

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
MARCH 2013

STAFF REPORT

A BIOLOGICAL SURVEY OF THE RED CEDAR WATERSHED AND SELECTED
TRIBUTARIES
INGHAM AND LIVINGSTON COUNTIES, MICHIGAN
JULY AND AUGUST 2011

Summary

The biological integrity, chemical characteristics, and physical habitat conditions of the Red Cedar River and selected tributaries were surveyed during low flow periods of the summer of 2011. Figure 1, Figure 2, and Table 1 identify the locations of 10 randomly selected, and 12 targeted, aquatic macroinvertebrate community and habitat assessment stations. The macroinvertebrates and physical habitat were qualitatively assessed using the Surface Water Assessment Section Procedure 51 (MDEQ, 1990). In addition, the warm water fish community was assessed at two of the sites. General water chemistry samples were collected at eight stations in the Sycamore Creek subwatershed, and one station in Herron Creek. Water samples (including appropriate quality assurance samples) were collected using the standard protocols (MDNR, 1994). As a summary of findings, macroinvertebrate communities rated acceptable most sites, poor at three of the sites (Pine Lake Outlet, Sycamore Creek, and the Middle Branch Red Cedar), and no sites rated excellent (Table 1).

Background Information

Geography and Natural History

The city of East Lansing, portions of the city of Lansing, Meridian Township and Lansing Township are the major population centers of the Red Cedar watershed, which is located in the south-central Lower Peninsula of Michigan. The Grand River is the longest river, and second largest watershed (about 5,572 square miles in area), in Michigan. The Red Cedar River is a large tributary that conflues with the Grand River within the city of Lansing, Michigan.

The Red Cedar watershed lies within the Lansing subsubsection of the regional Landscape Ecosystem Classification of Michigan (Albert, 1995). The watershed is made up of broad, gently sloping ground moraine, with end-moraine ridges. Hills are a maximum of 100 feet high, and slopes are less than 6 percent, leading to low gradient stream channels even prior to European settlement. Bedrock underlying the Red Cedar watershed is rarely exposed because it is buried deeply under a thick layer of glacial deposits. The soils in the ground moraines are approximately 30 percent poorly drained. The undulating topography of the moraines has resulted in alternating well-drained ridges and poorly-drained linear depressions. The nearly linear north-south oriented drainages in the eastern portions of the Red Cedar River watershed (e.g., Doan and Kalamink Creek), are an example of this (Figure 2). Lakes are uncommon in the Red Cedar watershed. Pre-settlement vegetation on uplands was largely beech-maple forests, with pockets of oak-hickory, which have been converted to crop production. Lowlands were formerly wet prairies or red maple swamps which contained the red cedars that gave the watershed its name. Most wetlands have been converted to pastureland or drained for

agriculture. Hydrology has been altered by historic and current efforts to quickly drain water from agricultural production areas via ditches. All wet prairies in the region have been destroyed or degraded beyond recognition and few large tracts of beech-maple forest exist due to conversion to agricultural land.

The 2006-era land cover for the Red Cedar Watershed is approximately 14 percent developed land, 37 percent cultivated, 22 percent pasture/hay, 12 percent upland forest/grassland, 13 percent wetland, with less than 1 percent water and bare land (Figure 3).

Nonpoint sources of pollution, particularly nutrients, pathogens, and sediment, are likely to be affecting the water quality, macroinvertebrate, and fish communities in the Red Cedar watershed. Urbanization and agricultural land use and accompanying artificial drainage are issues in this watershed. Wetlands, which act as natural storm water retention areas and provide pollutant filtration, were once prevalent. The wetlands have been drained and the functions they performed have been lost, particularly in Sullivan Creek, the headwater areas Dietz Creek, and Willow Creek (headwaters of Sycamore Creek), where more than 80 percent of pre-settlement wetlands have been lost (Rippke, 2012). Current efforts to decrease nonpoint pollution in the Red Cedar watershed include the development of Clean Water Act Section 319 watershed management plan for the Red Cedar River (in progress).

Historic Sampling

The macroinvertebrate and fish communities tend to be borderline between the poor and acceptable range (particularly in the Sycamore Creek subwatershed), which results in waffling between the poor and acceptable ratings among sampling years. In a 1996 survey of the Sycamore Creek subwatershed, macroinvertebrate communities scored poor at two sites on Willow Creek, and one site on Sycamore Creek, downstream of the Mason Wastewater Treatment Plant (WWTP) (Thelen, 1999). Willow Creek was not resampled in 2001, but in 2006 the macroinvertebrate community at these sites continued to score poor, while the Sycamore Creek site scored acceptable in both 2001 and 2006 (Rockafellow, 2003; Rippke, 2008). Macroinvertebrate communities in Doan Creek at Holt Road also scored poor in 1996. However, Doan Creek was sampled in four locations in the 2006 survey and macroinvertebrate communities scored acceptable at all sites. Fish were determined to be poor during the 1996 survey of Doan Creek, due to less than 50 fish being captured, and the site has not been resampled. During the 2001 survey of the Red Cedar Watershed, Kalamink Creek at Holt Road and the Middle Branch of the Red Cedar at Sargent Road scored poor for macroinvertebrates (Rockafellow, 2003). The exact sites were not resampled, but nearby sites on Kalamink Creek and Middle Branch of the Red Cedar found acceptable scores during the 2006 survey. Also in 2006, warm water fish communities were found to be acceptable in Willow Creek and downstream of the Mason WWTP on Sycamore Creek, but a poor community was found on Talmadge Creek.

Designated Use and Water Quality Standards Attainment

All water bodies in Michigan are expected to meet all designated uses described in Michigan's Water Quality Standards. As part of Michigan's effort to determine water quality status and trends, macroinvertebrate communities and habitat was evaluated at the sites listed in Table 1, and shown in Figure 1 and 2. The Red Cedar watershed was allocated eight status sites (Stations 4, 5, 6, 9, 12, 17, 18, and 24) which are used to generalize the attainment status of the whole Upper Grand watershed and the state (when combined with data from other watersheds). Trend sites (Stations 3 and 17) will be revisited every five years and macroinvertebrates and habitat will be evaluated to establish water quality trends throughout the state. For the purposes of reporting on whether designated uses or water quality standards are being met,

water bodies in Michigan are divided into segments called Assessment Unit Identifiers (AUID). The AUIDs that are associated with sampled stations are listed in Table 1. When designated uses are impaired, the Clean Water Act requires that a Total Maximum Daily Load (TMDL) is written to address the use impairment, with a goal of improving water quality to meet the designated use. Within the Red Cedar watershed, there are three designated uses that are currently considered impaired; warm water fishery (indicated by low dissolved oxygen levels), fish consumption (indicated by mercury and polychlorinated biphenyl [PCB] levels) and partial and total body contact recreation (indicated by high *E. coli* levels). To address the impaired body contact recreation uses, a TMDL was completed in 2012 to describe *E. coli* sources throughout the Red Cedar watershed (Rippke, 2012). To address the warm water fishery impairment, a dissolved oxygen TMDL will be completed in 2013 for the main stem Red Cedar, near Lansing. Dissolved oxygen data will be collected in 2013 throughout Sycamore Creek to determine if a TMDL is warranted in that subwatershed. The fish consumption designated use will be addressed via statewide mercury and PCB TMDLs to be completed in 2013.

The macroinvertebrate sampling results summarized in this report will be used to evaluate the 'other indigenous aquatic life and wildlife' (OIALW) designated use; including:

- In the past, the MDEQ did not have enough information on the macroinvertebrate communities in Sloan Creek, Conway Drain No. 15, Conway Drain No. 1, Marion Iosco Drain, Sullivan Creek, and Herron Creek to determine if the OIALW designated use was being met. The results of macroinvertebrate surveys at stations on Sloan Creek, Sullivan Creek, Conway Drain No. 15, and Conway Drain No. 1 found that the communities are attaining the OIALW designated use, although they did score in the low acceptable range. Both the Marion Iosco Drain and Herron Creek were not surveyed for macroinvertebrates, because they did not meet the definition of flowing water bodies provided by Procedure 51. The Marion Iosco Drain was a wetland, with undefined banks. Herron Creek had no flow.
- Willow Creek was previously not attaining the OIALW designated use based on scoring in the poor range. This site scored within the Procedure 51 acceptable range in the 2011 survey, indicating that it is now meeting the OIALW designated use.
- Results of the surveys at the remaining stations are used to support maintaining or changing their current status of meeting or not meeting the OIALW.

Results

Sycamore Creek

Sycamore Creek is the largest tributary to the Red Cedar River, with a watershed covering approximately 119 square miles, which is about 36 percent developed land, 44 percent agricultural land, and 20 percent other land cover types (natural uplands, wetlands, water, etc.) (NOAA, 2008). The Sycamore Creek land cover is very diverse, ranging from portions of the city of Lansing and Mason where developed land is common, to very rural areas such as those found in the Willow and Mud Creek where as much as 71 and 61 percent, respectively, is agricultural land cover. Human population ranges from very dense in downstream areas near Lansing (1 person for every 0.25 acre) to sparse in the headwaters areas (1 person for every 7 acres). The Sycamore Creek subwatershed has several active individual National Pollutant Discharge Elimination System (NPDES) permits, including Mason Manor Mobile Home Park Wastewater Sewage Lagoons, Columbia Lake Estates Mobile Home Community, and the Mason WWTPs. These NPDES permits authorize the discharge of treated wastewater to surface water.

Nine macroinvertebrate surveys were conducted in the Sycamore Creek subwatershed. Scores ranged from -5 (poor) to +1 (acceptable). The site located at Sycamore Creek at Holt Road (site 7) was the only site to rate poor (Table 3). At this site, there were no caddisflies and few mayfly individuals were found, and the overall number of taxa was low (19). Similarly, Sycamore Creek at Pine Tree Road (site 8) scored low acceptable (-4) although a few more mayfly individuals and 28 taxa were found (Table 3). Sycamore Creek at Holt Road has been sampled extensively in the past by the MDEQ, and scored mid to low acceptable on all other past surveys. Like many other locations in the Red Cedar watershed, the low acceptable range macroinvertebrate scores are likely a result of sedimentation and altered flow regimes from the combination of artificial drainage from agriculture and urbanization. We hypothesize that exceptionally high flow and flood conditions occurring earlier in 2011 may be the cause of the poor survey results and anticipate that the MDEQ will continue to monitor the macroinvertebrate community at this location.

