Elkhart-South Bend Aquatic Community Monitoring

Annual Report
2014

City of Elkhart
Public Works and Utilities
Dick Moore, Mayor

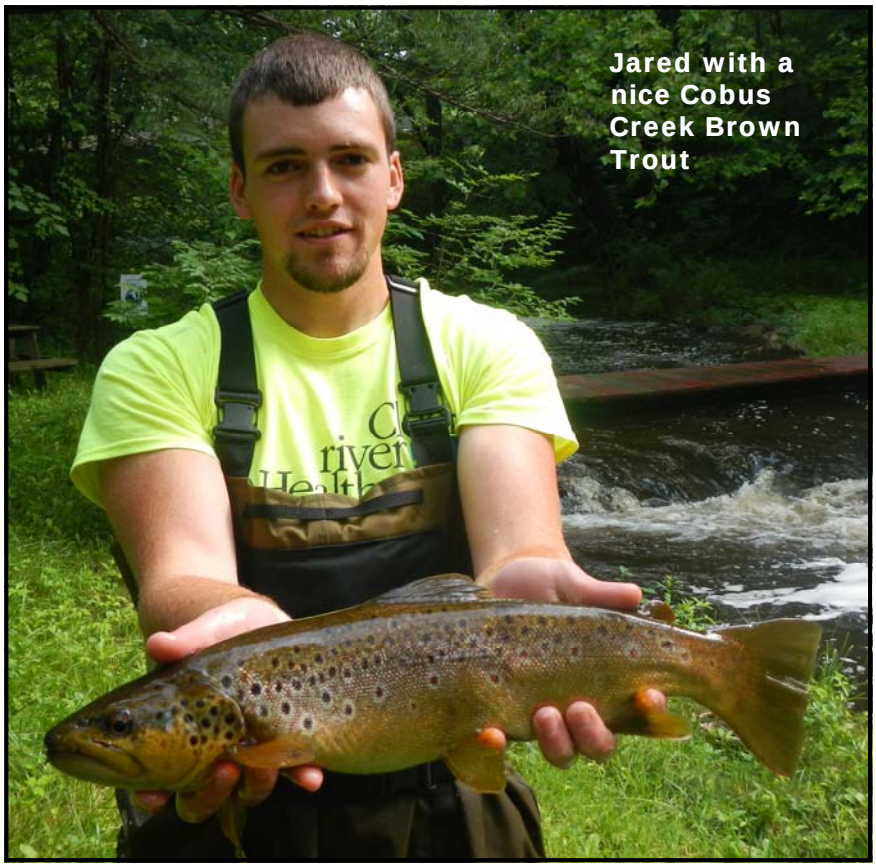
Clean river Healthy neighborhoods

ELKHART ▪ SOUTH BEND

Cover Photo: The Aquatics Program Crew and volunteers Erin and Erik Mawhorter pose with a nice selection of northern pike on the Elkhart River south of Goshen

TABLE OF CONTENTS

AQUATIC COMMUNITY MONITORING IN ELKHART AND ST. JOSEPH COUNTIES ON THE ST. JOSEPH RIVER AND SELECTED TRIBUTARIES 2014



Jared with a nice Cobus Creek Brown Trout

Prepared by
Daragh Deegan
Aquatic Biologist
April, 2015

INTRODUCTION

For many years, the Cities of South Bend and Elkhart have collected surface water samples from our local rivers to evaluate pollutant concentrations. In 1998, the City of Elkhart initiated biological community monitoring to compliment chemical and microbial sampling and to establish a robust long-term stream monitoring program. The City of South Bend joined forces with Elkhart in 2001, and since then both communities have gathered a great deal of information on the health of our local waterways.

Biological community monitoring in 2014 did not reveal any major surprises. The St. Joseph River Watershed in Elkhart and St Joseph Counties continues to support highly diverse communities of fish and macroinvertebrates. While long-term trends indicate minor improvements in certain streams, some local tributaries to the St. Joseph River remain impaired or show little signs of improvement.

In 2014, the cities of Elkhart and South Bend, through the City of Elkhart's Aquatics Program, continued to monitor local fish populations in area rivers and streams. The information gathered was integrated into an overall water quality program for each City. While the cities measure the chemical and microbial composition of local stream water, having the additional biological data gives a more accurate representation of the overall health of each stream. The way that biological communities are assembled can change as a result of a disturbance, such as a chemical spill or alteration of habitat. Chemical and microbial testing, while very important in pinpointing contaminants, is simply a snapshot of current conditions. In many cases, having both sets of data can help determine the cause and effect of disturbances to our local streams.

During the first 6 years (1998-2003), Elkhart's Aquatics Program established core fish sampling sites on the St. Joseph River and many of its primary tributaries in the Elkhart area. For 3 consecutive years, data were collected from these sites and a baseline was established for each stream. Baseline data are now used to compare with current monitoring results to determine if impairments or enhancements are taking place in Elkhart area streams.

In 2001, the City of South Bend combined forces with Elkhart's Aquatics program, establishing a unique biological monitoring partnership between municipalities. As with the Elkhart area, core sampling sites were determined and similar baselines were established for South Bend over a 6 year period (2001-2006). This year (2014) was the 8th year that the initial sites had been sampled since the baseline period, providing the community of South Bend with data to determine whether water quality in their area is improving or diminishing.

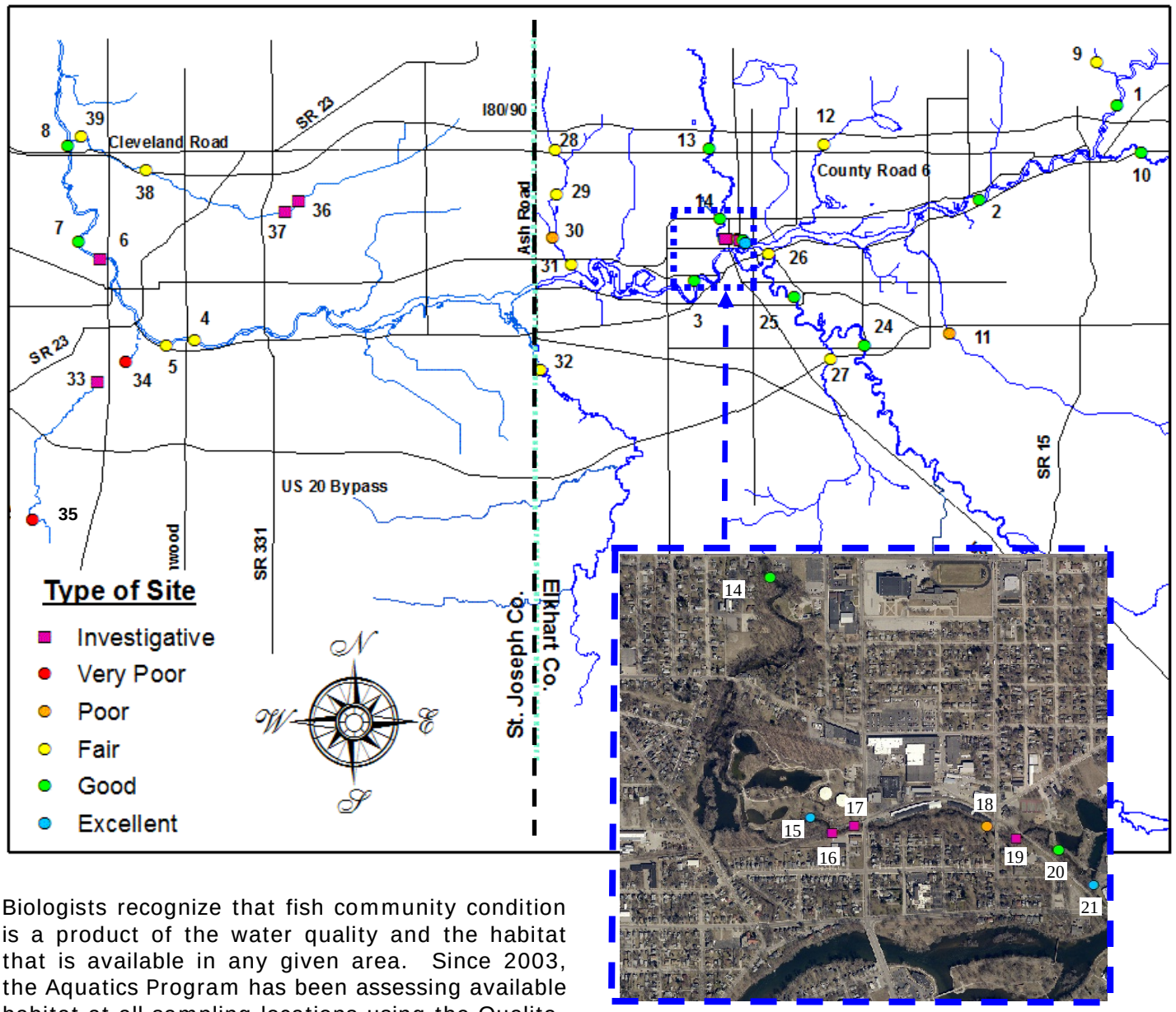
The Aquatics Program consists of more than just traversing through local streams collecting fish data. A considerable portion of the Program is education. The biologist travels to local schools and watershed stakeholder group meetings, giving presentations and demonstrations, in an effort to increase awareness about the health of our local streams.

