MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

BIOLOGICAL SURVEYS OF SELECTED LOWER GRAND RIVER STREAMS IONIA, KENT, MUSKEGON, AND OTTAWA COUNTIES, MICHIGAN AUGUST-SEPTEMBER 2014

Introduction

The biologic integrity and physical habitat conditions of the lower Grand River (Hydrologic Unit Code (HUC) 04050006) and selected tributaries were surveyed during August and September 2014 by staff of the Surface Water Assessment Section (SWAS), Water Resources Division (WRD). The objectives of this study were to:

1. Evaluate the attainment status of the other indigenous aquatic life and wildlife (OIALW) designated use.

2. Identify and investigate effects of nonpoint sources (NPS) of pollution.

3. Satisfy monitoring requests submitted by internal and external customers.

Methods: The macroinvertebrate communities were assessed and scored using the SWAS Procedure 51 (P-51) (MDEQ, 1990) with metrics that rate the communities on a scale from excellent to poor. Possible scores can range from 9 to -9. Stations with a score greater than or equal to +5 are considered excellent. Stations with a score less than or equal to -5 are classified as poor. Stations with a score of -4 through +4 are classified as acceptable (minimally to moderately impaired). Habitat evaluations are based on 10 metrics, with a possible maximum total score of 200. Stations are classified as excellent with a habitat score >154, good with a score between 105 and 154, marginal with a score between 56 and 104, and poor with a score <56. The nonwadeable procedure uses a different set of metrics and scoring scale than P-51, and rates macroinvertebrate communities as poor (0-25), marginal (26-50), good (51-75), and excellent (76-100). The habitat at these nonwadeable sites is not scored using P-51, but is described at each transect during the survey process.

Two site-selection methods were used to assess lower Grand River watershed streams in 2014: stratified random and targeted. A probabilistic monitoring approach, using stratified random site-selection to address statewide and regional questions about water quality, was used to select 15 sites within the lower Grand River watersheds. The sites were chosen randomly from a combined pool of streams that included this sampling area. Eleven sites were sampled to satisfy targeted monitoring requests that were submitted (described below). Four sites were sampled as part of the statewide trend program.

Summary Results of Monitoring Objectives

1. Evaluate the Attainment Status of the OIALW Designated Use

Thirty-one different stations (status/trend and targeted combined) were sampled throughout the lower Grand River watershed. Of those 31 stations, 2 scored poor. The other stations ranged from low acceptable to excellent. The entire main stem of the lower Grand River has historically not attained the OIALW designated use because of mercury and PCB exceedances. The section of the Grand River that received a poor score for the macroinvertebrate community has been historically dredged and scoured by logging activity and continues to lack stable habitat and substrate. Little Bass Creek (Ottawa County) at 68th Street scored poor and at 76th Street scored low acceptable. Those stations are in a section of Little Bass Creek that is maintained as a county drain (Ottawa County Drain Commissioner, per. Comm.). From Pierce Street upstream, Little Bass Creek is not attaining the OIALW designated use.

Stations that received either poor or low acceptable scores often times had macroinvertebrate communities that were dominated by Amphipoda taxa. Amphipoda are facultative, meaning that they can occur in environments ranging from pristine to those containing moderate levels of pollution/disturbance. However, Amphipoda tend to dominate in systems exhibiting more disturbance (Voshell, 2002). Amphipoda also tend to be habitat generalists (Voshell, 2002) and were often found to be the most abundant taxa at stations that were lacking a wide variety of habitat types.

All other stations scored either acceptable or excellent in this latest survey. The unnamed tributary to Pottawattomie Bayou (Ottawa County) was originally listed as not attaining the OIALW designated use because Pottawattomie Bayou is connected to the main stem lower Grand River (Michigan Department of Environmental Quality [MDEQ], 2014). That tributary has now been listed as attaining the OIALW designated use since the macroinvertebrate community scored acceptable. Plaster Creek is listed as not attaining the OIALW designated use because of sedimentation (MDEQ, 2014). All Plaster Creek and Plaster Creek tributary sites scored acceptable.

2. Identify and Investigate Effects of NPS of Pollution

Aerial photos of Crockery Creek at Behler Road in Casnovia Township (Station 14) appeared to show a section of stream being accessed by cattle. This area is upstream of where field staff sampled. A future visit may be necessary to investigate whether unrestricted cattle access is occurring at that station. An ineffective cattle crossing upstream of where Bass Creek was sampled at Stanton Street in Blendon Township (Station 10) has not been maintained, resulting in stream bank erosion. The Ottawa County Conservation District is currently working with the farmstead owners to repair the crossing and address other NPS issues. Plaster Creek at 68th Street SE near Dutton (Station 20) had several concerning issues: At least two erosional gullies are draining a nearby row crop field that is near the stream with minimal riparian vegetation. In addition, an active cattle crossing with no erosion protection is in place upstream of where staff sampled.

3. Satisfy Monitoring Requests Submitted by Internal and External Customers

All monitoring requests were generated internally and fulfilled. All of the sites within the Plaster Creek watershed requested by the MDEQ NPS program were assessed. The results of these biosurveys will be used as prerestoration, baseline data. Eight biosurveys were

performed within the Plaster Creek watershed. All of the macroinvertebrate communities scored acceptable with scores ranging from -4 to 1. Habitat was rated as marginal at five sites and good at three sites with scores ranging from 71 to 120. The fish community was surveyed at Shadyside Park and scored acceptable (-2). Most, if not all, of those sites will be revisited again in the future after restoration work has been performed. The unnamed tributary to Pottawattamie Bayou and Norris Creek were sampled because insufficient information was available for them for the 2014 Integrated Report (MDEQ, 2014). The macroinvertebrate community at the unnamed tributary to Pottawattomie Bayou scored low acceptable (-3) and habitat scored good (146). The macroinvertebrate community at Norris Creek scored high acceptable (3) and habitat scored good (139). SWAS personnel requested that Libhart Creek and Crooked Creek be sampled because they were known to have high water quality; however, biosurveys using the most updated P-51 methodology had not been performed on them. The macroinvertebrate community at Crooked Creek scored acceptable (2) and habitat scored good (141). At Libhart Creek the macroinvertebrate community scored acceptable (3) and habitat scored good (112).

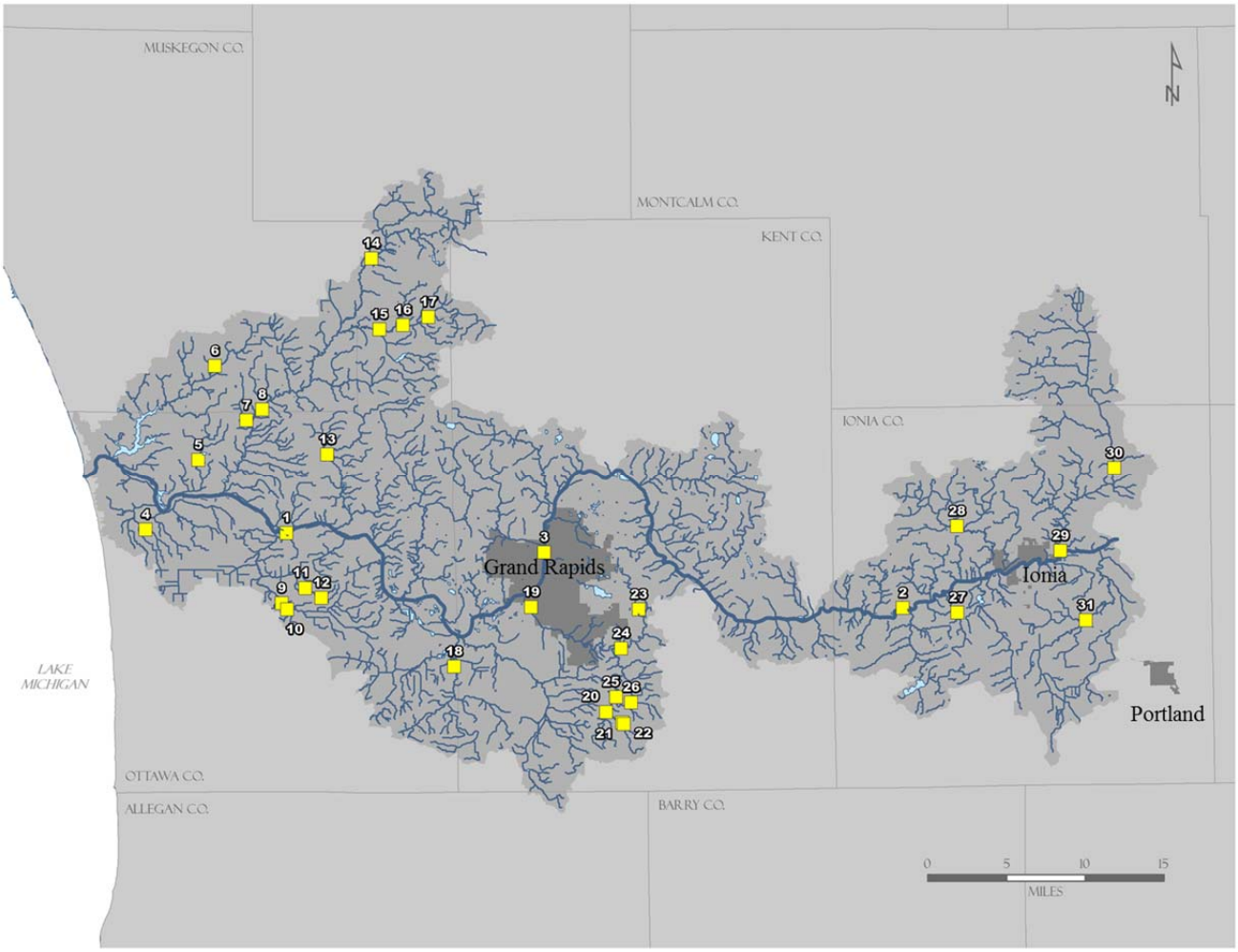

Figure 1. 2014 monitoring locations in the lower Grand River watershed. The thicker blue line denotes the main stem Grand River.

Watershed Information

Geology and Geography

The Lower Grand River watershed includes the main stem of the Grand River beginning in the town of Muir (Ionia County) to where it enters Lake Michigan in the city of Grand Haven (Ottawa County; Figure 1). The Grand River, together with all its tributaries, drains 5,570 square miles of Lower Michigan, spanning all or part of 18 counties. Major tributaries to the lower Grand River include the Maple, Thornapple, Rogue, and Flat Rivers.

The Lower Grand River and some of its tributaries (Rush, Buck, Indian Mill, and Mill Creeks), pass through the metro area of Grand Rapids, which is densely populated (Table 1; U.S. Census Bureau). The Grand River typically contributes some of the largest nutrient loads to Lake Michigan (Robertson, 1997). The majority of the Grand River watershed contains agricultural land use and the main stem of the river receives treated wastewater from several urban areas (Robertson 1997; Luscz et al., 2015).

Table 1. Predominant land use, population metrics, and wetland loss by 10-digit HUC in the lower Grand River watershed based on 2011 U.S. Census data. Note: data for all HUCs in the lower Grand River watershed are reported, however, only HUCs 0405000603, 605, 606, and 607 were surveyed in 2014. Land use percentages do not sum to 100. Remaining land uses were classified as "other."

10-Digit HUC	HUC 10 Name	Developed (%)	Agriculture (%)	Wetland (%)	Forest (%)	Population	Housing Units	Historic Wetland Loss (%)
0405000601	Coopers Creek-Flat River	8	51	16	19	20815	10047	9
0405000602	Flat River	10	45	15	24	40832	17213	7
0405000603	Prairie Creek-Grand River	9	61	10	18	44431	16290	26
0405000604	Rogue River	16	42	11	26	65269	24637	27
0405000605	Rush Creek-Grand River	52	23	5	16	510379	211405	33
0405000606	Crockery Creek	7	65	10	16	12057	4569	29
0405000607	Grand River	20	41	10	22	120050	47013	36

Table 2. Land use data by 12-digit HUC in the lower Grand River watershed based on 2011 U.S. Census data. Note: data for all HUCs in the lower Grand River watershed are reported, however, only 10-digit HUCs 0405000603, 605, 606, and 607 were surveyed in 2014.

12-Digit HUC	HUC 12 Name	Developed (%)	Agriculture (%)	Wetland (%)	Forest (%)
040500060101	Clear Lake-Black Creek	7	51	15	20
040500060102	Fifth Lake	8	57	15	13
040500060103	Townline Creek-Flat River	8	51	16	16
040500060104	Mud Lake-Flat River	6	59	16	14
040500060105	Hunter Lake-Flat River	7	42	11	34
040500060106	Alder Creek Drain-Black Creek	7	55	24	11
040500060107	Clear Creek	11	58	11	12
040500060108	Coopers Creek	10	31	14	37
040500060109	Perch Lake-Flat River	10	41	13	28
040500060201	Wabasis Creek	8	42	14	28
040500060202	County Farm Pond-Dickerson Creek	7	60	21	9
040500060203	Twin Lakes-Dickerson Creek	7	60	22	10
040500060204	Long Lake	7	38	28	21
040500060205	Dickerson Creek	6	33	22	34
040500060206	Sanderson Lake-Flat River	22	35	13	23
040500060207	Seely Creek	8	45	15	26
040500060208	Honey Lake-Flat River	21	44	9	22
040500060209	Flat River	9	47	7	32
040500060301	Taylor Drain-Libhart Creek	7	83	6	3
040500060302	Libhart Creek	5	78	6	10
040500060303	Bacon Creek-Prairie Creek	6	67	16	10
040500060304	Ross and Branch Drain-Prairie Creek	5	60	20	13
040500060305	Bow Pond	6	72	15	7
040500060306	Prairie Creek	7	67	11	14
040500060307	Dry Creek-Grand River	17	47	12	21
040500060308	Sessions Creek	6	75	6	10
040500060309	Bellemy Creek-Grand River	11	66	9	13
040500060310	Crooked Creek-Grand River	5	59	10	23
040500060311	Lake Creek	10	66	6	16
040500060312	Toles Creek-Grand River	13	36	10	38
040500060313	Lee Creek-Grand River	16	25	8	46
040500060401	Hickory Creek-Rogue River	6	45	11	33
040500060402	Duke Creek	15	42	18	22
040500060403	Spring Creek-Rogue River	6	42	14	33
040500060404	Nash Creek	11	77	5	7
040500060405	Ball Creek-Rogue River	16	46	13	21
040500060406	Cedar Creek	20	47	10	21
040500060407	Freska Lake-Rogue River	18	38	14	24
040500060408	Stegman Creek-Rogue River	32	25	6	32
040500060501	Bear Creek	15	32	13	36
040500060502	Egypt Creek-Grand River	25	21	10	39
040500060503	Mill Creek	20	65	2	10
040500060504	Indian Mill Creek	47	39	3	10
040500060505	Headwaters Plaster Creek	44	38	6	11
040500060506	Plaster Creek	90	2	3	5
040500060507	Lamberton Creek-Grand River	76	4	4	11
040500060508	Sharps Creek-Buck Creek	43	35	4	14
040500060509	East Branch Rush Creek	37	47	4	9
040500060510	Buck Creek	91	3	2	4
040500060511	Rush Creek	65	23	1	7
040500060512	Walker-Grand River	64	5	7	14
040500060601	North Branch Crockery Creek	6	72	8	11
040500060602	Eastland Drain-Crockery Creek	8	61	11	18
040500060603	Rio Grande Creek-Crockery Creek	8	71	6	14
040500060604	Lawrence Drain-Crockery Creek	5	62	10	19
040500060605	Crockery Creek	8	59	14	16
040500060701	East Fork	23	62	9	5
040500060702	Headwaters Sand Creek	8	78	6	7
040500060703	Sand Creek	20	43	9	24
040500060704	Dear Creek	12	77	6	4
040500060705	Ottawa Creek-Grand River	32	33	9	17
040500060706	Bass Creek	13	65	6	14
040500060707	Bass River	10	58	11	17
040500060708	Jubb Bayou-Grand River	8	45	13	19
040500060709	Pottawatomie Bayou	37	9	10	35
040500060710	Norris Creek	9	25	15	40
040500060711	Spring Lake	34	7	7	39
040500060712	Grand River	27	12	13	35

The Grand River Valley was formed approximately 12,000 years ago with the melting of the Laurentian ice sheets. Draining the large volume of glacial melt water left the valley with steep walls in some areas, which today results in areas where tributary streams have downcut their own steep valleys. In the mid-19th century the Grand River became an important means of transportation for logs and lumber (Figure 2). The entire lower Grand River watershed is within the Southern Michigan/Northern Indiana Till Plains (SMNITP) ecoregion, which broadly covers the majority of the southern half of the Lower Peninsula of Michigan (Omernik and Gallant, 1988). In terms of the United States Geological Survey (USGS) landscape ecosystem types, the lower Grand River watershed is composed of Lansing, Jamestown, Southern Lake Michigan Lake Plain, and Greenville subsections (Albert, 1995). The eastern portion of the watershed is in the Lansing ecosystem subsection, where soils are rich loams. Presettlement vegetation would have supported beech and maple forests with occasional pockets of forested wetlands, which formerly occupied about 30 percent of the area. Most uplands in the fertile Lansing subsection have been converted to agriculture while most wetlands were deforested and converted to pastureland. Drainage by tiling and ditching was necessary to support agriculture in many areas, and as a result, many stream headwaters that were once sprawling wetlands are now drainage ditches and maintained drains with low gradient (less than 1 meter elevation drop per kilometer). Topography is gently rolling in the Lansing subsection. The western portion of the watershed, most of Ottawa County, is part of the Southern Lake Michigan Lake Plain subsection.