Willow Creek is located in the headwaters of Sycamore Creek. This subwatershed is 71 percent agricultural land cover, and has lost about 85 percent of its pre-settlement wetlands to drainage for agriculture (Rippke, 2012). The Sycamore Creek Watershed Project, funded by Clean Water Act Section 319, involved the implementation of best management practices (BMP) in the Willow Creek watershed. The project was completed in 1999. Six years of pre-BMP sampling and one year of post-BMP water quality sampling were performed for turbidity, total suspended solids, chemical oxygen demand, nitrogen and phosphorus. According to this study, a statistically significant decrease was found in total suspended solids (60 percent) and total phosphorus load (57 percent) in Willow Creek the year following the implementation of BMPs (Spooner et al, 2011). Following project completion, macroinvertebrate and fish monitoring was conducted by the MDEQ in 2006 at Kipp and Toles Road (Rippke, 2008). Fish monitoring at Toles Road found a barely acceptable warm water fish community (-4), while macroinvertebrate monitoring found poor scores at both Toles and Kipp Roads. In order to continue to evaluate potential improvements due to the continued use of BMPs, macroinvertebrate communities were evaluated again in 2011 at Kipp and Toles Roads (Tables 2 and 4). Between the 2006 and 2011 surveys, the macroinvertebrate score at Kipp Road improved, going from a -6 (poor) to a -2 (acceptable). The score at Toles Road also improved, going from a score of -3 (acceptable) to a -1 (acceptable). The Toles Road site was classified as a glide pool in 2006, but in 2011 had formed some riffles (although sparse) and was classified as a riffle run (Figure 4). Although the habitat score decreased from 2006 to 2011 visits, the Kipp Road site appeared to be more sinuous and have more pool variation. Erosion of the banks at Kipp Road (resulting in bank instability), and narrower riparian buffers at both Willow Creek Sites were reported, causing a general decline in habitat metric score.

Fish surveys were conducted at station 3 (Mud Creek at Okemos Road) and Station 4 (headwaters area of Sycamore Creek at Rolf Road) (Table 6). The warm water fish designated use is listed in the Section 303(d) list as impaired throughout most of the Sycamore Creek watershed (AUIDs ranging between 040500040505-507), indicated by historic dissolved oxygen violations. The fish community scored +3 (acceptable) at Station 3, with a community dominated by green sunfish (50 percent of total individuals in the sample), and including 11 total taxa. Notably, a 25-inch northern pike was caught in the sample at Station 3. Station 4 scored lower (-3), but still in the acceptable range. Station 4 had fewer taxa (8) and creek chub and blacknose dace were the most numerous taxa in the sample. Sycamore Creek at Station 4 was considerably narrower with less flow than Mud Creek at Station 3, although Station 4 had more natural channel morphology and has not been recently channelized. Mud Creek at Station 3 has the appearance of a maintained drain, with no tree canopy, a straight channel, and steep banks.

To determine the overall nutrient levels in Sycamore Creek and in response to periodic nuisance algal expression in Mud Creek, general water chemistry samples were collected at eight sites in the subwatershed (Table 7). Chemical oxygen demand ranged from 13-19 milligrams per liter (mg/L), and total dissolved solids (TDS) was between 510-580 mg/L. The Michigan WQS for TDS states that TDS “shall not exceed 500 mg/L as a monthly average or 750 mg/L at any time, as a result of controllable point sources”. The TDS levels in Sycamore Creek were high, but not exceeding the maximum instantaneous WQS of 750, and were also high regardless of the presence of point sources. Total phosphorus in the Sycamore Creek subwatershed ranged from 0.035 (Willow Creek at Kipp Road) to 0.135 mg/L (Sycamore Creek at Rolfe). These phosphorus levels are higher than the median value (.032 mg/L) reported for the state calculated using probabilistic data from 250 sites from 2005-2009, and did exceed the 75th percentile value (.058 mg/L) reported in that study (Roush, 2013). No nuisance algal conditions were noted during this survey; however, local conditions of high sunlight and temperature combined with these nutrient conditions could cause algal blooms. Intense sunlight warming the water is likely an issue given that more than 50 percent of the stream length in Sycamore Creek has no significant vegetated buffer to provide shade (Rippke, 2012).



Figure 4. Willow Creek at Toles Road (Station 2).



Figure 5: Sullivan Creek at Perry Road (Station 16).

Sullivan Creek

The Sullivan Creek subwatershed is home to about 2,000 people, at a density of 1 person per 6 acres. Land cover is 64 percent agricultural and 18 percent developed (mainly due to the presence of the I-96 corridor). Agricultural soils tend to be poorly drained, and artificial drainage is necessary to maintain prime farmland. The majority of the watershed has no significant vegetated riparian buffer and has lost 70 percent of its pre-settlement wetland area.

The macroinvertebrate community and habitat in Sullivan Creek was evaluated at Perry Road (Station 16, Figure 5). The macroinvertebrate community rated -2 (acceptable), with good habitat. Twenty-three macroinvertebrate taxa were found, with amphipoda (scuds) clearly dominant and composing 2/3 of the sampled individuals (Table 3). The creek was categorized as a riffle/run, with marginal riffle frequency. Epifaunal substrate (macroinvertebrate niche habitat) was sparse and embedded with sediment.

Conway Drain No. 15 and Conway Drain No. 1

Conway Drain No. 15 and Conway Drain No. 1 are small tributaries, each less than 6 stream miles in length. Each of the two subwatersheds are home to 500-600 people at a low density (1 person per every 6-8 acres). Together, the land cover is 73 percent agricultural and 5 percent developed land. Much of the original wetland in these subwatersheds still exists, having lost about 8 percent of pre-settlement wetland area. Currently, about 14 percent of these subwatersheds are wetland and 10 percent is natural upland vegetation (forest and grassland).

Conway Drain No. 1 was sampled at Nicholson Road (Station 13, Figure 6), and the macroinvertebrate community scored -2 (acceptable), while the habitat scored marginal. Conway Drain No. 15 was sampled at Chase Lake Road (Station 14), and the macroinvertebrate community scored -3 (acceptable), while the habitat scored good. Station 13 had 5 more taxa than station 14, and a slightly higher composition of mayflies and 1 more mayfly taxa represented in the sample, resulting in the slightly higher macroinvertebrate score.



Figure 6. Conway Drain No. 1 at Nicholson Road (Station 13).



Figure 7. Pine Lake Outlet at Okemos Road (Station 22).

Pine Lake Outlet

Pine Lake Outlet subwatershed is home to about 19,400 people, living at a density of 1 person for every 0.7 acres. This is a high density of people relative to other areas within the Red Cedar watershed, however, the population is set-back from the creek and considerable vegetated riparian buffers exist in most of the subwatershed. Similarly, a considerable amount of pre-settlement wetland area still exists in Pine Lake Outlet subwatershed, with 74 percent of pre-settlement wetland remaining. Forty-four percent of the watershed is developed land cover, with only 14 percent in agricultural use. Given the high density of human population and associated impervious surfaces associated with developed land, storm sewers are a likely source of nonpoint source pollution and flashiness to the outlet. During times of low flow, MDEQ staff has reported that the Red Cedar River main stem backs up into Pine Lake Outlet due to the extremely low gradient of the channel.

Macroinvertebrate communities were sampled in Pine Lake Outlet upstream of Okemos Road (Station 22), and scored -5 (poor). About 1/3 of the individuals in the sample were Oligochaeta (segmented worms), and a further 1/3 of the sample was composed of Amphopoda (scuds) (Table 3). No mayflies were found. Habitat scored good, overall, but the high habitat score was mainly due to riparian metrics (Table 5). The instream habitat was sedimented, and it was evident that flashiness was an issue. Channelization had occurred in the past, resulting in an incised channel (Figure 7). Prior to channelization, this wetland area likely lacked a defined channel and was more of a wetland than stream.

West Branch Red Cedar

The West Branch Red Cedar is rural, with about 62 percent of the land in agriculture, and 5 percent developed cover. About 4,300 people live in the subwatershed, at a density of 1 person for every 6 acres. The area has lost about 45 percent of its pre-settlement wetland area.

The West Branch Red Cedar was sampled at one station, at Grand River Avenue (Station 15) (Figure 8). Macroinvertebrate community scored high acceptable (+3) and habitat scored good (149) (Table 5). The channel was about 25 feet wide and aquatic vegetation (Sparganium spp., Potamogeton spp. and Elodea spp.) covered about half of the stream bottom. Substrate was composed of sand and silt with coarse and fine organic matter. The riparian zone was well vegetated with a wetland and forested area.



Figure 8. West Branch Red Cedar River at Grand Avenue (Station 15).

Middle Branch Red Cedar

The Middle Branch Red Cedar has a population of about 3,700, living at a density of about 1 person for every 5 acres. It is a largely rural subwatershed with 62 percent of its land in agricultural cover, only 3 percent developed, and the remaining being wetland and natural upland. Roughly 39 percent of the pre-settlement wetlands have been lost, which is low in relation to other subwatersheds in the Red Cedar watershed (Rippke, 2012). The Middle Branch Red Cedar River was sampled at two locations: Munsell Road (Station 10, Figure 9) and Mason Road (Station 12). Macroinvertebrates scored poor (-5) at Mason Road and low acceptable (-4) at Munsell Road (Table 3). The channel width was approximately the same at both stations (around 20 feet) and both stations had some aquatic vegetation (Sparganium) at the margins, and sandy/silty substrates. Station 12 was more channelized than Station 10, which had some meanders and overall appeared to have a more natural morphology. Stable substrate for macroinvertebrate habitat was lacking at both Middle Branch stations, likely leading to the lower macroinvertebrate scores at these stations (Table 5).



Figure 9. Middle Branch Red Cedar at Munsell Road (Station 10).

Dietz and Doan Creeks

Dietz Creek and Hayhoe Drain are tributaries to Doan Creek. Hayhoe Drain is in the headwater area of Doan Creek. When combined, the entire Doan Creek watershed is home to about 2,900 people living at a relatively low density of less than 1 person per 12 acres. About 74 percent of the area is agricultural, with only 7 percent developed land cover. Of the three subwatersheds (Dietz, Hayhoe and Doan), Dietz is the most developed because it contains the village of Dansville as well as development from I-96 corridor near Williamston, Michigan. The three subwatersheds have lost between 51 and 81 percent of their pre-settlement wetlands, with the Dietz Creek portion having lost the most.

