6/26/2012 STATION 18
PORIFERA (sponges)		1		
PLATYHELMINTHES (flatworms)				
Turbellaria		22	8	
ANNELIDA (segmented worms)				
Oligochaeta (worms)	27	4	17	12
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	25	28	50	41
Decapoda (crayfish)				6
Isopoda (sowbugs)			18	3
Arachnoidea				
Hydracarina	3		6	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	47	14	56	2
Caenidae	6	6		5
Ephemerellidae	21			
Heptageniidae	10			1
Isonychiidae	1	1		
Leptophlebiidae				2
Tricorythidae		1		9
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	1		2
Gomphidae				1
Zygoptera (damselflies)				
Calopterygidae	1	1	1	2
Coenagrionidae		5	3	34
Plecoptera (stoneflies)				
Perlidae	1	1		
Perlodidae	6			1
Pteronarcyidae	1			
Hemiptera (true bugs)				
Corixidae			5	2
Gerridae	1	3	1	2
Veliidae		4		3
Megaloptera				
Corydalidae (dobson flies)	1			
Sialidae (alder flies)		1		
Trichoptera (caddisflies)				
Brachycentridae	10			
Helicopsychidae		3		
Hydropsychidae	2	28	14	1
Hydroptilidae			4	1
Leptoceridae	2	18	2	2
Limnephilidae		1	1	1
Philopotamidae		14		
Uenoidae		2		
Coleoptera (beetles)				
Dytiscidae (total)		1		
Gyrinidae (adults)	1		1	
Haliplidae (adults)		2		
Hydrophilidae (total)		11	2	4
Dryopidae	3			
Elmidae	15	26	32	125
Haliplidae (larvae)		1	1	
Diptera (flies)				
Athericidae	3			
Ceratopogonidae		3		
Chironomidae	41	57	64	13
Culicidae			1	3
Dixidae			1	

Simuliidae	36	7	35	
Tipulidae		1		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			
Hydrobiidae			11	
Physidae		7	20	4
Planorbidae		3		
Viviparidae				3
Pelecypoda (bivalves)				
Sphaeriidae (clams)		144	6	
TOTAL INDIVIDUALS	266	422	360	286

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012

METRIC	W B Tittabawassee River u/s Fitzwater Rd 6/20/2012 Min. Impact site		N B Chippewa River Glass Rd 6/27/2012 STATION 4		N B Chippewa River Jordan Rd 6/27/2012 STATION 17		N B Chippewa River Veron Rd 6/26/2012 STATION 18	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	25	1	32	1	25	1	28
NUMBER OF MAYFLY TAXA	5	1	4	1	1	-1	5	1
NUMBER OF CADDISFLY TAXA	3	0	6	1	4	0	4	0
NUMBER OF STONEFLY TAXA	3	1	1	1	0	-1	1	1
PERCENT MAYFLY COMP.	31.95	1	5.21	0	15.56	0	6.64	0
PERCENT CADDISFLY COMP.	5.26	0	15.64	0	5.83	0	1.75	-1
PERCENT DOMINANT TAXON	17.67	1	34.12	0	17.78	1	43.71	-1
PERCENT ISOPOD, SNAIL, LEECH	0.38	1	2.37	1	13.61	-1	3.50	1
PERCENT SURF. AIR BREATHERS	0.75	1	4.98	1	2.78	1	4.90	1
TOTAL SCORE		7		6		0		3
MACROINV. COMMUNITY RATING		EXCELLENT		EXCELLENT		ACCEPT.		ACCEPT.

Table 3. Habitat evaluation for the Tittabawassee River watershed, June 2012.