Indices

The Index of Biotic Integrity (IBI) is the system that is used to assess the local fish communities. The IBI was developed by Dr. James Karr in 1981 as a tool for assessing water/stream quality based on the fish communities that are present. The IBI was modified by Dr. Thomas Simon in 1997 for use in the St. Joseph River Watershed. The IBI is a great tool in that complex biological information can be analyzed to provide measurements of stream quality for non-biologists and members of the general public. The IBI is comprised of 3 broad categories (species composition, trophic composition, and fish condition) which are broken down into 12 smaller categories, known as metrics (see Appendix A). These metrics are given a score based on their similarity to least impacted (reference) sites. One of 3 scores can be given for each metric: 1 (not similar to reference conditions), 3 (somewhat similar to reference conditions), or 5 (very similar to reference conditions). In general, the total score for a site will range from 12 to 60, but in an instance where no fish are present at a site, a score of 0 is given. These scores can then be graphed and placed into 1 to 5 classifications (very poor, poor, fair, good, or excellent), which describes the overall condition of the fish community being monitored.

Figure 1. An MBI biologist using a kick net to sample macroinvertebrates in Yellow Creek

Figure 2: Fish sampling sites in Elkhart and St. Joseph Counties and associated fish community conditions for 2014



Biologists recognize that fish community condition is a product of the water quality and the habitat that is available in any given area. Since 2003, the Aquatics Program has been assessing available habitat at all sampling locations using the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989). This index is similar to the IBI in its structure. It has 6 broad categories which are broken down into 21 smaller categories or metrics (Appendix A). This index will have a final score of 0 to 100 and the scores will be classified as excellent, good, fair-good, poor, and very poor. This assessment will help determine to what extent the IBI scores are being affected by habitat. It may also show specific habitat degradation issues that need to be addressed.

Fish are not the only aquatic organisms that can be monitored to determine overall health of rivers and streams. Through a sub-contract with the Midwest Biodiversity Institute (Figure 1) (MBI, Columbus, Ohio), the Aquatics Program is also monitoring benthic (bottom dwelling) macroinvertebrates (visible animals without backbones). Fourteen sites were sampled in 2014 and results were compared to their respective baseline values. The macroinvertebrate communities are assessed with the Invertebrate Community Index (ICI) developed by the Ohio Environmental Protection Agency (EPA) (Ohio EPA 1987). This index is broken down into 10 metrics (Appendix A). Like the IBI metrics, the ICI metrics are given a score based on their similarity to relatively undisturbed sites; 6 (comparable to exceptional community), 4 (comparable to typical community), 2 (slightly different from the typical community), or 1 (very different from the typical community). The site scores range from 0 to 60 and are classified similar to IBI scores. This combination of fish, habi-

Table 1: Fish sampling sites and Index Scores in Elkhart and St. Joseph Counties, 2014

Stream	Site	Site Number	Type of Site	County	Method	IBI Scores 2014	ICI Scores 2014	QHEI Scores 2014
St. Joseph River	Toll Road (Bristol)	1	Index	Elkhart	Boat	51		81
	Six Span	2	Index	Elkhart	Boat	52	50	82
	Bridge Street	3	Index	Elkhart	Boat	51	52	80
	Ironwood Dive	4	Index	St. Joseph	Boat	44		69
	Sample Street	5	Index	St. Joseph	Boat	42		63
	Michigan Street (B)	6	Investigative	St. Joseph	Boat			78
	Angela Boulevard	7	Index	St. Joseph	Boat	47	54	85
	Darden Road	8	Index	St. Joseph	Boat	50	46	83
Trout Creek	County Road 2	9	Index	Elkhart	Tote Barge	45		65
Little Elkhart River*	SR 120	10	Index	Elkhart	Tote Barge	48	48	86
Pine Creek*	US 20 Bypass	11	Index	Elkhart	Tote Barge	28		72
Puterbaugh Creek*	Reedy Drive	12	Index	Elkhart	Tote Barge	40		70
Christiana Creek	County Road 6	13	Index	Elkhart	Tote Barge	50	50	82
	Willowdale Park	14	Index	Elkhart	Tote Barge	50		78
	North Main Well Field	15	Index	Elkhart	Tote Barge	55		80
	Wellfield Below	16	Investigative	Elkhart	Tote Barge			76
	Main Street Above	17	Investigative	Elkhart	Tote Barge			68
	Cassopolis (Above)	18	Index	Elkhart	Tote Barge	34		79
	Cassopolis (Below)	19	Investigative	Elkhart	Tote Barge			75
	High Dive Park (Above)	20	Index	Elkhart	Tote Barge	51		79
	High Dive Park (Below)	21	Index	Elkhart	Tote Barge	55	46	74
Elkhart River	State Road 15 (Below)	22	Investigative	Elkhart	Boat			73
	Shanklin Park	23	Investigative	Elkhart	Boat			81
	Hively Avenue (CR 18)	24	Index	Elkhart	Boat	50	40	79
	Studebaker Park (A)	25	Index	Elkhart	Boat	47		80
	American Park	26	Index	Elkhart	Boat	44	40	63

*** denotes a cool/cold water stream**
Underlined values are indicative of stream impairment
Coolwater scores are in (parenthesis)

Table 1: Fish sampling sites and Index Scores in Elkhart and St. Joseph Counties, 2014 (continued)

Stream	Site	Site Number	Type of Site	County	Method	IBI Scores	ICI Scores	QHEI Scores
						2014	2014	2014
Yellow Creek	U.S. 20 Bypass	27	Index	Elkhart	Tote Barge	40	40	80
Cobus Creek*	County Road 6	28	Index	Elkhart	Tote Barge	32 (37)		61
	County Road 8	29	Index	Elkhart	Tote Barge	38 (38)		75
	County Road 12	30	Index	Elkhart	Tote Barge	32 (32)		67
	Elkhart Conservation Club	31	Index	Elkhart	Tote Barge	49 (37)		89
Baugo Creek	Restoration Site	32	Index	Elkhart	Tote Barge	41	38	80
Bowman Creek	Main Street	33	Investigative	St. Joseph	Back Pack			29
	Studebaker Golf Course	34	Index	St. Joseph	Back Pack	6	34	45
Auten Ditch	Locust Road (S)	35	Index	St. Joseph	Back Pack	13		38
Juday Creek*	Trinity Parkway	36	Investigative	St. Joseph	Tote Barge			60
	Windingbrook Drive	37	Investigative	St. Joseph	Tote Barge			48
	Kintz Avenue	38	Index	St. Joseph	Tote Barge	32 (30)	48	64
	Izaak Walton League	39	Index	St. Joseph	Tote Barge	27 (28)	46	76

tat, macroinvertebrate, and chemical monitoring provides the cities of Elkhart and South Bend with the most comprehensive view of stream health.