Macroinvertebrate communities and habitat were evaluated at Station 17, on Doan Creek, and Station 18, on Dietz Creek (Table 3). Macroinvertebrate communities at both stations scored in the acceptable range, with marginal habitat. Thirty-two macroinvertebrate taxa were found in Doan Creek, while considerably fewer (19) were found in Dietz Creek.

Herron Creek

The Herron Creek subwatershed is home to about 5,600 people at an average density of 1 person per acre (U.S. Census Bureau, 2010a and 2010b). The Herron Creek subwatershed is about 46 percent agricultural and 39 percent developed land cover (NOAA, 2008), and contains more urbanized portions of Meridian Township, in addition to manure land-application areas from the Michigan State University Concentrated Animal Feeding Operation (NPDES permit number MI0057948). Herron Creek at Station 23 had defined banks and standing water, but no flow, and therefore no macroinvertebrate survey was completed (Figure 10). The water in Herron Creek was noticeably orange, and a water sample was collected for a metals and general chemistry analysis (Table 7). Iron seeps, resulting in small patches of orange coloration on sediments, can be found elsewhere in the Red Cedar watershed, though none were noted at Herron Creek. Chemistry results showed an unusually high chemical oxygen demand

(61 mg/L), accompanied by the correspondingly high total organic carbon (TOC) content (24 mg/L). Across the Southern Michigan/Northern Indiana Drift Plains (SMNIDP) ecoregion, the median TOC was found to be less than 10 mg/L during a study from 2000-2008 (Roush, 2013). Ammonia (0.126 milligrams nitrogen per liter [mg N/L]) was much higher than any concentration found in the eight Sycamore Creek samples (<0.055 mg N/L). This concentration of ammonia is well above the mean concentration (0.042 mg N/L) for the SMNIDP ecoregion calculated using reference sites (Lungdren, 1994) but falls within the range found in that study. Toxic amounts of metals were not found. Further investigation is necessary to determine the cause of the orange coloration and elevated ammonia.



Figure 10. The water in Herron Creek (Station 23) was stagnant and had an orange coloration (not visible in photo). The channel was incised and the banks were devoid of vegetation due to scouring, indicating that the creek is flashy following rainfall.

Main Stem Red Cedar River

The main stem Red Cedar River was evaluated in two locations; Kalamazoo Avenue (Station 24) and Dobie Road (Station 21), scoring +3 and +4 for macroinvertebrates, respectively (Table 3). Station 24 is located in the city of East Lansing. The immediate watershed (12-digit HUC) is inhabited by about 66,000 people, and is about 62 percent developed land cover, so impacts from storm water are likely high. Habitat was very similar at both sites, scoring 100 (marginal) at Station 21, and 108 (good) at Station 24.

Future Recommendations

In 2016 (the next scheduled monitoring year for the Red Cedar) it is recommended that macroinvertebrate sampling stations are targeted in areas that were not evaluated in this survey, including Handy-Howell Drain and the headwaters of the Red Cedar (HUC 040500040403); Kalamink Creek (HUC 0405000407); and Wolf Creek (western portion of HUC 040500040411). Since Doan Creek scored poor for fish in 1996, and hasn't been resampled since, the fish community should be evaluated in 2016 if resources are available.

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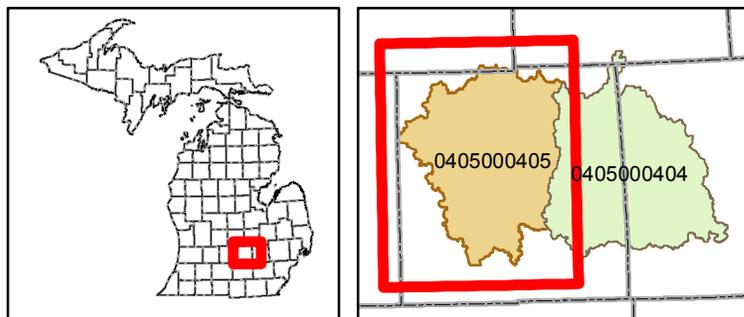
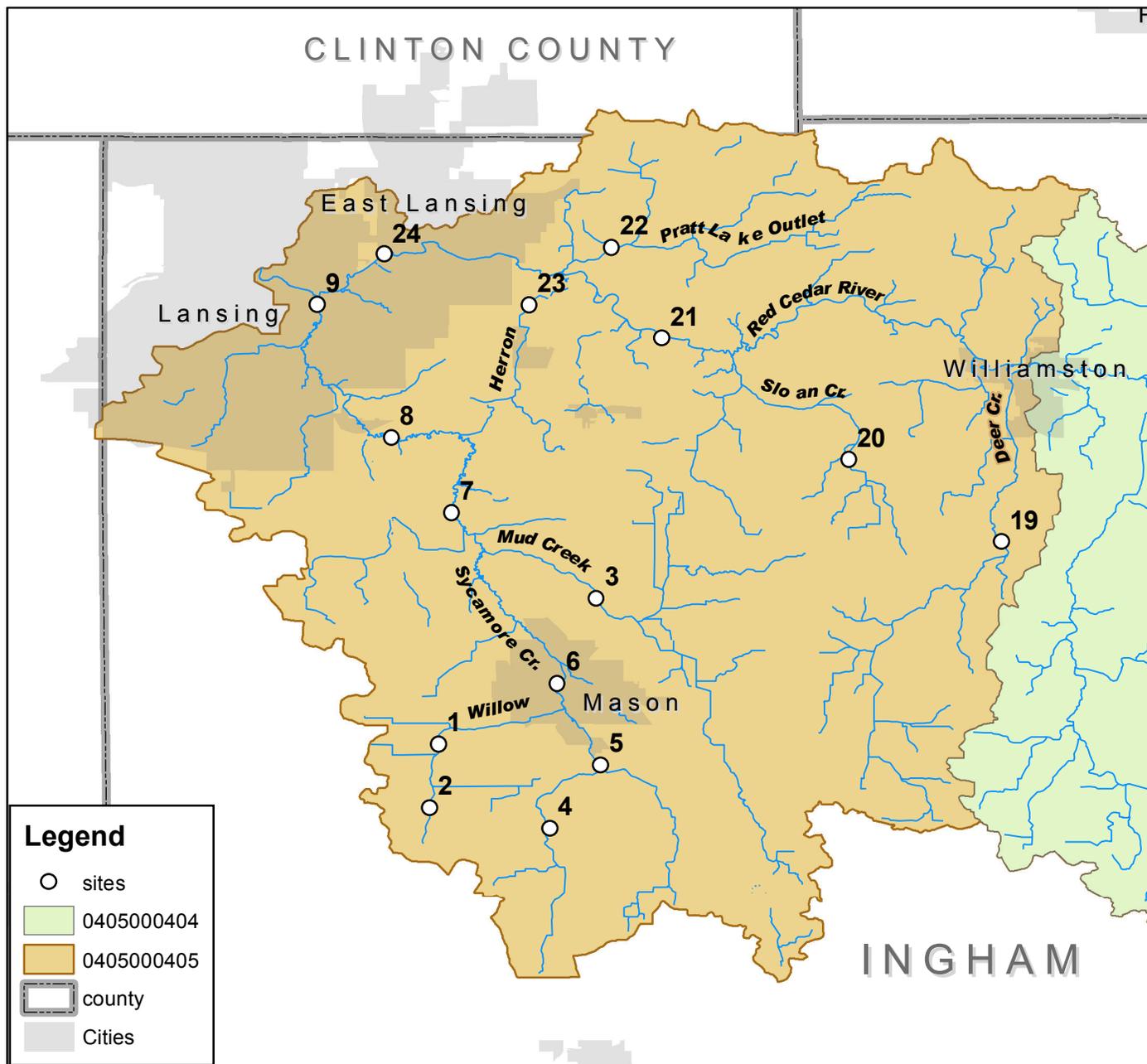


Figure 1: Locations of study sites and cities in the western portion of the Red Cedar watershed (HUC 0405000405).

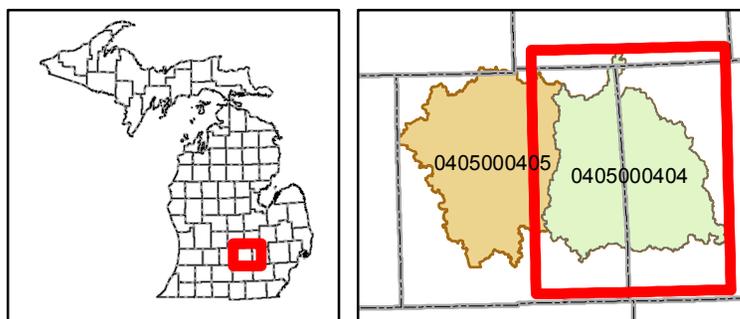
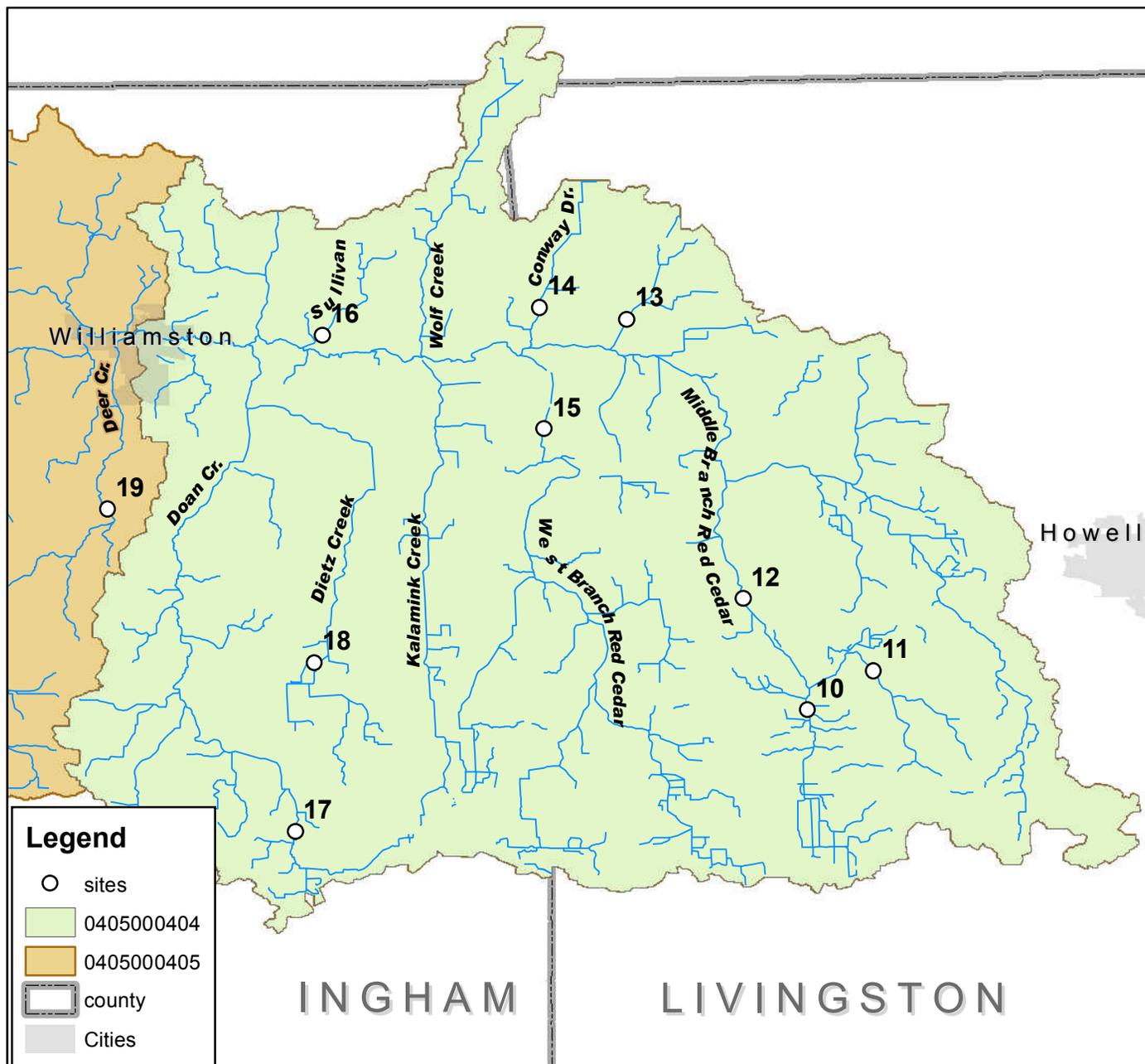