	Pine River Walton Rd	Pine River Chapman Rd	Pine River Lincoln Rd (Montcalm Rd)	Cedar River End of Woods Rd East side on 2 Track	Lewis Drain u/s Leaton Rd
	GLIDE/POOL	RIFFLE/RUN	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	5	15	10	15	7
Embeddedness (20)*		16			10
Velocity/Depth Regime (20)*		12			11
Pool Substrate Characterization (20)**	6		13	15	
Pool Variability (20)**	5		15	14	
Channel Morphology					
Sediment Deposition (20)	5	13	13	13	6
Flow Status - Maint. Flow Volume (10)	9	9	8	9	9
Flow Status - Flashiness (10)	9	4	6	6	2
Channel Alteration (20)	16	15	18	16	8
Frequency of Riffles/Bends (20)*		16			6
Channel Sinuosity (20)**	14		12	18	
Riparian and Bank Structure					
Bank Stability (L) (10)	9	7	7	7	6
Bank Stability (R) (10)	9	7	7	7	6
Vegetative Protection (L) (10)	7	8	9	9	5
Vegetative Protection (R) (10)	8	8	9	9	7
Riparian Veg. Zone Width (L) (10)	6	6	9	9	3
Riparian Veg. Zone Width (R) (10)	8	8	9	9	5
TOTAL SCORE (200):	116	144	145	156	91
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	MARGINAL (MODERATELY 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:	6/12/2012	6/12/2012	6/26/2012	6/13/2012	6/14/2012
Weather:	Partly Cloudy	Partly Cloudy	Sunny	Partly Cloudy	Partly Cloudy
Air Temperature:	72 Deg. F.	76 Deg. F.	61 Deg. F.	70 Deg. F.	70 Deg. F.
Water Temperature:	74 Deg. F.	66 Deg. F.	63 Deg. F.	63 Deg. F.	60 Deg. F.
Ave. Stream Width:	30 Feet	12 Feet	51 Feet	45 Feet	6 Feet
Ave. Stream Depth:	1.5 Feet	0.5 Feet	1.5 Feet	1.5 Feet	0.5 Feet
Surface Velocity:	0.7 Ft./Sec.	1 Ft./Sec.	0.7 Ft./Sec.	1 Ft./Sec.	0.3 Ft./Sec.
Estimated Flow:	31.5 CFS	6 CFS	53.55 CFS	67.5 CFS	0.9 CFS
Stream Modifications:	None	Canopy Removal	None	None	Dredged/Canopy removal
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	370146	370144	290186	260123	370132
Stream Name:	Pine River	Pine River	Pine River	Cedar River	Lewis Drain
Road Crossing/Location:	Walton Rd	Chapman Rd	Lincoln Road (Montcalm Rd)	End of Woods Rd East side on 2 Track	u/s Leaton Rd
County Code:	37	37	29	26	37
TRS:	13N06W03	13N06W06	12N04W31	18N01W18	15N03W19
Latitude (dd):	43.53823	43.54772	43.3791	43.95193	43.67425
Longitude (dd):	-85.01846	-85.08267	-84.8328	-84.48535	-84.70823
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Coldwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080202	4080202	4080202	4080201	4080201

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012 .

TAXA	Lake George Outlet (E B Tittabawassee River) u/s Greenwood Rd 6/13/2012 STATION 2T	Pine River Walton Rd 6/12/2012 STATION 10	Pine River Chapman Rd 6/12/2012 STATION 5	Pine River Lincoln Rd (Montcalm Rd) 6/26/2012 STATION 8T
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1		
Oligochaeta (worms)	6	20	3	10
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	73	10	130	52
Decapoda (crayfish)	5	1	1	6
Isopoda (sowbugs)			3	
Arachnoidea				
Hydracarina		8		8
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae		1		1
Baetidae	26	15	14	5
Caenidae		7		3
Ephemerellidae	11		1	1
Ephemeridae	13	6		
Heptageniidae	7		8	22
Tricorythidae	5			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1	1	4
Cordulegastridae	1			
Corduliidae			1	
Gomphidae				2
Zygoptera (damselflies)				
Calopterygidae	1	1	2	9
Plecoptera (stoneflies)				
Perlidae	9	1	2	
Perlodidae				1
Pteronarcyidae				1
Hemiptera (true bugs)				
Corixidae		9	1	60
Gerridae	1			6
Pleidae		2		
Veliidae				3
Megaloptera				
Corydalidae (dobson flies)			1	
Sialidae (alder flies)			1	
Neuroptera (spongilla flies)				
Sisyridae			1	
Trichoptera (caddisflies)				
Brachycentridae	59	1	15	34
Glossosomatidae	1		11	
Helicopsychidae	3		1	15
Hydropsychidae	57		27	
Lepidostomatidae				1
Leptoceridae	17	1	3	4
Limnephilidae	1	1	1	2
Polycentropodidae	1			
Rhyacophilidae			1	
Uenoidae	1			12
Coleoptera (beetles)				
Haliplidae (adults)	1	2		
Hydrophilidae (total)				1
Dryopidae			1	
Elmidae	8	2	15	25
Psephenidae (larvae)	10			

Diptera (flies)				
Ceratopogonidae	1	1		
Chironomidae	36	53	69	25
Culicidae		1		
Simuliidae	3		18	
Tabanidae	1			
Tipulidae	4		3	2
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	2	1	1	3
Bithyniidae		237		
Hydrobiidae	5		1	2
Physidae	8	1	1	2
Planorbidae	2	1		
Pelecypoda (bivalves)				
Sphaeriidae (clams)	7	6	1	6
TOTAL INDIVIDUALS	388	391	339	328

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012.

