MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
MAY 2011

STAFF REPORT

BIOLOGICAL SURVEY OF THE SHIAWASSEE RIVER AND SELECTED TRIBUTARIES IN OAKLAND, GENESEE, LIVINGSTON, AND SAGINAW COUNTIES, MICHIGAN JUNE 1-AUGUST 31, 2010

INTRODUCTION

As part of the five-year watershed review cycle, staff from the Surface Water Assessment Section (SWAS) conducted a qualitative biological assessment of the Shiawassee River watershed (Figure 1). These surveys were conducted within the confines of the SWAS Procedure 51 (Michigan Department of Environmental Quality [MDEQ], 1990) with survey objectives including, but not limited to:

- Collect sufficient data to help make the appropriate designated use determinations.
- Provide data to satisfy requirements of the biological trend monitoring program.
- Provide monitoring assistance to existing nonpoint source activities and total maximum daily load development or other issues related to the Michigan 2008 Sections 303(d) 305(b), and 314 Integrated Report (LeSage and Smith, 2008) in the watershed.
- Satisfy monitoring requests submitted by internal and external customers.
- Support area of concern related to beneficial use delisting decisions.

The location of the biological survey stations are illustrated in Figure 2 and described in Tables 1 and 3. Macroinvertebrate sampling results are found in Tables 2 and 4.

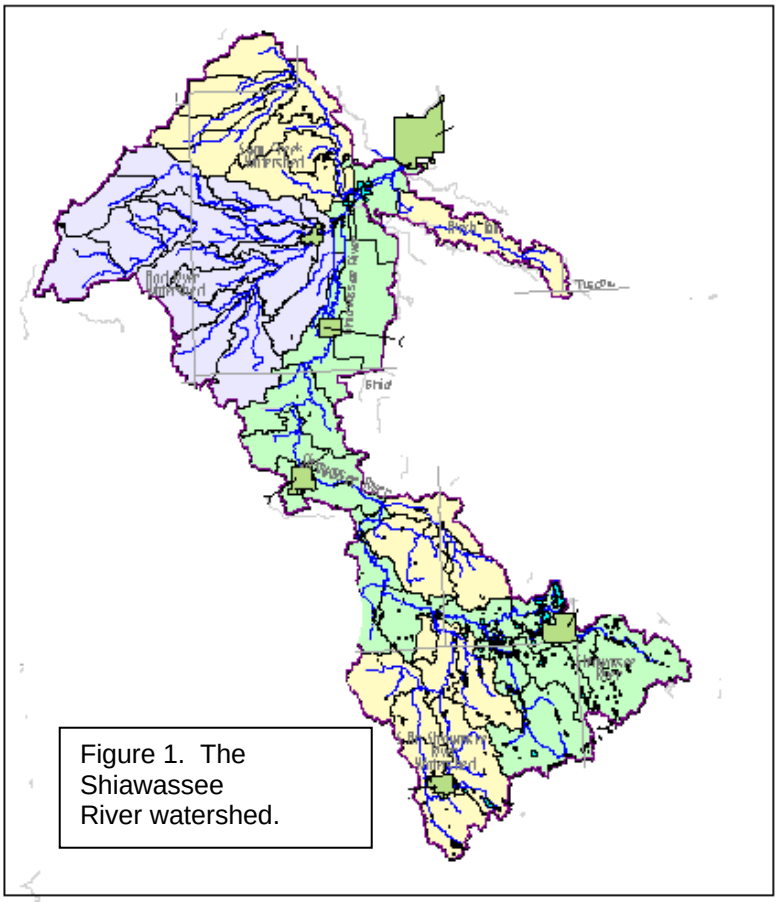

Figure 1. The Shiawassee River watershed.

WATERSHED DESCRIPTION

The southern portion of the Shiawassee River watershed, as defined by an east/west line through the city of Owosso, is part of the Southern Michigan Northern Indiana Till Plains ecoregion. The northern portion of the basin is within the Huron Erie Lake Plain ecoregion. The following provides a description of the river basin, including a physical description, brief history, and the 2010 sampling results.

The Shiawassee River begins in Section 21 in Springfield Township near Shiawassee Lake and flows northwest to Holly, then west toward Byron. The channel length from the headwaters to Byron is approximately 41 miles. Channel slope from Shiawassee Lake to Holly (12 miles) is approximately 9.2 feet per mile while the remaining 29 miles of channel between Holly and Byron has an average slope of approximately 2 feet per mile. Soils in the headwater portion (generally Oakland County) are composed of Oshtemo-Spinks-Houghton associations that are on nearly level to hilly soils that are well to poorly drained, sandy and mucky soils (United States Department of Agriculture [USDA], 1993). Soils downstream from Fenton are dominated by Marlete-Capac-Houghton and Boyer-Spinks-Ceresco-Cohochta associations that are characterized as being level to gently sloping with well to poorly drained sandy loam and mucky soils (USDA, 1974 and 1982).

From its headwaters, the Shiawassee River flows through a series of lakes and wetlands, including five significant impoundments. The topography upstream of Holly is composed of deciduous forests that are inundated with numerous small marshes and bogs.

The Shiawassee River receives a sanitary waste discharge from the village of Holly, the Genesee County Wastewater Treatment Plant (WWTP) #3 near Linden, and indirectly from the Chateau Holly Mobile Home Court, which will enter a wetland adjacent to the river in Section 35 of Holly Township. In addition, there are a number of general storm water discharges near Fenton that discharge to the Shiawassee River.

The Shiawassee River upstream from the Byron Millpond includes the drainage from a number of significant tributaries including Buckhorn, Denton, and North Ore Creeks. Water chemistry results from 2000 survey efforts revealed extremely low nutrient concentrations in headwater portions of the Shiawassee River that increase steadily as the river flows through Holly, Linden, and Fenton. Nutrient concentrations in Buckhorn, Denton, and North Ore Creeks were similar when compared to reference conditions (Lundgren, 1994) and were comparable to the 1995 effort (Hanshue, 1998) where similar sampling stations were used, and considering temporal and spatial variances that may naturally occur between any given year.

The south branch Shiawassee River begins in Sections 30 and 25 in Genoa Township, Livingston County, and flows approximately 32 miles north to its confluence with the main branch of the Shiawassee River near Byron in southeastern Shiawassee County. The average slope of the south branch Shiawassee River is 3.9 feet per mile with soils described as being medium to course textured that are moderately to well drained on level to strongly hilly terrain (USDA, 1974).

Both water quality and flow volume of the lower south branch Shiawassee River are heavily influenced by drainage from the Marion and Genoa Drain that joins the south branch Shiawassee River in Section 3 of Marion Township near the city of Howell. The Marion and Genoa Drain is approximately seven miles long and receives the discharge from the city of Howell's WWTP, as well as numerous storm water inputs. Much of this stream has a highly modified (dredged) channel with a significant quantity of degraded habitat. Additionally, the lower portion of the south branch Shiawassee River is influenced by drainage from Cranberry Creek and its respective tributaries. An additional description of the south branch Shiawassee River is provided in Cooper (2000c).

From the village of Byron in southeast Shiawassee County, the river flows approximately 34 miles to Owosso with an average slope of 2.6 feet per mile. Land use along this portion of the Shiawassee River watershed is dominated by agriculture with numerous adjoining tributaries serving as agricultural drains. Soil type associations in this area are highly variable, yet

dominated by soil groups that are generally poorly drained on gently rolling to flat till plains and floodplains (USDA, 1974).

Along with impacts associated with agricultural drainage, the Shiawassee River receives the discharge from WWTPs at or near Durand, Vernon, and Owosso, as well as a number wastewater sewage lagoons and small industrial discharges.

From Owosso, the river flows generally north 38.3 miles to the southern edge of the Shiawassee River State Game Area where the actual river channel becomes undefined within this man-made marsh. The river, now containing the flows from the Flint River, Cass River, and Bad River systems, reforms in Section 9 and joins the Tittabawassee River in Section 2 of Spaulding Township, Saginaw County, to form the Saginaw River. The average slope of the Shiawassee River between Owosso and the Shiawassee River State Game Area is slightly less than 3 feet per mile and flows entirely within the Huron Erie Lake Plain ecosystem.

The lower (downstream) portion of the watershed is influenced by several major tributaries, including Six Mile Creek and the Henderson Drain. Also included is the Bad River watershed, which is composed of drainage from the south fork of the Bad River, Potato Creek, the main branch of the Bad River, and Beaver Creek. The major tributaries of the Bad River converge near St. Charles before joining the Shiawassee River in the Shiawassee River State Game Area.

The Swan Creek watershed drains the northern most portion of the Shiawassee River watershed and includes the drainage from the Marsh Drain, McClellan Run, and Williams Creek, as well as numerous smaller agricultural drainage channels. Swan Creek begins as an agricultural drain in Section 23 of Mount Haley Township, Midland County, and flows south-southeast approximately 28 miles towards its confluence in the vicinity of the Shiawassee River State Game Area. Both the Bad River watershed and the Swan Creek watershed are largely driven by overland flow. As such, these systems are characteristic of very low base flow that are hydrologically unstable (flashy) during runoff events.

Land use along this northern portion of the Shiawassee River watershed is dominated by agriculture with numerous adjoining tributaries serving as agricultural drains. Soil associations in this area are dominated by Parkhill-Wixom, Wixom-Capac-Parkhill, and Sloan-Zilwaukee-Mistguay associations that are described as being nearly level to very gently sloping and poorly drained on lake plains and water worked till plains and floodplains (USDA, 1993). A more complete description of the Shiawassee River watershed is provided in Cooper (2000a, 2000b, 2000c, 2000d, and 2001) and MDEQ (1996).

HISTORY

Reports dating back to 1968 describe the water quality in the Shiawassee River between Linden and Byron as highly degraded, while little is said about the river upstream from Linden. Conditions in 1968 (MDEQ, 1968) included frequent dissolved oxygen (DO) violations, bacterial slimes, foul odors, and nuisance aquatic vegetation. The river near Linden was described by this same report as being lined with trash and full of organic sludge and farm animal waste. While the Genesee WWTP #3 was largely blamed for most of the DO violations in the 1968 report, subsequent studies (Wuycheck and Jackson, 1979; Roycroft and Buda, 1978) document continuing DO exceedances of Michigan's water quality standard for DO both upstream and downstream of the Genesee WWTP #3. However, overall water quality improvements, as cited by Roycroft and Buda (1978) were largely attributed to an 80 percent phosphorous removal from Genesee WWTP #3's effluent.

A comprehensive study of the Shiawassee River watershed, performed in 1995 (Hanshue, 1998), found a “noticeably impaired” fish community in the river below both Linden and the outfall from the Genesee WWTP’s outfall. Those species that were present were known to be tolerant of low oxygen levels. This same station (Seymour Road) lacked good fish habitat with a substratum composed of mostly silts and sandy materials.

Biological surveys in 1995 found significant concentrations of arsenic and manganese in river sediments from the headwaters of the south branch Shiawassee River, while elevated levels of chromium were found in sediments from the lower portions of the stream. In addition, PCB 1242 was found in superficial river sediments at this lower station (Hanshue, 1998). Survey results reported by Cooper (2000c) indicated that the south branch Shiawassee River exported relatively high concentrations of phosphorus to the Shiawassee River at Byron. Exceptionally high concentrations of hexavalent chromium were also reported in the south branch Shiawassee River below the confluence of the Marion and Genoa Drain and in the lower Marion and Genoa Drain itself. A follow-up investigation into the source of hexavalent chromium in the Marion and Genoa Drain is described by Cooper (2000e). Water chemistry sampling in 2008 indicated that this source of contamination has been mostly if not entirely removed (unpublished data).

Biological surveys in the Shiawassee River watershed in 2005 noted the continued impairment of the macroinvertebrate community in the Mikan Drain as well as several tributaries in the Bad River watershed (Cooper, 2005). Most of the headwater and middle portions of the Bad River watershed are surface runoff dependent systems with little evidence of chemical contamination with the exception of nutrient concentrations that were somewhat elevated. The 2005 survey of these streams concluded that the poor macroinvertebrate community ratings found are likely indicative of flow conditions and not a loss of water quality. Other tributaries that drain the northern portion of the Shiawassee River watershed are heavily modified channels that flow through agricultural landuse. Flow conditions have historically facilitated very silty substrates and poor habitat for fishes and macroinvetebrates.

Nuisance quantities of aquatic vegetation described by Johnson (1979) implied that massive nutrient loads were exported from the south branch Shiawassee River and the Marion and Genoa Drain to the Shiawassee River. Hanshue (1998) reported that instream concentrations of soluble reactive phosphorus and total phosphorus doubled in the south branch Shiawassee River at survey stations downstream from the Marion and Genoa Drain as compared to headwater portions in the south branch Shiawassee River, and nitrate nitrogen increased fivefold over the same area. Water chemistry samples from 2000 and 2005 continue to suggest that the south branch Shiawassee River and tributaries from the northern portion of the watershed contained relatively high concentrations of phosphorus and nitrogen (Cooper, 2000c; 2001; and 2005).

Biological samples from 1995 (Hanshue, 1998) from the south branch Shiawassee River described a fish community that was rated as moderately impacted to severely impacted; however, macroinvertebrate communities were considered to be acceptable to excellent. Habitat scores reflected a general lack of woody debris or other stable types of substrate materials. However, channels that had been previously dredged did reflect some degree of biological and habitat recovery. Fish surveys in the south branch Shiawassee River were repeated in 2006 and documented fish communities that were rated as acceptable at all stations surveyed (Cooper, 2007).

Previous water quality surveys downstream of WWTPs at Corunna and Owosso identified obvious water quality impacts (Wuycheck and Jackson, 1979). These impacts were generally associated with an excessive nutrient load that produced nuisance aquatic plant growth, bacterial slimes, and a reduction in the fish and macroinvertebrate communities. Additional studies (Creal, 1984) found that excessive residual chlorine was degrading fish and macroinvertebrate communities below the Owosso WWTP; however, a 1988 biological survey (Morse, 1990) suggested some degree of improvement over the 1983 (Creal, 1984) observations. All Shiawassee River stations surveyed between Byron and Owosso in 1995 had macroinvertebrate community and habitat ratings of good to excellent (Hanshue, 1998; Cooper, 2000c; Cooper, 2005).