Figure 2: Locations of study sites and cities in the eastern portion of the Red Cedar watershed (HUC 0405000404).

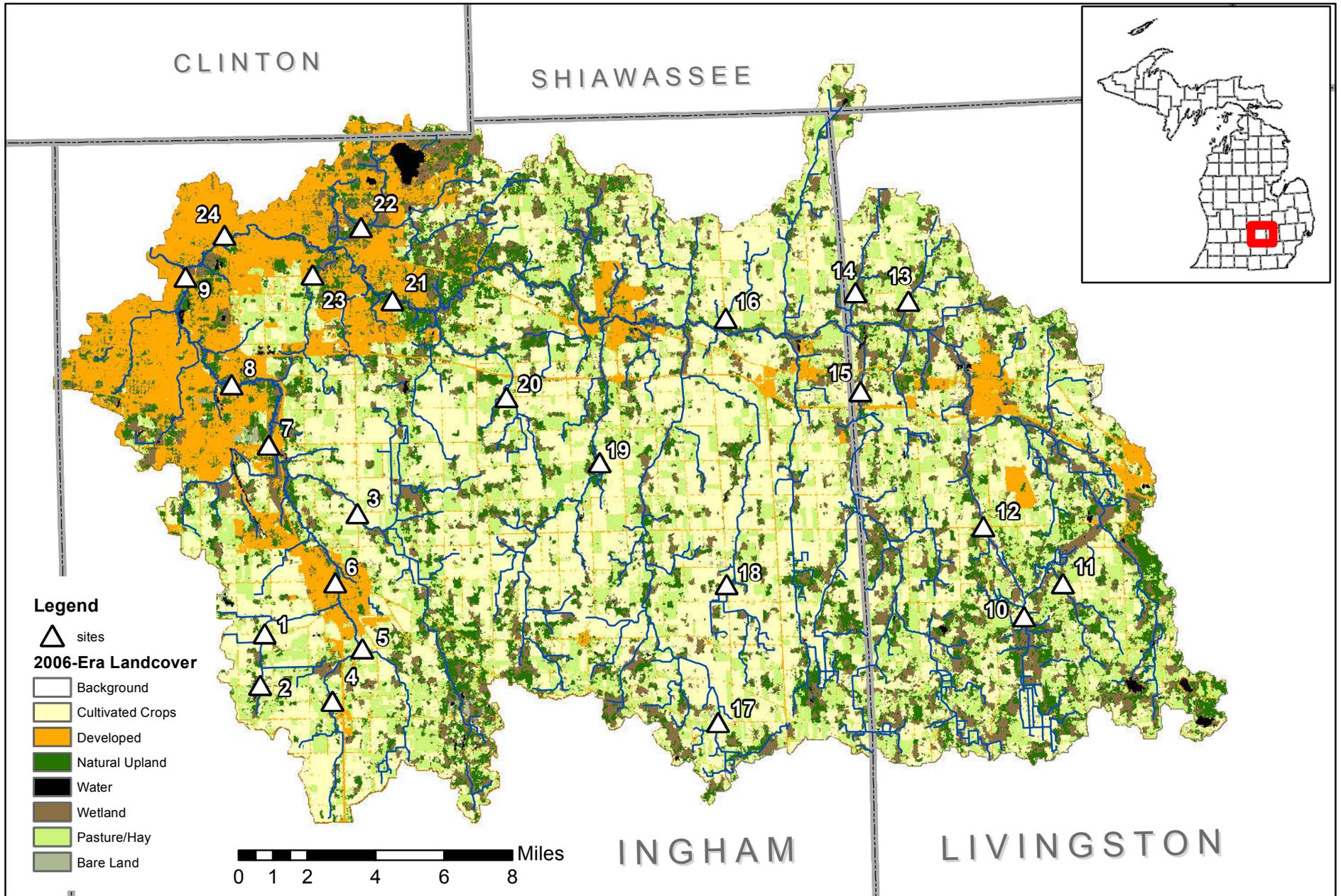


Figure 3. 2006-era land cover data and sampling station locations for the Red Cedar watershed.

Table 1. Summary of 2011 station locations and results of macroinvertebrate, fish, habitat and chemistry surveys.

Site ID	Waterbody Name	Location Description	longitude	latitude	2012 Assessment Unit	Macroinvertebrate Score	Habitat Score	Fish Score	Chemistry collected
1	Willow Creek	Kipp	-84.48727	42.56043	040500040506-03	-2 (acceptable)	76 (marginal)	na	x
2	Willow Creek	Toles	-84.49035	42.53854	040500040506-03	-1 (acceptable)	103 (marginal)	na	
3	Mud	Okemos	-84.43300	42.61060	040500040505-01	-2 (acceptable)	74 (marginal)	+3 (acceptable)	x
4	Sycamore Creek	Rolfe Road	-84.44907	42.53139	040500040506-01	0 (acceptable)	134 (good)	-3 (acceptable)	x
5	Sycamore Creek	Tomlinson Road	-84.43147	42.55320	040500040506-01	+1 (acceptable)	74 (marginal)	na	
6	Sycamore Creek	State Street	-84.44643	42.58138	040500040506-01	0 (acceptable)	108 (good)	na	x
7	Sycamore Creek	Holt	-84.48287	42.64026	040500040507-01	-5 (poor)	80 (marginal)	na	x
8	Sycamore Creek	Pine Tree	-84.50349	42.66602	040500040507-01	-4 (acceptable)	122 (good)	na	x
9	Sycamore Creek	Mount Hope Avenue	-84.52902	42.71188	040500040507-01	-1 (acceptable)	132 (good)	na	x
10	Middle Branch Red Cedar River	Munsell	-84.05243	42.56101	040500040402-01	-4 (acceptable)	140 (good)	na	
11	Marion Iosco Drain	Lange	-84.02967	42.57442	040500040402-01	na (na)	na (na)	na	
12	Middle Branch Red Cedar River	Mason Road	-84.07454	42.59932	040500040402-01	-5 (poor)	115 (good)	na	
13	Conway Drain No. 1	Nicholson	-84.11461	42.69553	040500040407-01	-2 (acceptable)	85 (good)	na	
14	Conway Drain No. 15	Chase Lake	-84.14468	42.69959	040500040407-01	-3 (acceptable)	105 (good)	na	
15	West Branch Red Cedar River	Grand River Ave	-84.14314	42.65778	040500040405-01	+3 (acceptable)	149 (good)	na	
16	Sullivan	Perry	-84.21948	42.69001	040500040411-01	-2 (acceptable)	119 (marginal)	na	
17	Doan Creek	Swan Rd	-84.22879	42.51913	040500040408-01	-1 (acceptable)	72 (marginal)	na	
18	Dietz Creek	Dietz Road	-84.22220	42.57730	040500040409-01	-3 (acceptable)	79 (marginal)	na	
19	Deer Creek	Frost	-84.29344	42.63017	040500040503-02	+4 (acceptable)	81 (marginal)	na	
20	Sloan Creek	Noble	-84.34605	42.65850	040500040502-01	-1 (acceptable)	91 (marginal)	na	
21	Red Cedar River	Dobie	-84.41045	42.70028	040500040508-03	+4 (acceptable)	100 (marginal)	na	
22	Pine Lake Outlet	Okemos	-84.42770	42.73149	040500040504-01	-5 (poor)	114 (good)	na	
23	Herron Creek	Mount Hope	-84.45608	42.71183	040500040508-01	na (na)	(na)	na	x
24	Red Cedar River	Kalamazoo Street	-84.50608	42.72943	040500040508-03	+3 (acceptable)	108 (good)	na	

na - not applicable

Table 2A. Qualitative macroinvertebrate sampling results for sites on Willow Creek in 2006 and 2011.