The Southern Lake Michigan Lake Plain soils are composed mainly of sandy lacustrine deposits of 50- to 350-feet thick, overlying shale bedrock, which is rarely exposed. These sandy areas were deltas formed by the periglacial Grand River. Clay dominated moraines are also present causing gentle slopes with a 6-12 percent gradient. A narrow band of the Jamestown subsection runs north-south through the eastern end of Ottawa County, where the Sand and Deer Creek watersheds are characterized by more clayey ground and end moraines and used largely for row crop agriculture. The northern portions of Kent County, in the vicinity of Indian Mill Creek and Mill Creek are in the Greenville subsection. The Greenville Subsection is characterized by a hillier landscape, with some hills up to 140-feet high resulting in occasional steep slopes. Upland soils tend to be excessively drained sands, while lowland areas are composed of poorly drained sandy outwash deposits. Due to the poor agricultural value of this land, after being cleared of forests for agriculture, much of these lands have been abandoned for this purpose and converted to residential areas near the city of Grand Rapids and old field forest succession further from the city.

Historical Information and Sampling Efforts

Beginning in 1881, the Grand River was dredged from Grand Rapids to Grand Haven to make the river much wider and deeper than it naturally was (United States Army Corps of Engineers [USACE], 1919). This dredging allowed for the movement of massive amounts of logs, as well as steamboats, from Grand Rapids to Grand Haven (Figure 2). Today, the Grand River from Grand Rapids downstream remains unnaturally deep and wide, with steep banks. Today, a navigation channel of eight feet is maintained by the USACE from the mouth of the Bass River to Lake Michigan (Hanshue and Harrington, 2011). This deep profile and steep banks often prevents large woody debris retention within the river and is not conducive to macrophyte growth, both of which would provide habitat for fish and macroinvertebrates.

Currently, there are 228 registered dams throughout the entire Grand River basin. The section of the lower Grand River covered in this report only contains ten registered dams. The most significant dams in the lower Grand River basin are on the main stem of the river where it flows

through the city of Grand Rapids: The Sixth Street Dam and the beautification dam set. Construction of the Sixth Street Dam began in 1849, with the placement of rocks, logs, and brush in the channel. The final structure was completed in 1866. The Sixth Street Dam was originally used to divert impounded water to canals to the east and west of the river that powered sawmills. The dam is now classified as a retired hydroelectric dam and maintains about eight feet of hydrologic head (Figure 3). The beautification dam, which is actually a set of 4 separate structures located in close proximity to each other, was constructed in 1931. The beautification dam structures only serve aesthetic purposes (Hanshue and Harrington, 2011). The impacts of low-head dams in general, such as flow and sediment transport disruption, increased downstream scouring, impoundment temperature increases, increased evaporative water loss from the impoundment, changes in macroinvertebrate communities, and fragmentation of fish communities are well documented (e.g., Allan, 1995). In the Grand River, construction of the dam in Lyons (just upstream of the Lower Grand River study area) had detrimental impacts on native mussel populations (van der Schalie, 1948). Hanshue and Harrington (2011) noted that the beautification dam structures may impede native fish movement during periods of low flow. Currently, plans are underway to remove the Sixth Street Dam and beautification dam structures.

Figure 2. Portion of massive log jam in Grand River that occurred in 1883. Photo from http://blog.mlive.com/chronicle/2008/07/grand_jam_of_1883.html.

Past sampling by MDEQ staff and others have found that the lower Grand River main stem has degraded habitat (Wilhelm et al., 2005) and macroinvertebrate communities (Wessell et al., 2008; Rippke, 2011) when compared to other large rivers in Michigan. Tributaries to the Lower Grand River were surveyed in 2004 (Rockafellow, 2005) and 2009 (Rippke, 2011). The depth and size of the main stem Grand River preclude the use of P-51 to evaluate macroinvertebrate and fish communities. The MDEQ has recently developed a procedure for evaluating aquatic communities in nonwadeable streams, which was implemented during the 2009 survey at status and trend sites. In 2004, the MDEQ visited 56 sites and conducted

macroinvertebrate community surveys at 45 of these stations, and fish community surveys at 21 stations. The majority of sites surveyed contained acceptable macroinvertebrate communities, with 4 sites rated poor, and 4 scoring excellent. Poor macroinvertebrate communities were found at Indian Mill Creek, Rush Creek, Red Creek, and Plaster Creek. The fish communities rated poor at 10 stations, including sites in Indian Mill Creek, Mill Creek, Plaster Creek, Bear Creek, York Creek, and Sand Creek. The coldwater fishery designated use is not being attained in Indian Mill Creek (MDEQ, 2014), an urban, highly flashy system in the city of Grand Rapids. Eleven sites were sampled for common water quality chemical parameters, and results throughout the watershed indicated no exceedances of water quality standards (WQS), but an overall elevated phosphorus concentration when compared with reference sites (Lundgren, 1994).

In 2009, Rippke (2011) found that the majority of sites were attaining the OIALW designated use. Of the wadeable sites, one station in North Branch Crockery Creek was not attaining the OIALW designated use (Rippke, 2011). Of the nonwadeable sites on the main stem of the Grand River, 6 of 13 sites that were sampled, were not attaining the OIALW designated use. Based on the results using the P-51 method, water bodies supporting high quality macroinvertebrate communities (excellent P-51 score) in 2009 were Prairie and Bellamy Creeks (Ionia County). Habitat throughout the lower Grand River watershed was generally categorized as marginal-excellent.

Twenty-eight sites were sampled in 2014. In September 2015 three additional sites in Plaster Creek were sampled as a result of targeted monitoring requests (Table 3). The results of the P-51 biosurveys performed in Plaster Creek in 2015 are included in this report.

Table 3. Lower Grand River watershed 2014 monitoring locations and score summaries.

Station	Type	Waterbody	Location	County	Latitude	Longitude	Macroinvertebrate score	Macroinvertebrate rating	Habitat score	Habitat rating
1	Status	Grand River	D/S 68th Ave, Eastmanville	Ottawa	43.00589	-85.99676	22	poor	.	.
2	Status	Grand River	Bridge ST, Saranac	Ionia	42.93449	-85.22455	66	good	.	.
3	Status	Grand River	Leonard ST, Grand Rapids	Kent	42.98779	-85.6732	43	fair	.	.
4	Targeted	Unnamed tributary to Pottawattomie Bayou	Hofma Park, Grand Haven	Ottawa	43.00923	-86.17337	-3	acceptable	146	good
5	Trend	Black Creek	Cleveland ST	Ottawa	43.0741	-86.10714	-2	acceptable	113	good
6	Targeted	Norris Creek	Hilton Park RD	Muskegon	43.16048	-86.08656	3	acceptable	139	good
7	Status	Unnamed tributary to Crockery Creek	104th Ave	Ottawa	43.11036	-86.04705	1	acceptable	133	good
8	Status	Crockery Creek	Ensley Road	Muskegon	43.12028	-86.02711	3	acceptable	68	marginal
9	Status	Bass Creek	88th Ave	Ottawa	42.94156	-86.00228	-1	acceptable	96	marginal
10	Status	Bass Creek	Stanton ST	Ottawa	42.93605	-85.9955	-2	acceptable	72	marginal
11	Status	Little Bass Creek	76th St	Ottawa	42.95559	-85.97313	-4	acceptable	106	good
12	Status	Little Bass Creek	68th St	Ottawa	42.94645	-85.9529	-5	poor	119	good
13	Status	Deer Creek	Sheridan Park	Ottawa	43.07882	-85.94541	-3	acceptable	109	good
14	Status	Crockery Creek	Behler Road	Muskegon	43.25905	-85.88939	1	acceptable	145	good
15	Trend	North Branch Crockery Creek	36th Ave	Ottawa	43.19407	-85.87922	-2	acceptable	134	good
16	Trend	North Branch Crockery Creek	24th Ave	Ottawa	43.19776	-85.84983	1	acceptable	119	good
17	Status	North Branch Crockery Creek	Sherman Boulevard	Muskegon	43.20533	-85.81793	-1	acceptable	103	marginal
18	Status	East Branch Rush Creek/ Bliss Creek Inter County Drain	44th St SW	Ottawa	42.88329	-85.78674	0	acceptable	93	marginal
19	Targeted	Plaster Creek	Godfrey Ave SW	Kent	42.93752	-85.69001	-3	acceptable	111	good
20	Targeted	Plaster Creek	68th St SE	Kent	42.84109	-85.59683	1	acceptable	87	marginal
21	Targeted	Plaster Creek	Shadyside Park	Kent	42.83115	-85.57641	1	acceptable	87	marginal
22	Targeted	Plaster Creek	Hammond Ave SE	Kent	42.82972	-85.57452	-4	acceptable	71	marginal
23	Targeted	Little Plaster Creek	Forest Hill Ave SE	Kent	42.93501	-85.55533	-2	acceptable	120	good
24	Targeted	Plaster Creek	Broadmoor Ave SE	Kent	42.89919	-85.57757	-2	acceptable	101	marginal
25	Targeted	Unnamed tributary to Plaster Creek	60th St SE	Kent	42.85457	-85.58432	-2	acceptable	90	marginal
26	Targeted	Unnamed tributary to Plaster Creek	Paul Henry Thornapple TR	Kent	42.8495	-85.56539	-2	acceptable	105	good
27	Targeted	Crooked Creek	David Highway	Ionia	42.92965	-85.15629	2	acceptable	141	good
28	Status	Bellamy Creek	Dildine Rd	Ionia	43.0091	-85.15527	6	excellent	101	marginal
29	Trend	Prairie Creek	Main ST	Ionia	42.98552	-85.0261	7	excellent	145	good
30	Status	Prairie Creek	E. Charles Rd	Ionia	43.06153	-84.95701	6	excellent	165	excellent
31	Targeted	Libhart Creek	Sunfield Highway	Ionia	42.92126	-84.99519	3	acceptable	112	good

2014 Macroinvertebrate and Habitat Biosurvey Sampling Results

Grand River

Three different sites (Stations 1-3) were sampled in the main stem of the Grand River using the nonwadeable biosurvey method (Procedure 22; MDEQ, 2013). All other sites were sampled using the wadeable biosurvey method (P-51; MDEQ, 1990 and Creal et al., 1996).

Station 1 began about one mile downstream from the 68th Avenue bridge near Eastmanville in Ottawa County. The macroinvertebrate community scored poor (22). Chironomidae dominated the macroinvertebrate community, followed by Amphipoda. Sand was the dominant substrate at most of the sites where macroinvertebrates were collected, both along the margins and in the thalweg. Unstable sand is considered to be very poor substrate for most macroinvertebrates. Typically, only small invertebrates such as Chironomidae can reside between sand grains (Allan, 1995), which may explain why they were the dominant taxa. Chironomidae are found in waters ranging from pristine to severely degraded. However, typically if they are the dominant taxa in a stream or river that is an indication of disturbed conditions (Voshell, 2002). Some woody debris was present at most of the sites sampled; however, the debris was typically very smooth, with no crevices to retain macroinvertebrates. Very few macrophytes were present at Station 1. This section of the Grand River is largely surrounded by agricultural land use and is also downstream of highly urbanized areas within and around Grand Rapids. Station 1 is located in an area with an extremely low slope (Figure 3) and historic dredging impacts, which may explain the lack of habitat diversity and poor macroinvertebrate community.