The Indiana Department of Environmental Management (IDEM) has established guidelines to determine if a body of water is impaired or if its condition is supportive of aquatic life for the IBI and QHEI (IDEM 2010). The ICI is not an index used by IDEM, however, similar guidelines have been established by OHIO EPA for a nearby region, and those values are being used with the Elkhart and St. Joseph County data. Values of 36 or higher for IBI and ICI scores are indicators of a stream with the ability to support aquatic life. QHEI scores of 51 or greater indicate enough quality habitat is available to support aquatic communities.

In addition to performing water quality monitoring in the St. Joseph River basin, fish collections are conducted to determine the overall species diversity throughout the watershed. Walleye (*Sander vitreus*) and smallmouth bass (*Micropterus dolomieu*) populations are monitored from previous tagging events in cooperation with the Indiana Department of Natural Resources (IDNR). Tissue from 4 fish species was collected and analyzed for mercury and polychlorinated biphenyl (PCB) content. Current Indiana Fish Consumption Advisory data for the State of Indiana (Table 12) displays many species from the Indiana portion of the St. Joseph River Watershed. The cities involved in the Program believe it is vital to continually provide local citizens with the most updated information on fish consumption.

Methods

For the past 17 years, the Aquatics staff has used 2 collection protocols (investigative sampling and index sampling) to quickly catalog the major fish species and to quantify stream quality in the St. Joseph River Watershed. Investigative sites are sampled once during the season and the fish collected at these sites are identified to species, the largest and smallest specimens are measured to the nearest millimeter (mm), and all fish are counted and then released. Index sites are sampled twice during the season, with a minimum 5 week "rest" period between sampling events. Individual species maximum and minimum lengths are recorded, all fish are counted, and game fish

and are weighed and measured individually, while most non-game fish are mass weighed. Individual length and weight data are also collected for some of the important species like greater redhorse.

The length of stream sampled at an index site is dependent on the wetted width of the stream. The length of sites is 15 times this width, with a minimum of 50 meters and a maximum of 500 meters. Differences in sampling and processing (Foy 2004) have allowed multiple investigative sites to be sampled in a day versus 1 or 2 index sites. Every species collected at each site is verified either by retaining and preserving a small specimen for the Public Works & Utilities voucher museum or by photographing a large specimen. This practice allows for the verification of the field and lab identifications if needed.

In 2014, 8 index and 4 investigative sites were sampled in St. Joseph County and 22 index and 5 investigative sites were sampled in Elkhart County. One index sites on Baugo Creek was located right on the Elkhart/St. Joseph County border. (Figure 2 and Table 1). IBI scores were calculated for each of the index sites and an average from the 2 visits was obtained to give the final score (Table 1).

Fish were collected using either boat mounted,

Figure 3: Hester-Dendy sampler placed into the stream bed.

Table 2: Macroinvertebrate Sampling Sites, 2014

Site Number	Stream	Location	Site Number	Stream	Location
1	St. Joseph River	Six Span.	8	Elkhart River	CR 18
2	St. Joseph River	Bridge Street	9	Elkhart River	American Park
3	St. Joseph River	Angela Boulevard	10	Yellow Creek	US 20 Bypass
4	St. Joseph River	Darden Road	11	Baugo Creek	Restoration Site
5	Little Elkhart River	SR 120	12	Bowman Creek	Studebaker Golf Course
6	Christiana Creek	CR 6	13	Juday Creek	Kintz Avenue
7	Christiana Creek	High Dive (B)	14	Juday Creek	Izaak Walton League

Figure 4: Location of macroinvertebrate sampling sites for 2014

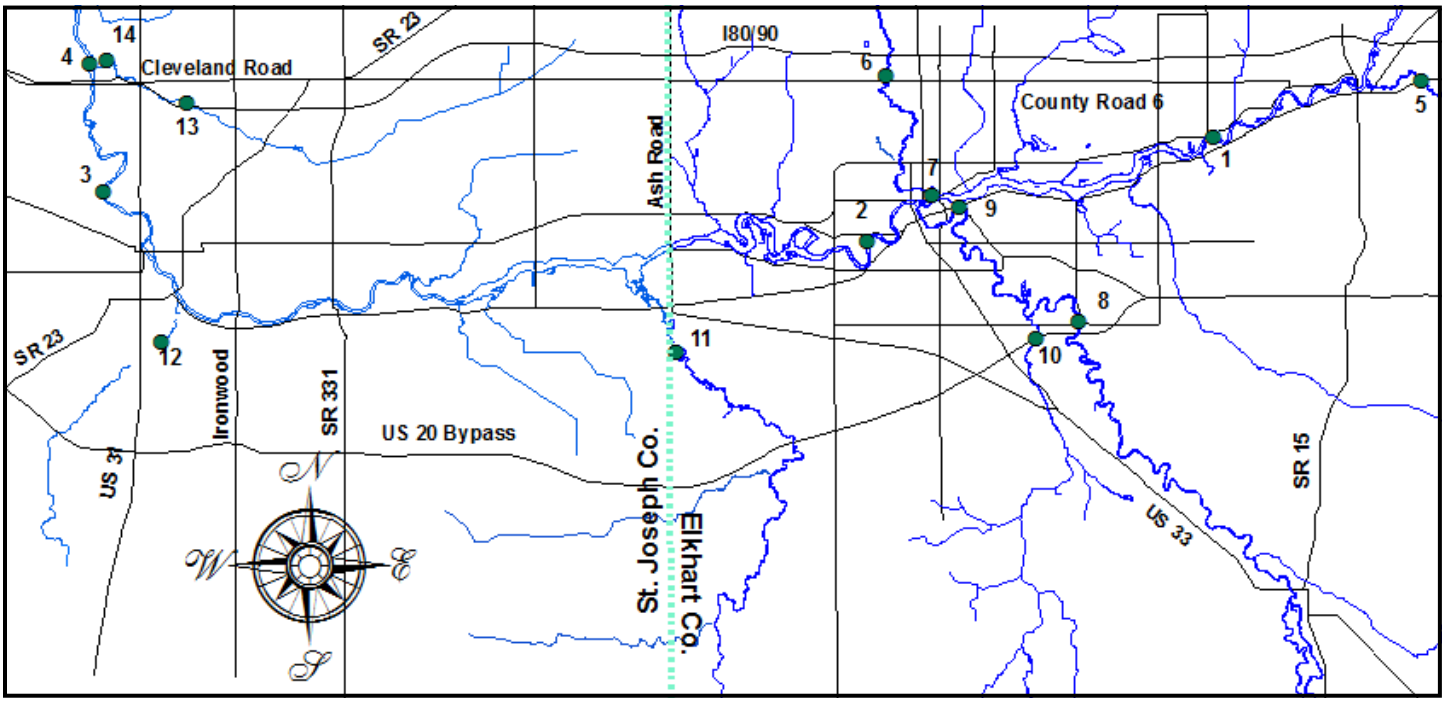
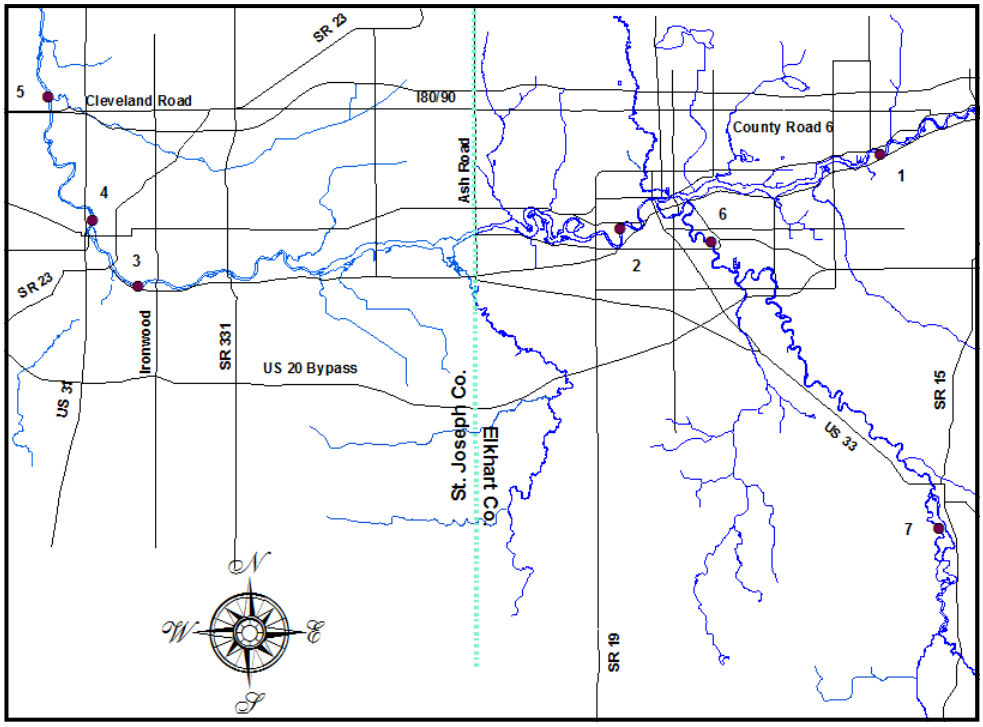