METRIC	Lake George Outlet (E B u/s Greenwood Rd 6/13/2012 STATION 2T		Pine River Walton Rd 6/12/2012 STATION 10		Pine River Chapman Rd 6/12/2012 STATION 5		Pine River Lincoln Rd (Montcalm Rd) 6/26/2012 STATION 8T	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	34	1	27	1	31	1	31	1
NUMBER OF MAYFLY TAXA	5	1	4	1	3	0	5	1
NUMBER OF CADDISFLY TAXA	8	1	3	0	7	1	6	1
NUMBER OF STONEFLY TAXA	1	1	1	1	1	1	2	1
PERCENT MAYFLY COMP.	15.98	0	7.42	0	6.78	0	9.76	0
PERCENT CADDISFLY COMP.	36.08	1	0.77	-1	17.40	0	20.73	0
PERCENT DOMINANT TAXON	18.81	1	60.61	-1	38.35	-1	18.29	1
PERCENT ISOPOD, SNAIL, LEECH	4.38	0	61.64	-1	1.77	1	2.13	1
PERCENT SURF. AIR BREATHERS	0.52	1	3.58	1	0.29	1	21.34	-1
TOTAL SCORE		7		1		4		5
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		ACCEPT.		EXCELLEN

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012 .

TAXA	Cedar River	Lewis Drain	M B Tobacco River	S B Tobacco
	End of Woods Rd East side on 2 Track	Upstream Leaton Rd	Upstream Hoover Rd	Eberhart Ave (d/s of Rd)
	6/13/2012 STATION 9T	6/14/2012 STATION 6T	6/21/2012 STATION 3T	6/21/2012 STATION 4T
PORIFERA (sponges)			1	
PLATYHELMINTHES (flatworms)				
Turbellaria		4		
ANNELIDA (segmented worms)				
Oligochaeta (worms)	1	3	3	3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	21	5	14	1
Decapoda (crayfish)	1	10	1	1
Isopoda (sowbugs)	1	28		
Arachnoidea				
Hydracarina	2	5	1	6
Insecta				
Ephemeroptera (mayflies)				
Baetidae	6	4	11	1
Caenidae	1	2	1	2
Ephemerellidae	15		19	
Ephemeridae	1			
Heptageniidae	21	1	10	26
Isonychiidae	1			
Tricorythidae			4	1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	1	1	2
Gomphidae				1
Zygoptera (damselflies)				
Calopterygidae	2	1	1	
Coenagrionidae	1	2		2
Plecoptera (stoneflies)				
Perlidae	21		4	5
Pteronarcyidae	2			
Hemiptera (true bugs)				
Corixidae		1	1	
Gerridae			1	
Nepidae				1
Megaloptera				
Corydalidae (dobson flies)	1		1	
Sialidae (alder flies)			2	
Trichoptera (caddisflies)				
Brachycentridae	138		15	2
Glossosomatidae			1	1
Helicopsychidae	3	1	1	1
Hydropsychidae	37	2	25	140
Leptoceridae	5	1	5	20
Limnephilidae	2	1	1	
Philopotamidae				21
Polycentropodidae	4			
Coleoptera (beetles)				
Hydrophilidae (total)			1	
Dryopidae	1		2	
Elmidae	19	7	9	8
Gyrinidae (larvae)	1			
Haliplidae (larvae)		2		
Psephenidae (larvae)	3			
Diptera (flies)				
Athericidae	1		3	

Ceratopogonidae			1	2
Chironomidae	18	165	113	18
Simuliidae	1	1	7	4
Tipulidae	1		4	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1	1		3
Hydrobiidae	1			
Physidae	1	36	1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)		1	1	
Unionidae (mussels)				1
<hr/>				
TOTAL INDIVIDUALS	336	285	266	273

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012.

METRIC	Cedar River End of Woods Rd East side on 2 6/13/2012 STATION 9T		Lewis Drain u/s Leaton Rd 6/14/2012 STATION 6T		M B Tobacco River u/s Hoover Rd 6/21/2012 STATION 3T		S B Tobacco Eberhart Ave (d/s of Rd) 6/21/2012 STATION 4T	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	34	1	24	1	33	1	25
NUMBER OF MAYFLY TAXA	6	1	3	1	5	1	4	1
NUMBER OF CADDISFLY TAXA	6	1	4	1	6	1	6	1
NUMBER OF STONEFLY TAXA	2	1	0	-1	1	1	1	1
PERCENT MAYFLY COMP.	13.39	0	2.46	-1	16.92	0	10.99	0
PERCENT CADDISFLY COMP.	56.25	1	1.75	-1	18.05	0	67.77	1
PERCENT DOMINANT TAXON	41.07	-1	57.89	-1	42.48	-1	51.28	-1
PERCENT ISOPOD, SNAIL, LEECH	1.19	1	22.81	-1	0.38	1	1.10	1
PERCENT SURF. AIR BREATHERS	0.00	1	0.35	1	1.13	1	0.37	1
TOTAL SCORE		6		-1		5		6
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		EXCELLENT		EXCELLENT