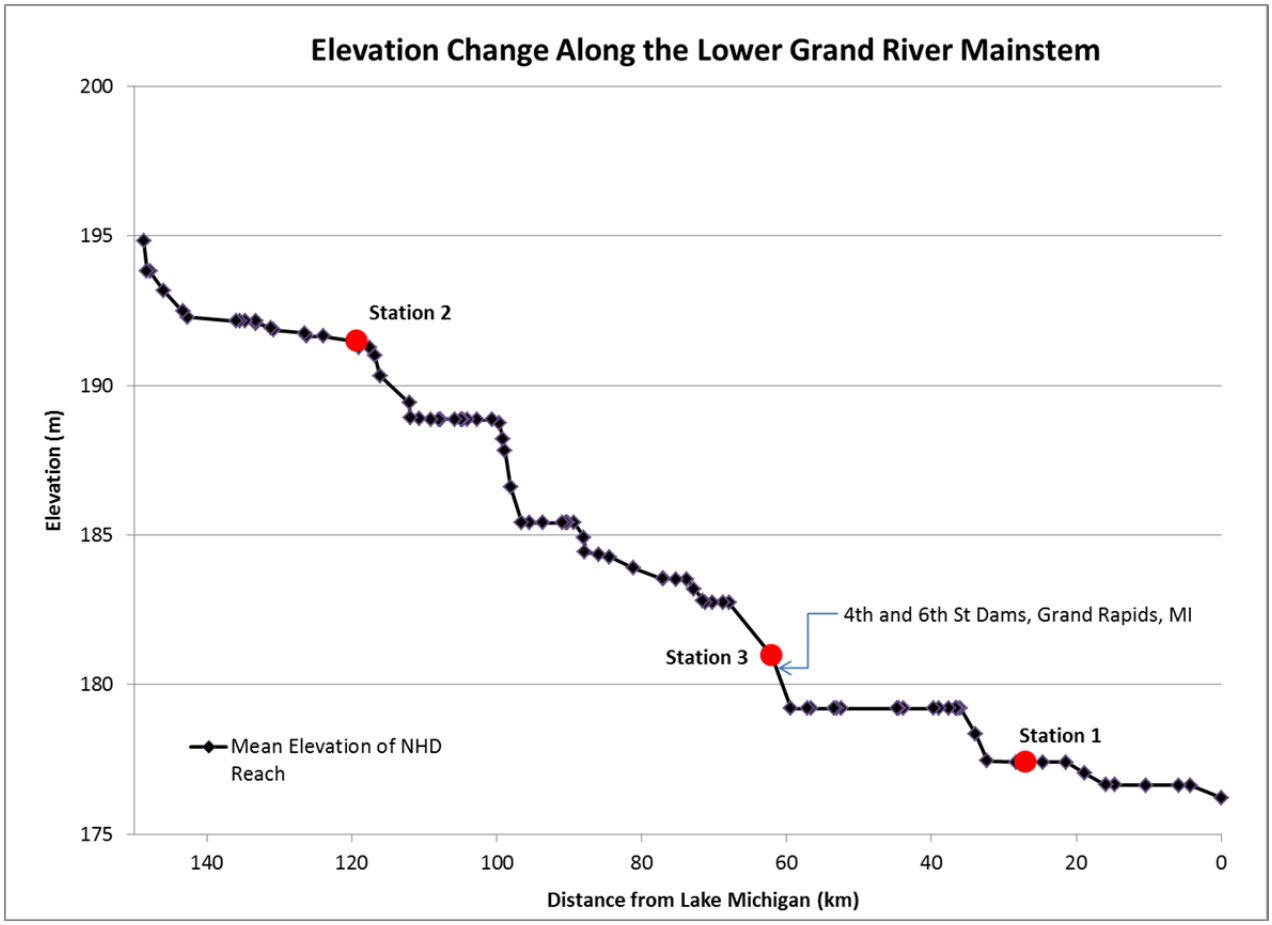

Figure 3. Elevation gradient of lower main stem Grand River.

The Grand River was sampled downstream from Bridge Street near the town of Saranac (Station 2). The macroinvertebrate community scored good (66). Sphaeridae clams dominated the community followed by Amphipoda and Chironomidae. Sphaeridae, which prefer slow-moving water and fine sediment, have a facultative stress tolerance meaning that they can be found in a wide range of habitats but are most abundant in moderately disturbed environments (Voshell, 2002). The riparian vegetation was largely intact, although in parts of the surveyed area, only a thin line of trees existed between the river and row crops. The greater surrounding area consists of a mix of agriculture and forest, with some urban land in the town of Saranac. Large woody debris was quite abundant. Sediment consisted mostly of fine substrate and the thalweg consisted of sand and small gravel.

The Grand River was sampled just upstream of Leonard Street NW where it flows through a heavily urbanized section of Grand Rapids (Station 3). The macroinvertebrate community at that station scored fair (43). Chironomidae dominated the community; however, four Ephemeroptera and two Trichoptera families were present, indicating that some sensitive families persist in that section of the river. Riparian vegetation was largely absent, with most of the right bank being composed of seawall. Sediment type ranged from fine particulate organic matter and silt to gravel and cobble, which was largely embedded in the thalweg. Some large woody debris and macrophytes were observed. This section of the Grand River is within the Sixth Street Dam impoundment at the time of this writing. Currently, plans are underway to remove the Sixth Street Dam for the purpose of restoring more natural flow conditions.

Unnamed Tributary to Pottawatomie Bayou

An unnamed tributary to Pottawatomie Bayou was sampled just inside Hofma Park/Hofma Preserve in Grand Haven Township (Station 4). This stream was sampled because there was insufficient information for the OIALW use support. Because the stream was sampled in the largely forested park, habitat scored good (146; Table 6); however, the macroinvertebrate community scored low acceptable (-3; Table 4). The macroinvertebrate community consisted largely of Amphipoda and Calopterygidae. Both Amphipoda and Calopterygidae have facultative disturbance tolerances, with some Calopterygidae being somewhat tolerant of disturbance (Voshell, 2002). The immediate riparian vegetation was forested and overhanging vegetation into the stream was extensive. However, large woody debris, undercut banks, and macrophytes were sparse. Sediment was dominated by sand, with small amounts of silt. In the immediate area that we sampled, the stream was sinuous and surrounded by forest. However, upstream of Ferris Street, which is very close to Station 4, the stream is managed as a county drain (Ottawa County Drain Commission, per. Comm.) and is surrounded by a mix of agriculture and residential land use. The dominance of facultative and disturbance-tolerant taxa at Station 4 may be a result of flashy flow conditions and associated sediment load from the upstream drain portion of the stream.

Black Creek

Black Creek was sampled downstream of M-104/Cleveland Street in Crockery Township (Station 5). The macroinvertebrate community scored acceptable (-2; Table 4) and habitat scored good (113; Table 6). This site was also sampled in 2009, when macroinvertebrates scored acceptable (0) and habitat scored good (108). Amphipoda and Calopterygidae (facultative and somewhat disturbance-tolerant taxa [Voshell, 2002]) dominated the macroinvertebrate community in 2014. The immediate riparian area is forested, which provided extensive overhanging vegetation; however, large woody debris was sparse. The stream channel was straight, possibly from historic dredging and sediment was mostly sand. The surrounding area contains a mix of forest and agricultural land uses, although residential land use has grown along the M-104 corridor in the last decade.

Norris Creek

Norris Creek was sampled upstream of Hilton Park Road (Station 6). Norris Creek is the main tributary to Spring Lake, which is a eutrophic lake in Ottawa County. A recent, in-depth analysis of land use in the Spring Lake watershed found that the upper portion, which is where Station 6 is located, is largely forested and relatively unimpacted compared to many other parts of the watershed (Steinman et al., 2015). The macroinvertebrate community scored high acceptable (3; Table 4) and habitat scored good (139; Table 6). Amphipoda dominated the macroinvertebrate community; however, Ephemeroptera, Trichoptera, and Plecoptera (EPT) families were also collected. Amphipoda are facultative taxa that tend to dominate in more-disturbed habitat (Voshell, 2002); however, the EPT taxa presence indicate that this site is only moderately impacted. The substrate was almost entirely sand (95% visual estimate); however, there were moderate amounts of large woody debris, including some that appeared to be in place for habitat improvement purposes. Besides the woody debris, other habitat types such as undercut banks, overhanging vegetation, and macrophytes were sparse or absent. A residential yard along the left bank reduced the amount of riparian vegetation; however, large trees remained along the stream on both sides, which provided abundant canopy cover. The right bank contained intact riparian vegetation. The greater surrounding area is mostly forested

with some residential land use. The lack of stable substrate and available habitat may have limited the disturbance-intolerant taxa at this site.

Crockery Creek, North Branch Crockery Creek, and Unnamed Tributary to Crockery Creek

Crockery Creek, North Branch Crockery Creek, and an unnamed tributary to Crockery Creek were sampled at the following locations: the unnamed tributary to Crockery Creek was sampled downstream of 104th Avenue in Crockery Township (Station 7), Crockery Creek was sampled where it flows along Ensley Road in Ravenna Township (Station 8) and Behler Road in Casnovia Township (Station 14). North Branch Crockery Creek was sampled at 36th Avenue in Chester Township (Station 15), 24th Avenue in Chester Township (Station 16), and Sherman Boulevard in Casnovia Township (Station 17).

Crockery Creek is the largest tributary to the lower Grand River. Much of the Crockery Creek watershed contains poorly drained soils (Lower Grand River Organization of Watersheds [LGROW], 2011) and agriculture is the dominant land use throughout the watershed (Tables 1 and 2). During the spring, precipitation and snowmelt often raise the water levels of Crockery Creek by several feet above base flow (Figure 4). Although habitat is lacking throughout Crockery Creek, temperatures typically remain low and the Michigan Department of Natural Resources (MDNR), Fisheries Division, continues to stock it with Brown Trout (*Salmo trutta*) and Steelhead (*Onchorhynchus mykiss*) (Hanshue and Harrington, 2011).

At Station 7 the macroinvertebrate community scored acceptable (1; Table 4) and habitat scored good (133; Table 6). The macroinvertebrate community was dominated by Isopoda, Calopterygidae, and Chironomidae, which are considered facultative to somewhat tolerant of disturbance; however, some sensitive taxa (two Ephemeroptera and four Trichoptera families) were also collected, indicating intermediate disturbance at this site. The immediate riparian vegetation consisted of dense button bush, which provided extensive overhanging vegetation habitat and canopy cover. Large woody debris was moderately available; however, other habitat types such as macrophytes, rootwads, and undercut banks were either sparse or absent. The sediment type was mostly sand (95% visual estimate). We spoke to a local resident at the site who said that the immediate riparian area used to be a cattle pasture and that cattle were allowed unrestricted access to the stream, but that the area has not been used as pasture land for many years now. This former land use was evidenced by the lack of large trees along the left bank. Upstream of 104th Avenue, the stream runs alongside the dirt road for about 0.1 mile. The greater surrounding area consists of a mix of forest and agricultural land use.

At Station 8 the macroinvertebrate community scored a high acceptable (3; Table 4), although habitat was marginal (68; Table 6). The macroinvertebrate community was dominated by Amphipoda and Brachycentridae. Three Ephemeroptera and five Trichoptera families were found. While Amphipoda are facultative, Brachycentridae are considered to be very sensitive to disturbance (Voshell, 2002). Although in-stream large woody debris was sparse at this site, Brachycentridae and other Ephemeroptera and Trichoptera taxa were colonizing what little stable habitat was available. The large woody debris that was present was largely out of the water and lying parallel to the stream, indicating flashy flow conditions (Figure 4). The banks were very steep and largely devoid of vegetation with active erosion occurring on both sides. This section of the creek appeared to have been historically dredged and channelized. Along the right bank was Ensley Road, which is a gravel/dirt road and along the left bank was a small row crop field. Crockery Creek runs parallel to Ensley Road for over 0.1 mile. Large trees were growing immediately alongside the stream, which provided good canopy cover. The sediment

type was mostly sand (95% visual estimate). The greater surrounding area contains a mix of forest and agricultural land use. This site was sampled in 2009 with the macroinvertebrate community scoring acceptable (0) and habitat scoring marginal (104; Rippke, 2011).

Figure 4. Crockery Creek, Ensley Road site (Station 8). Photo on left is from August 2009 and photo on right is from March 2016.

At Station 14 the macroinvertebrate community scored acceptable (1; Table 4) and habitat scored good (145; Table 6). The macroinvertebrate community was largely dominated by Amphipoda. Two Ephemeroptera, one Trichoptera, and one Plecoptera family were also collected, indicating intermediate disturbance at this site. The stream was sinuous; however, there were signs of flashiness such as bank scour and heavy sediment deposition. The stream bed was largely sand. The riparian areas were largely intact with large trees that provided plenty of canopy cover. Further upstream from where we sampled is a cattle pasture that is near the stream. Aerial photos revealed one area where cattle may be accessing the stream and should be investigated with a site visit later. Grand Rapids district staff have been notified of potential unrestricted cattle access near this site. The larger surrounding area consists of a mix of agricultural and forest land use.

At Station 15 the macroinvertebrate community scored acceptable (-2; Table 4) and habitat scored good (134; Table 6). This site was also sampled in 2009. At that time macroinvertebrates also scored acceptable (-2) and habitat was rated as good (153). In the most recent survey, the macroinvertebrate community was dominated by Amphipoda. The only available habitat was sparse large woody debris and macrophytes. The sediment consisted mainly of hard pan clay (70% visual estimate). There was evidence of flashiness such as logs perched above the water, > 20 inches of bank scour, and reduced bank vegetative protection. The immediate riparian vegetation was intact and included large trees, which provide abundant canopy cover; however, there are several row crop fields nearby. The greater surrounding area contains a mix of forest and agricultural land use. The abundance of clay substrate at this site may account for the dominance of the facultative Amphipoda and the lower abundance of taxa with more specialized habitat requirements. Clay substrate is largely considered to provide poor habitat for macroinvertebrates, which seem to prefer irregular substrate and substrate that they can burrow in, as opposed to smooth, hard pan clay (Allan, 1995).

At Station 16 the macroinvertebrate community scored acceptable (1; Table 4) and habitat scored good (119; Table 6). This site was sampled in 2009 and macroinvertebrates scored poor (-5) and habitat scored low good (106). In 2009, the macroinvertebrate community was dominated by Amphipoda and only one Ephemeroptera and one Trichoptera family were collected. In 2014, the macroinvertebrate community was still dominated by Amphipoda; however, three Ephemeroptera and three Trichoptera families were collected. The current results indicate moderate disturbance at the site, but the conditions may be improved since the last sampling event. During the 2009 survey, biologists observed that horses were allowed access to a section of the stream (Figure 5; Rippke, 2011).

Figure 5. Photo of restricted, but direct access for horses in a section of North Branch Crockery Creek near 24th Avenue during 2009 survey.

The restricted, but direct horse access to the stream caused localized bank erosion as well as localized stream bed disturbance. The direct access was reported to Grand Rapids district staff who worked with the Michigan Department of Agriculture and Rural Development to restrict all access to the stream. During the 2014 visit, the fence was set back from the stream and vegetation was starting to regrow in areas along the bank where bare soil was present in 2009. Rootwads were extensive and undercut banks, overhanging vegetation, and large woody debris were moderately available. The stream showed signs of flashiness though, with moderate amounts of sediment deposition and bank scour. Riparian vegetation along the stream is reduced by a crop near one bank and the horse pasture along the other bank. In some areas

there are no large trees along the stream to provide canopy cover. The greater surrounding area contains mostly agricultural land use with some forested land.

At Station 17 the macroinvertebrate community scored acceptable (-1; Table 4) and habitat scored marginal (103; Table 6). The macroinvertebrate community was dominated by Amphipoda. Two Ephemeroptera and two Trichoptera families were also collected. The dominance of the facultative Amphipoda and few EPT taxa indicate intermediate disturbance. Sand was the dominant sediment type (80% visual estimate). Large woody debris was moderately available; however, all other potential habitat types were either sparse or absent. Heavy sediment deposits were present and most of the pools were shallow. There were also moderate amounts of bank scour and some stream banks that were devoid of vegetation. A thin margin of trees are present along the right bank between the stream and a large row crop. Along the left bank is a larger area of riparian forest. The trees on both banks are large though, which provide abundant canopy cover. The greater surrounding area consists mostly of agricultural land use and some forests.

Bass Creek and Little Bass Creek

Bass Creek and Little Bass Creek in Ottawa County were each sampled at two stations: Bass Creek was sampled at 88th Avenue (Station 9) and at Stanton Street (Station 10) in Blendon Township. Little Bass Creek was sampled at 76th Street (Station 11) and 68th Street (Station 12) in Allendale Township.

At Station 9, the macroinvertebrate community scored acceptable (-1; Table 4) and habitat scored marginal (96; Table 6). Calopterygidae was the dominant taxa, followed by Hydropsychidae, although they only composed 22% and 16% of the sampled community, respectively. Calopterygidae are somewhat tolerant to pollution and some Hydrodropsychidae are facultative. The facultative Hydropsychidae can become abundant in streams with moderate levels of organic pollution (Voshell, 2002). The dominant sediment type was sand (90% visual estimate) and overhanging vegetation, large woody debris, aquatic macrophytes, and rootwads were only sparsely available. Heavy sediment deposits were present and bank scour was evident. The stream channel was not sinuous and riparian vegetation consisted of small trees. Further upstream from this site are row crops on both sides of the stream with minimal riparian vegetation. The greater surrounding area is dominated by agricultural land use.