Most of the Shiawassee River tributaries between Byron and Owosso and downstream from Owosso have been modified (dredged and/or straightened) to facilitate agricultural drainage. Survey work in 1995 described impacts to the biological community as being the consequence of channel modifications within the watershed (Hanshue, 1998). In addition, excessive concentrations of *E. coli* bacteria have been reported in the Three Mile Creek and Holly Drain drainage systems (Davidson, 2001). Other reports cite biological impairment due to frequent flooding, excessive siltation and embeddedness, and a general lack of stable, hard substrate materials. All of these characteristics were credited as being a consequence of poor land use (Waggoner, 1988; Masterson, 1989; Morse, 1992; and Cooper, 2001 and 2005).

Sampling Locations and Site Selection Method

Rivers in Michigan have been delineated into individual classifications called valley segments that are based on flow and temperature characteristics as related to available groundwater and local geology/geomorphology. The Shiawassee River watershed was divided into five different flow/temperature characteristic types based on an assemblage of valley segment data provided by the Michigan Department of Natural Resources (MDNR), Fisheries Division (Wehrly et al., 1997 and 1999; Seelbach and Wiley, 1997; Baker et al., 2001; and Baker, 2006). These characteristic types are:

1. Warm Small (WS) – low volume warmwater streams draining less than 40 square miles.
2. Cold/Cool Small (CS) – small, groundwater influenced, draining less than 40 square miles.
3. Warm Medium (WM) – medium-sized warmwater stream draining an area 41-179 square miles.
4. Warm Large (WL) – typically the main stem of a river draining 180-620 square miles.
5. Warm Very Large (WVL) – draining more than 620 square miles and likely to be nonwadeable.

The total channel length within the Shiawassee River watershed, as represented by each (above) classification was determined using the RF3 database to estimate the total stream miles per classification segment. Based on survey work from previous basin years, it was estimated that approximately 50 biological survey stations would represent an achievable work load and the number of stations that would be necessary to adequately assess the entire Shiawassee River watershed. Two additional stations were sampled to assess targeted point source discharge locations and to support nonpoint source monitoring efforts in the lower Shiawassee River watershed. Fifty sampling locations were distributed by the percentage of river miles each respective classification represented by the total stream miles in the basin (as an example, if 25 percent of the watershed were classified as WS, 25 percent of the total sampling effort [approximately 12 stations] would be given to WS).

Individual valley segments, as grouped by classifications 1-5 (below) were randomly chosen with each river segment selected representing a survey location. Sampling locations selected from the WVL stratum were sampled using the nonwadeable macroinvertebrate sampling procedure (in draft) using an independent contractor.

The following percentages of the above classifications were determined for the Shiawassee River watershed. Each percentage is followed by an estimate of the number of sampling stations to proportionately represent the entire watershed.

1) WS – 44.8 percent = 9 sampling stations
2) CS – 18 percent = 22 sampling stations
3) WM – 18.7 percent = 10 sampling stations
4) WL – 12.3 percent = 6 sampling stations
5) WVL – 5.2 percent = 3 sampling stations

Table 1. Biological survey locations in the Shiawassee River watershed, June 1-August 31, 2010.

SITE #	WATER BODY NAME	LOCATION	LATITUDE	LONGITUDE	COUNTY	TRS	TWP	AUID
1	Shiawassee R.	Hogan Road	42.81563	-83.80227	GENESEE	05N06ES19	Fenton	040802030111-01
2	Shiawassee R.	Bird Road	42.80877	-83.87522	GENESEE	05N05ES28	Argentine	040802030111-01
3	Shiawassee R.	Lehring Road	42.84017	-84.00987	SHIAWASSEE	05N04ES08	Burns	040802030202-01
4	Shiawassee R.	Lytle Road	42.97702	-84.07265	SHIAWASSEE	07N03ES26	Caledonia	040802030206-02
5	Shiawassee R.	Oliver Street	43.00330	-84.18655	SHIAWASSEE	07N02ES14	Owosso	040802030206-02
6	Shiawassee R.	Harmon Patride Pk.	43.01974	-84.18417	SHIAWASSEE	07N02ES12	Owosso	040802030207-02
7	Shiawassee R.	Henderson Road	43.08596	-84.18425	SHIAWASSEE	08N02ES24	Rush	040802030207-02
8	North Ore Creek	Crouse Road	42.65502	-83.75636	LIVINGSTON	03N06ES16	Hartland	040802030106-01
9	Unnamed Trib	Musson Road	42.65831	-83.80815	LIVINGSTON	03N05ES13	Oceola	040802030106-01
10	S B Shiawassee R.	Norton Road	42.59363	-83.96093	LIVINGSTON	02N04ES03	Marion	040802030101-01
11	S B Shiawassee R.	Chase Lake Road	42.70885	-83.98227	LIVINGSTON	04N04ES28	Cohoctah	040802030103-01
12	S B Shiawassee R.	Oak Grove Road	42.72623	-83.94879	LIVINGSTON	04N04ES23	Cohoctah	040802030110-01
13	Bogue Creek	Gulley Road	42.62000	-83.86522	LIVINGSTON	03N05ES28	Oceola	040802030104-01
14	Bogue Creek	Latson Road	42.61950	-83.87509	LIVINGSTON	03N05ES28	Oceola	040802030104-01
15	Bogue Creek	Marr Road	42.66405	-83.91688	LIVINGSTON	03N04ES12	Howell	040802030104-01
16	Bogue Creek	Allen Road	42.68788	-83.92372	LIVINGSTON	03N04ES01	Howell	N/A
17	Bogue Creek	Jones Road	42.72164	-83.93175	LIVINGSTON	04N04ES24	Cohoctah	040802030104-01
18	Unnamed Trib	Eager Road	42.65593	-83.89610	LIVINGSTON	03N05ES18	Oceola	040802030104-01
19	Unnamed Trib	Latson Road	42.75410	-83.88480	LIVINGSTON	04N05ES08	Deerfield	040802030105-02
20	Cranberry Creek	White Road	42.76891	-83.87434	LIVINGSTON	04N05ES04	Deerfield	040802030105-01
21	Sprague Creek	Gannon Road	42.74422	-84.00140	LIVINGSTON	04N04ES17	Cohoctah	040802030102-01
22	Sprague Creek	Betterly Road	42.74552	-83.98414	LIVINGSTON	04N04ES09	Cohoctah	040802030102-01
23	Unnamed Trib	Bliven Road	42.80349	-84.05528	SHIAWASSEE	05N03ES25	Antrim	040802030205-01
24	Three Mile Creek	Pittsburg Road	42.89628	-83.98387	SHIAWASSEE	06N04ES27	Vernon	040802030203-02
25	Three Mile Creek	Monroe Road	42.91844	-83.96596	SHIAWASSEE	06N04ES14	Vernon	040802030203-02
26	Webb Creek	I 69	42.95599	-83.96924	SHIAWASSEE	06N04ES02	Vernon	040802030204-01
27	Webb Creek	Reed Road	42.96193	-84.00705	SHIAWASSEE	07N04ES33	Venice	040802030204-01
28	Six Mile Creek	Seymour Road	43.09147	-84.15380	SHIAWASSEE	08N03ES18	New Haven	040802030208-02

Table 1 cont. Biological survey locations in the Shiawassee River watershed, June 1-August 31, 2010.

SITE #	WATER BODY NAME	LOCATION	LATITUDE	LONGITUDE	COUNTY	TRS	TWP	AUID
29	Deer Creek	Sharon Road	43.22312	-84.11603	SAGINAW	10N03ES33	St Charles	040802030209-01
30	Unnamed Trib	M57 (Broad Street)	43.18609	-84.12556	SAGINAW	09N03ES16	Chesaning	040802030209-01
31	Carson Drain	Fergus Road	43.25485	-84.11384	SAGINAW	10N03ES21	St Charles	040802030312-01
32	Bad R.	Blair Road	43.25742	-84.50386	GRATIOT	10N02WS14	North Star	040802030301-01
33	Bad R.	Meridian Road	43.30730	-84.36950	GRATIOT	11N01WS25	Lafayette	040802030309-01
34	Bad R.	Chapin Road	43.30188	-84.30959	SAGINAW	10N01ES02	Marion	040802030313-01
35	Potato Creek	Hemlock Road	43.26486	-84.22927	SAGINAW	10N02ES16	Brant	040802030306-01
36	Little Potato Creek	Chapin Road	43.23847	-84.30786	SAGINAW	10N01ES26	Marion	040802030306-01
37	Lamb Creek	Gary Road	43.21517	-84.25311	SAGINAW	09N02ES05	Brady	040802030304-01
38	Griffus Creek	Brennan Road	43.14050	-84.24676	SAGINAW	09N02ES32	Brady	040802030304-01
39	South Fork Bad R.	Chapin Road	43.19842	-84.30671	SAGINAW	09N01ES11	Chapin	040802030303-01
40	South Fork Bad R.	Brant Rd.	43.25894	-84.20886	Saginaw	10N02ES23	Brant	
41	Beaver Creek	Ransom Road	43.36480	-84.44924	GRATIOT	11N01WS08	Lafayette	040802030307-01
42	Beaver Creek	Merrill Road	43.34226	-84.33027	SAGINAW	11N01ES22	Lakefield	040802030308-01
43	Beaver Creek	Brennan Road	43.33739	-84.24873	SAGINAW	11N02ES21	Fremont	040802030311-01
44	Unnamed Trib	Fehn Road	43.48090	-84.22039	SAGINAW	12N02ES03	Richland	040802030405-01
45	McClellan Run	Orr Road	43.43192	-84.17054	SAGINAW	12N02ES24	Richland	040802030407-05
46	Williams Creek	Graham Road	43.40777	-84.13085	SAGINAW	12N03ES33	Thomas	040802030407-03
47	Swan Creek	Schomaker Road	43.40122	-84.09955	SAGINAW	12N03ES34	Thomas	040802030407-04
48	Shiawassee R.	Upstream River Rd.	43.35709	-84.05811	SAGINAW	11N03ES13	James	040802030410-03
49	Shiawassee R.	Birch River Mouth	43.37216	-84.00047	SAGINAW	11N04ES09	James	040802030410-03
50	Shiawassee R.	Off Ryan Rd.	43.36743	-84.01915	SAGINAW	11N04ES05	James	040802030410-03

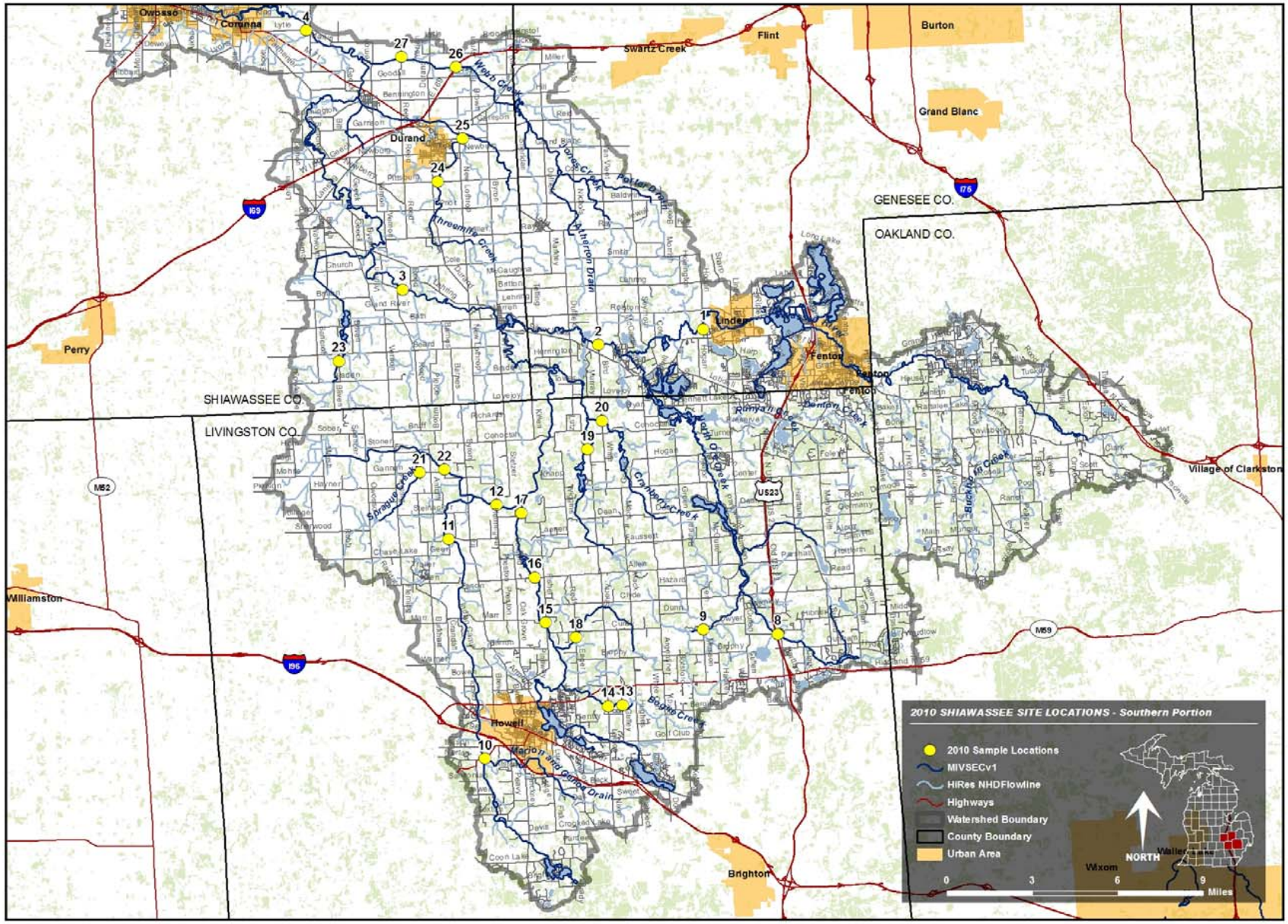

Figure 2. Macroinvertebrate sampling sites in the Shiawassee River watershed, June-August 2010.