Table 2A. Qualitative macroinvertebrate sampling results for Tittabawassee River watershed, June 2012 .

Vernon City Creek (Little Tobacco Joint Drain)
 6th Street (in Clare between Jackson & Hemlock)
 6/21/2012
 STATION 5T

TAXA	
ANNELIDA (segmented worms)	
Oligochaeta (worms)	12
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	140
Decapoda (crayfish)	1
Isopoda (sowbugs)	12
Insecta	
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	1
Zygoptera (damselflies)	
Calopterygidae	2
Coenagrionidae	1
Hemiptera (true bugs)	
Corixidae	1
Gerridae	1
Coleoptera (beetles)	
Haliplidae (adults)	1
Diptera (flies)	
Chironomidae	116
MOLLUSCA	
Gastropoda (snails)	
Physidae	7
TOTAL INDIVIDUALS	295

Table 2B. Macroinvertebrate metric evaluation of the Tittabawassee River watershed, June 2012.

Vernon City Creek (Little Tobacco Joint Drain)
 6th Street (in Clare between Jackson & Hemlock)
 6/21/2012
 STATION 5T

METRIC	Value	Score			
TOTAL NUMBER OF TAXA	12	0			
NUMBER OF MAYFLY TAXA	0	-1			
NUMBER OF CADDISFLY TAXA	0	-1			
NUMBER OF STONEFLY TAXA	0	-1			
PERCENT MAYFLY COMP.	0.00	-1			
PERCENT CADDISFLY COMP.	0.00	-1			
PERCENT DOMINANT TAXON	47.46	-1			
PERCENT ISOPOD, SNAIL, LEECH	6.44	0			
PERCENT SURF. AIR BREATHERS	1.02	1			
TOTAL SCORE		-5			
MACROINV. COMMUNITY RATING		POOR	ACCEPT.	ACCEPT.	ACCEPT.

Table 3. Habitat evaluation for the Tittabawassee River watershed, June 2012.

	Onion Creek Broomfield Rd GLIDE/POOL	Spring Creek Leaton Rd RIFFLE/RUN	Pete Drain Upstream Hockaday Road GLIDE/POOL	Chippewa River Chippewa Nature Center RIFFLE/RUN	Potter Creek Downstream Wise Road GLIDE/POOL
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	11	7	10	16	9
Embeddedness (20)*		10		17	
Velocity/Depth Regime (20)*		10		17	
Pool Substrate Characterization (20)**	13		10		7
Pool Variability (20)**	17		10		11
Channel Morphology					
Sediment Deposition (20)	15	5	13	18	16
Flow Status - Maint. Flow Volume (10)	8	8	8	9	8
Flow Status - Flashiness (10)	4	1	6	9	4
Channel Alteration (20)	10	10	10	19	11
Frequency of Riffles/Bends (20)*		5		17	
Channel Sinuosity (20)**	18		7		16
Riparian and Bank Structure					
Bank Stability (L) (10)	8	6	9	8	9
Bank Stability (R) (10)	8	6	9	8	9
Vegetative Protection (L) (10)	9	6	9	9	8
Vegetative Protection (R) (10)	6	6	9	9	8
Riparian Veg. Zone Width (L) (10)	9	5	9	10	5
Riparian Veg. Zone Width (R) (10)	8	5	9	7	4
TOTAL SCORE (200):	144	90	128	173	125