At Station 10 the macroinvertebrate community scored acceptable (-2; Table 4) and habitat scored marginal (72; Table 6). The macroinvertebrate community was dominated by Amphipoda, Coenagrionidae, and Physidae. Amphipoda are facultative and Coenagrionidae and Physidae snails are somewhat tolerant of pollution (Voshell, 2002). The sediment was mostly sand (90% visual estimate). Overhanging vegetation and aquatic macrophyte habitat were moderately available; however, large woody debris, undercut banks, and rootwads were absent. The stream reach appeared to have been channelized in the last several years and heavy sediment deposits were present. Vegetative protection on the stream banks was lacking in some areas and riparian vegetation was largely absent along both sides of the stream, thus canopy cover in that reach is almost nonexistent. Row crops are present along both sides of the stream. Upstream of the station is a cattle crossing through the stream. The crossing has not been maintained to prevent erosion and is now ineffective. The farm owners are currently working with the Ottawa County Conservation District to possibly resolve the crossing issue as well as other NPS issues affecting Bass Creek downstream of Station 10. The entire stream

reach upstream of this site is channelized and surrounding land use is almost entirely agricultural.

At Station 11 the macroinvertebrate community scored low acceptable (-4; Table 4). The macroinvertebrate community was dominated by Amphipoda and Isopoda. Two Ephemeroptera and four Trichoptera families were collected, but in low numbers. Amphipoda are facultative and have a tendency to dominate degraded habitats and Isopoda are somewhat tolerant to organic pollution (Voshell, 2002). The habitat scored low good (106; Table 6). Little Bass Creek is maintained as a county drain at this station (Ottawa County Drain Commisioner, per. Comm.). The sediment appeared to be half sand and half silt. Overhanging vegetation was moderately available; however, all other potential habitat types were absent. The stream was composed of mostly shallow pools and heavy sedimentation was present. The riparian areas on both sides of the creek were not being farmed; however, large trees are absent. A review of aerial photos showed past farming in the riparian area north of the stream. By 2005 though, several residential lots were in the former cropland and the remaining land is now fallow. The greater surrounding area contains a mix of agricultural land use with some forest and residential subdivisions.

At Station 12 the macroinvertebrate community scored poor (-5; Table 4). Amphipoda comprised 80.5% of the macroinvertebrates collected. The next most abundant taxa group was Isopoda. Amphipoda tend to dominate stream systems that exhibit moderate pollution/disturbance and Isopoda are somewhat tolerant to organic pollution (Voshell, 2002). Little Bass Creek is maintained as a county drain at this station (Ottawa County Drain Commisioner, per. Comm.). The habitat scored low good (119; Table 6). Large woody debris was moderately available; however, all other habitat types were sparse. The stream was shallow and had heavy amounts of sedimentation. Where this station was sampled has intact riparian forest on both sides of the stream, which provide good canopy cover. However, further upstream, the stream flows through agricultural and residential areas with minimal amounts of riparian vegetation.

Deer Creek

Deer Creek was sampled in Sheridan Park in Polkton Charter Township (Station 13). Macroinvertebrate and fish community surveys were performed at this site. Fish were sampled because Deer Creek is currently not attaining the warmwater fishery designated use. Dissolved oxygen measurements in 2013 were below warmwater WQS (MDEQ, 2014). During the spring of 2014 a fish kill was reported: Grand Rapids district staff observed dead fish from Garfield Street, near the Ottawa County Farms Landfill, downstream to the confluence with the Grand River (Mike Worm, MDEQ; per. Comm.). Land use within the Deer Creek watershed is predominantly agricultural (Table 2; Rediske et al., 2004; MDEQ, 2012). Past in-depth studies of Deer Creek have revealed high concentrations of suspended sediment, nutrients, and *E. coli* (Rediske et al., 2004; MDEQ, 2012). The soils in the Deer Creek watershed are clayey, with low water infiltration rates (LGROW, 2011; MDEQ, 2012). According to LGROW (2011), 39% of the soils in the Deer Creek watershed are in hydrologic soil group D, which are clay soils with the lowest infiltration rates and highest runoff potentials. Rediske et al. (2004) found that during storm events, Deer Creek exhibited a 30-fold increase in stream discharge from base flow. This flashy hydrology coupled with predominant agricultural land use throughout the watershed has led to erosion and sedimentation issues in Deer Creek (Rediske et al., 2004).

The macroinvertebrate community scored low acceptable (-3; Table 4) and the fish community scored acceptable (-2; Table 5). Amphipoda dominated the macroinvertebrate community,

indicating moderate levels of pollution/disturbance. The fish community was dominated by Central Mudminnows (*Umbra limi*) and Creek Chubs (*Semotilus atromaculatus*), which are pollution/disturbance tolerant taxa. No Salmonidae species were collected and only one pollution-intolerant taxa, Rock Bass (*Ambloplites rupestris*), was collected. Deer Creek is a warmwater stream and does not receive any fisheries management from the MDNR, Fisheries Division (Hanshue and Harrington, 2011). Habitat scored low good (109; Table 6). Undercut banks, overhanging vegetation, and rootwads were moderately available; however, large woody debris was sparse and aquatic macrophytes were absent. The bottom sediment consisted mostly of clay (80% visual estimate). Sand and silt made up the remainder of the sediment. There was one small area of the stream bed where rocks were placed artificially for people to walk on while crossing the stream. Deer Creek does exhibit some channel sinuosity in this area, and some deep pools were present. There were signs of stream flashiness such as raw areas of bank scour, slumping sod falling into the stream, and heavy sedimentation. Low-cut grass is maintained at Sheridan Park up to Deer Creek. Some vegetation is growing immediately adjacent to the stream where bank slopes are too steep for lawn mowers to reach. A few large trees are present along the stream; however, canopy cover is lacking. Upstream of Sheridan Park land use is dominated by agriculture with some forested areas (MDEQ, 2012). Beaver Creek enters Deer Creek upstream of Sheridan Park. Land use in the Beaver Creek subwatershed consists of 88% agricultural land use, with 38% of cultivated land located on poorly-drained soils (MDEQ, 2012). Rediske et al. (2004) found that the Beaver Creek subwatershed was a major source of nutrients and suspended solids to Deer Creek.

East Branch Rush Creek/Bliss Creek Inter County Drain

East Branch Rush Creek/Bliss Creek Inter County Drain was sampled at 44th Street in Georgetown Township (Station 18). The macroinvertebrate community scored acceptable (0; Table 4) and habitat scored marginal (93; Table 6). The macroinvertebrate community was dominated by Amphipoda and Hydropsychidae, both facultative taxa that tend to dominate moderately disturbed environments (Voshell, 2002). Sand was the predominant sediment type (80% visual estimate). Some gravel was present and in one area, rocks had been placed in the stream by people. Undercut banks, overhanging vegetation, large woody debris, and rootwads were all sparse. No aquatic macrophytes were present. The stream bed showed moderate amounts of sediment deposition and flashiness was evident by bank scour 9-18 inches above the water surface. Perched logs were observed above the stream bank. The stream was rather straight in this area and water depth was shallow. Immediate riparian vegetation contained large trees, which provide good canopy cover; however, many areas of bare soil were present on the stream banks and in nearby riparian areas. Two large apartment complexes are on both sides of the stream. This section of stream has a history of localized flooding during heavy rain events, and as a result, East Branch Rush Creek was shortened by a diversion channel upstream, near Kenowa Avenue in the early 1990s. The diversion channel and what was formerly named East Branch Rush Creek are managed as an inter-county drain by the Ottawa and Kent County Drain Commision offices as Bliss Creek Inter-County Drain, including where Station 18 was sampled (Kent County Drain Commissioner, per. Comm.). The greater surrounding area consists of suburban residential land use and some forested areas.

Plaster Creek

Plaster Creek is a warmwater stream that has a long history of degradation, especially in the lower reach, which flows through urban Grand Rapids before its confluence with the Grand River. Sylvester (1977) described leachate entering Plaster Creek from an abandoned landfill, three major storm drains, and industrial and raw sewage discharges to Plaster Creek.

Other known contamination sources at the time were a large xylene leak from a storage tank in 1975, an oil leak in 1977, and hexavalent chromium groundwater contamination. Sediments at the time contained elevated concentrations of lead, cyanide, copper, zinc, oils, cadmium, nickel, arsenic, PCBs, and phenols (Sylvester, 1977). A ditch that was connected to Cole Drain was found to contain the most contaminated sediments. The source of contamination was determined to be from Chem Central, an industrial chemical distribution center, located 1,000 feet away from the ditch. From 1957 to 1962, hazardous material had leaked into the ground via a faulty pipe used to transfer liquids between rail cars and storage tanks. In 1978, the United States Environmental Protection Agency excavated contaminated sediment from the ditch. In 1984 a purge well was constructed on Chem Central's property to remove contaminated groundwater and discharge it to a municipal wastewater treatment facility.

Industrial pollution has improved in Plaster Creek; however, it is currently not attaining the OIALW designated use with sedimentation/siltation listed as the cause of impairment (MDEQ, 2014). Currently, plans are underway to implement several Best Management Practices throughout the Plaster Creek watershed to improve stream conditions related to storm water discharge and erosion issues (e.g., MDEQ grant number 2014-0019, "Plaster Creek Watershed Restoration 2"). In 2014 and 2015 eight different sites were sampled throughout the Plaster Creek watershed to serve as pre-Best Management Practices data.

In 2014 and 2015 the Plaster Creek watershed was sampled at the following locations: Plaster Creek at Godfrey Avenue SW, in the city of Grand Rapids (Station 19), Plaster Creek at 68th Street SE near the town of Dutton (Station 20), Plaster Creek at Shadyside Park in Gaines Township (Site 21), Plaster Creek upstream of Hammond Avenue SE (Station 22), Little Plaster Creek at Forest Hill Avenue SE in the city of Kentwood (Station 23), Plaster Creek at Broadmoor Avenue SE in the city of Kentwood (Station 24), an unnamed tributary to Plaster Creek at 60th Street SE in the city of Kentwood (Station 25), and an unnamed tributary to Plaster Creek near Paul Henry Thornapple Trail (Station 26).

Station 19 is located in a densely urbanized section of Grand Rapids with many surrounding industries. This site has been sampled previously in 1977, 2001, and 2004. Sylvester (1977) used multi-plate samplers to collect macroinvertebrates and found numerous snails and oligochaetes, but no EPT taxa. Sylvester (1977) also noted that oil sheens were on the water surface and that raw sewage was being discharged at the site. When Wuycheck (2002) sampled that site in 2001 the macroinvertebrate community scored poor (-5) and habitat scored good. Rockafellow (2005) found that the macroinvertebrate community was still poor (-6) in 2004 even though habitat rated good.

The macroinvertebrate community that we collected in the most recent survey scored low acceptable (-3; Table 4) and habitat scored a low good (111; Table 6). Macroinvertebrate abundance was low at this station with only 206 individuals collected (target collection is 300 individuals). Hydropsychidae was the dominant taxa collected, followed by Isopoda. Some species of Hydropsychidae are facultative and tend to be abundant in moderately disturbed environments and Isopoda are somewhat tolerant of moderate disturbance/pollution (Voshell, 2002). Rootwads were abundant and undercut banks were moderately available as habitat for macroinvertebrates; however, overhanging vegetation, large woody debris, and aquatic macrophytes were either sparse or absent. The sediment consisted of a mix of sand, silt, and clay. Throughout the stream bed and along the stream bank were also numerous bricks and cement blocks. This site was adjacent to a building supply company, which had disposed of the bricks and blocks in the stream. The bricks and blocks were quite embedded into the sediment, so they did not provide much epifaunal substrate. Deep holes as well as shallow riffles were

present at this station. The stream bank appeared stable, but other than a few large trees, was devoid of vegetation and some bank scouring was evident. Riparian vegetation did not extend beyond the few trees on the stream bank.

Station 20 had previously been sampled in 2001 and 2004. In 2001 the macroinvertebrate community scored poor (-7) and habitat scored fair (Wuycheck, 2002). During that biosurvey, an illicit raw sewage discharge and an unrestricted cattle crossing were observed at this site. In 2004 the macroinvertebrate community scored minimally acceptable (-4) and habitat scored marginal. The illicit raw sewage discharge was still present and was reported to the Kent County Health Department. In the latest biosurvey the macroinvertebrate community scored acceptable (1; Table 4). The macroinvertebrate community was dominated by Chironomidae, Baetidae, and Calopterygidae. Calopterygidae tend to be somewhat tolerant of disturbed/polluted environments. The Chironomidae and Baetidae families contain species with a wide range of tolerances, but if they are the dominant taxa, that is usually an indication of moderate disturbance (Voshell, 2002). Habitat at this site scored marginal (87; Table 6). This section of stream is channelized and sediment consisted of mostly sand (80% visual estimate). Large woody debris was extensive, but all other habitat types were either sparse or absent. Most of the stream was shallow and heavy sedimentation was present, including an island of deposited sand. Bank scour was evident and moderate amounts of bare soil were observed along the banks. Two erosional gullies were observed on the left bank coming from an adjacent corn field. Riparian vegetation consisted of a thin line of large trees on both banks, which provides canopy cover. However, beyond the banks are the corn field and a cattle farm on the other side. The illicit sewage discharge was not observed; however, the cattle crossing is still active with no protective measures in place to reduce soil erosion into the stream. Grand Rapids district staff have been notified of the cattle crossing. Land use in the greater surrounding area consists of agricultural and residential land uses.

Fish and macroinvertebrate biosurveys were performed at Station 21. Upstream of Shadyside Park (starting at 76th Street), Plaster Creek is formed by the convergence of two county drains (Beesing and Schooley Drains and associated tributaries; https://www.kentcountymi.gov/819/City-Township-Drain-Maps). Plans are currently in place to begin excavating a two-stage ditch in this stream reach starting in 2016 (MDEQ grant number 2014-0019, “Plaster Creek Watershed Restoration 2”). The macroinvertebrate community scored acceptable (1; Table 4). Chironomidae dominated the macroinvertebrate community. Three Ephemeroptera and two Trichoptera families were collected. The Chironomidae family contains taxa with a broad range of tolerances; however, dominance by Chironomidae is typically indicative of moderate disturbance (Voshell, 2002). The fish community scored acceptable (-2; Table 5). Bluntnose minnow (*Pimephales notatus*) and Johnny Darter (*Etheostoma nigrum*) dominated the fish community. No Salmonidae species were collected and 98% of the fish collected were pollution-tolerant taxa. Habitat at Shadyside Park scored marginal (87; Table 6). Overhanging vegetation was available in moderate amounts, but all other habitat types were either sparse or absent. The sediment type was mainly sand with some silt and gravel. In some localized areas, boulders have been artificially placed on the stream bed. Heavy sedimentation was evident in the stream and the banks had large areas of bare soil where scouring had occurred. In some areas, large sections of sod and soil were slumping into the stream. Foot traffic from park visitors appeared to be accelerating bank erosion in some areas. Riparian vegetation was limited to areas that were too steep for park maintenance workers to mow, and some large trees, which provide limited canopy cover. The land use upstream of Shadyside Park is primarily agricultural with some residential and forest use.