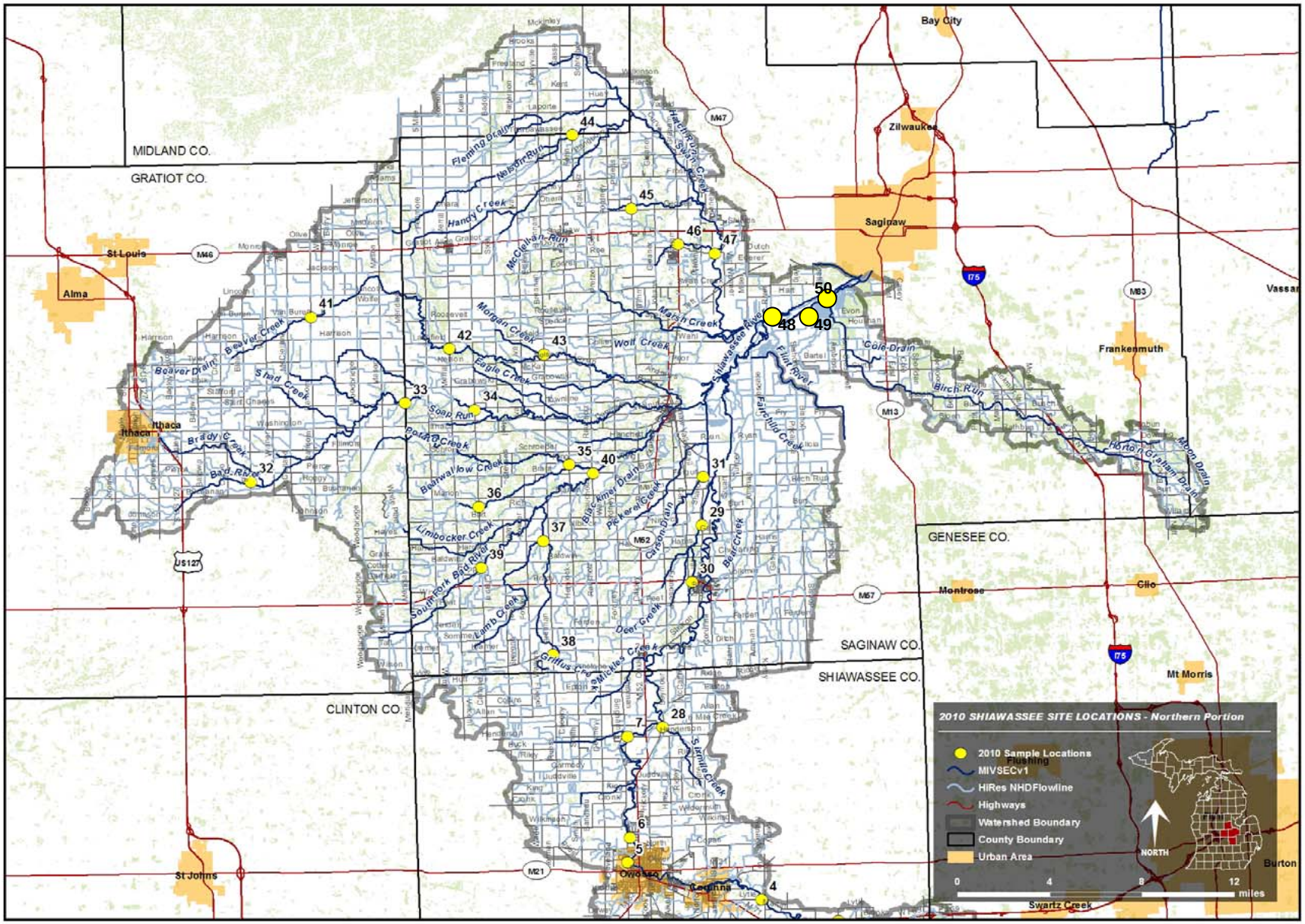

Figure 2 cont.

Total Maximum Daily Load-Related Survey Stations

The South Fork Bad River is currently listed on the Section 305(d) list as nonattaining the other indigenous aquatic life and wildlife designated use due to a poor macroinvertebrate community. Macroinvertebrate and habitat sampling were performed at one location and visually assessed at two others.

Point Source Monitoring

The Marion and Genoa Drain, which is tributary to the south branch Shiawassee River, currently receives storm water that is contaminated with hexavalent chrome (Cooper, 2000e). Contaminated groundwater near the Diamond Chrome Plating Company continues to infiltrate portions of the storm water collection system in Howell, resulting in the discharge of hexavalent chrome to the drain approximately 0.75 miles upstream from the confluence with the south branch Shiawassee River. At the request of the Lansing District Office, ambient samples were collected from the Marion and Genoa Drain on August 12, 2010, downstream from storm water and suspected groundwater discharge locations to the drain and from the south branch Shiawassee River below the confluence of the Marion and Genoa Drain. Samples were taken following a period of relatively stable weather. Hexavalent chrome was not detected in any of the ambient water samples.

Nonpoint Source Monitoring

There were specific 2010 nonpoint source monitoring requests for the Shiawassee River watershed that were addressed during the 2010 effort.

Biological Sampling Results

Forty-seven of the 50 sampling locations in the Shiawassee River watershed were sampled using Procedure 51 while 3 were surveyed using the nonwadeable macroinvertebrate and habitat sampling procedure (in draft). Of the 47 wadeable sites sampled, 6 scored in the “poor” range (a Procedure 51 score of less than -4 on a scale of -9 to +9). Five of the sites that scored in the poor range were in streams that had modified channels and minimal habitat available to the macroinvertebrate and fish communities.

The main branch of the Shiawassee River was surveyed at 7 locations between the village of Linden in Genesee County and Henderson in northern Shiawassee County. Stations 1-7 all contained macroinvertebrate communities that were indicative of good to excellent water quality and were supported by riverine habitats that were rated as good.

The south branch Shiawassee River was surveyed at 3 locations (Stations 10-12) along with an additional 12 stations on tributaries to the south branch Shiawassee River (Stations 8, 9, and 13-22). All of the sampling locations in the south branch basin contained macroinvertebrate communities that were rated as acceptable; however, most of the channels had been previously dredged resulting in limited substrates for macroinvertebrate colonization and relatively poor habitat for fishes. Habitat scores ranged from a low of 62 (200 possible) at Station 21 to a high of 175 at Station 13. Macroinvertebrate scores ranged from 0-5 (potential range of -9 to +9).

Stations 23-31 represent tributaries to the Shiawassee River located in an area beginning just south of the city of Durand, to approximately 5 miles north of Chesaning in southern Saginaw County. Significant portions of all these tributaries have been modified (dredged) to facilitate agricultural drainage. Habitat scores ranged from a low of 37 (Station 27) to 103 (Station 26) and were rated as marginal or poor. Station 28 was in the lower portion of Six Mile Creek where

the stream channel had been rehabilitated below an old mill impoundment. As such, the habitat scores reported may not be typical in the rest of the watershed up gradient. Macroinvertebrate scores ranged from a high of +4 at Station 24 to a low of -7 at Stations 26 and 31 (scores less than -4 are rated as poor) and were represented by taxonomic groups typically found in moderately to heavily disturbed stream ecosystems.

Figure 3. A typical summer view of many headwater and middle order sections of the Bad River Watershed. This photo was taken on August 31, 2010 on the South Fork Bad River at S. Brennan Rd in Saginaw County.

The northern half of the Shiawassee River watershed is drained primarily by the Bad River watershed, which includes the south branch Bad River and Beaver Creek, and the Swan Creek watershed, which drains the northern Saginaw County and southeastern Gratiot County. The northern half of the Shiawassee River is somewhat unique in that most of the headwaters and the distal portions of the main branches of streams are intermittent during the late summer months (Figure 3). A number of the survey locations in 2010 were in channels where stream flow was barely detectable with both lotic and lentic channel characteristics, strongly suggesting that these streams are more heavily influence by surfical drainage and less by groundwater inputs. As such, the macroinvertebrate communities consisted of mostly members considered to be “generalists” in that their presence was typical of an aquatic environs but not necessarily unique to a stream environment. Obligate stream communities were found but in relatively low densities. Additionally, significant portions of both the Bad River and Swan Creek watersheds have been heavily modified (dredged and straightened) to facilitate agricultural drainage. This loss of habitat contributes to the relatively low diversity of aquatic organisms seen in this area.

Habitat scores at Stations 32-43 in the Bad River ranged from a high of 135 to a low of 51. Only Stations 33, 35, 42, and 43 contained habitat that was considered to be good and none of these 4 sites had been dredged within recent history. The remaining stations in the Bad River system

were ranked as marginal or poor with impacts common to dredged streams. Macroinvertebrate scores at Stations 32-43 ranged from a high of +3 at 1 of 3 stations in the Bad River (Station 32) to a low of -7 at 1 of 3 sites in Beaver Creek (Station 41). In general, the taxonomic groups found in Stations 32-43 were considered to be somewhat to very tolerant of conditions typically associated with marginal water quality.

The Marsh Creek basin contains drainage and channel characteristics that are similar to the Bad River watershed in that most of the tributaries have been heavily modified and groundwater is not available in sufficient quantities to sustain flow to the minor channels during the summer months. Habitat scores ranged from a high of 108 to a low of 54 while macroinvertebrate scores ranged from a high of 0 to a low of -7. The biological communities at Stations 46 and 47 were considered to be poor, likely due to relatively poor habitat conditions.

The nonwadeable portions of the Shiawassee River (Stations 48-50) were surveyed on June 29 and 30, 2010. The river's habitat at Stations 48-50 is somewhat typical of a low gradient delta area with slow flow velocities and heavy deposits of small grain particulates creating relatively poor colonization potential for macroinvertebrate communities that are often typical of large river environments. This portion of the river is heavily influenced by frequent seiche and flooding events. The macroinvertebrate communities found at Stations 48-50 were as expected for the existing habitats.

CONCLUSION

The probabilistic estimation for the Shiawassee River watershed was 88 percent (+/- 10 percent) meaning that statistically, we are 95 percent confident that approximately 88 percent of the watersheds surveyed would have a macroinvertebrate community that was rated as acceptable or better using Procedure 51.

Forty-four of the 50 biological surveys of the streams surveyed in the Shiawassee River watershed contained macroinvertebrate communities that were rated as acceptable or better. Furthermore, all of the streams with macroinvertebrate communities that were rated as poor, with the exception of Station 47 on Swan Creek, were in streams with heavily modified channels containing habitat defects typical of dredged streams. The lower portion of Swan Creek appears to be relatively unchanged from biological surveys conducted in 2000 and 2005. Flow was extremely slow and turbid with heavy deposits of fine silt and a general lack of colonizable habitat in the stream channel. The source (cause) of the silt and turbidity in Swan Creek remains undefined but is likely related to intrinsic deposits of lake plains soils complicated by a heavily modified watershed. In addition, several sampling stations were located very close to the intermittent portion of its respective watershed (i.e., Stations 31, 41, and 46), which may partially or completely explain lower than expected macroinvertebrate community scores at these sites. Biological communities in these types of unstable habitats can be highly variable, reflecting the unstable habitat of a stream channel that periodically becomes dry.

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Table 2

Table 2A. Qualitative macroinvertebrate sampling results for the Shiawassee River Watershed, June 1 - August 31, 2010.

TAXA	Shiawassee River Hogan Rd 6/2/2010 STATION 1	Shiawassee River Bird Road 6/2/2010 STATION 2	Shiawassee River Lehring Road 6/2/2010 STATION 3	Shiawassee River Lytle Road 6/1/2010 STATION 4
PORIFERA (sponges)	1	1	1	1
PLATYHELMINTHES (flatworms)				
Turbellaria	1			
BRYOZOA (moss animals)				1
ANNELIDA (segmented worms)				
Oligochaeta (worms)	5	5	3	3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	30	15	20	11
Decapoda (crayfish)	1	1	10	3
Isopoda (sowbugs)			8	8
Arachnoidea				
Hydracarina	1			
Insecta				
Ephemeroptera (mayflies)				
Baetidae	3	33	17	20
Caenidae	13	3		
Ephemerellidae			1	1
Heptageniidae	1	1	20	9
Isonychiidae			1	1
Polymitarcyidae			1	1
Potamanthidae			1	3
Tricorythidae		1	2	11
Odonata				
Zygoptera (damselflies)				
Calopterygidae			1	
Coenagrionidae	1	5	2	3
Plecoptera (stoneflies)				
Perlidae		9	19	5
Hemiptera (true bugs)				
Corixidae	1	16	6	
Gerridae			1	1
Pleidae				1
Megaloptera				
Sialidae (alder flies)	2			
Trichoptera (caddisflies)				
Brachycentridae	36	86	34	230
Glossosomatidae			1	
Helicopsychidae			2	
Hydropsychidae	118	74	28	8
Hydroptilidae	8	3		
Leptoceridae	3	6	38	12
Limnephilidae	1		1	1
Philopotamidae			3	1
Polycentropodidae		1		3
Uenoidae	5	4	8	2
Coleoptera (beetles)				
Gyrinidae (adults)			1	
Hydrophilidae (total)		1		
Elmidae	21	12	8	20
Gyrinidae (larvae)	1			
Psephenidae (larvae)	1		1	
Scirtidae (larvae)				1
Diptera (flies)				
Ceratopogonidae			1	
Chironomidae	33	64	30	13
Simuliidae	1	2		
Tabanidae			1	
Tipulidae			3	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)			1	2
Hydrobiidae			5	2
Lymnaeidae				7
Physidae	3	4		5
Planorbidae	1			1
Pleuroceridae			6	
Pelecypoda (bivalves)				
Sphaeriidae (clams)			7	7
Unionidae (mussels)			1	1
TOTAL INDIVIDUALS	292	347	294	399

Table 2B. Macroinvertebrate metric evaluation.