TAXA	Willow Creek at Kipp Road		Willow Creek at Toles Road	
	6/28/2006 STATION 4	9/7/2011 STATION 1	6/28/2006 STATION 3	9/7/2011 STATION 2
PLATYHELMINTHES (flatworms)				
Turbellaria			1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1		4
Oligochaeta (worms)	6	53	2	12
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	15	15	73	128
Decapoda (crayfish)	2	1	2	1
Isopoda (sowbugs)	26		113	6
Insecta				
Ephemeroptera (mayflies)				
Baetidae	5	3		17
Caenidae	1		1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1		1
Zygoptera (damselflies)				
Calopterygidae		4	4	19
Coenagrionidae		1	3	
Hemiptera (true bugs)				
Belostomatidae		1		1
Corixidae	93	37	1	2
Gerridae			1	
Mesoveliidae		3	1	
Notonectidae		1		1
Pleidae		3		
Veliidae		2		
Megaloptera				
Corydalidae (dobson flies)		1		
Sialidae (alder flies)	1			
Trichoptera (caddisflies)				
Hydropsychidae	9	8	2	14
Leptoceridae			1	
Limnephilidae			2	
Phryganeidae		1		
Coleoptera (beetles)				
Dytiscidae (total)		1	1	1
Gyrinidae (adults)	1			6
Haliplidae (adults)	4	6		
Dryopidae		1		
Elmidae	6	7	2	
Diptera (flies)				
Ceratopogonidae			1	
Chironomidae	51	132	10	33
Culicidae		1		
Simuliidae	20		1	26
Tabanidae		4		
Tipulidae			1	1
MOLLUSCA				
Gastropoda (snails)				
Lymnaeidae	2			
Physidae	13	1	4	
Planorbidae	2		2	1
Pelecypoda (bivalves)				
Sphaeriidae (clams)		3		
TOTAL INDIVIDUALS	260	292	229	274

Table 2B. Macroinvertebrate metric evaluation of sites on Willow Creek in 2006 and 2011.

METRIC	Willow Creek at Kipp Road				Willow Creek at Toles Road			
	6/28/2006 STATION 4		9/7/2011 STATION 1		6/28/2006 STATION 3		9/7/2011 STATION 2	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	19	0	26	1	22	1	18	1
NUMBER OF MAYFLY TAXA	2	0	1	0	1	0	1	0
NUMBER OF CADDISFLY TAXA	1	-1	2	0	3	0	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	2.31	-1	1.03	-1	0.44	-1	6.20	0
PERCENT CADDISFLY COMP.	3.46	-1	3.08	-1	2.18	-1	5.11	0
PERCENT DOMINANT TAXON	35.77	0	45.21	-1	49.34	-1	46.72	-1
PERCENT ISOPOD, SNAIL, LEECH	16.92	-1	0.68	1	51.97	-1	4.01	0
PERCENT SURF. AIR BREATHERS	37.69	-1	18.84	0	1.75	1	4.01	1
TOTAL SCORE		-6		-2		-3		-1
MACROINV. COMMUNITY RATING		POOR		ACCEPT.		ACCEPT.		ACCEPT.

Table 3A. Qualitative macroinvertebrate sampling results for sites in the Red Cedar Watershed, surveyed in July-September, 2011.

TAXA	Mud Creek Okemos Road 7/25/2011 STATION 3	Sycamore Creek Rolf Road 9/7/2011 STATION 4	Sycamore Creek Tomlinson Road 9/7/2011 STATION 5	Sycamore Creek State Street 9/8/2011 STATION 6
PLATYHELMINTHES (flatworms)				
Turbellaria	1		1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)	3			1
Oligochaeta (worms)	23	1	4	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	77	33	70	32
Decapoda (crayfish)	8	1	1	7
Isopoda (sowbugs)	8		1	1
Arachnoidea				
Hydracarina	1	1		
Insecta				
Ephemeroptera (mayflies)				
Baetidae	1			3
Caenidae	5	2	2	1
Heptageniidae	14	21	3	15
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4	3		2
Gomphidae	1			
Zygoptera (damselflies)				
Calopterygidae	1	20	55	15
Coenagrionidae	10		2	
Hemiptera (true bugs)				
Belostomatidae	1		1	
Corixidae	40		2	
Gerridae		1	3	
Mesoveliidae			2	1
Nepidae	1		1	
Notonectidae	1		1	
Pleidae			3	
Veliidae		1		
Megaloptera				
Sialidae (alder flies)	5	1		
Trichoptera (caddisflies)				
Hydropsychidae	1	118	16	59
Leptoceridae	2			
Phryganeidae			1	
Coleoptera (beetles)				
Dytiscidae (total)	6			
Halplidae (adults)	10		1	
Hydrophilidae (total)	1			
Dryopidae		1		
Elmidae	38	9	8	5
Diptera (flies)				
Ceratopogonidae		1		
Chironomidae	11	41	67	59
Muscidae				1
Simuliidae		15	2	35
Tabanidae	2		3	
Tipulidae		2		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				2
Hydrobiidae	1			
Physidae	1	2	1	
Viviparidae	1			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	2	1	1	
TOTAL INDIVIDUALS	281	275	252	243

Table 3B. Macroinvertebrate metric evaluation of sites in the Red Cedar Watershed, surveyed in July-September, 2011.

METRIC	Mud Creek Okemos Road 7/25/2011 STATION 3		Sycamore Creek Rolf Road 9/7/2011 STATION 4		Sycamore Creek Tomlinson Road 9/7/2011 STATION 5		Sycamore Creek State Street 9/8/2011 STATION 6	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	31	1	20	0	25	1	17
NUMBER OF MAYFLY TAXA	3	0	2	0	2	0	3	0
NUMBER OF CADDISFLY TAXA	2	0	1	-1	2	0	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	7.1	0	8.4	0	2.0	-1	7.82	0
PERCENT CADDISFLY COMP.	1.1	-1	42.9	1	6.7	0	24.28	0
PERCENT DOMINANT TAXON	27.4	0	42.9	-1	27.8	0	24.28	0
PERCENT ISOPOD, SNAIL, LEECH	5.0	0	0.7	1	0.8	1	1.65	1
PERCENT SURF. AIR BREATHERS	21.4	-1	0.7	1	5.6	1	0.41	1
TOTAL SCORE		-2		0		1		0
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 3A. Qualitative macroinvertebrate sampling results for sites in the Red Cedar Watershed, surveyed in July-September, 2011.

TAXA	Sycamore Creek Holt Road 9/8/2011 STATION 7	Sycamore Creek Pine Tree Road 9/8/2011 STATION 8	Sycamore Creek Mount Hope Avenue 9/1/2011 STATION 9
ANNELIDA (segmented worms)			
Hirudinea (leeches)		1	2
Oligochaeta (worms)	18	8	3
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	28	65	38
Decapoda (crayfish)	1	1	3
Isopoda (sowbugs)	6	6	7
Insecta			
Ephemeroptera (mayflies)			
Baetidae		6	20
Caenidae	1		
Heptageniidae	2	7	
Odonata			
Anisoptera (dragonflies)			
Aeshnidae			1
Gomphidae		1	1
Libellulidae	1	1	
Macromiidae		1	
Zygoptera (damselflies)			
Calopterygidae	2	16	31
Coenagrionidae	1	2	13
Hemiptera (true bugs)			
Corixidae	56	38	
Gerridae	10	4	2
Nepidae		2	
Notonectidae		2	
Pleidae	4	27	2
Veliidae		4	
Megaloptera			
Sialidae (alder flies)	2		
Trichoptera (caddisflies)			
Hydropsychidae			77
Leptoceridae		2	
Coleoptera (beetles)			
Dytiscidae (total)		1	
Halplidae (adults)		6	
Dryopidae			4
Elmidae	2	5	9
Diptera (flies)			
Chironomidae	11	12	31
Culicidae	1		
Simuliidae			4
Tabanidae	2	2	
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)		20	
Hydrobiidae		2	2
Physidae	1	2	2
Viviparidae		1	
Pelecypoda (bivalves)			
Sphaeriidae (clams)	1		7
TOTAL INDIVIDUALS	150	245	259

Table 3B. Macroinvertebrate metric evaluation of sites in the Red Cedar Watershed, surveyed in July-September, 2011.

METRIC	Sycamore Creek Holt Road 9/8/2011 STATION 7		Sycamore Creek Pine Tree Road 9/8/2011 STATION 8		Sycamore Creek Mount Hope Avenue 9/1/2011 STATION 9	
	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	19	0	28	1	20
NUMBER OF MAYFLY TAXA	2	0	2	0	1	-1
NUMBER OF CADDISFLY TAXA	0	-1	1	-1	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	2.00	-1	5.31	0	7.72	0
PERCENT CADDISFLY COMP.	0.00	-1	0.82	-1	29.73	1
PERCENT DOMINANT TAXON	37.33	0	26.53	0	29.73	0
PERCENT ISOPOD, SNAIL, LEECH	4.67	0	13.06	-1	5.02	0
PERCENT SURF. AIR BREATHERS	47.33	-1	34.29	-1	1.54	1
TOTAL SCORE		-5		-4		-1
MACROINV. COMMUNITY RATING		POOR		ACCEPT.		ACCEPT.

Table 3A. Qualitative macroinvertebrate sampling results for sites in the Red Cedar Watershed, surveyed in July-September, 2011.

TAXA	M B Red Cedar Munsell Road 8/30/2011 STATION 10	M B Red Cedar West Mason Road 8/30/2011 STATION 12	Conway Drain No. 1 Nicholson Road 8/30/2011 STATION 13	Conway Drain No. 15 Chase Lake Road 9/13/2011 STATION 14
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1	1	
Oligochaeta (worms)	4	5	5	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	8	37	34	61
Decapoda (crayfish)	2	1	1	1
Isopoda (sowbugs)		27		
Arachnoidea				
Hydracarina	4	2		
Insecta				
Ephemeroptera (mayflies)				
Baetidae		4	5	4
Caenidae	1		2	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1	3	1
Gomphidae	1			
Libellulidae	3	4		2
Zygoptera (damselflies)				
Calopterygidae	57	44	32	40
Coenagrionidae	16	24	5	12
Hemiptera (true bugs)				
Belostomatidae	3	5	4	12
Corixidae	65	13	56	51
Gerridae		6	5	1
Nepidae	1	1	1	14
Notonectidae	6	10	2	6
Pleidae	6	26	5	
Veliidae	2	2		
Megaloptera				
Sialidae (alder flies)		2	13	11
Trichoptera (caddisflies)				
Hydropsychidae	1			
Phryganeidae			2	1
Coleoptera (beetles)				
Dytiscidae (total)		24		1
Gyrinidae (adults)	1			
Halplidae (adults)	28	1	6	17
Hydrophilidae (total)			1	2
Dryopidae	5			
Elmidae	8	5	12	3
Diptera (flies)				
Ceratopogonidae	1		5	
Chironomidae	24	9	10	6
Culicidae				1
Simuliidae			3	
Tabanidae	1		1	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1	3	
Physidae	5	1	5	1
Planorbidae	1		1	
Pleuroceridae			1	
Viviparidae			1	1
Pelecypoda (bivalves)				
Sphaeriidae (clams)			1	2
TOTAL INDIVIDUALS	257	256	226	253

Table 3B. Macroinvertebrate metric evaluation of sites in the Red Cedar Watershed, surveyed in July-September, 2011.