Station 22 was sampled below 76th Street, above which, Plaster Creek is formed by Beesing Drain and Schooley Drain (https://www.kentcountymi.gov/819/City-Township-Drain-Maps). The macroinvertebrate community was minimally acceptable (-4; Table 4). Because of a lack of habitat to sample, few macroinvertebrates were collected. Of the ones that were collected Chironomidae was the most abundant followed by Physidae. One Ephemeroptera family and two Trichoptera families were collected in low numbers. Dominance by Chironomidae and Physidae taxa is typically indicative of moderate disturbance (Voshell, 2002). The habitat scored marginal (71; Table 6). The sediment consisted mostly of silt (80% visual estimate) and the stream reach was shallow with no deep pools present. Sedimentation was heavy and large amounts of the stream bank on both sides had bare soil that had been scoured by high waters. Large trees are present along the immediate banks, which is keeping them stable. Along the right bank is a row crop, which had three drain tiles elevated above the stream. Along the left bank was a residential lawn and a tile drain from the residence was also elevated above the stream. As described above, upstream of this site, land use is primarily agricultural with some residential and forest use.

At Station 23 the macroinvertebrate community scored acceptable (-2; Table 4) and the habitat scored good (120; Table 6). Amphipoda dominated the macroinvertebrate community, which is indicative of moderate disturbance (Voshell, 2002). Undercut banks, large woody debris, and rootwad habitat was available in moderate amounts. The sediment type was mostly sand (80% visual estimate). The stream reach was mostly shallow and heavy sedimentation was evident. Bank scour was evident and large portions of the banks lacked vegetative protection. The stream reach was sinuous and the riparian area was intact forest that provided dense canopy cover. Upstream of the reach that we sampled, the creek is channelized and flows through a suburban neighborhood.

At Station 24 the macroinvertebrate community scored acceptable (-2; Table 4). Amphipoda comprised 80% of the macroinvertebrate community, which is indicative of moderate disturbance and a low variety of habitat (Voshell, 2002). The habitat scored marginal (101; Table 6). Large woody debris was available in moderate amounts; however, all other habitat types were either sparse or absent. Sand was the dominant sediment type (94% visual estimate). Large sediment deposits were present and debris from high flows was observed caught in trees about four feet above the base flow. The stream banks only showed moderate stability. The riparian area consisted of intact forest; however, large trees were lacking, which provided diminished canopy cover. The greater surrounding area contains mostly residential and business land use with some forests.

At Station 25 the macroinvertebrate community scored acceptable (-2; Table 4). Calopterygidae and Elmidae were the most abundant taxa collected. Calopterygidae are somewhat tolerant of pollution and Elmidae are facultative, indicating moderate disturbance. Habitat scored marginal (90; Table 6). Large woody debris was moderately available; however, all other habitat types were either sparse or absent. The dominant sediment type was sand (95% visual estimate). Heavy sediment deposits were present and the stream did not occupy the entire channel. The banks were heavily scoured and the stream channel appeared to have been channelized a while ago. The riparian area to the left of the stream was mostly intact forest. On the right side was mostly intact forest, with some residential yards nearby. Upstream of Station 25 the stream is mostly channelized and surrounding land use consists of large subdivisions in the town of Dutton.

The same unnamed tributary to Plaster Creek that was sampled at Station 25 was sampled further upstream, near Paul Henry Thornapple Trail, where it is channelized along the entranceway to the former Steelcase corporate building (Station 26). The macroinvertebrate community scored acceptable (-2; Table 4). Amphipoda, Calopterygidae, and Elmidae were the most abundant macroinvertebrates collected. The three dominant taxa are either facultative or somewhat tolerant to disturbance. The habitat scored low good (105 Table 6). In many areas along the bank, thick shrub vegetation was present, which provided dense thickets of overhanging vegetation. Undercut banks were moderately available, but all other habitat types were either sparse or absent. The sediment was a mix of gravel and clay. The stream was shallow and channelized for a long distance; however, there was no heavy sedimentation present. The banks appeared to be stable and did not show much scouring. Beyond the thick shrubs along the steep banks, riparian vegetation was absent. Along the right bank is a mowed lawn and the paved entranceway to the former Steelcase building. Along the left bank the vegetation was short and a gravel road ran parallel to the stream. Upstream of this station, the stream is channelized and the greater surrounding area contains agriculture, large businesses, and a two-lane highway.

Crooked Creek

Crooked Creek was sampled at David Highway in Berlin Township (Station 27). The macroinvertebrate community scored acceptable (2; Table 4). Amphipoda, Hydropsychidae, and Elmidae dominated the macroinvertebrate community, although none of them occurred in very high percentages. Twenty-three different taxa were recorded at Station 27, which contributed to the high acceptable score. Habitat scored good (141; Table 6). Overhanging vegetation was moderately available; however, all other habitat types were either absent or sparse. The stream was sampled upstream of a pooled area above David Highway that appeared to have been dredged. Where the macroinvertebrates were collected was sinuous with a high frequency of riffles. There was some bank scouring and erosion noted. On both sides of the stream was forest although some selective logging had occurred that reduced canopy cover. Most of the surrounding area consists of agricultural land use and in some areas upstream of Station 27 row crops are very close to the stream and riparian vegetation has been removed.

Bellamy Creek

Bellamy Creek was sampled at Dildine Road in Easton Township (Station 28). Despite habitat that scored marginal (101; Table 6), the macroinvertebrate community scored excellent (6; Table 4). Hydropsychidae and Heptageniidae were the most abundant taxa collected. Six different EPT taxa were collected in total indicating high water quality despite marginal habitat. The stream bottom was mostly sand and heavy sediment deposits were present. Some lengths of the stream banks were steep and actively eroding. There were a few areas in the streams with cobble and large woody debris, which were heavily colonized by EPT taxa. The immediate riparian area was forest; however, the greater surrounding area is all agricultural. About one river mile upstream of Dildine Road Bellamy Creek is maintained as a county drain (*The link provided was broken and has been removed*). The drain and two tributary drains flow through row crop fields with minimal riparian vegetation. However, the agricultural areas above Station 28 contain high percentages of well-drained soils (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx), which may limit runoff and sedimentation impacts to Bellamy Creek.

Prairie Creek

Prairie Creek was sampled on East Main Street just east of the city of Ionia (Station 29). The macroinvertebrate community scored excellent (7; Table 4) and the habitat scored good (145; Table 6). Forty different taxa were collected, 14 of which, were EPT taxa, indicating excellent water quality. Sand only comprised about half of the sediment type on the stream bed, which also contained gravel, cobble, and boulder substrate. Other habitat types such as woody debris were either sparse or absent. The sampled stream reach had variable depth/flow regimes and a high frequency of riffle habitat. There was also no evidence of excessive sedimentation. Some reaches of the stream banks were devoid of vegetation and exhibited evidence of scouring. Along the right bank, near Main Street is a small park. In at least one spot, localized bank erosion is occurring because of park visitors walking down the steep bank to the stream. Riparian vegetation along the right bank is limited to large trees growing along the bank. Beyond the recreational park is a large industrial complex. The riparian area along the left bank consists of intact forest. The greater surrounding area is largely forested with some low density residential land use.

Prairie Creek was also sampled at East Charles Road in Ronald Township (Station 30). Both the macroinvertebrate community and habitat scored excellent at this site (6 [Table 4] and 165 [Table 6], respectively). Thirty-five different taxa were collected including 15 EPT taxa. Sand only comprised about 40% of the bottom substrate (visual estimate), whereas gravel, cobble, and boulders made up 50% of the substrate. Rootwads were extensive and large woody debris was moderately available in-stream. There was very little evidence of sedimentation or bank scouring. Large trees are present along both sides of the stream; however, the riparian vegetation along the right bank is diminished by a residential lawn. The greater surrounding area contains a mix of agricultural and forested land use. This station was sampled in 2009 and both macroinvertebrates and habitat scored excellent then as well (Rippke, 2011).

Libhart Creek

Libhart Creek was sampled at Sunfield Highway in Orange Township (Station 31). The macroinvertebrate community scored acceptable (3; Table 4) and was dominated by Hydropsychidae and Elmidae, although in low percentages. Thirty-five taxa were collected at Station 30 including 4 Epheroptera and 6 Trichoptera families, which resulted in the high acceptable rating. The habitat scored a low good (112; Table 6). The bottom substrate was predominantly a mix of sand, silt, and clay although some gravel and cobble was present. All other habitat types such as large woody debris and undercut banks were either sparse or absent and riffle habitat was infrequent. Sedimentation was not prevalent at the sampled station; however, some bank stretches were devoid of vegetation and actively eroding. In particular, one section of the right bank was steep and actively eroding. Along the left bank the riparian area was mostly forested. However, along the right bank is only a thin section of large trees between the stream and a row crop field. Upstream of Sunfield Highway many stretches of Libhart Creek have minimal riparian vegetation. The greater surrounding area contains mostly agricultural land use.

Conclusions and Recommendations

In 2014, 15 randomly selected sites within the lower Grand River watershed were sampled to support attainment status calculation. Based on the probabilistic monitoring aspect of this watershed survey, 86.7% +/- 18.5% of the randomly selected sites supported the OIALW designated use using biological monitoring procedures. Percent attainment was calculated by

dividing the number of random sites that met WQS by the total number of random locations ((13/15)100 = 86.7%). This value is coupled with a 95% confidence interval to provide our estimation of certainty, meaning there is 95% certainty that the true proportion of attainment in the lower Grand River watershed is between 68.2% and 100%. The four sites that were sampled for the statewide trend analysis and the 12 targeted sites were all attaining the OIALW designated use.

The most frequently noted impacts at stations sampled in the lower Grand River watershed were sedimentation, erosion, and lack of substrate and habitat diversity. Several tributaries in the eastern portion of the watershed (Crooked, Bellamy, Prairie, and Libhart Creeks) contained native gravel, cobble, and boulder substrate. The soils in those subwatersheds also tend to be well-drained (LGROW, 2011), which reduces runoff and erosion. The above factors may have contributed to the diverse, high-quality macroinvertebrate communities that were present in those streams (Table 3). The other sites that were sampled further west were in streams that drained sandy, lacustrine deposits, and clay-dominated, glacial moraines, which resulted in little native gravel, cobble, or boulder substrate. Although, even with such geologic material, the potential exists for minimal impacts to occur in-stream if the watershed is largely unimpacted (e.g., upper Norris Creek).

According to LGROW (2011), 74% of the lower Grand River watershed is considered to contain soil properties that would be considered “prime farmland” soils. Many tracts of fertile land are in low slope areas, and need to be drained or tiled to farm. Because of the ideal soil properties in the lower Grand River watershed, just over half of the entire watershed contains agricultural land use (LGROW, 2011). Development in the lower Grand River watershed typically takes place in areas with highly permeable surfaces. The combination of impervious surfaces covering highly permeable soils and agriculture dominating less permeable soils, leads to high amounts of precipitation runoff and erosion throughout the watershed (LGROW, 2011). These impacts were evident by the amount of sedimentation, bank erosion, and lack of habitat diversity at the majority of the sites that were sampled.

Future monitoring efforts in the lower Grand River watershed will include:

- Resample the four trend sites within the watershed.
- Resample sites with noted NPS impacts such as unrestricted cattle access: Station 14, Crockery Creek and Station 20, Plaster Creek.
- Resample sites that did not attain the OIALW designated use in 2014.
- Resample sites within the Plaster Creek subwatershed after restoration work has been completed.
- Collect and analyze sediment samples from Indian Mill Creek for metal, oil, and gas contamination in 2016.
- Collect and analyze ten Common Carp (*Cyprinus carpio*) from the lower Grand River for contaminants.

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Table 4A. Qualitative macroinvertebrate sampling results

TAXA	Grand River 9/16/14 0.2 miles u/s Leonard Street (Grand Rapids)	Grand River 8/18/14 0.6 miles d/s Bridge Street (Saranac)	Grand River 8/12/14 1.6 miles d/s 68th Avenue (Coopersville)
PLATYHELMINTHES (flatworms)			
Turbellaria		3	3
ANNELIDA (segmented worms)			
Hirudinea (leeches)	2	1	
Oligochaeta (worms)	10	45	3
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	18	159	54
Decapoda (crayfish)		1	
Isopoda (sowbugs)	12		1
Arachnoidea			
Hydracarina	6		8
Insecta			
Ephemeroptera (mayflies)			
Baetidae	5	2	1
Caenidae		5	
Ephemeridae	1		
Heptageniidae	1	5	
Tricorythidae	4	21	10
Odonata			
Anisoptera (dragonflies)			
Aeshnidae		2	
Gomphidae		9	1
Zygoptera (damselflies)			
Coenagrionidae	6	16	3
Hemiptera (true bugs)			
Belostomatidae		1	
Corixidae	3	16	1
Gerridae			16
Notonectidae		1	
Pleidae		4	
Trichoptera (caddisflies)			
Hydropsychidae		24	
Leptoceridae	13	13	7
Limnephilidae		3	
Polycentropodidae	1	4	1
Coleoptera (beetles)			
Dytiscidae (total)		1	
Haliplidae (adults)	1	3	3
Elmidae		20	
Diptera (flies)			
Ceratopogonidae		4	
Chironomidae	80	117	168
Tabanidae		1	
MOLLUSCA			
Gastropoda (snails)			
Hydrobiidae		11	
Physidae		25	5
Pleuroceridae		39	
Valvatidae	1		
Viviparidae		7	
Pelecypoda (bivalves)			
Sphaeriidae (clams)	6	380	

METRIC	STATION 1 Value	STATION 2 Value	STATION 3 Value
TOTAL ABUNDANCETOTAL ABUNDANCE	170	943	285
TOTAL RICHNESS	17	31	16
NUMBER OF EPHEMEROPTERA FAMILIES	4	4	2
NUMBER OF PLECOPTERA FAMILIES	0	0	0
NUMBER OF TRICHOPTERA FAMILIES	2	4	2
NUMBER OF DIPTERA TAXA	1	3	1
TRICHOPTERA ABUNDANCE	14	44	8
ABUNDANCE OF DOMINANT TAXON	80	380	168
SHREDDER ABUNDANCE	44	178	65
SCRAPER ABUNDANCE	2	87	5
COLL-FILTERER ABUNDANCE	6	404	0
COLL-GATH ABUNDANCE	103	230	186
PREDATOR ABUNDANCE	15	44	29

Table 4B. Macroinvertebrate metric evaluation of lower Grand River						
	Grand River		Grand River		Grand River	
	9/16/14		8/18/14		8/12/14	
	0.2 miles u/s Leonard Street (Grand Rapids)		0.6 miles d/s Bridge Street (Saranac)		1.6 miles d/s 68th Avenue (Coopersville)	
Metric Calculations	Value	Metric Score	Value	Metric Score	Value	Metric Score
FFG Diversity (25)	1.5	16	2.0	25	1.3	8
Habitat Stability FFG Surrogate (25)	0.1	0	1.2	8	0.0	0
% Trichoptera (20)	8.2	20	4.7	14	2.8	7
EPT Richness (8)	6.0	3	8.0	6	4.0	3
Total Richness (7)	17.0	2	31.0	7	16.0	2
Diptera Richness (5)	1.0	0	3.0	2	1.0	0
Plecoptera Richness (5)	0.0	0	0.0	0	0.0	0
% Dominance (5)	47.1	2	40.3	4	58.9	2
	Total Score=	43	Total Score=	66	Total Score=	22
Macroinvertebrate comm. Rating		FAIR		GOOD		POOR