	Shiawassee River Hogan Rd 6/2/2010 STATION 1		Shiawassee River Bird Road 6/2/2010 STATION 2		Shiawassee River Lehring Road 6/2/2010 STATION 3		Shiawassee River Lytle Road 6/1/2010 STATION 4	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	25	1	22	0	37	1	34	1
NUMBER OF MAYFLY TAXA	3	0	4	1	7	1	7	1
NUMBER OF CADDISFLY TAXA	6	1	6	1	8	1	7	1
NUMBER OF STONEFLY TAXA	0	-1	1	1	1	1	1	1
PERCENT MAYFLY COMP.	5.82	0	10.95	0	14.63	0	11.53	0
PERCENT CADDISFLY COMP.	58.56	1	50.14	1	39.12	1	64.41	1
PERCENT DOMINANT TAXON	40.41	-1	24.78	0	12.93	1	57.64	-1
PERCENT ISOPOD, SNAIL, LEECH	1.37	1	1.15	1	6.80	0	6.27	0
PERCENT SURF. AIR BREATHERS	0.34	1	4.90	1	2.72	1	0.50	1
TOTAL SCORE		3		6		7		5
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		EXCELLENT		EXCELLEN

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Shiawassee River Oliver Street 6/1/2010 STATION 5	Shiawassee River Harmon Partridge Park 6/1/2010 STATION 6	Shiawassee River Henderson Road 6/1/2010 STATION 1	North Ore Creek Crouse Road 8/11/2010 STATION 8
PORIFERA (sponges)	1		1	
PLATYHELMINTHES (flatworms)				
Turbellaria			1	1
ANNELIDA (segmented worms)				
BRYAZOA (moss animals)			1	
Hirudinea (leeches)		1		1
Oligochaeta (worms)	4	8	5	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	1	1	15	
Decapoda (crayfish)	3	1	2	2
Isopoda (sowbugs)	5	5	8	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	12	34	16	9
Caenidae	1		2	
Ephemerellidae	10	1	1	
Heptageniidae	6	10	12	14
Isonychiidae	3	16	1	
Polymitarcyidae	4	2	1	
Potamanthidae	1		2	
Tricorythidae	8	6	6	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae				4
Gomphidae	1	1		
Zygoptera (damselflies)				
Calopterygidae		1		10
Coenagrionidae	1	2	4	
Plecoptera (stoneflies)				
Perlidae	7	36	30	
Hemiptera (true bugs)				
Corixidae	1	1		1
Gerridae				1
Mesoveliidae				2
Notonectidae				2
Pleidae	1		1	
Veliidae	4	6		
Megaloptera				
Corydalidae (dobson flies)				2
Trichoptera (caddisflies)				
Brachycentridae	221	119	54	28
Helicopsychidae	2	1	6	4
Hydropsychidae	1	6		30
Hydroptilidae				2
Leptoceridae	5	13	18	5
Limnephilidae		1		6
Philopotamidae	2		2	6
Phryganeidae				2
Polycentropodidae	1	1	1	1
Psychomyiidae	1			
Uenoidae	3	1	1	19
Coleoptera (beetles)				
Gyrinidae (adults)				2
Haliplidae (adults)	1			
Hydrophilidae (total)	1			
Elmidae	12	13	16	54
Psephenidae (larvae)	1	5	1	23
Scirtidae (larvae)	1			
Diptera (flies)				
Ceratopogonidae		2		
Chironomidae	29	89	46	24
Simuliidae		1		4
Tipulidae			1	2
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			12
Hydrobiidae	6	10	43	
Lymnaeidae			3	
Physidae	8		5	4
Planorbidae				2
Pleuroceridae	18	6	4	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	10	5	12	3
Unionidae (mussels)	1	2	1	
TOTAL INDIVIDUALS	399	407	323	287

Table 2B. Macroinvertebrate metric evaluation (Continued).

METRIC	Shiawassee River Oliver Street 6/1/2010 STATION 5 Value	Score	Shiawassee River Harmon Partridge Park 6/1/2010 STATION 6 Value	Score	Shiawassee River Henderson Road 6/1/2010 STATION 7 Value	Score	North Ore Creek Crouse Road 8/11/2010 STATION 8 Value	Score
TOTAL NUMBER OF TAXA	39	1	33	1	34	1	34	1
NUMBER OF MAYFLY TAXA	8	1	6	1	8	1	2	0
NUMBER OF CADDISFLY TAXA	8	1	7	1	6	1	10	1
NUMBER OF STONEFLY TAXA	1	1	1	1	1	1	0	-1
PERCENT MAYFLY COMP.	11.28	0	16.95	0	12.69	-1	8.01	0
PERCENT CADDISFLY COMP.	59.15	1	34.89	1	25.39	1	35.89	1
PERCENT DOMINANT TAXON	55.39	-1	29.24	0	16.72	0	18.82	1
PERCENT ISOPOD, SNAIL, LEECH	9.52	0	5.41	0	19.50	-1	6.97	0
PERCENT SURF. AIR BREATHERS	2.01	1	1.72	1	0.31	1	2.79	1
TOTAL SCORE		5		6		4		4
MACROINV. COMMUNITY RATING		EXCELLENT		EXCELLENT		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Unnamed Tributary Musson Road 8/12/2010 STATION 9	So. Br. Shiawassee R. Norton Road 7/28/2010 STATION 10	So. Br. Shiawassee R. Chase Lake Road 8/11/2010 STATION 11	So. Br. Shiawassee R. Oak Grove Road 6/2/2010 STATION 12
PORIFERA (sponges)	1			
PLATYHELMINTHES (flatworms)				
Turbellaria	1			
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	1
Oligochaeta (worms)	1		5	10
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	57	81	73	27
Decapoda (crayfish)	1	3	1	1
Isopoda (sowbugs)			1	1
Arachnoidea				
Hydracarina	3			
Insecta				
Ephemeroptera (mayflies)				
Baetidae	3	16	13	28
Caenidae	62	1	3	
Heptageniidae	2	1	4	1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		1	1	1
Libellulidae	6			
Zygoptera (damselflies)				
Calopterygidae	16	43	39	1
Coenagrionidae	19	4	7	1
Plecoptera				
Perlidae				13
Hemiptera (true bugs)				
Belostomatidae		1	1	
Corixidae			57	12
Gerridae	1	1	1	1
Mesoveliidae			1	
Notonectidae	1	1	1	
Megaloptera				
Corydalidae (dobson flies)	1		1	
Sialidae (alder flies)	1			
Trichoptera (caddisflies)				
Brachycentridae			1	122
Helicopsychidae	2			
Hydropsychidae	12	47	25	32
Hydroptilidae	2		6	
Leptoceridae	17			
Limnephilidae		1		1
Molannidae	1			
Phryganeidae	1			
Polycentropodidae			2	10
Uenoidae	1			
Lepidoptera (moths)				
Pyralidae	1			
Coleoptera (beetles)				
Dytiscidae				2
Gyrinidae (adults)			1	
Haliplidae (adults)	1		4	
Hydrophilidae (total)			1	1
Elmidae	14	4	36	19
Diptera (flies)				
Ceratopogonidae		1		2
Chironomidae	50	31	5	43
Empididae	1			
Simuliidae		12		
Tabanidae	3			
Tipulidae		1		1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1		1
Hydrobiidae				
Lymnaeidae				2
Physidae	6	1	1	2
Pelecypoda (bivalves)				
Sphaeriidae (clams)		5	3	16
TOTAL INDIVIDUALS	288	257	295	352

Table 2B. Macroinvertebrate metric evaluation (Continued).

METRIC	Unnamed Tributary Musson Road 8/12/2010 STATION 9 Value	Score	S0. Br. Shiawassee R. Norton Road 7/28/2010 STATION 10 Value	Score	So. Br. Shiawassee R. Chase Lake Road 8/11/2010 STATION 11 Value	Score	So. Br. Shiawassee R. Oak Grove Road 6/2/2010 STATION 12 Value	Score
TOTAL NUMBER OF TAXA	30	1	21	0	28	1	27	0
NUMBER OF MAYFLY TAXA	3	0	3	0	3	0	2	0
NUMBER OF CADDISFLY TAXA	7	1	2	0	4	0	4	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	1	1
PERCENT MAYFLY COMP.	23.26	1	7.00	0	6.78	0	8.24	-1
PERCENT CADDISFLY COMP.	12.50	0	18.68	0	11.53	0	46.88	1
PERCENT DOMINANT TAXON	21.53	0	31.52	0	24.75	0	34.66	-1
PERCENT ISOPOD, SNAIL, LEECH	2.08	1	0.78	1	1.02	1	1.99	1
PERCENT SURF. AIR BREATHERS	1.04	1	1.17	1	22.71	-1	4.55	1
TOTAL SCORE		4		1		0		3
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Bogue Creek Gully Road 7/28/2010 STATION 13	Bogue Creek Latson Road 7/28/2010 STATION 14	Bogue Creek Marr Road 8/11/2010 STATION 15	Bogue Creek Allen Road 8/11/2010 STATION 16
PORIFERA (sponges)	1			
PLATYHELMINTHES (flatworms)				
Turbellaria	2			
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1		1
Oligochaeta (worms)	3	3	7	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	21		4	15
Decapoda (crayfish)		4		2
Arachnoidea				
Hydracarina			5	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	5	2	35	17
Caenidae	5	1	3	8
Heptageniidae	54	16	13	4
Leptophlebiidae	5	1		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		2	1	3
Gomphidae			1	
Zygoptera (damselflies)				
Calopterygidae	19	104	21	7
Coenagrionidae	1	7		4
Hemiptera (true bugs)				
Belostomatidae			1	
Corixidae		1		33
Gerridae	1		1	1
Mesoveliidae		1	1	
Nepidae			1	5
Notonectidae				1
Pleidae				9
Saldidae	2			
Megaloptera				
Corydalidae (dobson flies)		2		
Sialidae (alder flies)	3	2		1
Neuroptera (spongilla flies)				
Sisyridae	1			
Trichoptera (caddisflies)				
Brachycentridae			4	1
Glossosomatidae	1			
Helicopsychidae	3	2		
Hydropsychidae	89	2	97	1
Leptoceridae	5	4	2	4
Limnephilidae	4	1	1	9
Philopotamidae	26			2
Polycentropodidae		6		10
Psychomyiidae	1		1	
Uenoidae	1	1		
Coleoptera (beetles)				
Haliplidae (adults)	1	1		
Hydrophilidae (total)		2		
Elmidae	11	29	8	64
Gyrinidae (larvae)				1
Diptera (flies)				
Ceratopogonidae	2		1	
Chironomidae	27	35	37	36
Culicidae				5
Dixidae		3		4
Simuliidae	2	5	6	
Tabanidae		1	1	4
Tipulidae	1	1	1	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	10		6	3
Lymnaeidae	1			
Physidae	1	3		7
Planorbidae	1	2		
Viviparidae	2			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	32	12		
TOTAL INDIVIDUALS	345	257	259	264

Table 2B. Macroinvertebrate metric evaluation (Continued)

	Bogue Creek Gully Road 7/28/2010 STATION 13		Bogue Creek Latson Road 7/28/2010 STATION 14		Bogue Creek Marr Road 8/11/2010 STATION 15		Bogue Creek Allen Road 8/11/2010 STATION 16	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	35	1	31	1	25	1	31	1
NUMBER OF MAYFLY TAXA	4	1	4	1	3	0	3	0
NUMBER OF CADDISFLY TAXA	8	1	6	1	5	1	6	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	20.00	1	7.78	0	19.69	1	10.98	0
PERCENT CADDISFLY COMP.	37.68	1	6.23	0	40.54	1	10.23	0
PERCENT DOMINANT TAXON	25.80	0	40.47	-1	37.45	0	24.24	0
PERCENT ISOPOD, SNAIL, LEECH	4.64	0	2.33	1	2.32	1	4.17	0
PERCENT SURF. AIR BREATHERS	1.16	1	1.95	1	1.54	1	20.45	-1
TOTAL SCORE		5		3		5		0
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		EXCELLENT		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Bogue Creek Jones Road 6/2/2010 STATION 17	Unnamed Tributary Eager Road 7/28/2010 STATION 18	Unnamed Tributary Latosn Road 8/11/2010 STATION 19	Cranberry Creek White Road 8/31/2010 STATION 20
PLATYHELMINTHES (flatworms)				
Turbellaria	1		4	3
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1	1	2
Oligochaeta (worms)	77	4		
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	17		5	46
Decapoda (crayfish)	2	1		1
Arachnoidea				
Hydracarina		1	1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	21	12	3	8
Caenidae			2	5
Ephemerellidae	1			2
Heptageniidae	8	6	1	27
Tricorythidae			4	13
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	1		
Gomphidae			1	
Libellulidae				1
Zygoptera (damselflies)				
Calopterygidae	1	11	2	6
Coenagrionidae	2		35	10
Plecoptera (stoneflies)				
Perlidae	3		1	
Hemiptera (true bugs)				
Corixidae	1			
Gerridae		1		1
Mesoveliidae		1		
Nepidae			1	
Notonectidae				1
Veliidae			1	
Megaloptera				
Sialidae (alder flies)		3	2	2
Trichoptera (caddisflies)				
Brachycentridae	48			
Glossosomatidae		1		
Helicopsychidae		1		22
Hydropsychidae	21	85	67	65
Hydroptilidae		2		
Leptoceridae	6		5	9
Limnephilidae	3	4		
Philopotamidae			21	10
Polycentropodidae	2			1
Uenoidae		3		8
Lepidoptera (moths)				
Pyralidae				2
Coleoptera (beetles)				
Dytiscidae (total)	2	3		
Gyrinidae (adults)	1			1
Haliplidae (adults)				1
Hydrophilidae (total)		4	1	
Psephenidae (adults)				3
Dryopidae		2		
Elmidae	13	8	46	13
Gyrinidae (larvae)	1		1	
Diptera (flies)				
Ceratopogonidae	1	2	3	1
Chironomidae	22	109	65	27
Ephydridae			1	
Ptychopteridae		2		
Simuliidae	1	20	15	7
Stratiomyidae		1		
Tabanidae	2	1	1	1
Tipulidae	4	7		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1	1	1	
Hydrobiidae	2		14	6
Lymnaeidae	1			
Physidae	7		3	2
Planorbidae	1		19	3
Pleuroceridae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	9	2	2	12
TOTAL INDIVIDUALS	284	300	329	323

Table 2B. Macroinvertebrate metric evaluation (Continued).