Figure 5: Location of fish tissue collection sites for 2013



tote barge, or backpack electrofishing equipment. The type of gear used depended on the size of the stream. The St. Joseph and Elkhart Rivers were sampled with the boat. Smaller, wadeable streams were sampled with the tote barge, unless the stream was extremely small and shallow, in which case, the backpack was used. Power output from the 3 devices differed. The boat output was 8-16 amperes, the tote barge was 4-6 amperes, and the backpack was 0.5-1.5 amperes.

During each fish sampling event, stream habitat information was methodically collected using the QHEI as developed by Ohio EPA (Rankin 1989). Given that each index site was sampled twice, scores were averaged to give a final score (Table 1).

In early July 2014, MBI personnel placed Hester-Dendy samplers (artificial substrates used to collect small aquatic organisms) (Figure 3) at 14 sites that were also sampled for fish (Table 2 and Figure 4) following Ohio EPA macroinvertebrate sampling procedures (Ohio EPA 1987, 1989). All 14 samplers were successfully retrieved approximately 7 weeks after being set and their contents were preserved in alcohol for later identification. The data gathered from the samplers is considered a quantitative sample where species are identified and specimens are counted. This information was then used to calculate ICI scores for each site. Qualitative sampling also took place at

Table 3: Location of fish tissue collection sites for 2014

Site Number	Stream	Location
1	St. Joseph River	Six Span
2	St. Joseph River	Bridge Street
3	St. Joseph River	Sample Street
4	St. Joseph River	Michigan Street
5	St. Joseph River	Darden Road
6	Elkhart River	Studebaker Park
7	Elkhart River	Shanklin Park

each site with the use of a kick net through all available habitat near the location of the sampler. This extra sampling is used to capture additional species as well as provide information to make an estimate of stream health in the case where an ICI score can not be calculated due to the loss or vandalism of a sampler.

Fish tissue in the form of skin-on fillets was collected from black crappie (*Pomoxis nigromaculatus),* bluegill (*Lepomis macrochirus*), northern pike *(Esox Lucius)* rock bass (*Ambloplites rupestris*), shorthead redhorse (*Moxostoma macrolepidotum*), steelhead (*Oncorhynchus mykiss*), and walleye (*Sander vitreus).* Table 3 and Figure 5 display the locations of tissue sample collection. Each tissue sample sent in for laboratory analysis (Pace Analytical, Green Bay, WI) was a composite of fillets from 3 fish of the same species from the

sample reach. The shortest specimen was within 90% of the length of the longest specimen. The samples were collected following the procedures in Appendix B (this report) and Appendix III in "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (1993).

Long-term index monitoring consists of rotational sampling of stream stations. Each station is visited at least once every 3 years to gather biological and chemical data and to compare against previous sampling results.

Results and Discussion

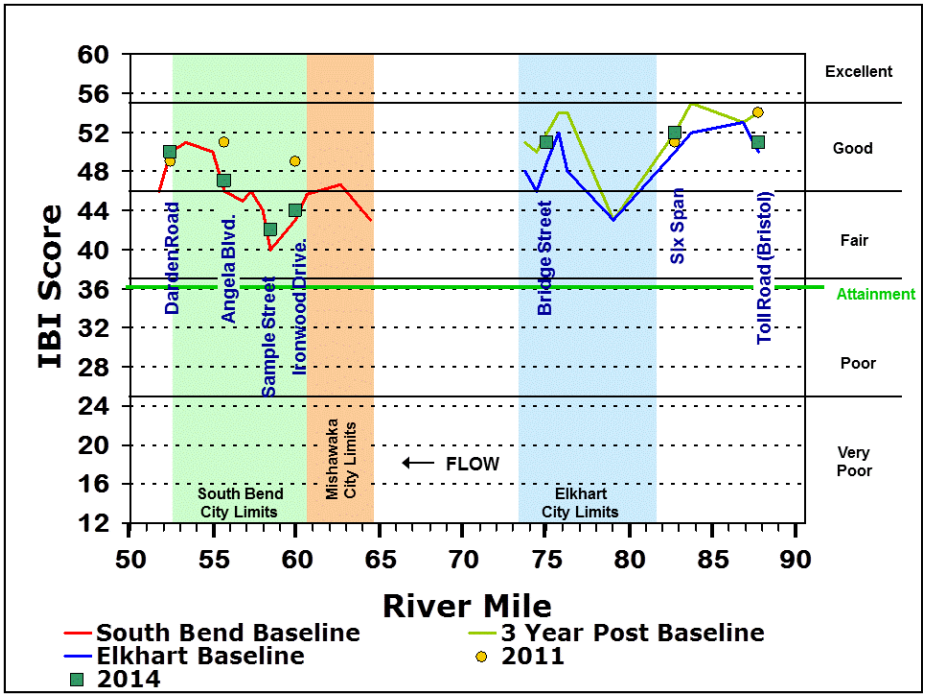
During the summer of 2014, a total of 18,733 fish, representing 17 families and 71 species, were collected in Elkhart County. In St. Joseph County, 6,418 fish, representing 13 families and 49 species were collected. In total, 72 different species were captured from the 2 counties. Rock bass (*Ambloplites rupterus*), bluegill (*Lepomis macrochirus*), and striped shiner (*Luxilus chrysocephalus*) were the most abundant species collected in Elkhart County, while longear sunfish (*Lepomis megalotis*), rock bass, and smallmouth bass (*Micropterus dolomieu*) were the most abundant in St. Joseph County. See Appendix C for more detailed information.

Indices

Fish community conditions at the index sites ranged from very poor (6) at Studebaker Golf Course on Bowman Creek to excellent (55) at High Dive Park (B) and North Main Wellfield on Christiana Creek. Macroinvertebrate community scores ranged from fair (34) at Studebaker Golf Course on Bowman Creek to exceptional (54) at Angela Boulevard on the St. Joseph River. Habitat quality ranged from fair (29) at Main Street on Bowman Creek to excellent (89) at the Elkhart Conservation Club on Cobus Creek.

Since the completion of baseline monitoring, fish IBI scores have been obtained 3 times over a period of 10 years at most index sites in Elkhart County. IBI scores can be influenced by natural conditions such as flooding or drought events and sometimes it can be difficult to determine whether stream quality is improving or diminishing because of natural variability. By averaging IBI scores from the last 3 monitoring events, variability can be reduced to give a good overall picture of stream health since the completion of baseline sampling. In this report we will provide a comparison between baseline and post-baseline average IBI scores for most streams in Elkhart County.

Figure 6: IBI scores for the St. Joseph River, Elkhart and St. Joseph Counties



St. Joseph River

The longitudinal trends in fish community condition for the entire Indiana portion of the St. Joseph River are displayed in Figure 6. Fish, macroinvertebrate, and habitat index scores are presented in Table 4.