METRIC	M B Red Cedar Munsell Road 8/30/2011 STATION 10		M B Red Cedar West Mason Road 8/30/2011 STATION 12		Conway Drain No. 1 Nicholson Road 8/30/2011 STATION 13		Conway Drain No. 15 Chase Lake Road 9/13/2011 STATION 14	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	27	1	25	1	30	1	25
NUMBER OF MAYFLY TAXA	1	-1	1	-1	2	1	1	0
NUMBER OF CADDISFLY TAXA	1	-1	0	-1	1	-1	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	0.4	-1	1.6	-1	3.1	0	1.6	-1
PERCENT CADDISFLY COMP.	0.4	-1	0.0	-1	0.9	-1	0.4	-1
PERCENT DOMINANT TAXON	25.3	0	17.2	1	24.8	0	24.1	0
PERCENT ISOPOD, SNAIL, LEECH	2.7	1	11.7	-1	5.3	0	0.8	1
PERCENT SURF. AIR BREATHERS	43.6	-1	34.4	-1	35.4	-1	41.5	-1
TOTAL SCORE		-4		-5		-2		-3
MACROINV. COMMUNITY RATING		ACCEPT.		POOR		ACCEPT.		ACCEPT.

Table 3A. Qualitative macroinvertebrate sampling results for sites in the Red Cedar Watershed, surveyed in July-September, 2011.

TAXA	W B Red Cedar River Grand River Avenue 8/30/2011 STATION 15	Sullivan Creek Perry Road 8/31/2011 STATION 16	Doan Creek Swan Road 7/25/2011 STATION 17	Dietz Creek Dietz Road 8/31/2011 STATION 18
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1		1	7
Oligochaeta (worms)	2	4	10	12
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	70	137	90	91
Decapoda (crayfish)	2	3	3	14
Isopoda (sowbugs)				10
Arachnoidea				
Hydracarina	1		1	3
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae	3			
Baetidae	83	5	4	
Caenidae			2	
Heptageniidae	3			1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4	1	1	
Libellulidae			1	
Zygoptera (damselflies)				
Calopterygidae	23	9	2	16
Coenagrionidae	25		5	1
Hemiptera (true bugs)				
Belostomatidae	1			
Corixidae	2	9	14	1
Gerridae		1	2	1
Nepidae			1	
Notonectidae		1		
Veliidae			1	
Megaloptera				
Sialidae (alder flies)			1	3
Trichoptera (caddisflies)				
Brachycentridae	2			
Hydropsychidae	1	37	30	5
Hydroptilidae	32			
Leptoceridae	2	2	6	
Molannidae	1	7		
Phryganeidae		4		1
Coleoptera (beetles)				
Dytiscidae (total)			1	2
Gyrinidae (adults)				1
Halplidae (adults)		1	1	
Hydrophilidae (total)			1	
Dryopidae	1			
Elmidae	21	4	1	2
Gyrinidae (larvae)	1	2		
Halplidae (larvae)		1		
Scirtidae (larvae)			1	
Diptera (flies)				
Ceratopogonidae			3	
Chironomidae	7	10	98	34
Culicidae		1	1	
Simuliidae	11	7	3	
Tabanidae	3	4	1	
Tipulidae		1	4	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	2	6		
Physidae	12	8	66	
Planorbidae			4	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1		1	37
TOTAL INDIVIDUALS	317	265	361	242

Table 3B. Macroinvertebrate metric evaluation of sites in the Red Cedar Watershed, surveyed in July-September, 2011.

METRIC	W B Red Cedar River Grand River Avenue 8/30/2011 STATION 15		Sullivan Creek Perry Road 8/31/2011 STATION 16		Doan Creek Swan Road 7/25/2011 STATION 17		Dietz Creek Dietz Road 8/31/2011 STATION 18	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	27	1	23	0	32	1	19
NUMBER OF MAYFLY TAXA	3	0	1	0	2	0	1	0
NUMBER OF CADDISFLY TAXA	5	1	4	0	2	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	28.1	1	1.9	-1	1.7	-1	0.4	-1
PERCENT CADDISFLY COMP.	12.0	0	18.9	0	10.0	0	2.5	-1
PERCENT DOMINANT TAXON	26.2	0	51.7	-1	27.1	0	37.6	-1
PERCENT ISOPOD, SNAIL, LEECH	4.7	0	5.3	0	19.7	-1	7.0	0
PERCENT SURF. AIR BREATHERS	0.9	1	4.9	1	6.1	1	2.1	1
TOTAL SCORE		3		-2		-1		-3
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 3A. Qualitative macroinvertebrate sampling results for sites in the Red Cedar Watershed, surveyed in July-September, 2011.

TAXA	Deer Creek Frost Road 8/31/2011 STATION 19	Sloan Creek Noble Road 8/31/2011 STATION 20	Red Cedar River Dobie Road 9/1/2011 STATION 21	Pine Lake Outlet Okemos Road 9/1/2011 STATION 22
ANNELIDA (segmented worms)				
Oligochaeta (worms)	18		24	140
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	28	108	40	102
Decapoda (crayfish)	2	1	7	1
Isopoda (sowbugs)	1		2	19
Insecta				
Ephemeroptera (mayflies)				
Baetidae	5	5	12	
Caenidae			3	
Ephemeridae			1	
Heptageniidae	17		23	
Isonychiidae			1	
Tricorythidae			3	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	8	2	1	1
Gomphidae	5		9	
Libellulidae		1		
Zygoptera (damselflies)				
Calopterygidae	50	29	13	30
Coenagrionidae	1		1	
Hemiptera (true bugs)				
Belostomatidae	1		1	
Corixidae			1	1
Gerridae		4		3
Nepidae	4			
Notonectidae	1			1
Pleidae	2			1
Veliidae	1	1		
Megaloptera				
Sialidae (alder flies)	2		5	
Trichoptera (caddisflies)				
Brachycentridae	20			
Helicopsychidae			1	
Hydropsychidae	3	27	20	7
Leptoceridae	1	2		
Phryganeidae	1	1		
Polycentropodidae	1			
Coleoptera (beetles)				
Dytiscidae (total)	4		2	2
Haliplidae (adults)				1
Hydrophilidae (total)	1			
Psephenidae (adults)			7	
Dryopidae	12		11	1
Elmidae	7	17	26	3
Diptera (flies)				
Chironomidae	42	47	19	18
Culicidae	1			
Simuliidae	2			3
Stratiomyidae				1
Tabanidae	15	3	19	2
Tipulidae			1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	2		1	
Hydrobiidae	1			
Physidae	2	2	1	2
Pleuroceridae				1
Viviparidae	1			1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	3	8	
Unionidae (mussels)			2	
TOTAL INDIVIDUALS	263	253	265	341

Table 3B. Macroinvertebrate metric evaluation of sites in the Red Cedar Watershed, surveyed in July-September, 2011.

METRIC	Deer Creek Frost Road 8/31/2011 STATION 19		Sloan Creek Noble Road 8/31/2011 STATION 20		Red Cedar River Dobie Road 9/1/2011 STATION 21		Pine Lake Outlet Okemos Road 9/1/2011 STATION 22	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	34	1	16	0	30	1	22
NUMBER OF MAYFLY TAXA	2	0	1	0	6	1	0	-1
NUMBER OF CADDISFLY TAXA	5	1	3	0	2	0	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	8.4	0	2.0	-1	16.2	0	0	-1
PERCENT CADDISFLY COMP.	9.9	0	11.9	0	7.9	0	2.1	-1
PERCENT DOMINANT TAXON	19.0	1	42.7	-1	15.1	1	41.1	-1
PERCENT ISOPOD, SNAIL, LEECH	2.7	1	0.8	1	1.5	1	6.7	0
PERCENT SURF. AIR BREATHERS	5.7	1	2.0	1	4.2	1	2.9	1
TOTAL SCORE		4		-1		4		-5
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		POOR

Table 3A. Qualitative macroinvertebrate sampling results for sites in the Red Cedar Watershed, surveyed in July-September, 2011.

Red Cedar River downstream of Kalamazoo Street 9/1/2011 STATION 24	
TAXA	
ANNELIDA (segmented worms)	
Oligochaeta (worms)	1
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	50
Isopoda (sowbugs)	8
Arachnoidea	
Hydracarina	2
Insecta	
Ephemeroptera (mayflies)	
Baetidae	5
Ephemeridae	8
Heptageniidae	13
Tricorythidae	2
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	1
Zygoptera (damselflies)	
Calopterygidae	25
Coenagrionidae	2
Hemiptera (true bugs)	
Belostomatidae	1
Gerridae	2
Notonectidae	1
Trichoptera (caddisflies)	
Hydropsychidae	5
Leptoceridae	4
Limnephilidae	1
Philopotamidae	6
Coleoptera (beetles)	
Hydrophilidae (total)	1
Elmidae	71
Psephenidae (larvae)	1
Diptera (flies)	
Chironomidae	4
Stratiomyidae	1
Tabanidae	2
Tipulidae	1
MOLLUSCA	
Pelecypoda (bivalves)	
Sphaeriidae (clams)	1
TOTAL INDIVIDUALS	219

Table 3B. Macroinvertebrate metric evaluation of sites in the Red Cedar Watershed, surveyed in July-September, 2011.

Red Cedar River downstream of Kalamazoo Street 9/1/2011 STATION 24			
METRIC	Value	Score	
TOTAL NUMBER OF TAXA	26	1	1
NUMBER OF MAYFLY TAXA	4	1	1
NUMBER OF CADDISFLY TAXA	4	0	0
NUMBER OF STONEFLY TAXA	0	-1	-1
PERCENT MAYFLY COMP.	12.8	0	0
PERCENT CADDISFLY COMP.	7.3	0	0
PERCENT DOMINANT TAXON	32.4	0	0
PERCENT ISOPOD, SNAIL, LEECH	3.7	1	1
PERCENT SURF. AIR BREATHERS	2.7	1	1
TOTAL SCORE			3
MACROINV. COMMUNITY RATING		ACCEPT.	