Table 4A. Qualitative macroinvertebrate sampling results for

TAXA	Tributary to Pottawattomie Bayou Ferris Street 9/9/2014 STATION 4	Black Creek Cleveland Street (M104) (downstream) 8/28/2014 STATION 5	Norris Creek Hilton Park Road 9/9/2014 STATION 6	Unnamed Tributary to Crockery Creek 104th Avenue 9/9/2014 STATION 7
ANNELIDA (segmented worms)				
Hirudinea (leeches)				7
Oligochaeta (worms)	1	4	2	13
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	131	160	145	12
Decapoda (crayfish)		2	1	8
Isopoda (sowbugs)	27	18		48
Arachnoidea				
Hydracarina				2
Insecta				
Ephemeroptera (mayflies)				
Baetidae			4	13
Caenidae			1	
Ephemeridae			1	
Heptageniidae	1	2	27	5
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	7	5	5	2
Zygoptera (damselflies)				
Calopterygidae	58	34	6	42
Coenagrionidae		1		
Plecoptera (stoneflies)				
Perlidae			1	
Hemiptera (true bugs)				
Belostomatidae		1		
Corixidae				3
Gerridae	2	2	1	3
Mesoveliidae	1	1		1
Veliidae	1		5	
Megaloptera				
Corydalidae (dobson flies)	1		2	
Sialidae (alder flies)		1		
Trichoptera (caddisflies)				
Brachycentridae			17	
Hydropsychidae	7	1	9	3
Leptoceridae	2			
Limnephilidae		14	4	4
Molannidae				2
Phryganeidae	1	7		14
Coleoptera (beetles)				
Dytiscidae (total)	1	1		
Haliplidae (adults)		2		
Hydrophilidae (total)		1		1
Dryopidae	1	3		
Elmidae	2	1		
Diptera (flies)				
Athericidae				1
Ceratopogonidae				1
Chironomidae	4	18	6	35
Dixidae		5		
Simuliidae	2	3	22	7
Tabanidae			1	1
Tipulidae			11	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1		1
Physidae	5	3		3
Pleuroceridae				2
Viviparidae		1		
Pelecypoda (bivalves)				
Sphaeriidae (clams)	3			10
TOTAL INDIVIDUALS	258	292	271	245

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

	Tributary to Pottawattomie Bayou Ferris Street 9/9/2014 STATION 4		Black Creek Cleveland Street (M104) (downstream) 8/28/2014 STATION 5		Norris Creek Hilton Park Road 9/9/2014 STATION 6		Unnamed Tributary to Crockery Creek 104th Avenue 9/9/2014 STATION 7	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	20	1	26	1	20	0	28	1
NUMBER OF MAYFLY TAXA	1	0	1	-1	4	1	2	0
NUMBER OF CADDISFLY TAXA	3	0	3	0	3	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	1	1	0	-1
PERCENT MAYFLY COMP.	0.39	-1	0.68	-1	12.18	0	7.35	0
PERCENT CADDISFLY COMP.	3.88	-1	7.53	0	11.07	0	9.39	0
PERCENT DOMINANT TAXON	50.78	-1	54.79	-1	53.51	-1	19.59	1
PERCENT ISOPOD, SNAIL, LEECH	12.40	-1	7.88	0	0.00	1	24.90	-1
PERCENT SURF. AIR BREATHERS	1.94	1	2.74	1	2.21	1	3.27	1
TOTAL SCORE		-3		-2		3		1
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2014

TAXA	Crockery Creek Ensley Road (downstream) 9/9/2014 STATION 8	Bass Creek 88th Avenue 9/4/2014 STATION 9	Bass Creek Stanton Road 9/4/2014 STATION 10	Little Bass Creek 76th Street 9/4/2014 STATION 11
PLATYHELMINTHES (flatworms)				
Turbellaria		3		
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	4	6	
Oligochaeta (worms)		17	3	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	107	11	71	162
Decapoda (crayfish)	1	1	1	1
Isopoda (sowbugs)	1	14	1	40
Arachnoidea				
Hydracarina		3		
Insecta				
Ephemeroptera (mayflies)				
Baetidae	13	1	1	1
Caenidae	1		6	1
Heptageniidae	1	1		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	1	1	1
Libellulidae			1	5
Zygoptera (damselflies)				
Calopterygidae	9	59	10	10
Coenagrionidae		7	62	7
Hemiptera (true bugs)				
Belostomatidae		1	2	
Corixidae		5	7	6
Gerridae	1	3	1	1
Notonectidae	1			1
Pleidae			1	2
Veliidae			1	7
Megaloptera				
Corydalidae (dobson flies)	1	1		
Sialidae (alder flies)	3			1
Trichoptera (caddisflies)				
Brachycentridae	40			
Hydropsychidae	23	42	3	1
Leptoceridae	11	5		1
Limnephilidae	1			3
Phryganeidae				4
Polycentropodidae	2		1	
Coleoptera (beetles)				
Dytiscidae (total)		1	1	1
Gyrinidae (adults)			1	1
Haliplidae (adults)		3	4	2
Dryopidae	3	9		
Elmidae	3	16	5	4
Diptera (flies)				
Athericidae	4			
Ceratopogonidae		2		
Chironomidae	20	17	17	5
Culicidae				2
Dixidae				4
Simuliidae	2	11		2
Stratiomyidae		3		1
Tabanidae		5		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1		
Physidae	1	14	48	1
Viviparidae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	3	3	1
TOTAL INDIVIDUALS	252	264	258	280

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

	Crockery Creek Ensley Road (downstream) 9/9/2014 STATION 8		Bass Creek 88th Avenue 9/4/2014 STATION 9		Bass Creek Stanton Road 9/4/2014 STATION 10		Little Bass Creek 76th Street 9/4/2014 STATION 11	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	25	1	30	1	25	1	31	1
NUMBER OF MAYFLY TAXA	3	0	2	0	2	0	2	0
NUMBER OF CADDISFLY TAXA	5	1	2	0	2	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	5.95	0	0.76	-1	2.71	-1	0.71	-1
PERCENT CADDISFLY COMP.	30.56	1	17.80	0	1.55	-1	3.21	-1
PERCENT DOMINANT TAXON	42.46	-1	22.35	0	27.52	0	57.86	-1
PERCENT ISOPOD, SNAIL, LEECH	1.19	1	12.50	-1	21.32	-1	15.00	-1
PERCENT SURF. AIR BREATHERS	0.79	1	6.06	1	6.98	1	8.57	0
TOTAL SCORE		3		-1		-2		-4
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2014

TAXA	Little Bass Creek 68th Street 9/4/2014 STATION 12	Deer Creek Sheridan Park 9/17/2014 STATION 13	Crockery Creek Behler Road 9/17/2014 STATION 14	North Branch Crockery Creek 36th Avenue 8/28/2014 STATION 15
PLATYHELMINTHES (flatworms)				
Turbellaria	5			
ANNELIDA (segmented worms)				
Oligochaeta (worms)	1		1	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	260	218	197	157
Decapoda (crayfish)		2	1	7
Isopoda (sowbugs)	34	9	3	9
Arachnoidea				
Hydracarina		1		
Insecta				
Ephemeroptera (mayflies)				
Baetidae	4	3	11	4
Heptageniidae		2	10	14
Leptophlebiidae		1		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	3	1	2
Zygoptera (damselflies)				
Calopterygidae		24	10	5
Coenagrionidae	1			
Plecoptera (stoneflies)				
Perlidae			3	
Hemiptera (true bugs)				
Belostomatidae		3		
Corixidae		2		
Gerridae		1		4
Notonectidae	1	1		
Pleidae		2		
Veliidae	2	3	1	
Megaloptera				
Corydalidae (dobson flies)				1
Trichoptera (caddisflies)				
Hydropsychidae	3	2	11	20
Limnephilidae		1		
Phryganeidae		1		
Coleoptera (beetles)				
Hydrophilidae (total)	1			
Dryopidae		3		4
Elmidae	1	7	3	28
Diptera (flies)				
Athericidae			7	4
Chironomidae	2	10	6	8
Culicidae		1		
Dixidae		11		
Simuliidae			6	1
Stratiomyidae	1			
Tabanidae	1	4		
Tipulidae	2		1	4
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				2
Physidae	2	30		
Viviparidae		1		
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	6		
TOTAL INDIVIDUALS	323	352	272	274

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

	Little Bass Creek 68th Street 9/4/2014 STATION 12		Deer Creek Sheridan Park 9/17/2014 STATION 13		Crockery Creek Behler Road 9/17/2014 STATION 14		North Branch Crockery Creek 36th Avenue 8/28/2014 STATION 15	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	18	0	27	1	16	0	17	0
NUMBER OF MAYFLY TAXA	1	0	3	0	2	0	2	0
NUMBER OF CADDISFLY TAXA	1	-1	3	0	1	-1	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	1	1	0	-1
PERCENT MAYFLY COMP.	1.24	-1	1.70	-1	7.72	0	6.57	0
PERCENT CADDISFLY COMP.	0.93	-1	1.14	-1	4.04	0	7.30	0
PERCENT DOMINANT TAXON	80.50	-1	61.93	-1	72.43	-1	57.30	-1
PERCENT ISOPOD, SNAIL, LEECH	11.15	-1	11.36	-1	1.10	1	4.01	0
PERCENT SURF. AIR BREATHERS	1.55	1	3.69	1	0.37	1	1.46	1
TOTAL SCORE		-5		-3		1		-2
MACROINV. COMMUNITY RATING		POOR		ACCEPT.		ACCEPT.		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2014

TAXA	North Branch Crockery Creek 24th Avenue 8/28/2014 STATION 16	North Branch Crockery Creek Sherman Boulevard 9/17/2014 STATION 17	Rush Creek 44th Street 9/17/2014 STATION 18	Plaster Creek Godfrey Ave 9/18/2014 STATION 19
PLATYHELMINTHES (flatworms)				
Turbellaria			1	1
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1		
Oligochaeta (worms)			7	16
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	231	164	64	9
Decapoda (crayfish)	7	1	4	1
Isopoda (sowbugs)	7	11	6	36
Arachnoidea				
Hydracarina	1			1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	11	7	1	8
Heptageniidae	8	10	18	
Siphlonuridae	5			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		1	1	1
Zygoptera (damselflies)				
Calopterygidae	4	11	27	21
Coenagrionidae				6
Hemiptera (true bugs)				
Corixidae		2		
Gerridae	1			
Mesoveliidae	1			
Nepidae	1		1	
Veliidae			1	
Trichoptera (caddisflies)				
Hydropsychidae	12	36	65	94
Hydroptilidae	1			
Leptoceridae		1		
Limnephilidae	1			
Coleoptera (beetles)				
Dytiscidae (total)	1			
Dryopidae	1	1		
Elmidae	6	1	16	
Diptera (flies)				
Athericidae	3		2	
Chironomidae	9	19	19	6
Dixidae	1		3	
Empididae				1
Simuliidae	9	3	4	
Stratiomyidae		1		
Tabanidae	1	5		
Tipulidae	2	3	1	2
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			
Physidae	1		1	3
Viviparidae		1		
Pelecypoda (bivalves)				
Sphaeriidae (clams)		2	1	
TOTAL INDIVIDUALS	326	281	243	206

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

METRIC	North Branch Crockery Creek 24th Avenue 8/28/2014 STATION 16 Value	Score	North Branch Crockery Creek Sherman Boulevard 9/17/2014 STATION 17 Value	Score	East Branch Rush Creek/ Bliss Creek Inter County Drain 44th Street 9/17/2014 STATION 18 Value	Score	Plaster Creek Godfrey Ave SW 9/18/2014 STATION 19 Value	Score
TOTAL NUMBER OF TAXA	25	1	20	0	20	0	15	0
NUMBER OF MAYFLY TAXA	3	0	2	0	2	0	1	-1
NUMBER OF CADDISFLY TAXA	3	0	2	0	1	-1	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	7.36	0	6.05	0	7.82	0	3.88	0
PERCENT CADDISFLY COMP.	4.29	0	13.17	0	26.75	0	45.63	1
PERCENT DOMINANT TAXON	70.86	-1	58.36	-1	26.75	0	45.63	-1
PERCENT ISOPOD, SNAIL, LEECH	2.76	1	4.63	0	2.88	1	18.93	-1
PERCENT SURF. AIR BREATHERS	1.23	1	1.07	1	0.82	1	0.00	1
TOTAL SCORE		1		-1		0		-3
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2014

TAXA	Plaster Creek 68th Street 9/11/2014 STATION 20	Plaster Creek Shadyside Park 9/11/2014 STATION 21	Plaster Creek upstream Hammond Avenue 9/11/2014 STATION 22	Little Plaster Creek downstream Forest Hill Avenue 9/11/2014 STATION 23
PLATYHELMINTHES (flatworms)				
Turbellaria	3	4	1	12
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	3	1	
Oligochaeta (worms)	9	14	9	2
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	17		5	138
Decapoda (crayfish)		1	1	
Isopoda (sowbugs)	1			
Arachnoidea				
Hydracarina	2	1	2	3
Insecta				
Ephemeroptera (mayflies)				
Baetidae	32	20	1	1
Caenidae		1		4
Heptageniidae	4			
Siphlonuridae		1		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	2	7	1
Zygoptera (damselflies)				
Calopterygidae	32	17	4	18
Coenagrionidae		3	1	1
Hemiptera (true bugs)				
Belostomatidae		3		
Corixidae	11	6	22	
Gerridae		2	3	
Mesoveliidae	1		11	1
Notonectidae			1	
Veliidae		1	4	
Trichoptera (caddisflies)				
Hydropsychidae	17	17	4	32
Phryganeidae	1	2		
Polycentropodidae			1	
Coleoptera (beetles)				
Dytiscidae (total)				1
Dryopidae	1		5	
Elmidae	10	1		1
Scirtidae (larvae)				1
Diptera (flies)				
Athericidae				1
Ceratopogonidae	1	2	1	1
Chironomidae	77	150	68	22
Culicidae		1		
Dixidae	2	1		
Simuliidae	1	5	1	
Stratiomyidae		1		
Syrphidae	1			
Tabanidae	1		2	1
Tipulidae		1	12	4
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		2		
Physidae	1	14	39	
Pleuroceridae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)		2	17	16
TOTAL INDIVIDUALS	228	278	223	262

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

	Plaster Creek 68th Street 9/11/2014 STATION 20		Plaster Creek Shadyside Park 9/11/2014 STATION 21		Plaster Creek upstream Hammond Avenue 9/11/2014 STATION 22		Plaster Creek downstream Forest Hill Avenue 9/11/2014 STATION 23	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	23	0	28	1	25	1	21	0
NUMBER OF MAYFLY TAXA	2	0	3	1	1	-1	2	0
NUMBER OF CADDISFLY TAXA	2	0	2	0	2	0	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	15.79	0	7.91	0	0.45	-1	1.91	-1
PERCENT CADDISFLY COMP.	7.89	0	6.83	0	2.24	-1	12.21	0
PERCENT DOMINANT TAXON	33.77	0	53.96	-1	30.49	0	52.67	-1
PERCENT ISOPOD, SNAIL, LEECH	1.32	1	6.83	0	17.94	-1	0.38	1
PERCENT SURF. AIR BREATHERS	5.70	1	5.04	1	18.39	0	0.76	1
TOTAL SCORE		1		1		-4		-2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2015

TAXA	Plaster Creek Broadmoor Avenue SE 9/21/2015 STATION 24	Unnamed Tributary toPlaster Creek 60th Street 9/21/2015 STATION 25	Unnamed Tributary toPlaster Creek Paul Henry Thornapple Trail 9/21/2015 STATION 26
PLATYHELMINTHES (flatworms)			
Turbellaria		14	
ANNELIDA (segmented worms)			
Hirudinea (leeches)	1		
Oligochaeta (worms)	3	1	46
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	220	32	59
Decapoda (crayfish)	1	1	1
Isopoda (sowbugs)	1	15	7
Arachnoidea			
Hydracarina		2	1
Insecta			
Ephemeroptera (mayflies)			
Baetidae	4		
Caenidae			1
Heptageniidae	1		
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	2	1	1
Zygoptera (damselflies)			
Calopterygidae	12	60	50
Coenagrionidae		5	
Hemiptera (true bugs)			
Belostomatidae			1
Corixidae		15	
Gerridae		1	1
Nepidae	1		
Notonectidae			1
Pleidae			10
Veliidae			1
Trichoptera (caddisflies)			
Hydropsychidae	16	13	
Lepidostomatidae		2	
Leptoceridae			3
Philopotamidae			1
Coleoptera (beetles)			
Gyrinidae (adults)		1	
Haliplidae (adults)			1
Elmidae	1	56	53
Scirtidae (larvae)			1
Diptera (flies)			
Chironomidae	4	31	42
Dixidae			1
Empididae		1	
Simuliidae		1	
Tipulidae	1	1	
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)			3
Physidae	2		12
Planorbidae			1
Pelecypoda (bivalves)			
Sphaeriidae (clams)	4		1
TOTAL INDIVIDUALS	274	253	299

Table 4B. Macroinvertebrate metric evaluation of Lower Grand River, September, 2015.