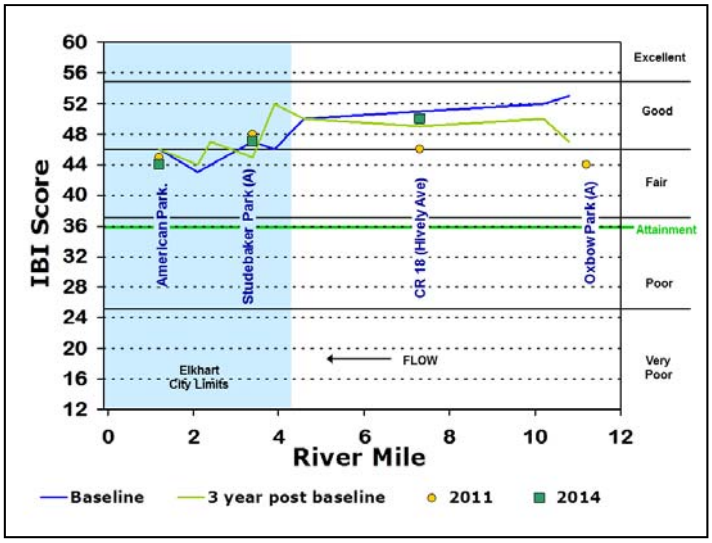
The Elkhart County portion of the river continues to support fair to excellent fish communities. IBI scores remained at or above initial baseline values at all sites. Post baseline average IBI scores suggest that fish community conditions have slightly improved since the inception of monitoring in 1998. Macroinvertebrate community assessments were performed at the Six Span and Bridge Street sites on the St. Joseph River. The ICI scores for both sites were up significantly from when they were last sampled in 2011. The Bridge Street site also had a significantly lower ICI score in 2008 suggesting improvement at this site. Biological index scores at Bridge Street reflect diverse and abundant communities of fish an macroinvertebrates which is very encouraging given the location of this site is in a highly urbanized area of Elkhart.

Table 4. Index scores for St. Joseph River sites, Elkhart and St. Joseph Counties

Station	County	River Mile	Fish IBI Scores				2014 Habitat Scores	(ICI) Macroinvertebrate Scores	
			Baseline	2008	2011	**2014**		Baseline/ Previous Score	**2014**
Toll Road (Bristol)	Elkhart	87.7	50	56	54	**51**	81		
Six Span	Elkhart	82.7	50	53	51	**52**	82	40	**50**
Bridge Street	Elkhart	75	49	53	51	**51**	80	42	**52**
Ironwood Drive	St. Joseph	59.9	43	45	49	**44**	69		
Sample Street	St. Joseph	58.4	40			**42**	63		
Angela Boulevard	St. Joseph	55.6	46	52	51	**47**	85	Good	**54**
Darden Road	St. Joseph	52.4	50	53	49	**50**	83	38	**46**

In St. Joseph County, IBI scores were either at or slightly above baseline values at all sites. In 2013, IBI scores were significantly higher than baselines values indicating a strong year for fish communities. IBI scores in 2014, however, were not as good and suggest that there is still some room for improvement in the South Bend area of the St. Joseph River. Regardless, fish communities appear to be stable if not slightly stronger since the implementation of this monitoring program. Sampling in 2014 marked the end of baseline monitoring at the Sample Street location. The baseline value of 40 at Sample Street is the lowest of all sites in the South Bend section of the St. Joseph River. Habitat scores indicate that lack of habitat in this section could be a major reason for the reduced fish community score (Deegan, 2013), although urban pollution issues may also be a major influence at this particular location.

Figure 7: IBI scores for the Elkhart River, Elkhart County

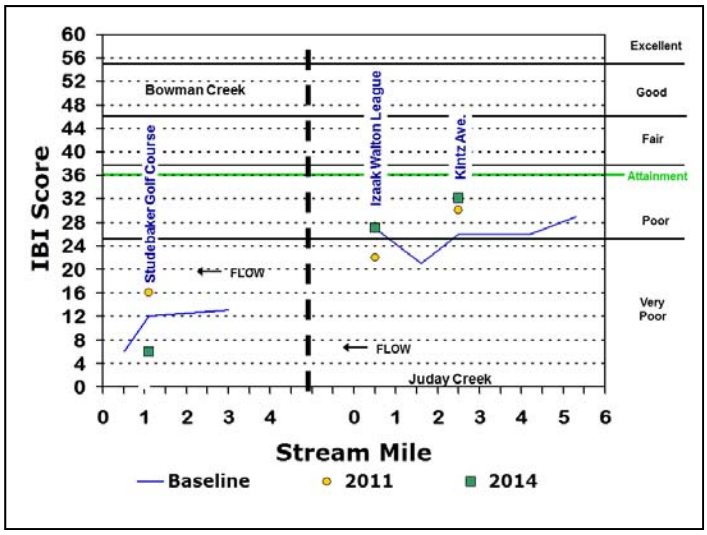


Macroinvertebrates were sampled at Angela Boulevard and Darden Road in the South Bend area, with respective ICI scores of 46 and 52. ICI scores were significantly higher than 2011 for both sites. It is interesting that macroinvertebrate scores at Angela Boulevard have increased while fish community scores have decreased. However, it is well understood by aquatic biologists that both communities of organisms react differently to stressors. Of most importance, both groups of organisms indicate that the St. Joseph River at Angela Boulevard is doing well.

Elkhart River

IBI scores for the Elkhart River were similar to the St. Joseph River in that scores were close to initial baseline values (Figure 7, Table 5). Scores at American Park and CR 18 (Hively Avenue) were actually slightly lower than initial baseline scores, but not low enough to demonstrate a downward shift in stream quality. Since the initiation of sampling in the St. Joseph River Watershed, IBI scores have improved slightly in some streams including the St. Joseph River. While the Elkhart River has had some strong years which were likely influenced by natural variables, there appears be little improvement in the fish

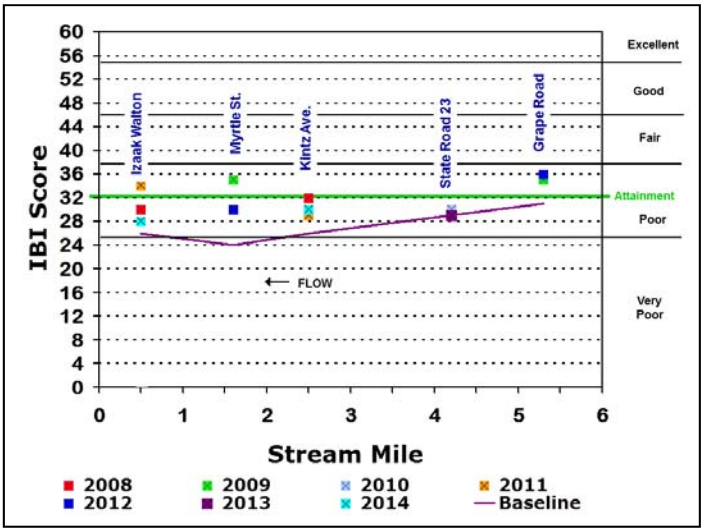
Figure 8: IBI scores for Bowman Creek and Juday Creek, St. Joseph County



communities in the past 17 years. The Elkhart River maintains high quality instream and riparian habitat as indicated by its impressive QHEI scores. However, many of the tributaries of the Elkhart River have been modified significantly for drainage, causing unstable flow and associated water quality issues in the Elkhart River.

The ICI scores for CR 18 and American Park were both 40 in 2014, down significantly from when the sites were previously sampled in 2011, but almost identical to the initial sampling scores from 2008. Interestingly, these 2 sites have scored identically in all the years they have been sampled, despite the fact that they are almost 6 miles apart. Furthermore, other sites on the Elkhart River that are sampled in the same year also have ICI scores that are identical or almost identical. These results suggest that stressors to the Elkhart River are widespread at the watershed level and support the idea that the river's biggest challenge is its unstable hydraulic conditions.