Table 4. Habitat evaluation for sites on Willow Creek, comparing 2006 results with 2011 results.

HABITAT METRIC	Willow Creek at Kipp Road		Willow Creek at Toles Road	
	GLIDE/POOL 2006	GLIDE/POOL 2011	GLIDE/POOL 2006	RIFFLE/RUN 2011
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	8	5	10	10
Embeddedness (20)*				8
Velocity/Depth Regime (20)*				13
Pool Substrate Characterization (20)**	9	8	11	
Pool Variability (20)**	1	5	7	
Channel Morphology				
Sediment Deposition (20)	1	3	7	6
Flow Status - Maint. Flow Volume (10)	10	10	9	10
Flow Status - Flashiness (10)	3	2	2	3
Channel Alteration (20)	8	8	14	11
Frequency of Riffles/Bends (20)*				6
Channel Sinuosity (20)**	0	3	10	
Riparian and Bank Structure				
Bank Stability (L) (10)	9	6	8	7
Bank Stability (R) (10)	9	6	8	7
Vegetative Protection (L) (10)	7	7	9	6
Vegetative Protection (R) (10)	7	7	9	6
Riparian Veg. Zone Width (L) (10)	8	3	9	5
Riparian Veg. Zone Width (R) (10)	8	3	9	5
TOTAL SCORE (200):	88	76	122	103
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY 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:	6/28/2006	9/7/2011	6/28/2006	9/7/2011
Weather:	Partly Cloudy	Cloudy	Rainy	Cloudy
Air Temperature:	70 Deg. F.	73 Deg. F.	68 Deg. F.	83 Deg. F.
Water Temperature:	65 Deg. F.	55 Deg. F.	62 Deg. F.	61 Deg. F.
Ave. Stream Width:	12 Feet	7 Feet	12 Feet	5 Feet
Ave. Stream Depth:	1 Feet	1 Feet	0.5 Feet	0.5 Feet
Surface Velocity:	0.5 Ft./Sec.	0.3 Ft./Sec.	1 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	6 CFS	2.1 CFS	6 CFS	2.5 CFS
Stream Modifications:	Dredged	Dredged	Dredged	
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	330408	330408	330319	330319
Stream Name:	Willow Creek	Willow Creek	Willow Creek	Willow Creek
Road Crossing/Location:	Kipp Road	Kipp Road	Toles Road	Toles Road
County Code:	33	33	33	33
TRS:	02N02W13	02N02W13	02N02W24	02N02W24
Latitude (dd):	42.56021048	42.56021048	42.53854	42.53854
Longitude (dd):	-84.48724888	-84.48724888	-84.49035	-84.49035
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 5. Habitat evaluation for sites in the Red Cedar Watershed; July-September, 2011.

HABITAT METRIC	Mud Creek Okemos Road STATION 3 GLIDE/POOL	Sycamore Creek Rolf Road STATION 4 RIFFLE/RUN	Sycamore Creek Tomlinson Road STATION 5 GLIDE/POOL	Sycamore Creek State Street STATION 6 RIFFLE/RUN	Sycamore Creek Holt Road STATION 7 GLIDE/POOL
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	13	16	8	10	2
Embeddedness (20)*		13		15	
Velocity/Depth Regime (20)*		13		10	
Pool Substrate Characterization (20)**	11		8		6
Pool Variability (20)**	2		5		11
Channel Morphology					
Sediment Deposition (20)	5	11	5	13	3
Flow Status - Maint. Flow Volume (10)	9	10	10	9	9
Flow Status - Flashiness (10)	2	4	2	3	2
Channel Alteration (20)	6	16	6	13	13
Frequency of Riffles/Bends (20)*		13		3	
Channel Sinuosity (20)**	2		6		8
Riparian and Bank Structure					
Bank Stability (L) (10)	4	6	5	6	7
Bank Stability (R) (10)	4	6	5	6	7
Vegetative Protection (L) (10)	6	8	5	7	2
Vegetative Protection (R) (10)	6	8	5	7	2
Riparian Veg. Zone Width (L) (10)	2	5	2	3	4
Riparian Veg. Zone Width (R) (10)	2	5	2	3	4
TOTAL SCORE (200):	74	134	74	108	80
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY 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).

	7/25/2011	9/7/2011	9/7/2011	9/8/2011	9/8/2011
Date:	7/25/2011	9/7/2011	9/7/2011	9/8/2011	9/8/2011
Weather:	Sunny	Cloudy	Cloudy	Sunny	Cloudy
Air Temperature:	72 Deg. F.	50 Deg. F.	Deg. F.	71 Deg. F.	79 Deg. F.
Water Temperature:	72 Deg. F.	56 Deg. F.	60 Deg. F.	58 Deg. F.	60 Deg. F.
Ave. Stream Width:	10 Feet	7 Feet	7 Feet	25 Feet	45 Feet
Ave. Stream Depth:	0.75 Feet	0.5 Feet	0.5 Feet	1 Feet	2 Feet
Surface Velocity:	0.5 Ft./Sec.	0.5 Ft./Sec.	0.3 Ft./Sec.	0.5 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	3.75 CFS	1.75 CFS	1.05 CFS	12.5 CFS	9 CFS
Stream Modifications:	Dredged	None	Dredged	None	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	330417	330322	330411	330448	330018
Stream Name:	Mud Creek	Sycamore Creek	Sycamore Creek	Sycamore Creek	Sycamore Creek d/s of Kalamazoo Street
Road Crossing/Location:	Okemos Road	Rolf Road	Tomlinson Road	State Street	
County Code:	33	33	33	33	33
TRS:	03N01WS33	02N01W29	02N01W16	02N01W08	03N01W19
Latitude (dd):	42.6106	42.531115	42.55317	42.58137	42.6401
Longitude (dd):	-84.433	-84.448892	-84.43141	-84.446426	-84.4827
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 5. Habitat evaluation for sites in the Red Cedar Watershed; July-September, 2011.

HABITAT METRIC	Sycamore Creek Pine Tree Road STATION 8 GLIDE/POOL	Sycamore Creek Mount Hope Avenue STATION 9 GLIDE/POOL	M B Red Cedar Munsell Road STATION 10 GLIDE/POOL	M B Red Cedar River West Mason Road STATION 12 GLIDE/POOL	Conway Drain #1 Nicholson Road STATION 13 GLIDE/POOL
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	11	11	10	5	5
Embeddedness (20)*					
Velocity/Depth Regime (20)*					
Pool Substrate Characterization (20)**	10	8	10	6	6
Pool Variability (20)**	13	16	6	5	5
Channel Morphology					
Sediment Deposition (20)	6	5	8	11	5
Flow Status - Maint. Flow Volume (10)	9	9	10	10	10
Flow Status - Flashiness (10)	3	6	10	9	5
Channel Alteration (20)	15	16	13	10	6
Frequency of Riffles/Bends (20)*					
Channel Sinuosity (20)**	13	16	13	5	10
Riparian and Bank Structure					
Bank Stability (L) (10)	8	10	10	10	6
Bank Stability (R) (10)	8	10	10	10	9
Vegetative Protection (L) (10)	6	8	10	10	6
Vegetative Protection (R) (10)	6	8	10	10	6
Riparian Veg. Zone Width (L) (10)	7	2	10	4	3
Riparian Veg. Zone Width (R) (10)	7	7	10	10	3
TOTAL SCORE (200):	122	132	140	115	85
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY 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 Rating describes the general riverine environment at the site(s).

Date:	9/8/2011	9/1/2011	8/30/2011	8/30/2011	8/30/2011
Weather:	Cloudy	Sunny			Sunny
Air Temperature:	60 Deg. F.	84 Deg. F.	Deg. F.	68 Deg. F.	77 Deg. F.
Water Temperature:	60 Deg. F.	60 Deg. F.	60 Deg. F.	64 Deg. F.	68 Deg. F.
Ave. Stream Width:	45 Feet	30 Feet	18 Feet	20 Feet	6 Feet
Ave. Stream Depth:	2 Feet	1.2 Feet	0.5 Feet	0.5 Feet	0.3 Feet
Surface Velocity:	0.5 Ft./Sec.	0.5 Ft./Sec.	0.5 Ft./Sec.	0.25 Ft./Sec.	0.25 Ft./Sec.
Estimated Flow:	45 CFS	18 CFS	4.5 CFS	2.5 CFS	0.45 CFS
Stream Modifications:	None	None	None	Dredged	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	330160	330057	470647	470481	470648
Stream Name:	Sycamore Creek	Sycamore Creek	MB Red Cedar	M B Red Cedar	Conway Drain #1 d/s of
Road Crossing/Location:	Pine Tree Road	Mount Hope Avenue	Munsell Road	West Mason Road	Kalamazoo Street
County Code:	33	33	47	47	47
TRS:	03N02W12	04N02W27	02N03E14	03N03E34	04N03E33
Latitude (dd):	42.66623	42.71188	42.56101	42.599161	42.69552
Longitude (dd):	-84.50348	-84.529024	-84.052432	-84.07451	-84.11461
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 5. Habitat evaluation for sites in the Red Cedar Watershed; July-September, 2011.

HABITAT METRIC	Conway Drain #15 Chase Lake Road STATION 14 GLIDE/POOL	W B Red Cedar River Grand River Avenue STATION 15 GLIDE/POOL	Sullivan Creek Perry Road STATION 16 RIFFLE/RUN	Doan Creek Swan Road STATION 17 GLIDE/POOL	Dietz Creek Dietz Road STATION 18 GLIDE/POOL
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	10	15	13	8	8
Embeddedness (20)*			8		
Velocity/Depth Regime (20)*			14		
Pool Substrate Characterization (20)**	13	15		8	6
Pool Variability (20)**	10	10		5	3
Channel Morphology					
Sediment Deposition (20)	5	10	8	3	5
Flow Status - Maint. Flow Volume (10)	9	10	10	9	8
Flow Status - Flashiness (10)	7	8	8	5	5
Channel Alteration (20)	5	16	11	5	10
Frequency of Riffles/Bends (20)*			10		
Channel Sinuosity (20)**	5	16		1	3
Riparian and Bank Structure					
Bank Stability (L) (10)	8	10	8	7	8
Bank Stability (R) (10)	8	10	8	7	8
Vegetative Protection (L) (10)	7	10	7	6	5
Vegetative Protection (R) (10)	7	10	7	6	5
Riparian Veg. Zone Width (L) (10)	8	3	5	1	2
Riparian Veg. Zone Width (R) (10)	3	6	2	1	3
TOTAL SCORE (200):	105	149	119	72	79
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 Rating describes the general riverine environment at the site(s).