METRIC	Bogue Creek Jones Road 6/2/2010 STATION 17		Unnamed Tributary Eager Road 7/28/2010 STATION 18		Unnamed Tributary Latosn Road 8/11/2010 STATION 19		Cranberry Creek White Road 8/31/2010 STATION 20	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	32	1	30	1	31	1	35	1
NUMBER OF MAYFLY TAXA	3	0	2	1	4	1	5	1
NUMBER OF CADDISFLY TAXA	5	1	6	1	3	0	6	1
NUMBER OF STONEFLY TAXA	1	1	0	-1	1	1	0	-1
PERCENT MAYFLY COMP.	10.56	0	6.00	0	3.04	0	17.03	0
PERCENT CADDISFLY COMP.	28.17	0	32.00	1	28.27	0	35.60	1
PERCENT DOMINANT TAXON	27.11	0	36.33	0	20.36	0	20.12	0
PERCENT ISOPOD, SNAIL, LEECH	4.58	0	0.67	1	11.55	-1	4.33	0
PERCENT SURF. AIR BREATHERS	1.41	1	4.00	1	0.91	1	2.17	1
TOTAL SCORE		4		5		3		4
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Sprague Creek Gannon Road 8/12/2010 STATION 21	Sprague Creek Betterly Road 6/2/2010 STATION 22	Scribner Creek Bliven Road 8/31/2010 STATION 23	Three Mile Creek Pittsburg Road 8/12/2010 STATION 24
PLATYHELMINTHES (flatworms)				
Turbellaria	1		1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)	2		1	
Oligochaeta (worms)	7	10	2	3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	62	89	24	
Decapoda (crayfish)	2	1		4
Isopoda (sowbugs)			24	7
Arachnoidea				
Hydracarina				1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	11	2		18
Heptageniidae	54			28
Leptophlebiidae		1		
Metretopodidae	14			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4	1	1	4
Libellulidae			3	
Zygoptera (damselflies)				
Calopterygidae	13	1	20	8
Coenagrionidae			9	
Plecoptera (stoneflies)				
Perlidae		1		
Hemiptera (true bugs)				
Belostomatidae	1			
Corixidae	7	1		1
Gerridae	1		1	4
Nepidae	1		2	
Notonectidae	2		1	
Pleidae	1		1	
Veliidae	1			
Megaloptera				
Sialidae (alder flies)			3	
Trichoptera (caddisflies)				
Brachycentridae	5	33		
Glossosomatidae				5
Helicopsychidae				11
Hydropsychidae	32	17		36
Hydroptilidae	4			1
Leptoceridae	4		1	
Limnephilidae		1		
Molannidae				3
Phryganeidae			2	
Polycentropodidae		1		
Psychomyiidae		1		
Coleoptera (beetles)				
Dytiscidae (total)	1			
Hydrophilidae (total)	1	1	1	
Elmidae	33	27	30	47
Diptera (flies)				
Ceratopogonidae	2	3		1
Chironomidae	33	72	219	27
Culicidae			6	1
Dixidae		1	7	3
Ptychopteridae			1	
Simuliidae	4	2		
Tabanidae	9		2	6
Tipulidae		1		7
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1	3	1	3
Hydrobiidae			1	
Lymnaeidae	1			1
Physidae	1	1	29	5
Planorbidae			1	1
Pleuroceridae			1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	15	1	8	12
TOTAL INDIVIDUALS	330	272	403	248

Table 2B. Macroinvertebrate metric evaluation (Continued).

METRIC	Sprague Creek Gannon Road 8/12/2010 STATION 21		Sprague Creek Betterly Road 6/2/2010 STATION 22		Scribner Creek Bliven Road 8/31/2010 STATION 23		Three Mile Creek Pittsburg Road 8/12/2010 STATION 24	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	32	1	24	0	29	1	27	1
NUMBER OF MAYFLY TAXA	3	1	2	0	0	-1	2	0
NUMBER OF CADDISFLY TAXA	4	0	5	1	2	0	5	1
NUMBER OF STONEFLY TAXA	0	-1	1	1	0	-1	0	-1
PERCENT MAYFLY COMP.	23.94	1	1.10	-1	0.00	-1	18.55	1
PERCENT CADDISFLY COMP.	13.64	0	19.49	0	0.74	-1	22.58	0
PERCENT DOMINANT TAXON	18.79	1	32.72	0	54.34	-1	18.95	1
PERCENT ISOPOD, SNAIL, LEECH	1.52	1	1.47	1	14.39	-1	6.85	0
PERCENT SURF. AIR BREATHERS	4.85	1	0.74	1	3.23	1	2.42	1
TOTAL SCORE		5		3		-4		4
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Three Mile Creek Monroe Road 6/1/2010 STATION 25	Webb Creek I69 6/1/2010 STATION 26	Webb Creek Reed Road 8/31/2010 STATION 27	Six Mile Creek Seymore Road 8/12/2010 STATION 28
PORIFERA (sponges)			1	
PLATYHELMINTHES (flatworms)				
Turbellaria		1		15
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	
Oligochaeta (worms)	6	1		
ARTHROPODA				
Crustacea				
Amphipoda (scuds)		8	182	20
Decapoda (crayfish)	1		1	
Isopoda (sowbugs)	9	145	5	1
Arachnoidea				
Hydracarina	1			
Insecta				
Ephemeroptera (mayflies)				
Baetidae	4		1	8
Caenidae		1		10
Ephemerellidae				1
Heptageniidae	1		8	23
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1			
Zygoptera (damselflies)				
Calopterygidae	2	2	1	5
Coenagrionidae		4		4
Plecoptera (stoneflies)				
Perlidae	2			
Hemiptera (true bugs)				
Corixidae		7	9	2
Gerridae		1	4	1
Pleidae	1	1		
Megaloptera				
Sialidae (alder flies)			5	
Trichoptera (caddisflies)				
Helicopsychidae				24
Hydropsychidae	2		35	65
Hydroptilidae	1			5
Leptoceridae		1	2	1
Limnephilidae	1			
Philopotamidae				8
Polycentropodidae	1		1	
Uenoidae				1
Coleoptera (beetles)				
Dytiscidae (total)	2			1
Haliplidae (adults)		1	2	
Hydrophilidae (total)				4
Elmidae	2	1	3	19
Haliplidae (larvae)	2			
Psephenidae (adults)				5
Diptera (flies)				
Ceratopogonidae		1		
Chironomidae	235	1	15	32
Culicidae				1
Muscidae				1
Ptychopteridae				1
Simuliidae	40			
Stratiomyidae				4
Tabanidae			8	
Tipulidae	3			3
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)			1	1
Hydrobiidae			2	
Physidae	1	1	7	6
Planorbidae		1		1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	3	6	1
TOTAL INDIVIDUALS	319	141	300	274

Table 2B. Macroinvertebrate metric evaluation (Continued)

METRIC	Three Mile Creek Monroe Road 6/1/2010 STATION 25		Webb Creek I69 6/1/2010 STATION 26		Webb Creek Reed Road 8/31/2010 STATION 27		Six Mile Creek Seymore Road 8/12/2010 STATION 28	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	22	0	18	0	22	0	31	1
NUMBER OF MAYFLY TAXA	2	0	1	-1	2	0	4	1
NUMBER OF CADDISFLY TAXA	4	0	1	-1	3	0	6	1
NUMBER OF STONEFLY TAXA	1	1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	1.57	-1	0.71	-1	3.00	0	15.33	0
PERCENT CADDISFLY COMP.	1.57	-1	0.71	-1	12.67	0	37.96	1
PERCENT DOMINANT TAXON	73.67	-1	74.47	-1	60.67	-1	23.72	-1
PERCENT ISOPOD, SNAIL, LEECH	3.13	1	75.89	-1	5.33	0	3.28	1
PERCENT SURF. AIR BREATHERS	0.94	1	7.09	0	5.00	1	6.93	1
TOTAL SCORE		0		-7		-1		4
MACROINV. COMMUNITY RATING		ACCEPT.		POOR		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Deer Creek Sharon Road 8/10/2010 STATION 29	Unnamed Tributary M57 (Broad Street) 8/10/2010 STATION 30	Carson Drain Fergus Road 6/3/2010 STATION 31	Bad River Blair Road 6/4/2010 STATION 32
PLATYHELMINTHES (flatworms)				
Turbellaria		16	3	
ANNELIDA (segmented worms)				
Hirudinea (leeches)	2	3	4	
Oligochaeta (worms)	2	88	7	17
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	9		49	
Decapoda (crayfish)	3			
Isopoda (sowbugs)	53	13	122	17
Arachnoidea				
Hydracarina		2	1	2
Insecta				
Ephemeroptera (mayflies)				
Baetidae			1	1
Caenidae			4	5
Heptageniidae				2
Leptophlebiidae	1			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4		1	1
Zygoptera (damselflies)				
Calopterygidae	8			
Coenagrionidae	1	1	1	1
Plecoptera (stoneflies)				
Perlidae				1
Hemiptera (true bugs)				
Corixidae			75	2
Gerridae	2		1	
Megaloptera				
Sialidae (alder flies)	1			
Trichoptera (caddisflies)				
Helicopsychidae	8			1
Hydropsychidae	15			7
Hydroptilidae				4
Leptoceridae	3		1	1
Phryganeidae	1			
Polycentropodidae	1			
Uenoidae				1
Coleoptera (beetles)				
Dytiscidae (total)	1		11	
Gyrinidae (adults)			1	
Haliplidae (adults)		10	6	4
Hydrophilidae (total)		1		
Dryopidae	2			
Elmidae	61	2	1	13
Haliplidae (larvae)				3
Diptera (flies)				
Ceratopogonidae	1	6		4
Chironomidae	24	1	25	227
Simuliidae			1	
Stratiomyidae	1			
Tabanidae	2	1		1
Tipulidae	1			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			
Hydrobiidae	1			3
Lymnaeidae			1	
Physidae	57	1		1
Planorbidae	1	145	1	
Pleuroceridae	4			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	16	59	4	
TOTAL INDIVIDUALS	287	349	321	319

Table 2B. Macroinvertebrate metric evaluation (Continued).

	Deer Creek Sharon Road 8/10/2010 STATION 29		Unnamed Tributary M57 (Broad Street) 8/10/2010 STATION 30		Carson Drain Fergus Road 6/3/2010 STATION 31		Bad River Blair Road 6/4/2010 STATION 32	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	30	1	15	1	22	0	22	1
NUMBER OF MAYFLY TAXA	1	-1	0	-1	2	0	3	1
NUMBER OF CADDISFLY TAXA	5	1	0	-1	1	-1	5	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	1	1
PERCENT MAYFLY COMP.	0.35	-1	0.00	-1	1.56	-1	2.51	-1
PERCENT CADDISFLY COMP.	9.76	0	0.00	-1	0.31	-1	4.39	0
PERCENT DOMINANT TAXON	21.25	0	41.55	-1	38.01	-1	71.16	-1
PERCENT ISOPOD, SNAIL, LEECH	41.46	-1	46.42	-1	39.88	-1	6.58	0
PERCENT SURF. AIR BREATHERS	1.39	1	3.15	1	29.28	-1	1.88	1
TOTAL SCORE		-1		-5		-7		3
MACROINV. COMMUNITY RATING		ACCEPT.		POOR		POOR		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Bad River Meridian Road 6/3/2010 STATION 33	Bad River Chapin Road 8/9/2010 STATION 34	Potato Creek Hemlock Rd 8/10/2010 STATION 35	Little Potato Creek Chapin Road 6/4/2010 STATION 36
PORIFERA (sponges)			1	
PLATYHELMINTHES (flatworms)				
Turbellaria		1	3	
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	1
Oligochaeta (worms)	1	10	1	7
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	13	11	32	45
Decapoda (crayfish)	8	6	1	2
Isopoda (sowbugs)			5	
Arachnoidea				
Hydracarina			4	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	10	7		7
Caenidae	16	19	25	4
Ephemeridae			2	
Heptageniidae	9	48	1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1	1	1
Libellulidae	1		1	1
Zygoptera (damselflies)				
Calopterygidae				1
Coenagrionidae	1		25	
Plecoptera (stoneflies)				
Perlidae	53			9
Hemiptera (true bugs)				
Belostomatidae			1	
Corixidae	1	1	93	29
Gerridae	1	4	1	2
Notonectidae			1	
Veliidae				1
Megaloptera				
Sialidae (alder flies)		2	15	
Trichoptera (caddisflies)				
Hydropsychidae	7	3		15
Hydroptilidae				1
Leptoceridae		1	5	
Limnephilidae				2
Molannidae			1	
Lepidoptera (moths)				
Pyralidae	1			
Coleoptera (beetles)				
Dytiscidae (total)	1		1	1
Gyrinidae (adults)		1		
Haliplidae (adults)			1	1
Hydrophilidae (total)		1		
Dryopidae	2	1		1
Elmidae	15	12	4	49
Diptera (flies)				
Ceratopogonidae	2	1	2	5
Chironomidae	63	39	68	35
Culicidae		1	2	
Tabanidae	1	5		1
Tipulidae		8		1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	3	3		2
Hydrobiidae	2	38	49	38
Lymnaeidae				1
Physidae	35	26	6	
Planorbidae			3	15
Pelecypoda (bivalves)				
Sphaeriidae (clams)	10	5	10	22
Unionidae (mussels)		1		
TOTAL INDIVIDUALS	258	256	366	301

Table 2B. Macroinvertebrate metric evaluation (Continued)