Figure 9: IBI Scores for Juday Creek using the coolwater methodology. Note that the attainment line is set at 32 using the coolwater methodology.



Bowman Creek

In 2014, Bowman Creek was sampled at Studebaker Golf Course for the sixth time since the initiation of sampling. During the first sampling pass in 2014, no fish were collected at the site. During the second pass only 10 juvenile largemouth bass and 5 creek chubs were collected. In previous years sampling events, there were several occasions were no fish were collected. Bowman Creek, above and below Studebaker Golf Course, is ran underground and stream flow is significantly altered. It's not uncommon for this stream to run dry. Although the habitat at the Golf Course is limited (QHEI score 45), the lack of continuous, adequate flow, and the fragmentation between different stream sections, are serious detriments to aquatic life in this stream.

When comparing macroinvertebrate communities to fish communities, it is understood that macroinvertebrates have shorter life-cycles and are quicker to reestablish following a disturbance. ICI

Table 5: Index scores for Elkhart River sites, Elkhart County

Station	River Mile	Fish IBI Scores				2014 Habitat Scores	(ICI) Macroinvertebrate Scores	
		Baseline	2008	2011	**2014**		2011	**2014**
CR 18 (Hively Ave)	7.3	51	50	46	**50**	82	50	**40**
Studebaker Park (A)	3.4	47	46	48	**47**	82		
American Park	1.2	46	49	45	**44**	83	50	**40**

Table 6: Index scores for Bowman Creek and Juday Creek sites, St. Joseph County

Stream	Station	Stream Mile	Fish IBI Scores (Coolwater IBI Scores)				2014 Habitat Scores	(ICI) Macroinvertebrate Scores	
			Baseline	2008	2011	**2014**		2011	**2014**
Auten Ditch	Locust Road (S)	6.0				**13**	38		
Bowman Creek	Studebaker Golf Course	1.1	12	6	16	**6**	45	36	**34**
Juday Creek	Kintz	2.5	26 (26)	34 (32)	30 (29)	**32 (30)**	64	58	**48**
Juday Creek	Izaak Walton League	0.5	27 (26)	27 (30)	22 (34)	**27 (28)**	76	40	**46**

scores at Bowman Creek in 2014 were 34 which is relatively good for this stream. The ICI score for this site was 36 in 2011 which is actually considered attaining. While the fish communities illustrate significant impairment in Bowman Creek, the macroinvertebrate communities suggest that it does have the ability to reestablish quickly following issues related to lack of flow. The ICI scores also suggest that water quality in the Creek may not be all that bad.

The Aquatics Program performed Index sampling at Locust Road (S) on Auten Ditch for the second time in 2014. Initial baseline sampling commenced in 2013 and baseline sampling will be completed during the summer of 2015. The IBI score in 2014 of 13 was just slightly lower than the score in 2013. This site, in the headwaters of the Bowman Creek Watershed, is essentially a small agricultural drainage ditch with very little habitat for fish. The QHEI score for this site in 2014 was 38. IDEM considers QHEI scores below 51 to be inadequate to support aquatic life. Only 4 small tolerant fish species have been collected at this site in the 2 years of sampling which supports the idea that habitat is inadequate. Water quality issues related to agricultural drainage may also be a limiting factor at this site.

Juday Creek

IBI scores for Juday Creek at the Izaak Walton League (IWL) and at Kintz Avenue were in the poor range and indicative of impaired fish communities (Figure 9 and Table 6). Because it is a coolwater stream, we have assessed Juday Creek using the conventional IBI system in addition to a system that has been developed for coolwater streams. Although both analytical methods provide different results, scores remain low. Our program has been experimenting with the two different IBI methods for several years to assess Juday Creek, and will continue to assess this stream using both methods. At this time, macroinvertebrate communities appear to provide a more meaningful reflection of the quality of Juday Creek. In 2014, ICI scores at Kintz Avenue and the IWL were 48 and 46 respectively, putting macroinvertebrates communities from both sites in the exceptional range. The ICI score at Kintz Avenue dropped significantly from 2011, when a score of 58 was recorded, and the score at the IWL increased significantly from the score of 40 recorded in 2011. Much of Juday Creek has relatively poor habitat due to historical modification and ditching activities. However, it is a very stable stream and flow does not fluctuate significantly like many other St. Joseph River tributaries. These stable conditions are likely one of the reasons why the macroinvertebrate communities thrive.

Yellow Creek

The IBI score at the U.S. 20 Bypass on Yellow Creek (40) was slightly above the baseline value of 39 and significantly higher than score of 36 that was obtained the last time it was sampled in 2011 (Table 7, Figure 10). This site underwent major modifications for drainage purposes in 2003, dropping IBI scores to 31 at the time. The stream channel was restored following 2003, but much of the forest canopy and instream habitat at this location has not been replaced. Prior to 2003, this site held large smallmouth bass that would migrate into the Yellow Creek from Elkhart River and hold in the deep pools with dense vegetation. While the IBI scores at this site appear to be slowly getting better with natural reestablishment of habitat, the quality of the smallmouth bass population appears to be getting better as well.

The macroinvertebrate community at this site re-

Figure 10: IBI scores for Pine Creek and Yellow Creek, Elkhart County

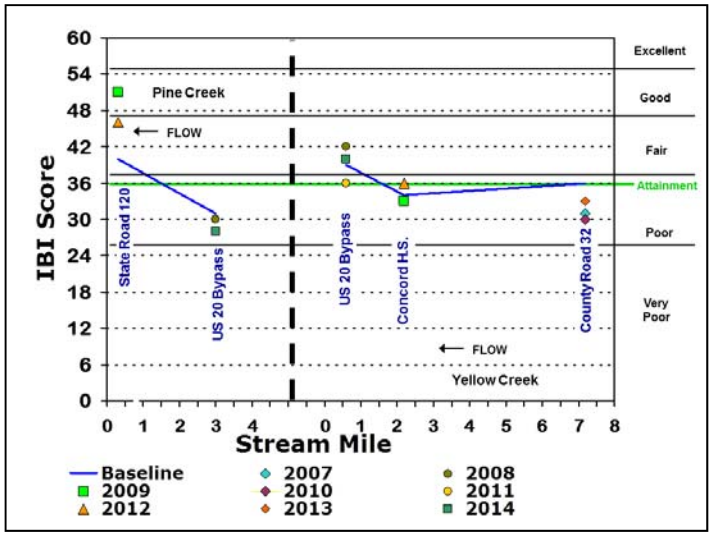
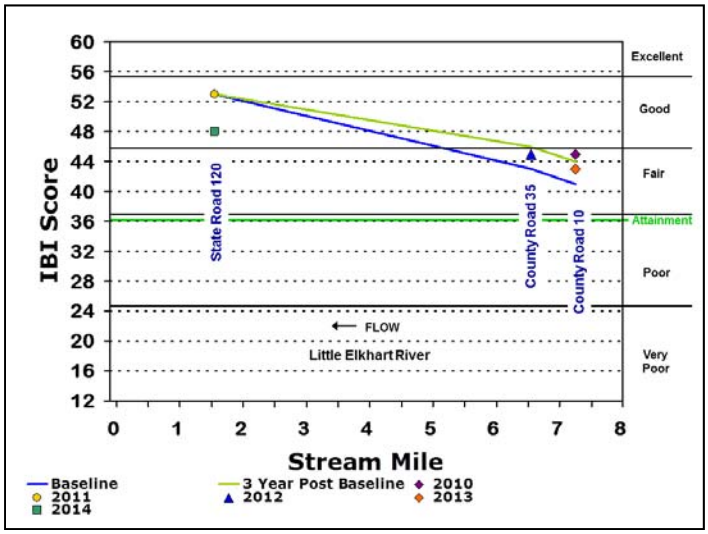


Figure 11: IBI scores for the Little Elkhart River, Elkhart County



mains good as reflected by the ICI value of 40 that was obtained in the 2014 season. However, it did drop significantly since the site was last sampled in 2011.