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at th

Date:	6/26/2012	6/14/2012	6/13/2012	6/26/2012	6/26/2012
Weather:	Sunny	Partly Cloudy	Partly Cloudy	Sunny	Sunny
Air Temperature:	81 Deg. F.	70 Deg. F.	65 Deg. F.	74 Deg. F.	83 Deg. F.
Water Temperature:	72 Deg. F.	58 Deg. F.	58 Deg. F.	67 Deg. F.	67 Deg. F.
Ave. Stream Width:	6.5 Feet	15 Feet	5 Feet	150 Feet	13 Feet
Ave. Stream Depth:	0.5 Feet	0.7 Feet	0.5 Feet	1.5 Feet	0.7 Feet
Surface Velocity:	0.7 Ft./Sec.	0.5 Ft./Sec.	0.5 Ft./Sec.	1.3 Ft./Sec.	0.3 Ft./Sec.
Estimated Flow:	2.275 CFS	5.25 CFS	1.25 CFS	292.5 CFS	2.73 CFS
Stream Modifications:	emoval/Dredged	Dredged	Dredged	None	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	370148	370145	260122	560208	370125
Stream Name:	Onion Creek	Spring Creek	Pete Drain	Chippewa River	Potter Creek
Road Crossing/Location:	Broomfield Rd	Leaton Rd	Upstream Hockaday Road	Chippewa Nature Center	Downstream Wise Road
County Code:	37	37	26	56	37
TRS:	14N03W23	15N03W18	18N01W28	14N01E24	14N03W35
Latitude (dd):	43.58267	43.68593	43.92446	43.60246	43.56527
Longitude (dd):	-84.638	-84.70792	-84.42602	-84.29224	-84.64774
Ecoregion:	HELP	HELP	HELP	HELP	HELP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080202	4080201	4080201	4080202	4080202

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3. Habitat evaluation for the Tittabawassee River watershed, June 2012.

	Mostellar Creek M-61 RIFFLE/RUN	N B Tobacco River Cornwell Rd RIFFLE/RUN	N B Cedar River Bard Rd RIFFLE/RUN	Canham Drain River Rd GLIDE/POOL	
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	16	17	16	5	
Embeddedness (20)*	18	17	16		
Velocity/Depth Regime (20)*	18	15	17		
Pool Substrate Characterization (20)**				6	
Pool Variability (20)**				5	
Channel Morphology					
Sediment Deposition (20)	15	16	15	5	
Flow Status - Maint. Flow Volume (10)	9	9	9	7	
Flow Status - Flashiness (10)	9	9	8	3	
Channel Alteration (20)	19	19	16	8	
Frequency of Riffles/Bends (20)*	13	19	10		
Channel Sinuosity (20)**				1	
Riparian and Bank Structure					
Bank Stability (L) (10)	10	10	9	6	
Bank Stability (R) (10)	10	10	9	6	
Vegetative Protection (L) (10)	9	8	2	8	
Vegetative Protection (R) (10)	9	9	9	8	
Riparian Veg. Zone Width (L) (10)	9	9	2	5	
Riparian Veg. Zone Width (R) (10)	9	9	9	3	
TOTAL SCORE (200):	173	176	147	76	0
HABITAT RATING:	EXCELLENT (NON- IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	POOR (SEVERELY 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).

	6/20/2012	6/20/2012	6/20/2012	6/13/2012	
Date:	6/20/2012	6/20/2012	6/20/2012	6/13/2012	
Weather:	Partly Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy	
Air Temperature:	92 Deg. F.	92 Deg. F.	82 Deg. F.	Deg. F.	Deg. F.
Water Temperature:	68 Deg. F.	65 Deg. F.	66 Deg. F.	Deg. F.	Deg. F.
Ave. Stream Width:	12 Feet	18 Feet	18 Feet	6 Feet	Feet
Ave. Stream Depth:	0.5 Feet	0.8 Feet	1 Feet	0.5 Feet	Feet
Surface Velocity:	1 Ft./Sec.	1.2 Ft./Sec.	1.5 Ft./Sec.	0.2 Ft./Sec.	Ft./Sec.
Estimated Flow:	6 CFS	17.28 CFS	27 CFS	0.6 CFS	CFS
Stream Modifications:	None	None	Canopy Removal	Dredged	
Nuisance Plants (Y/N):	N	N	N	N	
Report Number:					
STORET No.:	180188	180001	260141	260140	
Stream Name:	Mostellar Creek	N B Tobacco River	N B Cedar River	Canham Drain	
Road Crossing/Location:	M61	Cornwell Rd	Bard Rd	River Rd	
County Code:	18	18	26	26	
TRS:	18N04W1	18N04W12	19N02W05	18N01W18	
Latitude (dd):	43.98711	43.967227	44.06271	43.95196	
Longitude (dd):	-84.74039	-84.727782	-84.58599	-84.47676	
Ecoregion:	NLAF	NLAF	NLAF	NLAF	
Stream Type:	Coldwater	Coldwater	Coldwater	Warmwater	
USGS Basin Code:	4080201	4080201	4080201	4080201	