METRIC	Bad River Meridian Road 6/3/2010 STATION 33		Bad River Chapin Road 8/9/2010 STATION 34		Potato Creek Hemlock Rd 8/10/2010 STATION 35		Little Potato Creek Chapin Road 6/4/2010 STATION 36	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	24	1	27	1	31	1	30	1
NUMBER OF MAYFLY TAXA	3	1	3	0	3	1	2	1
NUMBER OF CADDISFLY TAXA	1	-1	2	0	2	0	3	1
NUMBER OF STONEFLY TAXA	1	1	0	0	0	0	1	1
PERCENT MAYFLY COMP.	13.57	-1	28.91	1	7.65	-1	3.65	-1
PERCENT CADDISFLY COMP.	2.71	-1	1.56	-1	1.64	-1	5.98	0
PERCENT DOMINANT TAXON	24.42	-1	18.75	0	25.41	-1	16.28	0
PERCENT ISOPOD, SNAIL, LEECH	15.50	-1	26.17	-1	17.49	-1	18.94	-1
PERCENT SURF. AIR BREATHERS	1.16	1	3.13	1	27.32	-1	11.30	0
TOTAL SCORE		-1		1		-3		2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Lamb Creek Gary Road 8/9/2010 STATION 37	Griffus Creek Brennan Road 8/10/2010 STATION 38	So. Fork Bad River Chapin Road 6/4/2010 STATION 39	So. Fork Bad River Brant Road 8/31/2010 STATION 40
PORIFERA (sponges)				1
PLATYHELMINTHES (flatworms)				
Turbellaria		1		
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	
Oligochaeta (worms)		3	9	3
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	4	3	6	
Decapoda (crayfish)	3	4	2	6
Isopoda (sowbugs)	1	5		6
Arachnoidea				
Hydracarina		3	1	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	7			
Caenidae	18	1	2	
Ephemeridae				1
Heptageniidae	61		1	16
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4		4	1
Zygoptera (damselflies)				
Calopterygidae			2	5
Coenagrionidae		2	1	9
Hemiptera (true bugs)				
Corixidae	9	1	4	57
Gerridae		1	3	
Nepidae				1
Notonectidae				1
Veliidae	1			
Megaloptera				
Sialidae (alder flies)				1
Trichoptera (caddisflies)				
Brachycentridae			1	
Helicopsychidae	1	6		
Hydropsychidae			1	
Leptoceridae	8	3		
Limnephilidae				1
Molannidae		3		
Phryganeidae				1
Coleoptera (beetles)				
Dytiscidae (total)			1	
Haliplidae (adults)			3	1
Hydrophilidae (total)	1	1	1	
Elmidae	39	28	7	12
Diptera (flies)				
Chironomidae	49	27	182	143
Culicidae				4
Dixidae	1			
Tabanidae	3		1	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	10	5		3
Hydrobiidae	1			28
Physidae	9	26	3	3
Planorbidae	1			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	11	6	5	11
TOTAL INDIVIDUALS	242	129	241	316

Table 2B. Macroinvertebrate metric evaluation (Continued).

METRIC	Lamb Creek Gary Road 8/9/2010 STATION 37 Value	Score	Griffus Creek Brennan Road 8/10/2010 STATION 38 Value	Score	So. Fork Bad River Chapin Road 6/4/2010 STATION 39 Value	Score	So. Fork Bad River Brant Road 8/31/2010 STATION 40 Value	Score
TOTAL NUMBER OF TAXA	21	0	19	1	22	0	24	1
NUMBER OF MAYFLY TAXA	3	1	1	1	2	0	2	1
NUMBER OF CADDISFLY TAXA	2	0	3	1	2	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	35.54	1	0.78	-1	1.24	-1	5.38	-1
PERCENT CADDISFLY COMP.	3.72	0	9.30	0	0.83	-1	0.63	-1
PERCENT DOMINANT TAXON	25.21	-1	21.71	0	75.52	-1	45.25	-1
PERCENT ISOPOD, SNAIL, LEECH	9.09	0	27.91	-1	1.66	1	12.66	0
PERCENT SURF. AIR BREATHERS	4.55	1	2.33	1	4.98	1	20.25	0
TOTAL SCORE		1		1		-2		-2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	Beaver Creek Ransom Road 6/3/2010 STATION 41	Beaver Creek Merrill Road 6/3/2010 STATION 42	Beaver Creek Brennan Road 6/3/2010 STATION 43	Nelson Run Fehn Road 6/4/2010 STATION 44
PLATYHELMINTHES (flatworms)				
Turbellaria				8
BRYOZOA (moss animals)				1
ANNELIDA (segmented worms)				
Hirudinea (leeches)				1
Oligochaeta (worms)	3	4	2	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	1	3		44
Decapoda (crayfish)	3	3	16	1
Isopoda (sowbugs)	3	1		11
Arachnoidea				
Hydracarina	2		1	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	4	2	10	9
Caenidae	1			3
Ephemerellidae		1		
Heptageniidae		6	9	4
Tricorythidae				16
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		2		
Libellulidae	1	2	1	1
Zygoptera (damselflies)				
Coenagrionidae	1		1	1
Plecoptera (stoneflies)				
Perlidae		28	25	
Hemiptera (true bugs)				
Corixidae		8	72	
Gerridae			2	1
Trichoptera (caddisflies)				
Helicopsychidae				8
Hydropsychidae			16	
Leptoceridae		2	1	
Limnephilidae		3		
Uenoidae		3	1	
Coleoptera (beetles)				
Dytiscidae (total)	1	1		1
Haliplidae (adults)	6	2	4	
Elmidae	1	1	34	19
Gyrinidae (larvae)				1
Haliplidae (larvae)	1			14
Diptera (flies)				
Ceratopogonidae			2	5
Chironomidae	177	29	68	104
Simuliidae				5
Tabanidae		2	1	
Tipulidae		1		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)			1	
Hydrobiidae	9	3	23	16
Lymnaeidae			1	9
Physidae	1	27		5
Planorbidae	59	1		4
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	5	5	8
TOTAL INDIVIDUALS	275	140	296	305

Table 2B. Macroinvertebrate metric evaluation (Continued).

METRIC	Beaver Creek Ransom Road 6/3/2010 STATION 41		Beaver Creek Merrill Road 6/3/2010 STATION 42		Beaver Creek Brennan Road 6/3/2010 STATION 43		Nelson Run Fehn Road 6/4/2010 STATION 44	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	17	-1	24	0	22	0	28	1
NUMBER OF MAYFLY TAXA	2	-1	3	0	2	0	4	1
NUMBER OF CADDISFLY TAXA	0	-1	3	0	3	0	1	-1
NUMBER OF STONEFLY TAXA	0	-1	1	1	1	1	0	-1
PERCENT MAYFLY COMP.	1.82	-1	6.43	-1	6.42	-1	10.49	-1
PERCENT CADDISFLY COMP.	0.00	-1	5.71	0	6.08	0	2.62	-1
PERCENT DOMINANT TAXON	64.36	-1	20.71	0	24.32	-1	34.10	-1
PERCENT ISOPOD, SNAIL, LEECH	26.18	-1	22.86	-1	8.45	0	15.08	-1
PERCENT SURF. AIR BREATHERS	2.55	1	7.86	1	26.35	-1	0.66	1
TOTAL SCORE		-7		0		-2		-3
MACROINV. COMMUNITY RATING		POOR		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results (Continued).

TAXA	McClellan Run Orr Rd 8/10/2010 STATION 45	Williams Creek Graham Road (M52) 8/10/2010 STATION 46	Swan Creek Schomaker Road 6/3/2010 STATION 47
PLATYHELMINTHES (flatworms)			
Turbellaria	11	48	
ANNELIDA (segmented worms)			
Hirudinea (leeches)	13	18	
Oligochaeta (worms)	2	56	14
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	56	28	32
Decapoda (crayfish)	1		2
Isopoda (sowbugs)	14	100	11
Arachnoidea			
Hydracarina		1	9
Insecta			
Ephemeroptera (mayflies)			
Baetidae	14		
Caenidae	14		27
Ephemerellidae	1		
Heptageniidae	1		
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1	1	
Zygoptera (damselflies)			
Coenagrionidae	155	35	22
Hemiptera (true bugs)			
Belostomatidae	3	1	1
Corixidae	3	3	78
Gerridae	1	1	1
Notonectidae		1	1
Megaloptera			
Sialidae (alder flies)	1		
Trichoptera (caddisflies)			
Helicopsychidae	83		
Hydropsychidae			1
Hydroptilidae			1
Leptoceridae	10		2
Coleoptera (beetles)			
Curculionidae (adults)			1
Dytiscidae (total)		2	
Gyrinidae (adults)		1	
Haliplidae (adults)	10	3	2
Hydrophilidae (total)	9		2
Elmidae	14	9	2
Haliplidae (larvae)	1		
Diptera (flies)			
Ceratopogonidae	2	1	2
Chironomidae	12	20	30
Culicidae	3		
Tabanidae	1		
Tipulidae			1
MOLLUSCA			
Gastropoda (snails)			
Physidae	8	1	22
Planorbidae	1	2	17
Pelecypoda (bivalves)			
Sphaeriidae (clams)	5	4	
TOTAL INDIVIDUALS	450	336	281

Table 2B. Macroinvertebrate metric evaluation (Continued).

	McClellan Run Orr Rd 8/10/2010 STATION 45		Williams Creek Graham Road (M52) 8/10/2010 STATION 46		Swan Creek Schomaker Road 6/3/2010 STATION 47	
METRIC	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	28	1	21	1	23	0
NUMBER OF MAYFLY TAXA	4	1	0	-1	1	-1
NUMBER OF CADDISFLY TAXA	2	0	0	-1	3	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	6.67	-1	0.00	-1	9.61	-1
PERCENT CADDISFLY COMP.	20.67	0	0.00	-1	1.42	-1
PERCENT DOMINANT TAXON	34.44	-1	29.76	-1	27.76	-1
PERCENT ISOPOD, SNAIL, LEECH	8.00	0	36.01	-1	17.79	-1
PERCENT SURF. AIR BREATHERS	6.44	1	3.57	1	30.60	-1
TOTAL SCORE		0		-5		-7
MACROINV. COMMUNITY RATING		ACCEPT.		POOR		POOR

Table 3

HABITAT METRIC	Shiawassee River Hogan Rd GLIDE/POOL Station 1	Shiawassee River Bird Road GLIDE/POOL Station 2	Shiawassee River Lehring Road GLIDE/POOL Station 3	Shiawassee River Lytle Road RIFFLE/RUN Station 4	Shiawassee River Oliver Street GLIDE/POOL Station 5
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	10	7	10	13	11
Embeddedness (20)*				11	
Velocity/Depth Regime (20)*				6	
Pool Substrate Characterization (20)**	10	7	5		16
Pool Variability (20)**	11	6	5		1
Channel Morphology					
Sediment Deposition (20)	10	8	15	17	18
Flow Status - Maint. Flow Volume (10)	8	9	8	9	9
Flow Status - Flashiness (10)	9	8	7	8	8
Channel Alteration (20)	16	13	15	15	14
Frequency of Riffles/Bends (20)*				13	
Channel Sinuosity (20)**	10	6	8		11
Riparian and Bank Structure					
Bank Stability (L) (10)	10	10	8	7	8
Bank Stability (R) (10)	10	10	8	7	8
Vegetative Protection (L) (10)	10	10	9	7	9
Vegetative Protection (R) (10)	10	10	9	7	9
Riparian Veg. Zone Width (L) (10)	9	10	9	9	3
Riparian Veg. Zone Width (R) (10)	9	8	9	8	4
TOTAL SCORE (200):	142	122	125	137	129
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	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 Ratir describes the general riverine environment at the site(s)