Pine Creek

Pine Creek at the U.S. 20 Bypass continues to have impaired fish communities (Table 7, Figure 10). This stream, while having relatively good habitat at the U.S. 20 Bypass, has been highly modified for drainage and is very unstable. Water levels, flow and the input of sediment and other pollutants will increase significantly in this stream following a rain event. The Aquatics Program will continue long-term monitoring of this stream.

Little Elkhart River

The Little Elkhart at SR 120 scored significantly lower than its baseline value of 53 in 2014, posting the lowest score since the initiation of sampling at this site (Table 8, Figure 11). This stream has shown slight improvements in fish community integrity at other sites upstream of SR 120 in recent years, but the decline at SR 120 does represent a slight concern. This site offers exceptional instream habitat (QHEI score 86) consisting of a significant amount of woody debris, several riffle and pool complexes, and highly variable substrates. The ICI score for this site (48) was down significantly from the last time it was sampled in 2011, but still in the exceptional range. Macroinvertebrates were initially sampled at this site in 2008 producing the same ICI score of 48. Given the lower index scores in 2014, the Aquatics Program will continue to pay close attention to this site and the Little Elkhart River. It is our hope that the reduced IBI score is merely a result of natural influences.

Trout Creek

IBI scores on Trout Creek at CR 2 have decreased significantly since the completion of baseline monitoring (Table 8). While there does not appear to be any obvious signs of water quality impairment for this stream, there is an overabundance of sunfish, which negatively effects some of the IBI metrics. Trout Creek drains some relatively large

Table 7: Index scores for Yellow Creek and Pine Creek, Elkhart County

Stream	Station	River Mile	Fish IBI Scores								2014 Habitat Scores	(ICI) Macroinvertebrate Scores	
			Baseline	2002	2003	2004	2005	2008	2011	**2014**		2011	**2014**
Yellow Creek	US 20 Bypass	0.6	39	38	31	37	34	42	36	**40**	80	48	**40**
Pine Creek	US 20 Bypass	3.0	31				26	30	28	**28**	72		

Table 8: Index scores for sites on Trout Creek, Puterbaugh Creek and the Little Elkhart River, Elkhart County

Stream	Station	River Mile	Fish IBI Scores				2014 Habitat Scores	Macroinvertebrate scores (ICI)	
			Baseline	2008	2011	**2014**		2011	2014
Trout Creek	County Road 2	0.7	51	44	47	**45**	65		
Puterbaugh Creek	Reedy Drive	2.3	37	40	39	**40**	70		
Little Elkhart River	State Road 120	1.6	53	56	53	**48**	86	52	**48**
Baugo Creek	Restoration Site	1.8	43		43	**41**	80	48	**38**

lakes in Michigan, connecting them with the St. Joseph River in a little over a mile. Fish diversity was also very low in 2014 relative to previous years, which does present a slight concern. The Aquatics Program will monitor this site closely in the future.

Puterbaugh Creek

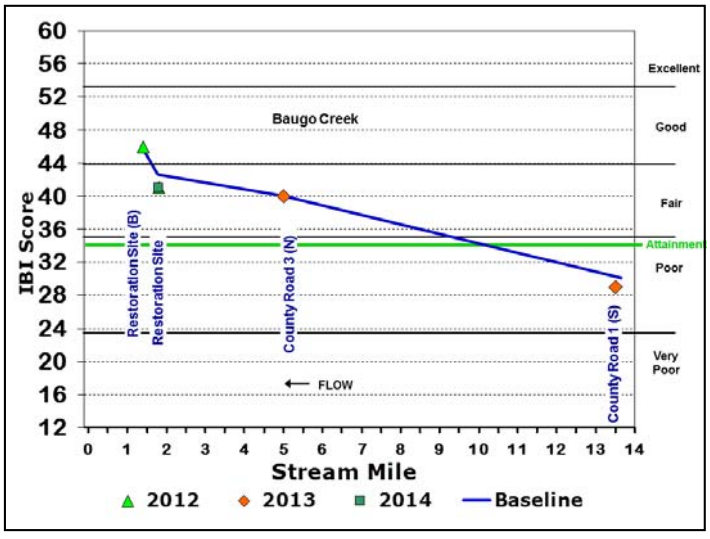
Puterbaugh Creek at Reedy Drive has had relatively consistent scores since the initiation of monitoring at this location (Table 8). Since the completion of baseline monitoring, IBI scores have been slightly higher than the baseline value. Puterbaugh Creek has an interesting mix of both warm and coolwater species. This creek has significant groundwater influences which help maintain cooler water temperatures. It drains Heaton Lake to the St. Joseph River and is also connected to East Lake in northeast Elkhart: all three bodies of water are likely sources for the warmwater species found in Puterbaugh Creek.

Baugo Creek

In 2014, Baugo Creek was sampled at the Restoration site for the first time since the completion of baseline monitoring in 2012. The IBI score in 2014 was slightly lower than the baseline, while the ICI score at the site was significantly lower than the baseline. The Restoration site is a location where a significant amount of instream restoration work was completed in 2010 by the Elkhart County Drainage Board in an effort to help stabilize the stream. Several structures called "j hooks" were placed in the stream and while the j hooks have certainly promoted better instream habitat, they do not appear to have significantly benefited the biological communities at this location.

Despite the restoration work that has been completed at this site, it is not very surprising that the biological communities have not significantly benefited. Baugo Creek has an significant enrichment problem (Deegan, 2014). It also has a very flashy flow regime, meaning that water levels rise rapidly following a rain event but will drop back to normal levels relatively quickly. This instability in flow is a result of how the watershed has been modified for agricultural land use and drainage. According to wetlands assessments of the Baugo Creek Watershed conducted by the Friends of the St. Joseph River, approximately 90% of the wetlands in the Baugo Creek system have been lost, resulting in a loss of 90% of the watershed's flood storage capacity (http://fotsjr.wildapricot.org/). Therefore, when it rains, 90% of the water that was previously stored by wetlands is quickly sent to Baugo Creek. Flooding events in Baugo Creek and other local streams is strongly correlated with input of sediment and other pollutants (Deegan 2013).

Figure 12: IBI scores of Baugo Creek, Elkhart and St. Joseph Counties



So, wetlands loss is a huge issue for the Baugo system and an indication that wetlands or some form of water storage is needed to protect Baugo Creek and the St. Joseph River downstream.

Christiana Creek

In 2013 and 2014, the Aquatics Program sampled multiple sites along Christiana Creek. The site at County Road 6 was sampled as part of the ongoing long-term monitoring program. However, additional sites including Willowdale Park, North Main Wellfield, and several investigative sites were sampled as part of fish passage study of Christiana Creek. Results of 2013 and 2014 surveys confirm that dams and other barriers within the first mile of Christiana Creek have a significant impact on fish migration from the St. Joseph River. Being the closest barrier to the St. Joseph River, the dam at High Dive causes the greatest impact, blocking about 15 species from swimming upstream. The Cassopolis Above site has very low diversity and numbers of fish, despite having excellent habitat to support a strong fish community. Fish diversity does increase at the North Main Wellfield site, yielding an excellent IBI score of 55, although the ponds located at the Wellfield appear to be a source area for fish in the creek. Species such as bluegill, largemouth bass, and common carp are abundant in the creek at the Wellfield.

The site located at County Road 6 has remained stable since the initiation of baseline monitoring (Figure 13 and Table 10). This site has always scored very well and hosts a high diversity of fish and insects. Fish species such as the tadpole madtom and the river chub, which are not common in other local streams are abundant at CR 6. Hellgrammites and other sensitive aquatic macroinvertebrates are also abundant at this location.

Macroinvertebrate sampling was conducted at 2 locations on Christiana Creek in 2014 (High Dive Park and CR 6). ICI scores for High Dive Park (B) and CR 6 were 46 and 50 respectively, putting the macroinvertebrate communities for both sites in the exceptional range.