	Plaster Creek Broadmoor Avenue Southeast 9/21/2015 STATION 24		Unnamed Tributary toPlaster Creek 60th Street 9/21/2015 STATION 25		Unnamed Tributary toPlaster Creek Paul Henry Thornapple Trail 9/21/2015 STATION 26	
METRIC	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	16	0	19	0	24	0
NUMBER OF MAYFLY TAXA	2	0	0	-1	1	0
NUMBER OF CADDISFLY TAXA	1	-1	2	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	1.82	-1	0.00	-1	0.33	-1
PERCENT CADDISFLY COMP.	5.84	0	5.93	0	1.34	-1
PERCENT DOMINANT TAXON	80.29	-1	23.72	0	19.73	1
PERCENT ISOPOD, SNAIL, LEECH	1.46	1	5.93	0	7.69	0
PERCENT SURF. AIR BREATHERS	0.36	1	6.72	1	5.02	1
TOTAL SCORE		-2		-2		-1
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2014

TAXA	Crooked Creek David Highway 9/4/2014 STATION 27	Bellamy Creek Dildine Road 9/17/2014 STATION 28	Prairie Creek Main Street (Ionia) 9/3/2014 STATION 29	Libhart Creek downstream Sunfield Highway 9/3/2014 STATION 30
PORIFERA (sponges)				1
ANNELIDA (segmented worms)				
Hirudinea (leeches)				7
Oligochaeta (worms)	9	3		8
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	73		7	35
Decapoda (crayfish)	2	1	1	5
Isopoda (sowbugs)		2		8
Arachnoidea				
Hydracarina			10	2
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae			3	
Baetidae	5	17	40	14
Caenidae		1		3
Ephemerellidae			1	
Ephemeridae			2	
Heptageniidae	4	52	21	11
Isonychiidae			4	
Leptophlebiidae			2	
Siphlonuridae			5	
Tricorythidae			3	1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	10	3	3	1
Gomphidae		1	1	
Zygoptera (damselflies)				
Calopterygidae	5	5	10	10
Coenagrionidae	1			10
Plecoptera (stoneflies)				
Perlidae		1	4	
Hemiptera (true bugs)				
Belostomatidae	1	2		
Corixidae			10	4
Gerridae	2	1	1	
Nepidae			1	
Notonectidae		1	1	
Pleidae			3	
Veliidae	1			
Megaloptera				
Corydalidae (dobson flies)			1	
Trichoptera (caddisflies)				
Brachycentridae			1	
Helicopsychidae		1		3
Hydropsychidae	80	99	50	58
Hydroptilidae			2	1
Leptoceridae			3	1
Limnephilidae				1
Uenoidae	1			1
Coleoptera (beetles)				
Dytiscidae (total)				2
Haliplidae (adults)				1
Hydrophilidae (total)			1	
Dryopidae	6	3	1	3
Elmidae	54	8	13	41
Diptera (flies)				
Athericidae		5	3	
Ceratopogonidae	1		1	1
Chironomidae	3	36	25	10
Dixidae	1		1	
Empididae				1
Simuliidae		8	27	2
Stratiomyidae			1	
Tabanidae	6	1	2	1
Tipulidae	6	17	3	2
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	3			5
Hydrobiidae				1
Physidae	2	2	1	6
Planorbidae		1		
Viviparidae			1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	4	1	6
TOTAL INDIVIDUALS	277	275	271	267

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

	Crooked Creek David Highway 9/4/2014 STATION 27		Bellamy Creek Dildine Road 9/17/2014 STATION 28		Prairie Creek Main Street (Ionia) 9/3/2014 STATION 29		Libhart Creek downstream Sunfield Highway 9/3/2014 STATION 30	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	23	0	25	1	40	1	35	1
NUMBER OF MAYFLY TAXA	2	0	3	0	9	1	4	1
NUMBER OF CADDISFLY TAXA	2	0	2	0	4	0	6	1
NUMBER OF STONEFLY TAXA	0	-1	1	1	1	1	0	-1
PERCENT MAYFLY COMP.	3.25	0	25.45	1	29.89	1	10.86	0
PERCENT CADDISFLY COMP.	29.24	1	36.36	1	20.66	0	24.34	0
PERCENT DOMINANT TAXON	28.88	0	36.00	0	18.45	1	21.72	0
PERCENT ISOPOD, SNAIL, LEECH	1.81	1	1.82	1	0.74	1	10.11	0
PERCENT SURF. AIR BREATHERS	1.44	1	1.45	1	6.64	1	2.62	1
TOTAL SCORE		2		6		7		3
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		EXCELLENT		ACCEPT.

Table 4A. Qualitative macroinvertebrate sampling results for lower Grand River watershed, 2014

TAXA	Prairie Creek Charles Road 9/3/2014 STATION 31
ANNELIDA (segmented worms)	
Oligochaeta (worms)	2
ARTHROPODA	
Crustacea	
Amphipoda (scuds)	11
Decapoda (crayfish)	5
Insecta	
Ephemeroptera (mayflies)	
Baetiscidae	4
Baetidae	22
Caenidae	1
Ephemeridae	2
Heptageniidae	7
Isonychiidae	1
Siphlonuridae	1
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	2
Gomphidae	3
Zygoptera (damselflies)	
Calopterygidae	13
Plecoptera (stoneflies)	
Perlidae	3
Pteronarcyidae	4
Hemiptera (true bugs)	
Corixidae	12
Pleidae	2
Megaloptera	
Corydalidae (dobson flies)	3
Trichoptera (caddisflies)	
Brachycentridae	7
Helicopsychidae	2
Hydropsychidae	36
Leptoceridae	5
Limnephilidae	1
Uenoidae	1
Coleoptera (beetles)	
Dryopidae	6
Elmidae	14
Diptera (flies)	
Athericidae	1
Chironomidae	23
Empididae	1
Simuliidae	12
Tipulidae	4
MOLLUSCA	
Gastropoda (snails)	
Physidae	14
Planorbidae	1
Pleuroceridae	8
Pelecypoda (bivalves)	
Sphaeriidae (clams)	7
TOTAL INDIVIDUALS	241

Table 4B. Macroinvertebrate metric evaluation of lower Grand River watershed

	Prairie Creek Charles Road 9/3/2014 STATION 31	
METRIC	Value	Score
TOTAL NUMBER OF TAXA	35	1
NUMBER OF MAYFLY TAXA	7	1
NUMBER OF CADDISFLY TAXA	6	1
NUMBER OF STONEFLY TAXA	2	1
PERCENT MAYFLY COMP.	15.77	0
PERCENT CADDISFLY COMP.	21.58	0
PERCENT DOMINANT TAXON	14.94	1
PERCENT ISOPOD, SNAIL, LEECH	9.54	0
PERCENT SURF. AIR BREATHERS	5.81	1
TOTAL SCORE		6
MACROINV. COMMUNITY RATING		EXCELLENT

Table 5A. Qualitative fish sampling results for Deer Creek at Sheridan Park; September 2014.

TAXA	Deer Creek Sheridan Park 9/17/2014 STATION 13
Umbridae (mudminnows)	
Umbra limi (Central mudminnow)	42
Cyprinidae (minnows and carps)	
Semotilus atromaculatus (Creek chub)	32
Luxilus cornutus (Common shiner)	24
Pimephales notatus (Bluntnose minnow)	15
Catostomidae (suckers)	
Catostomus commersoni (White sucker)	14
Aphredoderidae (pirate perch)	
Aphredoderus sayanus (Pirate perch)	1
Centrarchidae (sunfish)	
Ambloplites rupestris (Rock bass)	2
Lepomis cyanellus (Green sunfish)	6
Lepomis gibbosus (Pumpkinseed sf)	1
Micropterus salmoides (Largemouth bass)	2
Percidae (perch)	
Etheostoma nigrum (Johnny darter)	5
TOTAL INDIVIDUALS	144
Number of hybrid sunfish	0
Number of anomalies	0
Percent anomalies	0.000
Percent salmonids	0.000
Reach sampled (ft)	300
Area sampled (sq ft)	3,000
Density (# fish/sq ft)	0.048
Gear	ss

Table 5B. Fish metric evaluation of fish community for Deer Creek at Sheridan Park; September 2014.

	Deer Creek Sheridan Park 9/17/2014 STATION 13	
METRIC	Value	Score
TOTAL NUMBER OF TAXA	11	1
NO. OF DARTER, SCULPIN, MADTOM TAXA	1	0
NUMBER OF SUNFISH TAXA	3	1
NUMBER OF SUCKER TAXA	1	0
NUMBER OF INTOLERANT TAXA	1	-1
PERCENT TOLERANT	79.17	-1
PERCENT OMNIVOROUS TAXA	71.53	-1
PERCENT INSECTIVOROUS TAXA	25.69	-1
PERCENT PISCIVOROUS TAXA	2.78	0
% SIMPLE LITHOPHILIC SPAWNER TAXA	26.39	0
TOTAL SCORE		-2
FISH COMMUNITY RATING		ACCEPT.

Table 5A. Qualitative fish sampling results for Plaster Creek at Shadyside Park; November 2015.

TAXA	Plaster Creek Shadyside Park 11/3/2015 STATION 21
Umbridae (mudminnows)	
Umbra limi (Central mudminnow)	25
Esocidae (pikes)	
Esox lucius (Northern Pike)	1
Cyprinidae (minnows and carps)	
Semotilus atromaculatus (Creek chub)	23
Pimephales notatus (Bluntnose minnow)	174
Rhinichthys atratulus (Blacknose dace)	44
Catostomidae (suckers)	
Catostomus commersoni (White sucker)	52
Centrarchidae (sunfish)	
Lepomis cyanellus (Green sunfish)	12
Lepomis gibbosus (Pumpkinseed sf)	1
Lepomis macrochirus (Bluegill sf)	4
Percidae (perch)	
Etheostoma nigrum (Johnny darter)	98
Percina maculata (Blackside darter)	2
TOTAL INDIVIDUALS	436
Number of hybrid sunfish	0
Number of anomalies	0
Percent anomalies	0.000
Percent salmonids	0.000
Reach sampled (ft)	1,000
Area sampled (sq ft)	
Density (# fish/sq ft)	
Gear	ss

Table 5B. Fish metric evaluation of fish community for Plaster Creek at Shadyside Park; November 2015.

METRIC	Plaster Creek Shadyside Park 11/3/2015 STATION 21 Value	Score
TOTAL NUMBER OF TAXA	11	1
NO. OF DARTER, SCULPIN, MADTOM TAXA	2	1
NUMBER OF SUNFISH TAXA	3	1
NUMBER OF SUCKER TAXA	1	0
NUMBER OF INTOLERANT TAXA	0	-1
PERCENT TOLERANT	98.17	-1
PERCENT OMNIVOROUS TAXA	72.94	-1
PERCENT INSECTIVOROUS TAXA	26.83	-1
PERCENT PISCIVOROUS TAXA	0.23	-1
% SIMPLE LITHOPHILIC SPAWNER TAXA	22.48	0
TOTAL SCORE		-2
FISH COMMUNITY RATING		ACCEPT.

Comments:

1 Bluegill/Green hybrid

Table 6. Habitat evaluation for lower Grand River watershed	UnnamedTributary to Pottawattomie Bayou		Black Creek		Norris Creek		Unnamed Tributary to Crockery Creek		Crockery Creek	
	Ferris Street		Cleveland Street (M104) (downstream)		Hilton Park Road		104th Avenue		Ensley Road (downstream)	
	GLIDE/POOL		GLIDE/POOL		GLIDE/POOL		GLIDE/POOL		GLIDE/POOL	
	STATION 4		STATION 5		STATION 6		STATION 7		STATION 8	
HABITAT METRIC										
Substrate and Instream Cover										
Epifaunal Substrate/ Avail Cover (20)	11		6		6		6		2	
Embeddedness (20)*										
Velocity/Depth Regime (20)*										
Pool Substrate Characterization (20)**	13		6		13		8		6	
Pool Variability (20)**	8		13		10		5		3	
Channel Morphology										
Sediment Deposition (20)	11		5		10		6		3	
Flow Status - Maint. Flow Volume (10)	10		10		9		10		10	
Flow Status - Flashiness (10)	9		8		8		10		0	
Channel Alteration (20)	13		10		18		19		13	
Frequency of Riffles/Bends (20)*										
Channel Sinuosity (20)**	13		5		16		16		5	
Riparian and Bank Structure										
Bank Stability (L) (10)	10		8		8		10		8	
Bank Stability (R) (10)	10		8		8		10		8	
Vegetative Protection (L) (10)	10		7		8		9		3	
Vegetative Protection (R) (10)	10		7		8		9		3	
Riparian Veg. Zone Width (L) (10)	9		10		7		10		2	
Riparian Veg. Zone Width (R) (10)	9		10		10		5		2	
TOTAL SCORE (200):	146		113		139		133		68	
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:	9/9/2014		8/28/2014		9/9/2014		9/9/2014		9/9/2014	
Weather:			Sunny		Sunny		Partly Cloudy		Partly Cloudy	
Air Temperature:	80	Deg. F.	57	Deg. F.	68	Deg. F.	75	Deg. F.	76	Deg. F.
Water Temperature:	72	Deg. F.	57	Deg. F.	60	Deg. F.	62	Deg. F.	65	Deg. F.
Ave. Stream Width:	5	Feet	16.2	Feet	20	Feet	6.7	Feet	49	Feet
Ave. Stream Depth:	0.53	Feet	1	Feet	0.61	Feet	0.6	Feet	1	Feet
Surface Velocity:	0.56	Ft./Sec.	0.34	Ft./Sec.	1	Ft./Sec.	0.6	Ft./Sec.	2	Ft./Sec.
Estimated Flow:	1.484	CFS	5.508	CFS	12.2	CFS	2.412	CFS	98	CFS
Stream Modifications:			Dredged				None		Dredged	
Nuisance Plants (Y/N):	N		N		N		N		N	
Report Number:										
STORET No.:	700662		700548		610787		700650		610477	
Stream Name:	UnnamedTributary to Pottawattomie Bayou		Black Creek		Norris Creek		Unnamed Tributary to Crockery Creek		Crockery Creek	
Road Crossing/Location:	Ferris Street		Cleveland Street (M104) (downstream)		Hilton Park Road		104th Avenue		Ensley Road (downstream)	
County Code:	70		70		61		70		61	
TRS:	07N16W11		08N15W20		09N15W22		08N15W2		09N15W36	
Latitude (dd):	43.00857		43.07412		43.16048		43.11036		43.12028	
Longitude (dd):	-86.17281		-86.10714		-86.08656		-86.04705		-86.02711	
Ecoregion:	SMNITP		SMNITP		SMNITP		SMNITP		SMNITP	
Stream Type:	Coldwater		Warmwater		Coldwater		Coldwater		Warmwater	
USGS Basin Code:	4050006		4050006		4050006		4050006		4050006	
* Applies only to Riffle/Run stream Surveys										
** Applies only to Glide/Pool stream Surveys										