Date:	6/2/2010	6/2/2010	6/2/2010	6/1/2010	6/1/2010
Weather:	Cloudy	Cloudy	Cloudy	Sunny	Sunny
Air Temperature:	70 Deg. F.	70 Deg. F.	70 Deg. F.	82 Deg. F.	78 Deg. F.
Water Temperature:	75 Deg. F.	75 Deg. F.	75 Deg. F.	78 Deg. F.	77 Deg. F.
Ave. Stream Width:	60 Feet	90 Feet	120 Feet	130 Feet	150 Feet
Ave. Stream Depth:	2.5 Feet	3 Feet	2 Feet	1.5 Feet	1.75 Feet
Surface Velocity:	0.8 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	120 CFS	135 CFS	240 CFS	195 CFS	262.5 CFS
Stream Modifications:	None	Dredged		None	Impounded
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	250462	250117	780202	780066	780053
Stream Name:	Shiawassee River	Shiawassee River	Shiawassee River	Shiawassee River	Shiawassee River
Road Crossing/Location:	Hogan Rd	Bird Road	Lehring Road	Lytle Road	Oliver Street
County Code:	25	25	78	78	78
TRS:	05N06E19	05N05E28	05N04E08	07N03E26	07N02E14
Latitude (dd):	42.81572	42.8088	42.84017	42.97684	43.0033
Longitude (dd):	-83.8021	-83.8751	-84.00987	-84.07018	-84.18655
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Shiawassee River Harmon Partridge Park RIFFLE/RUN Station 6	Shiawassee River Henderson Road RIFFLE/RUN Station 7	North Ore Creek Crouse Road RIFFLE/RUN Station 8	Unnamed Tributary Musson Road GLIDE/POOL Station 9	South Branch Shiawassee River Norton Road GLIDE/POOL Station 10
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	11	14	14	6	7
Embeddedness (20)*	10	13	13		
Velocity/Depth Regime (20)*	13	15	13		
Pool Substrate Characterization (20)**				7	6
Pool Variability (20)**				6	1
Channel Morphology					
Sediment Deposition (20)	17	15	13	6	6
Flow Status - Maint. Flow Volume (10)	8	9	9	7	6
Flow Status - Flashiness (10)	8	9	10	8	6
Channel Alteration (20)	17	17	15	11	10
Frequency of Riffles/Bends (20)*	7	10	15		
Channel Sinuosity (20)**				6	3
Riparian and Bank Structure					
Bank Stability (L) (10)	9	6	8	8	6
Bank Stability (R) (10)	9	6	8	8	6
Vegetative Protection (L) (10)	9	6	9	8	5
Vegetative Protection (R) (10)	6	6	9	8	5
Riparian Veg. Zone Width (L) (10)	5	7	8	7	7
Riparian Veg. Zone Width (R) (10)	3	7	9	7	4
TOTAL SCORE (200):	132	140	153	103	78
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	6/1/2010	6/1/2010	8/11/2010	8/12/2010	7/28/2010
Weather:	Sunny	Cloudy	Sunny	Rainy	Sunny
Air Temperature:	70 Deg. F.	65 Deg. F.	74 Deg. F.	74 Deg. F.	76 Deg. F.
Water Temperature:	74 Deg. F.	73 Deg. F.	68 Deg. F.	73 Deg. F.	71 Deg. F.
Ave. Stream Width:	120 Feet	75 Feet	18 Feet	15 Feet	12 Feet
Ave. Stream Depth:	1.5 Feet	4 Feet	1 Feet	0.25 Feet	0.75 Feet
Surface Velocity:	1.3 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.	0.75 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	234 CFS	300 CFS	18 CFS	2.8125 CFS	9 CFS
Stream Modifications:	None		None	Dredged	Dredged
Nuisance Plants (Y/N):	Y	N	N	N	N
Report Number:					
STORET No.:	780243	780059	470507	470637	470564
Stream Name:	Shiawassee River	Shiawassee River	North Ore Creek	Unnamed Tributary	South Branch Shiawassee River
Road Crossing/Location:	Harmon Partridge Park	Henderson Road	Crouse Road	Musson Road	Norton Road
County Code:	78	78	47	47	47
TRS:	07N02E12	08N02E13	03N06E16	03N05E13	02N04E03
Latitude (dd):	43.02061	43.08791	42.65502	42.65831	42.59487
Longitude (dd):	-84.1832	-84.18254	-83.75636	-83.80815	-83.96122
Ecoregion:	SMNITP	HELP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	So. Br. Shiawassee River Chase Lake Road GLIDE/POOL Station 11	So. Br. Shiawassee River Oak Grove Road GLIDE/POOL Station 12	Bogue Creek Gully Road RIFFLE/RUN Station 13	Bogue Creek Latson Road GLIDE/POOL Station 14	Bogue Creek Marr Road GLIDE/POOL Station 15
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	3	7	17	10	10
Embeddedness (20)*			17		
Velocity/Depth Regime (20)*			15		
Pool Substrate Characterization (20)**	7	8		9	8
Pool Variability (20)**	7	10		10	11
Channel Morphology					
Sediment Deposition (20)	7	10	17	12	7
Flow Status - Maint. Flow Volume (10)	7	8	9	8	8
Flow Status - Flashiness (10)	5	8	9	6	6
Channel Alteration (20)	12	13	18	18	12
Frequency of Riffles/Bends (20)*			16		
Channel Sinuosity (20)**	2	8		15	8
Riparian and Bank Structure					
Bank Stability (L) (10)	4	5	9	8	3
Bank Stability (R) (10)	4	5	9	8	3
Vegetative Protection (L) (10)	4	6	10	7	5
Vegetative Protection (R) (10)	4	6	10	7	5
Riparian Veg. Zone Width (L) (10)	5	6	9	7	9
Riparian Veg. Zone Width (R) (10)	0	10	10	7	8
TOTAL SCORE (200):	71	110	175	132	103
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON-IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	8/11/2010	6/2/2010	7/28/2010	7/28/2010	8/11/2010
Weather:	Cloudy	Partly Cloudy	Partly Cloudy	Cloudy	Cloudy
Air Temperature:	83 Deg. F.	72 Deg. F.	80 Deg. F.	79 Deg. F.	80 Deg. F.
Water Temperature:	70 Deg. F.	70 Deg. F.	80 Deg. F.	70 Deg. F.	70 Deg. F.
Ave. Stream Width:	38 Feet	90 Feet	7 Feet	8 Feet	22 Feet
Ave. Stream Depth:	3 Feet	3.5 Feet	0.4 Feet	1 Feet	1 Feet
Surface Velocity:	0.2 Ft./Sec.	0.8 Ft./Sec.	1.3 Ft./Sec.	0.5 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	22.8 CFS	252 CFS	3.64 CFS	4 CFS	22 CFS
Stream Modifications:	Dredged	Dredged	Impounded	None	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	470500	470177	470640	470639	470643
Stream Name:	Shiawassee River	Branch Shiawassee River	Bogue Creek	Bogue Creek	Bogue Creek
Road Crossing/Location:	Chase Lake Road	Oak Grove Road	Gully Road	Latson Road	Marr Road
County Code:	47	47	47	47	47
TRS:	04N04E28	04N04E23	03N05E28	03N05E28	03N04E12
Latitude (dd):	42.70885	42.72623	42.619883	42.6195	42.66405
Longitude (dd):	-83.98227	-83.94879	-83.86575	-83.87509	-83.91688
Ecoregion:	SMNITP	HELP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Bogue Creek Allen Road GLIDE/POOL Station 16	Bogue Creek Jones Road GLIDE/POOL Station 17	Unnamed Tributary Eager Road GLIDE/POOL Station 18	Unnamed Tributary Latosn Road GLIDE/POOL Station 19	Cranberry Creek White Road GLIDE/POOL Station 20
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	6	7	6	12	15
Embeddedness (20)*					
Velocity/Depth Regime (20)*					
Pool Substrate Characterization (20)**	7	7	6	13	12
Pool Variability (20)**	8	6	2	10	10
Channel Morphology					
Sediment Deposition (20)	8	8	8	17	14
Flow Status - Maint. Flow Volume (10)	8	8	8	8	8
Flow Status - Flashiness (10)	8	9	5	8	7
Channel Alteration (20)	13	16	11	13	13
Frequency of Riffles/Bends (20)*					
Channel Sinuosity (20)**	2	8	3	2	10
Riparian and Bank Structure					
Bank Stability (L) (10)	8	9	6	9	9
Bank Stability (R) (10)	8	9	6	9	9
Vegetative Protection (L) (10)	9	10	9	9	9
Vegetative Protection (R) (10)	9	10	7	9	9
Riparian Veg. Zone Width (L) (10)	10	10	8	7	9
Riparian Veg. Zone Width (R) (10)	10	10	7	8	2
TOTAL SCORE (200):	114	127	92	134	136
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	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 Ratir describes the general riverine environment at the site(s)

Date:	8/11/2010	6/2/2010	7/28/2010	8/11/2010	8/31/2010
Weather:	Rainy	Cloudy	Partly Cloudy	Cloudy	Sunny
Air Temperature:	83 Deg. F.	70 Deg. F.	86 Deg. F.	80 Deg. F.	90 Deg. F.
Water Temperature:	72 Deg. F.	71 Deg. F.	65 Deg. F.	73 Deg. F.	80 Deg. F.
Ave. Stream Width:	40 Feet	24 Feet	6 Feet	12 Feet	10 Feet
Ave. Stream Depth:	2 Feet	1 Feet	0.25 Feet	0.5 Feet	1 Feet
Surface Velocity:	0.05 Ft./Sec.	1 Ft./Sec.	0.8 Ft./Sec.	0.75 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	4 CFS	24 CFS	1.2 CFS	4.5 CFS	10 CFS
Stream Modifications:	Dredged	None	Dredged	Dredged	Canopy Removal
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	470642	470636	470638	470641	470644
Stream Name:	Bogue Creek	Bogue Creek	Unnamed Tributary	Unnamed Tributary	Cranberry Creek
Road Crossing/Location:	Allen Road	Jones Road	Eager Road	Latosn Road	White Road
County Code:	47	47	47	47	47
TRS:	03N04E01	04N04E24	03N05E20	04N05E08	04N05E04
Latitude (dd):	42.68788	42.72164	42.65593	42.7541	42.76891
Longitude (dd):	-83.92372	-83.93175	-83.8961	-83.8846	-83.87434
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Sprague Creek Gannon Road GLIDE/POOL Station 21	Sprague Creek Betterly Road GLIDE/POOL Station 22	Scribner Creek Bliven Road GLIDE/POOL Station 23	Three Mile Creek Pittsburg Road GLIDE/POOL Station 24	Three Mile Creek Monroe Road GLIDE/POOL Station 25
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	5	7	3	6	3
Embeddedness (20)*					
Velocity/Depth Regime (20)*					
Pool Substrate Characterization (20)**	6	7	6	6	7
Pool Variability (20)**	2	2	4	6	2
Channel Morphology					
Sediment Deposition (20)	5	11	3	9	13
Flow Status - Maint. Flow Volume (10)	7	7	3	6	4
Flow Status - Flashiness (10)	8	8	6	5	4
Channel Alteration (20)	8	12	7	8	9
Frequency of Riffles/Bends (20)*					
Channel Sinuosity (20)**	1	2	1	3	3
Riparian and Bank Structure					
Bank Stability (L) (10)	2	9	8	6	8
Bank Stability (R) (10)	2	9	8	6	8
Vegetative Protection (L) (10)	3	9	7	5	6
Vegetative Protection (R) (10)	3	9	7	5	6
Riparian Veg. Zone Width (L) (10)	2	4	8	5	8
Riparian Veg. Zone Width (R) (10)	8	4	8	5	8
TOTAL SCORE (200):	62	100	79	81	89
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	8/12/2010	6/2/2010	8/31/2010	8/12/2010	6/1/2010
Weather:	Cloudy	Cloudy	Sunny	Sunny	Sunny
Air Temperature:	78 Deg. F.	66 Deg. F.	85 Deg. F.	89 Deg. F.	82 Deg. F.
Water Temperature:	73 Deg. F.	70 Deg. F.	78 Deg. F.	73 Deg. F.	70 Deg. F.
Ave. Stream Width:	9 Feet	18 Feet	4 Feet	10 Feet	20 Feet
Ave. Stream Depth:	0.25 Feet	2 Feet	0.5 Feet	0.25 Feet	0.8 Feet
Surface Velocity:	1 Ft./Sec.	1 Ft./Sec.	0.3 Ft./Sec.	0.7 Ft./Sec.	0.8 Ft./Sec.
Estimated Flow:	2.25 CFS	36 CFS	0.6 CFS	1.75 CFS	12.8 CFS
Stream Modifications:	Dredged	Dredged	Dredged	Dredged	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	470553	470635	780219	780244	780241
Stream Name:	Sprague Creek	Sprague Creek	Scribner Creek	Three Mile Creek	Three Mile Creek
Road Crossing/Location:	Gannon Road	Betterly Road	Bliven Road	Pittsburg Road	Monroe Road
County Code:	47	47	78	78	78
TRS:	04N04E17	04N04E09	05N03E25	06N04E27	06N04E18
Latitude (dd):	42.7447	42.74552	42.8033	42.58911	42.91856
Longitude (dd):	-83.982	-83.98414	-84.0553	-83.93507	-83.96615
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Webb Creek I69 GLIDE/POOL Station 26	Webb Creek Reed Road GLIDE/POOL Station 27	Six Mile Creek Seymore Road RIFFLE/RUN Station 28	Deer Creek Sharon Road GLIDE/POOL Station 29	Unnamed Tributary M57 (Broad Street) GLIDE/POOL Station 30
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	7	4	18	4	2
Embeddedness (20)*			13		
Velocity/Depth Regime (20)*			8		
Pool Substrate Characterization (20)**	7	6		6	8
Pool Variability (20)**	5	3		5	1
Channel Morphology					
Sediment Deposition (20)	15	2	16	8	6
Flow Status - Maint. Flow Volume (10)	8	3	2	3	3
Flow Status - Flashiness (10)	3	3	4	1	5
Channel Alteration (20)	11	10	13	10	6
Frequency of Riffles/Bends (20)*			7		
Channel Sinuosity (20)**	5	2		6	2
Riparian and Bank Structure					
Bank Stability (L) (10)	8	1	2	2	8
Bank Stability (R) (10)	8	1	2	2	8
Vegetative Protection (L) (10)	8	0	3	1	6
Vegetative Protection (R) (10)	8	0	3	1	6
Riparian Veg. Zone Width (L) (10)	5	1	4	3	0
Riparian Veg. Zone Width (R) (10)	5	1	6	8	0
TOTAL SCORE (200):	103	37	101	60	61
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	POOR (SEVERELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	6/1/2010	8/31/2010	8/12/2010	8/10/2010	8/10/2010
Weather:	Sunny	Sunny	Sunny	Cloudy	Partly Cloudy
Air Temperature:	78 Deg. F.	85 Deg. F.	90 Deg. F.	80 Deg. F.	87 Deg. F.
Water Temperature:	72 Deg. F.	72 Deg. F.	73 Deg. F.	74 Deg. F.	73 Deg. F.
Ave. Stream Width:	20 Feet	14 Feet	1.5 Feet	12 Feet	6 Feet
Ave. Stream Depth:	2 Feet	0.75 Feet	0.2 Feet	0.7 Feet	0.75 Feet
Surface Velocity:	0.4 Ft./Sec.	0.1 Ft./Sec.	1 Ft./Sec.	0.2 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	16 CFS	1.05 CFS	0.3 CFS	1.68 CFS	0.45 CFS
Stream Modifications:	Dredged	Dredged	Bank Stabilization	Dredged	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	780242	780188	780099	730330	730355
Stream Name:	Webb Creek	Webb Creek	Six Mile Creek	Deer Creek	Unnamed Tributary
Road Crossing/Location:	I69	Reed Road	Seymore Road	Sharon Road	M57 (Broad Street)
County Code:	78	78	78	73	73
TRS:	06N04E02	07N04E33	08N03E18	10N03E28	09N03E16
Latitude (dd):	42.95661	42.96193	43.09147	43.23689	43.18609
Longitude (dd):	-83.9684	-84.00705	-84.1538	-84.11458	-84.12556
Ecoregion:	SMNITP	SMNITP	HELP	HELP	HELP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080103	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Carson Drain Fergus Road GLIDE/POOL Station 31	Bad River Blair Road GLIDE/POOL Station 32	Bad River Meridian Road GLIDE/POOL Station 33	Bad River Chapin Road RIFFLE/RUN Station 34	Potato Creek Hemlock Rd GLIDE/POOL Station 35
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	6	6	10	16	6
Embeddedness (20)*				16	
Velocity/Depth Regime (20)*				1	
Pool Substrate Characterization (20)**	6	8	5		6
Pool Variability (20)**	5	6	15		6
Channel Morphology					
Sediment Deposition (20)	14	8	15	15	8
Flow Status - Maint. Flow Volume (10)	6	4	5	1	4
Flow Status - Flashiness (10)	5	4	3	3	2
Channel Alteration (20)	1	2	18	13	11
Frequency of Riffles/Bends (20)*				10	
Channel Sinuosity (20)**	0	1	14		6
Riparian and Bank Structure					
Bank Stability (L) (10)	7	3	6	8	4
Bank Stability (R) (10)	7	3	6	8	4
Vegetative Protection (L) (10)	4	3	9	8	3
Vegetative Protection (R) (10)	4	3	9	8	3
Riparian Veg. Zone Width (L) (10)	0	0	10	9	1
Riparian Veg. Zone Width (R) (10)	0	0	10	1	5
TOTAL SCORE (200):	65	51	135	117	69
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	POOR (SEVERELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	6/3/2010	6/4/2010	6/3/2010	8/9/2010	8/10/2010
Weather:	Sunny	Cloudy	Partly Cloudy	Sunny	Cloudy
Air Temperature:	72 Deg. F.	72 Deg. F.	70 Deg. F.	80 Deg. F.	80 Deg. F.
Water Temperature:	67 Deg. F.	64 Deg. F.	67 Deg. F.	75 Deg. F.	73 Deg. F.
Ave. Stream Width:	30 Feet	8 Feet	40 Feet	22 Feet	12 Feet
Ave. Stream Depth:	1.5 Feet	1 Feet	2.5 Feet	0.5 Feet	0.75 Feet
Surface Velocity:	1 Ft./Sec.	1.3 Ft./Sec.	1.3 Ft./Sec.	0.1 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	45 CFS	10.4 CFS	130 CFS	1.1 CFS	0.9 CFS
Stream Modifications:	Dredged	Dredged	None	None	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	730348	290204	290203	730352	730305
Stream Name:	Carson Drain	Bad River	Bad River	Bad River	Potato Creek
Road Crossing/Location:	Fergus Road	Blair Road	Meridian Road	Chapin Road	Hemlock Rd
County Code:	73	29	29	73	73
TRS:	10N03E21	10N02W14	11N01W25	10N01E02	10N02E16
Latitude (dd):	43.25485	43.25742	43.3073	43.30188	43.2645315
Longitude (dd):	-84.11384	-84.50386	-84.3695	-84.30959	-84.2300109
Ecoregion:	HELP	HELP	HELP	HELP	HELP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Little Potato Creek Chapin Road GLIDE/POOL Station 36	Lamb Creek Gary Road GLIDE/POOL Station 37	Griffus Creek Brennan Road RIFFLE/RUN Station 38	South Fork Bad River Chapin Road GLIDE/POOL Station 39	South Fork Bad River Brant Road GLIDE/POOL Station 40
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	5	6	8	2	7
Embeddedness (20)*			14		
Velocity/Depth Regime (20)*			12		
Pool Substrate Characterization (20)**	8	6		6	7
Pool Variability (20)**	11	6		0	7
Channel Morphology					
Sediment Deposition (20)	8	12	9	7	10
Flow Status - Maint. Flow Volume (10)	4	5	3	7	3
Flow Status - Flashiness (10)	4	4	3	3	1
Channel Alteration (20)	10	8	13	11	13
Frequency of Riffles/Bends (20)*			8		
Channel Sinuosity (20)**	6	3		1	11
Riparian and Bank Structure					
Bank Stability (L) (10)	8	5	7	8	7
Bank Stability (R) (10)	8	5	7	8	7
Vegetative Protection (L) (10)	6	7	3	5	2
Vegetative Protection (R) (10)	6	7	3	5	2
Riparian Veg. Zone Width (L) (10)	8	2	3	10	8
Riparian Veg. Zone Width (R) (10)	8	2	2	10	4
TOTAL SCORE (200):	100	78	95	83	89
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	6/4/2010	8/9/2010	8/10/2010	6/4/2010	8/31/2010
Weather:	Partly Cloudy	Partly Cloudy	Sunny	Partly Cloudy	Partly Cloudy
Air Temperature:	71 Deg. F.	85 Deg. F.	87 Deg. F.	73 Deg. F.	75 Deg. F.
Water Temperature:	65 Deg. F.	Deg. F.	74 Deg. F.	66 Deg. F.	72 Deg. F.
Ave. Stream Width:	88 Feet	10 Feet	2 Feet	40 Feet	8 Feet
Ave. Stream Depth:	2 Feet	1 Feet	0.2 Feet	1 Feet	1 Feet
Surface Velocity:	1 Ft./Sec.	0.2 Ft./Sec.	0.4 Ft./Sec.	1 Ft./Sec.	0 Ft./Sec.
Estimated Flow:	176 CFS	2 CFS	0.16 CFS	40 CFS	0 CFS
Stream Modifications:	Dredged	Dredged	Dredged	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	730350	730353	730354	730331	730174
Stream Name:	ttle Potato Creek	Lamb Creek	Griffus Creek	South Fork Bad River	South Fork Bad River
Road Crossing/Location:	Chapin Road	Gary Road	Brennan Road	Chapin Road	Brant Road
County Code:	73	73	73	73	78
TRS:	10N02W14	09N02E05	09N02E32	09N01E11	10N02E23
Latitude (dd):	43.23847	43.21517	43.1405	43.1984	43.25839
Longitude (dd):	-84.30786	-84.25311	-84.24676	-84.3065	-84.2094
Ecoregion:	HELP	HELP	HELP	HELP	HELP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Beaver Creek Ransom Road GLIDE/POOL Station 41	Beaver Creek Merrill Road GLIDE/POOL Station 42	Beaver Creek Brennan Road RIFFLE/RUN Station 43	Nelson Run Fehn Road GLIDE/POOL Station 4	McClellan Run Orr Rd RIFFLE/RUN Station 45
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	6	7	10	6	12
Embeddedness (20)*			14		18
Velocity/Depth Regime (20)*			16		11
Pool Substrate Characterization (20)**	11	8		11	
Pool Variability (20)**	5	5		6	
Channel Morphology					
Sediment Deposition (20)	10	15	15	15	19
Flow Status - Maint. Flow Volume (10)	8	3	6	4	4
Flow Status - Flashiness (10)	4	2	6	4	4
Channel Alteration (20)	6	17	15	6	5
Frequency of Riffles/Bends (20)*			7		8
Channel Sinuosity (20)**	2	13		0	
Riparian and Bank Structure					
Bank Stability (L) (10)	2	8	2	3	6
Bank Stability (R) (10)	2	8	2	3	6
Vegetative Protection (L) (10)	3	10	9	5	6
Vegetative Protection (R) (10)	3	7	3	5	6
Riparian Veg. Zone Width (L) (10)	1	8	4	0	2
Riparian Veg. Zone Width (R) (10)	1	10	10	0	1
TOTAL SCORE (200):	64	121	119	68	108
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	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 Ratir describes the general riverine environment at the site(s)