Date:	9/13/2011	8/30/2011	8/31/2011	7/25/2011	8/31/2011
Weather:	Cloudy	Sunny	Cloudy		Cloudy
Air Temperature:	74 Deg. F.	73 Deg. F.	71 Deg. F.	75 Deg. F.	Deg. F.
Water Temperature:	68 Deg. F.	68 Deg. F.	60 Deg. F.	69 Deg. F.	63 Deg. F.
Ave. Stream Width:	5 Feet	25 Feet	8 Feet	7 Feet	8 Feet
Ave. Stream Depth:	1 Feet	1 Feet	0.2 Feet	1 Feet	0.4 Feet
Surface Velocity:	0.2 Ft./Sec.	0.5 Ft./Sec.	0.5 Ft./Sec.	0.5 Ft./Sec.	0.25 Ft./Sec.
Estimated Flow:	1 CFS	12.5 CFS	0.8 CFS	3.5 CFS	0.8 CFS
Stream Modifications:	Dredged	None	None	Dredged	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	470583	470489	330454	330432	330396
Stream Name:	Conway Drain #15 Chase Lake	W B Red Cedar River Grand River	Sullivan Creek	Doan Creek	Dietz Creek
Road Crossing/Location:	Road	Avenue	Perry Road	Swan Road	Dietz Road
County Code:	47	47	33	33	33
TRS:	04N03E33	03N03E07	04N02E33	02N02E32	02N02E09
Latitude (dd):	42.6998	42.66711	42.69	42.5191	42.57729
Longitude (dd):	-84.1118	-84.14075	-84.219476	-84.2287	-84.222195
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 5. Habitat evaluation for sites in the Red Cedar Watershed; July-September, 2011.

HABITAT METRIC	Deer Creek Frost Road STATION 19 GLIDE/POOL	Sloan Creek Noble Road STATION 20 RIFFLE/RUN	Red Cedar River Dobie Road STATION 21 GLIDE/POOL	Pine Lake Outlet Okemos Road STATION 22 GLIDE/POOL	Red Cedar River d/s of Kalamazoo Street STATION 24 GLIDE/POOL
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	10	5	6	11	11
Embeddedness (20)*		8			
Velocity/Depth Regime (20)*		6			
Pool Substrate Characterization (20)**	8		10	8	13
Pool Variability (20)**	11		8	13	11
Channel Morphology					
Sediment Deposition (20)	5	11	8	8	5
Flow Status - Maint. Flow Volume (10)	8	9	10	8	10
Flow Status - Flashiness (10)	2	4	4	5	5
Channel Alteration (20)	11	13	11	13	13
Frequency of Riffles/Bends (20)*		5			
Channel Sinuosity (20)**	8		8	8	8
Riparian and Bank Structure					
Bank Stability (L) (10)	2	6	7	5	7
Bank Stability (R) (10)	2	6	7	5	7
Vegetative Protection (L) (10)	5	7	6	5	5
Vegetative Protection (R) (10)	5	7	6	5	5
Riparian Veg. Zone Width (L) (10)	2	2	5	10	4
Riparian Veg. Zone Width (R) (10)	2	2	4	10	4
TOTAL SCORE (200):	81	91	100	114	108
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY 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 Rating describes the general riverine environment at the site(s).

Date:	8/31/2011	8/31/2011	9/1/2011	9/1/2011	9/1/2011
Weather:	Cloudy	Sunny	Sunny	Sunny	Sunny
Air Temperature:	Deg. F.	80 Deg. F.	75 Deg. F.	66 Deg. F.	90 Deg. F.
Water Temperature:	63 Deg. F.	64 Deg. F.	68 Deg. F.	66 Deg. F.	72 Deg. F.
Ave. Stream Width:	13 Feet	6 Feet	60 Feet	7 Feet	40 Feet
Ave. Stream Depth:	1 Feet	0.3 Feet	1.5 Feet	1 Feet	3 Feet
Surface Velocity:	0.25 Ft./Sec.	0.2 Ft./Sec.	0.3 Ft./Sec.	0.25 Ft./Sec.	0.3 Ft./Sec.
Estimated Flow:	3.25 CFS	0.36 CFS	27 CFS	1.75 CFS	36 CFS
Stream Modifications:	Dredged	Dredged	None	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	330453	330450	330452	330451	330006
Stream Name:	Deer Creek	Sloan Creek	Red Cedar River	Pine Lake Outlet	Red Cedar River d/s of Kalamazoo Street
Road Crossing/Location:	Frost Road	Noble Road	Dobie Road	Okemos Road	Street
County Code:	33	33	33	33	33
TRS:	03N01E23	03N01E08	04N01W27	04N01W16	04N02W13
Latitude (dd):	42.63016	42.65849	42.70027	42.73149	42.729448
Longitude (dd):	-84.293444	-84.346051	-84.410448	-84.427695	-84.506253
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050004	4050004	4050004	4050004	4050004

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 6A. Qualitative fish sampling results for sites on Mud and Sycamore Creek.

TAXA	Mud Creek	Sycamore Creek
	Okemos Road 7/25/2011 STATION 3	Rolf Road 9/7/2011 STATION 4
Umbridae (mudminnows)		
<i>Umbrina limi</i> (Central mudminnow)	6	3
Esocidae (pikes)		
<i>Esox lucius</i> (Northern Pike)	1	
Cyprinidae (minnows and carps)		
<i>Semotilus atromaculatus</i> (Creek chub)		25
<i>Rhinichthys atratulus</i> (Blacknose dace)		27
Catostomidae (suckers)		
<i>Catostomus commersoni</i> (White sucker)		10
Gasterosteidae (sticklebacks)		
<i>Culaea inconstans</i> (Brook stickleback)		2
Centrarchidae (sunfish)		
<i>Ambloplites rupestris</i> (Rock bass)	2	
<i>Lepomis cyanellus</i> (Green sunfish)	50	7
<i>Lepomis gibbosus</i> (Pumpkinseed sf)	2	
<i>Lepomis macrochirus</i> (Bluegill sf)	5	
<i>Pomoxis nigromaculatus</i> (Black crappie)	1	
<i>Micropterus salmoides</i> (Largemouth bass)	2	3
Percidae (perch)		
<i>Etheostoma caeruleum</i> (Rainbow darter)	3	
<i>Etheostoma nigrum</i> (Johnny darter)	14	17
<i>Percina maculata</i> (Blackside darter)	15	
TOTAL INDIVIDUALS	101	94
Number of hybrid sunfish	0	0
Number of anomalies	0	0
Percent anomalies	0.000	0.000
Percent salmonids	0.000	0.000
Reach sampled (ft)	400	330
Area sampled (sq ft)	4,000	2,310
Density (# fish/sq ft)	0.025	0.041
Gear	bps	

Table 6B. Fish metric evaluation of for sites on Mud and Sycamore Creek.

METRIC	Mud Creek		Sycamore Creek	
	Okemos Road 7/25/2011 STATION 3	Score	Rolfe Road 9/7/2011 STATION 4	Score
TOTAL NUMBER OF TAXA	11	1	8	1
NO. OF DARTER, SCULPIN, MADTOM TAXA	3	1	1	0
NUMBER OF SUNFISH TAXA	5	1	1	0
NUMBER OF SUCKER TAXA	0	-1	1	0
NUMBER OF INTOLERANT TAXA	2	0	0	-1
PERCENT TOLERANT	69.31	-1	94.68	-1
PERCENT OMNIVOROUS TAXA	5.94	1	69.15	-1
PERCENT INSECTIVOROUS TAXA	88.12	1	27.66	-1
PERCENT PISCIVOROUS TAXA	4.95	0	3.19	0
% SIMPLE LITHOPHILIC SPAWNER TAXA	17.82	0	39.36	0
TOTAL SCORE		3		-3
FISH COMMUNITY RATING		ACCEPT.		ACCEPT.

Table 7. Water chemistry results for selected stations in the Sycamore Creek watershed and Herron Creek; collected on September 8, 2011.

Parameter	Symbol	Units	STATION 1	STATION 3	STATION 4	STATION 6	STATION 7	STATION 7 (DUP)	STATION 8	STATION 9	STATION 23	
			Willow Creek at Kipp Rd.	Mud Creek at Okemos Rd.	Sycamore Creek at Rolfe Rd.	Sycamore Creek at State St.	Sycamore Creek at Holt Rd.	Sycamore Creek at Holt Rd. (duplicate)	Sycamore Creek at Pine Tree Rd.	Sycamore Creek at Mt. Hope Avenue	Herron Creek	Blank
Ammonia	NH3	mg N/L	.037	.052	.055	.023	.017	.017	.010	.022	.126	ND
Arsenic - Total	AS	µg/L									5.3	ND
Barium - Total	BA	µg/L									67	ND
Cadmium - Total	CD	µg/L									ND	ND
Chromium - Total	CR	µg/L									1.1	ND
COD	COD	mg/L	14	18	14	13	15	14	19	18	61	ND
Copper - Total	CU	µg/L									1.7	ND
Lead - Total	PB	µg/L									ND	ND
Mercury - Total	HG	µg/L									ND	ND
Ortho-phosphate	OP	mg P/L	.027	.029	.081	.030	.040	.040	.045	.042	.071	.004
Selenium - Total	SE	µg/L									ND	ND
Silver -Total	AG	µg/L									0.39	ND
Solids - Suspended	SS	mg/L	5	6	ND	4	5	ND	26	6	20	ND
Solids - Total Dissolved	TDS	mg/L	540	510	520	560	580	560	550	560	560	ND
TOC	TOC	mg/L	4.9	8.1	4.8	4.7	6.2	6.3	6.2	7.2	24	ND
Total Kjeldahl Nitrogen	KN	mg N/L	.51	.76	.86	.47	.63	.65	.77	.69	2.14	ND
Total Phosphorus	TP	mg P/L	.035	.047	.135	.043	.061	.058	.101	.060	.171	ND
Zinc - Total	ZN	µg/L									ND	ND

ND- Not detected