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

	W B Tittabawasee Upstream Fitzwater Road RIFFLE/RUN	N B Chippewa River Glass Rd RIFFLE/RUN	N B Chippewa River Jordan Rd GLIDE/POOL	N B Chippewa River Veron Rd GLIDE/POOL	Chippewa River Lincoln Rd GLIDE/POOL
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	12	15	8	10	15
Embeddedness (20)*	11	18			
Velocity/Depth Regime (20)*	16	15			
Pool Substrate Characterization (20)**			12	6	12
Pool Variability (20)**			11	11	16
Channel Morphology					
Sediment Deposition (20)	11	20	15	16	15
Flow Status - Maint. Flow Volume (10)	9	9	7	9	9
Flow Status - Flashiness (10)	8	9	5	5	4
Channel Alteration (20)	18	14	12	6	16
Frequency of Riffles/Bends (20)*	19	17			
Channel Sinuosity (20)**			3	6	16
Riparian and Bank Structure					
Bank Stability (L) (10)	9	8	7	6	8
Bank Stability (R) (10)	9	9	7	6	8
Vegetative Protection (L) (10)	8	2	6	6	8
Vegetative Protection (R) (10)	8	9	6	6	8
Riparian Veg. Zone Width (L) (10)	5	1	3	3	8
Riparian Veg. Zone Width (R) (10)	5	9	3	3	8
TOTAL SCORE (200):	148	155	105	99	151

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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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:	6/20/2012	6/27/2012	6/27/2012	6/26/2012	6/12/2012
Weather:	Sunny	Sunny	Sunny	Sunny	Partly Cloudy
Air Temperature:	80	Deg. F. 67	Deg. F. 79	Deg. F. 75	Deg. F. 75
Water Temperature:	63	Deg. F. 65	Deg. F. 65	Deg. F. 82	Deg. F. 77
Ave. Stream Width:	22	Feet 18	Feet 22	Feet 15	Feet 50
Ave. Stream Depth:	0.8	Feet 0.6	Feet 1	Feet 0.8	Feet 2
Surface Velocity:	1.1	Ft./Sec. 1	Ft./Sec. 0.9	Ft./Sec. 0.4	Ft./Sec. 1.6
Estimated Flow:	19.36	CFS 10.8	CFS 19.8	CFS 4.8	CFS 160
Stream Modifications:		Canopy Removal	dredged/canopy removal	Dredged/Canopy removal	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	260068	370143	370149	370150	370147
Stream Name:	W B Tittabawasee	N B Chippewa River	N B Chippewa River	N B Chippewa River	Chippewa River
Road Crossing/Location:	Jpstream Fitzwater Road	Glass Rd	Jordan Rd	Veron Rd	Lincoln Rd
County Code:	26	37	37	37	37
TRS:	20N02W23	16N05W24	16N05W36	15N05W26	14N04W20
Latitude (dd):	44.1044377	43.75982	43.65461	43.72718	43.58782
Longitude (dd):	-84.387464	-84.8636	-84.868648	-84.853235	-84.80756
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080201	4080202	4080202	4080202	4080202

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3. Habitat evaluation for the Tittabawassee River watershed, June 2012.