Date:	6/3/2010	6/3/2010	6/3/2010	6/4/2010	8/10/2010
Weather:	Cloudy	Partly Cloudy	Cloudy	Sunny	Cloudy
Air Temperature:	70 Deg. F.	72 Deg. F.	70 Deg. F.	67 Deg. F.	72 Deg. F.
Water Temperature:	66 Deg. F.	68 Deg. F.	70 Deg. F.	64 Deg. F.	70 Deg. F.
Ave. Stream Width:	25 Feet	55 Feet	65 Feet	12 Feet	10 Feet
Ave. Stream Depth:	4.5 Feet	4 Feet	1.5 Feet	2.5 Feet	0.5 Feet
Surface Velocity:	1.2 Ft./Sec.	1.2 Ft./Sec.	1 Ft./Sec.	1.3 Ft./Sec.	Ft./Sec.
Estimated Flow:	135 CFS	264 CFS	97.5 CFS	39 CFS	CFS
Stream Modifications:	Dredged	None	None	Dredged	Dredged
Nuisance Plants (Y/N):	Y	N	N	N	N
Report Number:					
STORET No.:	290202	730347	730346	730349	730298
Stream Name:	Beaver Creek	Beaver Creek	Beaver Creek	Nelson Run	McClellan Run
Road Crossing/Location:	Ransom Road	Merrill Road	Brennan Road	Fehn Road	Orr Rd
County Code:	29	73	73	73	73
TRS:	11N01W08	11N01E23	11N02E21	10N03E21	12N02E24
Latitude (dd):	43.3648	43.34226	43.33739	43.4809	43.43179
Longitude (dd):	-84.44924	-84.33027	-84.27873	-84.22039	-84.17057
Ecoregion:	HELP	HELP	HELP	HELP	HELP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203	4080203	4080203	4080203

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

COMMENTS:

Table 3 cont.

HABITAT METRIC	Williams Creek u/s Graham Road (M52) GLIDE/POOL Station 46	Swan Creek Schomaker Road GLIDE/POOL Station 47
Substrate and Instream Cover		
Epifaunal Substrate/ Avail Cover (20)	2	1
Embeddedness (20)*		
Velocity/Depth Regime (20)*		
Pool Substrate Characterization (20)**	6	6
Pool Variability (20)**	2	2
Channel Morphology		
Sediment Deposition (20)	11	2
Flow Status - Maint. Flow Volume (10)	3	9
Flow Status - Flashiness (10)	4	9
Channel Alteration (20)	3	11
Frequency of Riffles/Bends (20)*		
Channel Sinuosity (20)**	1	6
Riparian and Bank Structure		
Bank Stability (L) (10)	5	10
Bank Stability (R) (10)	5	10
Vegetative Protection (L) (10)	5	10
Vegetative Protection (R) (10)	5	10
Riparian Veg. Zone Width (L) (10)	1	7
Riparian Veg. Zone Width (R) (10)	1	7
TOTAL SCORE (200):	54	100
HABITAT RATING:	POOR (SEVERELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)

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

Date:	8/10/2010	6/3/2010
Weather:	Cloudy	Cloudy
Air Temperature:	78 Deg. F.	62 Deg. F.
Water Temperature:	69 Deg. F.	70 Deg. F.
Ave. Stream Width:	8 Feet	140 Feet
Ave. Stream Depth:	0.75 Feet	4.5 Feet
Surface Velocity:	0.1 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	0.6 CFS	63 CFS
Stream Modifications:	Dredged	Canopy Removal
Nuisance Plants (Y/N):	Y	N
Report Number:		
STORET No.:	730351	730345
Stream Name:	Williams Creek	Swan Creek
Road Crossing/Location:	upstream Graham Road (M	Schomaker Road
County Code:	73	73
TRS:	12N03E33	12N03E34
Latitude (dd):	43.40777	43.40122
Longitude (dd):	-84.13085	-84.09955
Ecoregion:	HELP	HELP
Stream Type:	Warmwater	Warmwater
USGS Basin Code:	4080203	4080203

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

COMMENTS:

Table 4. Qualitative aquatic macroinvertebrate sampling results from nonwadeable portions of the Shiawassee River Watershed in Saginaw County, June 29-30, 2010.

	Shiawassee River 6/29/10 Shiawassee Refuge Dr. Station 48	Shiawassee River 6/29/10 Birch Run Mouth Satation 49	Shiawassee River 6/30/10 River Rd. Station 50
TAXA			
ANNELIDA (segmented worms)			
Hirudinea (leeches)	4	1	5
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	100	70	134
Isopoda (sowbugs)		2	
Arachnoidea			
Hydracarina	170	450	597
Insecta			
Ephemeroptera (mayflies)			
Baetidae	4	10	12
Caenidae	26	26	101
Leptohyphidae (Trico.)	1		
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1	3	1
Zygoptera (damselflies)			
Coenagrionidae	21		53
Hemiptera (true bugs)			
Corixidae	3	10	22
Mesoveliidae	1		
Notonectidae		1	1
Trichoptera (caddisflies)			
Hydroptilidae	1		
Leptoceridae		4	5
Coleoptera (beetles)			
Haliplidae (adults)	1		2
Hydrophilidae (total)		3	
Elmidae (total)			13
Haliplidae (larvae)			3
Lampyridae (larvae)		1	1
Diptera (flies)			
Ceratopogonidae	9	2	9
Chironomidae	23	11	32
MOLLUSCA			
Gastropoda (snails)			
Physidae	4	10	5
Planorbidae	1		1

METRIC	Shiawassee Refuge Drive Station 48		Birch Run Mouth Station 49		River Rd. Station 50	
TOTAL ABUNDANCETOTAL ABUNDANCE	370		604		997	
TOTAL RICHNESS	16		15		18	
NUMBER OF EPHEMEROPTERA FAMILIES	3		2		2	
NUMBER OF PLECOPTERA FAMILIES	0		0		0	
NUMBER OF TRICHOPTERA FAMILIES	1		1		1	
NUMBER OF DIPTERA TAXA	2		2		2	
TRICHOPTERA ABUNDANCE	1		4		5	
ABUNDANCE OF DOMINANT TAXON	170		450		597	
SHREDDER ABUNDANCE	101		76		144	
SCRAPER ABUNDANCE	6		10		6	
COLL-FILTERER ABUNDANCE	0		0		0	
COLL-GATH ABUNDANCE	57		57		180	
PREDATOR ABUNDANCE	206		461		667	

Table 4. (Continued)

Table 4 cont.

	Shiawassee Refuge Drive Station 48		Birch Run Mouth Station 49		River Rd. Station 50	
Metric Calculations	Metric Score		Metric Score		Metric Score	
FFG Diversity (25)	16		0		8	
Habitat Stability FFG Surrogate (25)	0		0		0	
% Trichoptera (20)	0		0		0	
EPT Richness (8)	3		0		0	
Total Richness (7)	2		0		2	
Diptera Richness (5)	2		0		2	
Plecoptera Richness (5)	0		0		0	
% Dominance (5)	4		5		2	
Tota	27		5		14	