Table 6. Habitat evaluation for lower Grand River watershed	Bass Creek		Bass Creek		Little Bass Creek		Little Bass Creek		Deer Creek	
	88th Avenue		Stanton Road		76th Street		68th Street		Sheridan Park	
	GLIDE/POOL		GLIDE/POOL		GLIDE/POOL		GLIDE/POOL		GLIDE/POOL	
	STATION 9		STATION 10		STATION 11		STATION 12		STATION 13	
HABITAT METRIC										
Substrate and Instream Cover										
Epifaunal Substrate/ Avail Cover (20)	4		5		1		5		3	
Embeddedness (20)*										
Velocity/Depth Regime (20)*										
Pool Substrate Characterization (20)**	8		8		6		8		13	
Pool Variability (20)**	10		11		5		5		15	
Channel Morphology										
Sediment Deposition (20)	1		1		2		5		5	
Flow Status - Maint. Flow Volume (10)	10		10		10		10		10	
Flow Status - Flashiness (10)	3		5		9		9		2	
Channel Alteration (20)	11		3		15		13		15	
Frequency of Riffles/Bends (20)*										
Channel Sinuosity (20)**	5		3		10		10		15	
Riparian and Bank Structure										
Bank Stability (L) (10)	7		8		10		10		4	
Bank Stability (R) (10)	7		8		10		10		4	
Vegetative Protection (L) (10)	6		4		7		8		4	
Vegetative Protection (R) (10)	6		4		7		8		4	
Riparian Veg. Zone Width (L) (10)	9		1		7		9		6	
Riparian Veg. Zone Width (R) (10)	9		1		7		9		9	
TOTAL SCORE (200):	96		72		106		119		109	
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)		MARGINAL (MODERATELY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)		GOOD (SLIGHTLY IMPAIRED)	
	Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).									
Date:	9/4/2014		9/4/2014		9/4/2014		9/4/2014		9/17/2014	
Weather:	Rainy		Rainy		Partly Cloudy		Cloudy		Sunny	
Air Temperature:	77	Deg. F.	66	Deg. F.	78	Deg. F.	69	Deg. F.	65	Deg. F.
Water Temperature:	68	Deg. F.	67	Deg. F.	66	Deg. F.	65	Deg. F.	54	Deg. F.
Ave. Stream Width:	10.5	Feet	14	Feet	7.7	Feet	8.7	Feet	9.6	Feet
Ave. Stream Depth:	0.7	Feet	0.63	Feet	1	Feet	0.3	Feet	1.1	Feet
Surface Velocity:	0.9	Ft./Sec.	0.73	Ft./Sec.	0.9	Ft./Sec.	0.7	Ft./Sec.	0.3	Ft./Sec.
Estimated Flow:	6.615	CFS	6.4386	CFS	6.93	CFS	1.827	CFS	3.168	CFS
Stream Modifications:	Dredged		Dredged		Canopy Removal		None			
Nuisance Plants (Y/N):	N		N		N		N		N	
Report Number:										
STORET No.:	700652		700651		700653		700654		700663	
Stream Name:	Bass Creek		Bass Creek		Little Bass Creek		Little Bass Creek		Deer Creek	
Road Crossing/Location:	88th Avenue		Stanton Road		76th Street		68th Street		Sheridan Park	
County Code:	70		70		70		70		70	
TRS:	06N14W5		06N14W5		07N14W33		07N14W34		08N14W23	
Latitude (dd):	42.94156		42.93605		42.95559		42.94645		43.07882	
Longitude (dd):	-86.00228		-85.9955		-85.97313		-85.9529		-85.94541	
Ecoregion:	SMNITP		SMNITP		SMNITP		SMNITP		SMNITP	
Stream Type:	Warmwater		Warmwater		Warmwater		Warmwater		Warmwater	
USGS Basin Code:	4050006		4050006		4050006		4050006		4050006	
* Applies only to Riffle/Run stream Surveys										
** Applies only to Glide/Pool stream Surveys										

Table 6. Habitat evaluation for lower Grand River watershed	Crockery Creek	North Branch Crockery Creek	North Branch Crockery Creek	North Branch Crockery Creek	East Branch Rush Creek/ Bliss Creek Inter County Drain
	Behler Road	36th Avenue	24th Avenue	Sherman Boulevard	44th Street
	GLIDE/POOL	RIFFLE/RUN	RIFFLE/RUN	GLIDE/POOL	RIFFLE/RUN
	STATION 14	STATION 15	STATION 16	STATION 17	STATION 18
HABITAT METRIC					
Substrate and Instream Cover					
Epifaunal Substrate/ Avail Cover (20)	11	6	10	5	5
Embeddedness (20)*		18	15		5
Velocity/Depth Regime (20)*		10	10		11
Pool Substrate Characterization (20)**	13			8	
Pool Variability (20)**	16			10	
Channel Morphology					
Sediment Deposition (20)	10	16	10	3	8
Flow Status - Maint. Flow Volume (10)	9	8	8	10	10
Flow Status - Flashiness (10)	6	2	5	6	4
Channel Alteration (20)	18	15	8	16	11
Frequency of Riffles/Bends (20)*		15	16		2
Channel Sinuosity (20)**	18			15	
Riparian and Bank Structure					
Bank Stability (L) (10)	6	6	9	6	7
Bank Stability (R) (10)	6	6	9	6	7
Vegetative Protection (L) (10)	7	6	7	6	5
Vegetative Protection (R) (10)	7	6	7	6	5
Riparian Veg. Zone Width (L) (10)	10	10	3	2	7
Riparian Veg. Zone Width (R) (10)	8	10	2	4	6
TOTAL SCORE (200):	145	134	119	103	93
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:	9/17/2014	8/28/2014	8/28/2014	9/17/2014	9/17/2014
Weather:	Sunny	Sunny	Sunny	Sunny	W
Air Temperature:	65 Deg. F.	75 Deg. F.	70 Deg. F.	62 Deg. F.	68 Deg. F.
Water Temperature:	52 Deg. F.	64 Deg. F.	66 Deg. F.	55 Deg. F.	56 Deg. F.
Ave. Stream Width:	20 Feet	27 Feet	15 Feet	9 Feet	32 Feet
Ave. Stream Depth:	1 Feet	0.5 Feet	0.9 Feet	0.75 Feet	0.9 Feet
Surface Velocity:	1.2 Ft./Sec.	0.8 Ft./Sec.	0.4 Ft./Sec.	0.66 Ft./Sec.	0.9 Ft./Sec.
Estimated Flow:	24 CFS	10.8 CFS	5.4 CFS	4.455 CFS	25.92 CFS
Stream Modifications:	None	None	None	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	610509	700635	700634	610788	700656
Stream Name:	Crockery Creek	North Branch Crockery Creek	North Branch Crockery Creek	North Branch Crockery Creek	East Branch Rush Creek/ Bliss Creek Inter County Drain
Road Crossing/Location:	Behler Road	36th Avenue	24th Avenue	Sherman Boulevard	44th Street
County Code:	61	70	70	61	70
TRS:	10N13W17	09N13W05	09N13W03	09N13W2	06N13W25
Latitude (dd):	43.2591	43.19407	43.19776	43.20533	42.88329
Longitude (dd):	-85.9022	-85.87922	-85.84983	-85.81793	-85.78674
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater	Warmwater
USGS Basin Code:	4050006	4050006	4050006	4050006	4050006
* Applies only to Riffle/Run stream Surveys					
** Applies only to Glide/Pool stream Surveys					

Table 6. Habitat evaluation for lower Grand River watershed	Plaster Creek		Plaster Creek		Plaster Creek		Plaster Creek		Little Plaster Creek	
	Godfrey Ave SW		68th Street SE		Shadyside Park		upstream Hammond Avenue		downstream Forest Hill Avenue SE	
	RIFFLE/RUN		GLIDE/POOL		RIFFLE/RUN		GLIDE/POOL		GLIDE/POOL	
	STATION 19		STATION 20		STATION 21		STATION 22		STATION 23	
HABITAT METRIC										
Substrate and Instream Cover										
Epifaunal Substrate/ Avail Cover (20)	6		10		5		2		10	
Embeddedness (20)*	6				10					
Velocity/Depth Regime (20)*	14				13					
Pool Substrate Characterization (20)**			8				8		8	
Pool Variability (20)**			6				1		5	
Channel Morphology										
Sediment Deposition (20)	11		3		1		3		5	
Flow Status - Maint. Flow Volume (10)	10		10		10		9		10	
Flow Status - Flashiness (10)	6		3		2		2		3	
Channel Alteration (20)	15		13		14		13		19	
Frequency of Riffles/Bends (20)*	13				18					
Channel Sinuosity (20)**			4				4		16	
Riparian and Bank Structure										
Bank Stability (L) (10)	9		5		2		9		8	
Bank Stability (R) (10)	9		5		2		9		8	
Vegetative Protection (L) (10)	5		9		3		1		5	
Vegetative Protection (R) (10)	5		9		3		1		5	
Riparian Veg. Zone Width (L) (10)	1		1		2		3		9	
Riparian Veg. Zone Width (R) (10)	1		1		2		6		9	
TOTAL SCORE (200):	111		87		87		71		120	
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)		MARGINAL (MODERATELY IMPAIRED)		MARGINAL (MODERATELY IMPAIRED)		MARGINAL (MODERATELY 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:	9/18/2014		9/11/2014		9/11/2014		9/11/2014		9/11/2014	
Weather:	Sunny		Cloudy		Cloudy		Cloudy		Cloudy	
Air Temperature:	68	Deg. F.	55	Deg. F.	55	Deg. F.	55	Deg. F.	55	Deg. F.
Water Temperature:	59	Deg. F.	62	Deg. F.	66	Deg. F.	76	Deg. F.	65	Deg. F.
Ave. Stream Width:	34	Feet	18.2	Feet	5.5	Feet	11.3	Feet	7.5	Feet
Ave. Stream Depth:	2.2	Feet	0.72	Feet	1	Feet	0.72	Feet	0.55	Feet
Surface Velocity:	0.88	Ft./Sec.	1.4	Ft./Sec.	1	Ft./Sec.	0.27	Ft./Sec.	0.51	Ft./Sec.
Estimated Flow:	65.824	CFS	18.3456	CFS	5.5	CFS	2.19672	CFS	2.10375	CFS
Stream Modifications:	Dredged		Dredged		Canopy Removal		Dredged		None	
Nuisance Plants (Y/N):	N		N		N		N		N	
Report Number:										
STORET No.:	410628		410631		410785		410786		410784	
Stream Name:	Plaster Creek		Plaster Creek		Plaster Creek		Plaster Creek		Little Plaster Creek	
Road Crossing/Location:	Godfrey Ave SW		68th Street SE		Shadyside Park		upstream Hammond Avenue		downstream Forest Hill Avenue SE	
County Code:	41		41		41		41		41	
TRS:	06N11W02		05N10W10		05N11W11		05N11W11		06N11W01	
Latitude (dd):	42.9359		42.84102		42.83115		42.82972		42.93501	
Longitude (dd):	-85.68748		-85.59678		-85.57641		-85.57452		-85.55533	
Ecoregion:	SMNITP		SMNITP		SMNITP		SMNITP		SMNITP	
Stream Type:	Warmwater		Warmwater		Warmwater		Warmwater		Warmwater	
USGS Basin Code:	4050006		4050006		4050006		4050006		4050006	
* Applies only to Riffle/Run stream Surveys										
** Applies only to Glide/Pool stream Surveys										

Table 6. Habitat evaluation for lower Grand River watershed						
	Plaster Creek		Unnamed tributary to Plaster Creek		Unnamed tributary to Plaster Creek	
	Broadmoor Avenue SE		60th Street SE		Paul Henry Thornapple Trail	
	RIFFLE/RUN		RIFFLE/RUN		GLIDE/POOL	
	STATION 24		STATION 25		STATION 26	
HABITAT METRIC						
Substrate and Instream Cover						
Epifaunal Substrate/ Avail Cover (20)	8		6		8	
Embeddedness (20)*	3		1			
Velocity/Depth Regime (20)*	11		6			
Pool Substrate Characterization (20)**					14	
Pool Variability (20)**					1	
Channel Morphology						
Sediment Deposition (20)	3		4		17	
Flow Status - Maint. Flow Volume (10)	4		5		9	
Flow Status - Flashiness (10)	0		2		8	
Channel Alteration (20)	18		12		11	
Frequency of Riffles/Bends (20)*	8		4			
Channel Sinuosity (20)**					1	
Riparian and Bank Structure						
Bank Stability (L) (10)	5		8		8	
Bank Stability (R) (10)	5		8		8	
Vegetative Protection (L) (10)	8		8		7	
Vegetative Protection (R) (10)	8		8		7	
Riparian Veg. Zone Width (L) (10)	10		9		3	
Riparian Veg. Zone Width (R) (10)	10		9		3	
TOTAL SCORE (200):	101		90		105	
HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)		MARGINAL (MODERATELY 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:	9/21/2015		9/21/2015		9/21/2015	
Weather:	Sunny		Sunny		Sunny	
Air Temperature:	59	Deg. F.	76	Deg. F.	86	Deg. F.
Water Temperature:	60	Deg. F.	59	Deg. F.	62	Deg. F.
Ave. Stream Width:	0.7	Feet		Feet		Feet
Ave. Stream Depth:	1	Feet		Feet		Feet
Surface Velocity:	0.71	Ft./Sec.	0.49	Ft./Sec.	0.08	Ft./Sec.
Estimated Flow:	0.497	CFS		CFS		CFS
Stream Modifications:	None		None		None	
Nuisance Plants (Y/N):	N		N		N	
Report Number:						
STORET No.:	410801		410802		410803	
Stream Name:	Plaster Creek		Unnamed tributary to Plaster Creek		Unnamed tributary to Plaster Creek	
Road Crossing/Location:	Broadmoor Avenue SE		60th Street SE		Paul Henry Thornapple Trail	
County Code:	41		41		41	
TRS:	06N11W14		06N11W35		06N11W35	
Latitude (dd):	42.89919		42.85457		42.8495	
Longitude (dd):	-85.57757		-85.58435		-85.565391	
Ecoregion:	SMNITP		SMNITP		SMNITP	
Stream Type:						