	Newton Creek	Pony Creek	Wolf Creek	Lake George Outlet (E B Tittabawassee River) u/s Greenwood Rd				
	Surrey Rd RIFFLE/RUN	Brinton Rd GLIDE/POOL	Pine Grove Rd RIFFLE/RUN	RIFFLE/RUN				
HABITAT METRIC								
Substrate and Instream Cover								
Epifaunal Substrate/ Avail Cover (20)	add site	11	10	15	15			
Embeddedness (20)*		15		14	14			
Velocity/Depth Regime (20)*		16		12	13			
Pool Substrate Characterization (20)**			11					
Pool Variability (20)**			8					
Channel Morphology								
Sediment Deposition (20)		10	5	16	16			
Flow Status - Maint. Flow Volume (10)		8	8	10	9			
Flow Status - Flashiness (10)		8	9	9	8			
Channel Alteration (20)		16	16	18	16			
Frequency of Riffles/Bends (20)*		9		12	16			
Channel Sinuosity (20)**			16					
Riparian and Bank Structure								
Bank Stability (L) (10)		6	1	9	7			
Bank Stability (R) (10)		9	1	9	9			
Vegetative Protection (L) (10)		6	3	9	6			
Vegetative Protection (R) (10)		9	3	9	9			
Riparian Veg. Zone Width (L) (10)		1	1	9	1			
Riparian Veg. Zone Width (R) (10)		9	1	7	9			
TOTAL SCORE (200):		133	93	158	148			
HABITAT RATING:		GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)			
Date:		6/21/2012	6/12/2012	6/12/2012	6/13/2012			
Weather:		Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy			
Air Temperature:	Deg. F.		72	Deg. F.	65	Deg. F.	60	Deg. F.
Water Temperature:	Deg. F.	68	Deg. F.	76	Deg. F.	72	Deg. F.	59
Ave. Stream Width:	Feet	18	Feet	9	Feet	22	Feet	8
Ave. Stream Depth:	Feet	0.8	Feet	1	Feet	1	Feet	0.5
Surface Velocity:	Ft./Sec.	1	Ft./Sec.	0.1	Ft./Sec.	0.5	Ft./Sec.	1
Estimated Flow:	CFS	14.4	CFS	0.9	CFS	11	CFS	4
Stream Modifications:		Canopy Removal	Canopy Removal	None	Canopy Removal			
Nuisance Plants (Y/N):		N	N	N	N			
Report Number:								
STORET No.:		180189	370142	590348	650111			
Stream Name:		Newton Creek	Pony Creek	Wolf Creek	Lake George Outlet (E B Tittabawassee River)			
Road Crossing/Location:		Surrey Rd	Brinton Rd	Pine Grove Rd	u/s Greenwood Rd			
County Code:		18	37	59	65			
TRS:		17N05W13	14N06W27	12N05W18	21N02E29			
Latitude (dd):		43.85764	43.57235	43.42304	44.17619			
Longitude (dd):		-84.85015	-85.0065	-84.95026	-84.21976			
Ecoregion:		SMNITP	SMNITP	SMNITP	SMNITP			
Stream Type:		Coldwater	Warmwater	Warmwater	Coldwater			
USGS Basin Code:		4080201	4080202	4080202	4080201			
* Applies only to Riffle/Run stream Surveys								
** Applies only to Glide/Pool stream Surveys								
COMMENTS:								

Table 3. Habitat evaluation for the Tittabawassee River watershed, June 2012.

	Pine River Walton Rd	Pine River Chapman Rd	Pine River Lincoln Rd (Montcalm Rd)	Cedar River End of Woods Rd East side on 2 Track	Lewis Drain u/s Leaton Rd
	GLIDE/POOL	RIFFLE/RUN	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	5	15	10	15	7
Embeddedness (20)*		16			10
Velocity/Depth Regime (20)*		12			11
Pool Substrate Characterization (20)**	6		13	15	
Pool Variability (20)**	5		15	14	
Channel Morphology					
Sediment Deposition (20)	5	13	13	13	6
Flow Status - Maint. Flow Volume (10)	9	9	8	9	9
Flow Status - Flashiness (10)	9	4	6	6	2
Channel Alteration (20)	16	15	18	16	8
Frequency of Riffles/Bends (20)*		16			6
Channel Sinuosity (20)**	14		12	18	
Riparian and Bank Structure					
Bank Stability (L) (10)	9	7	7	7	6
Bank Stability (R) (10)	9	7	7	7	6
Vegetative Protection (L) (10)	7	8	9	9	5
Vegetative Protection (R) (10)	8	8	9	9	7
Riparian Veg. Zone Width (L) (10)	6	6	9	9	3
Riparian Veg. Zone Width (R) (10)	8	8	9	9	5
TOTAL SCORE (200):	116	144	145	156	91
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	MARGINAL (MODERATELY 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:	6/12/2012	6/12/2012	6/26/2012	6/13/2012	6/14/2012
Weather:	Partly Cloudy	Partly Cloudy	Sunny	Partly Cloudy	Partly Cloudy
Air Temperature:	72 Deg. F.	76 Deg. F.	61 Deg. F.	70 Deg. F.	70 Deg. F.
Water Temperature:	74 Deg. F.	66 Deg. F.	63 Deg. F.	63 Deg. F.	60 Deg. F.
Ave. Stream Width:	30 Feet	12 Feet	51 Feet	45 Feet	6 Feet
Ave. Stream Depth:	1.5 Feet	0.5 Feet	1.5 Feet	1.5 Feet	0.5 Feet
Surface Velocity:	0.7 Ft./Sec.	1 Ft./Sec.	0.7 Ft./Sec.	1 Ft./Sec.	0.3 Ft./Sec.
Estimated Flow:	31.5 CFS	6 CFS	53.55 CFS	67.5 CFS	0.9 CFS
Stream Modifications:	None	Canopy Removal	None	None	Dredged/Canopy removal
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	370146	370144	290186	260123	370132
Stream Name:	Pine River	Pine River	Pine River	Cedar River	Lewis Drain
Road Crossing/Location:	Walton Rd	Chapman Rd	Lincoln Road (Montcalm Rd)	End of Woods Rd East side on 2 Track	u/s Leaton Rd
County Code:	37	37	29	26	37
TRS:	13N06W03	13N06W06	12N04W31	18N01W18	15N03W19
Latitude (dd):	43.53823	43.54772	43.3791	43.95193	43.67425
Longitude (dd):	-85.01846	-85.08267	-84.8328	-84.48535	-84.70823
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Coldwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080202	4080202	4080202	4080201	4080201

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 3. Habitat evaluation for the Tittabawassee River watershed, June 2012.

	M B Tobacco River	S B Tobacco	Vernon City Creek (Little Tobacco Joint Drain)		
	u/s Hoover Rd	Eberhart Ave (downstream of Rd)	6th Street (in Clare between Jackson & Hemlock)		
	RIFFLE/RUN	RIFFLE/RUN	GLIDE/POOL		
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	11	14	10		
Embeddedness (20)*	14	15			
Velocity/Depth Regime (20)*	16	16			
Pool Substrate Characterization (20)**			2		
Pool Variability (20)**			3		
Channel Morphology					
Sediment Deposition (20)	9	10	8		
Flow Status - Maint. Flow Volume (10)	8	9	9		
Flow Status - Flashiness (10)	7	7	6		
Channel Alteration (20)	18	16	6		
Frequency of Riffles/Bends (20)*	17	13			
Channel Sinuosity (20)**			2		
Riparian and Bank Structure					
Bank Stability (L) (10)	10	9	9		
Bank Stability (R) (10)	10	9	9		
Vegetative Protection (L) (10)	9	6	3		
Vegetative Protection (R) (10)	9	6	3		
Riparian Veg. Zone Width (L) (10)	9	4	2		
Riparian Veg. Zone Width (R) (10)	9	4	2		
TOTAL SCORE (200):	156	138	74	0	0

HABITAT RATING:	EXCELLENT (NON-IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	POOR (SEVERELY IMPAIRED)	POOR (SEVERELY IMPAIRED)
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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:	6/21/2012		6/21/2012		6/21/2012			
Weather:	Partly Cloudy		Partly Cloudy		Partly Cloudy			
Air Temperature:	78	Deg. F.	80	Deg. F.	78	Deg. F.	Deg. F.	Deg. F.
Water Temperature:		Deg. F.	68	Deg. F.	68	Deg. F.	Deg. F.	Deg. F.
Ave. Stream Width:	25	Feet	35	Feet	12	Feet	Feet	Feet
Ave. Stream Depth:	0.5	Feet	1	Feet	1	Feet	Feet	Feet
Surface Velocity:	0.8	Ft./Sec.	0.9	Ft./Sec.	0.5	Ft./Sec.	Ft./Sec.	Ft./Sec.
Estimated Flow:	10	CFS	31.5	CFS	6	CFS	CFS	CFS
Stream Modifications:	None		Canopy Removal		Canopy Removal/Dredged			
Nuisance Plants (Y/N):	N		N		N			
Report Number:								
STORET No.:	180172		180171		180170			
Stream Name:	M B Tobacco River		S B Tobacco River		Vernon City Creek (Little Tobacco Joint Drain)			
Road Crossing/Location:	Upstream Hoover Rd		Eberhart Ave (downstream of Rd)		6th Street (in Clare between Jackson & Hemlock)			
County Code:	18		18		18			
TRS:	18N03W35		17N04W36		17N04W35			
Latitude (dd):	43.91223		43.82917		43.82037			
Longitude (dd):	-84.62653		-84.74816		-84.76207			
Ecoregion:	SMNITP		SMNITP		SMNITP			
Stream Type:	Coldwater		Warmwater		Warmwater			
USGS Basin Code:	4080201		4080201		4080201			

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

COMMENTS:

Table 4. 2013 Water chemistry results for select locations within the Tittabawassee River watershed collected on June 27, 2013.

Site Location	COD	Total Kjeldahl Nitrogen	Total Phosphorus	Ammonia	Nitrate + Nitrite	TOC
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Pony Creek u/s cattle access	41	1.2	0.143	0.027	0.305	16
Pony Creek d/s cattle access	18	0.6	0.069	0.02	1.98	6.6
NBCR at Vernon Road	17	0.45	0.029	0.005	0.956	5.9
NBCR at Jordan Road	13	0.42	0.067	0.009	0.869	4.8
NBCR at Nottawa Road	13	0.44	0.063	0.005	1.15	4.5
Beal City Drain	5.1	0.29	0.022	0.021	0.55	2.8