Cobus Creek

Cobus Creek was sampled in 4 locations in 2014 to get a good overall picture of the health of this stream (Table 11). Previously, Index sampling has only occurred at CR 8 along Cobus Creek. IBI scores were rather disappointing at the 4 sites that were sampled, but all fell slightly higher than the attainment value of 32 for coolwater streams. Some interesting findings along Cobus Creek include naturally reproducing trout and high diversity of fish at the Elkhart Conservation Club (Deegan, 2014.a). The Elkhart Conservation Club (ECC) site is located close to its confluence of the St. Joseph River. The ECC location is also located downstream of at least three low head dams. Little fish diversity was observed at the locations upstream of the ECC suggesting that the dams might be impacting fish movement into Cobus Creek. Additional monitoring upstream and downstream of the ECC will take place to see if that is the case. The CR 8 site was also sampled in 2013 and at that time, IBI scores were significantly lower than the baseline. Results from 2014 indicate that the site rebounded in 2014 with an IBI score falling closer to the baseline.

Figure 13: IBI scores for Christiana Creek, Elkhart County

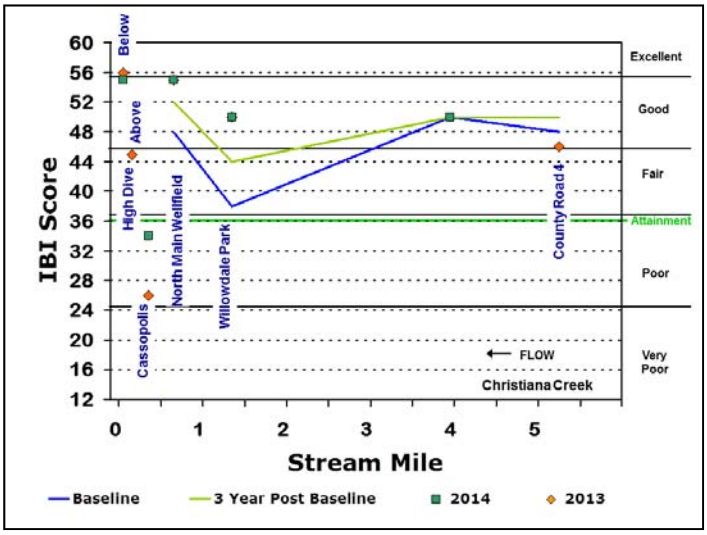


Table 9: Index Scores at new sites along Christiana Creek, Elkhart County

Station	Stream Mile	Fish IBI Scores		2014 Habitat Scores	2014 ICI Scores
		2013	**2014**		
Cassopolis Above	0.34	26	**34**	79	
High Dive Park (Above)	0.2	45	**51**	79	
High Dive Park (Below)	0.1	55	**55**	74	**46**

Table 10: Index scores at long-term monitoring sites along Christiana Creek, Elkhart County

Station	Stream Mile	Fish IBI Scores								2014 Habitat Scores	(ICI) Scores 2014
		Baseline	2008	2009	2010	2011	2012	2013	**2014**		
County Road 6	5.3	50	50			52			**50**	82	**50**
Willowdale Park	1.4	38	45			56		50	**50**	78	
North Main Well Field	0.7	48		53			51	55	**55**	80	

Fish Tissue

In 2014, tissue was collected from fish in both Elkhart and St. Joseph Counties. Collections were based on the current Fish Consumption Advisory (FCA) for area streams and potential data gaps within the FCA. The FCA provides guidance on the rate of consumption of local wild fishes (Table 12), based on the concentration of polychlorinated biphenyl (PCB) or mercury (Hg) concentrations in their tissue. It should be noted that the State FCA has more restrictive guidance for individuals that are considered to be part of the "sensitive population." Women who are pregnant or are breast-feeding, women who plan to have children, or children under the age of 15 are considered to be part of the sensitive population. For more information on local fish consumption, visit the Indiana State Department of Health's website (http://www.in.gov/isdh/23650.htm).

Many variables play a role in contaminant concentrations in fish. In general, larger fish will tend to have higher concentrations of contaminants in their tissue. Concentrations of contaminants can vary from one fish to another, so the methodology for collecting tissue samples requires collecting three fish and compositing all fish into one sample. In addition, the Aquatics Program will often sample the same fish species more than once to get a more accurate understanding of contaminant concentrations. The following narrative describes results of the Aquatics Program's fish tissue collections from Elkhart and St. Joseph Counties in 2014:

Walleye, ranging from 14.3 to 15.1 inches long were collected from the Elkhart River at Studebaker Park in Elkhart and Shanklin Park in Goshen. Walleye were stocked in the Elkhart River in 2012, by the Elkhart River Restoration Association, and have since grown to legal size for anglers to keep and consume. Results indicate very low concentrations of both PCBs and Hg and there should be no restrictions on consumption of walleye in this size range from the Elkhart River.

Black crappie are a species that are not listed in the fish consumption advisory for the St. Joseph River in Elkhart County. The Aquatics Program collected samples of black crappie for the first time in 2014. They have not been collected previously by our program for fish tissue because they are difficult to collect with electrofishing equipment. However, three black crappie ranging from 10.2-10.8 inches were collected at the Six Span

Table 11: Index scores for Christiana Creek and the Little Elkhart River, Elkhart County

Stream	Station	River Mile	Fish IBI Scores (Coolwater Index Scores)			2014 Habitat Scores
			Baseline	2013	**2014**	
Cobus Creek	County Road 6	3.7			**32 (37)**	61
Cobus Creek	County Road 8	2.2	30 (36)	30 (32)	**29 (38)**	75
Cobus Creek	County Road 12	1.1			**29 (32)**	67
Cobus Creek	Elkhart Conservation Club	0.2			**49 (37)**	89

Table 12: Fish consumption guidance taken from the Fish4Health Website

Location	Species	Fish Size (inches)	Contaminant	Consumption Guidance	***Sensitive Population Guidance***
Elkhart River *Elkhart County*	Rock Bass	Up to 7		Unrestricted	*1 meal/week*
	Smallmouth Bass	Up to 12		Unrestricted	*1 meal/week*
Christiana Creek *Elkhart County*	Northern Hogsucker	Up to 14		Unrestricted	*1 meal/week*
	Rock Bass	Up to 7		Unrestricted	*1 meal/week*
	Yellow Bullhead	Up to 9		Unrestricted	*1 meal/week*
St. Joseph River *Elkhart County*	Bluegill	Up to 8		Unrestricted	*1 meal/week*
	Channel Catfish	All	PCBs	1 meal/month	***Do Not Eat***
	Common Carp	Up to 31	PCBs	1 meal/month	***Don Not Eat***
		31+	PCBs	1 meal/2 months	***Do Not Eat***
	Rock Bass	Up to 7		Unrestricted	*1 meal/week*
	Northern Pike	Up to 30		Unrestricted	*1 meal/week*
	Smallmouth Bass	Up to 13		Unrestricted	*1 meal/week*
	Redhorse Species	17+	PCBs	1 meal/month	***Do Not Eat***
	Walleye	25+	PCBs	1 meal/month	***Do Not Eat***
	White Sucker	Up to 14		Unrestricted	*1 meal/week*
St. Joseph River *St. Joseph County (Baugo Bay Area to Twin Branch Dam)*	Bluegill	Up to 8		Unrestricted	*1 meal/week*
	Channel Catfish	Up to 20	PCBs	1 meal/month	***Do Not Eat***
		20+	PCBs	1 meal/2 months	***Do Not Eat***
	Largemouth Bass	Up to 13		Unrestricted	*1 meal/week*
	Rock Bass	Up to 8		Unrestricted	*1 meal/week*
	Spotted Sucker	Up to 17		Unrestricted	*1 meal/week*
	White Sucker	Up to 14		Unrestricted	*1 meal/week*
St. Joseph River *St. Joseph County (Twin Branch Dam to Indiana State Line)*	Bluegill	7+	PCBs	1 meal/2 months	***Do Not Eat***
	Channel Catfish	All	PCBs	1 meal/2 months	***Do Not Eat***
	Chinook Salmon	28+	PCBs	1 meal/2 months	***Do Not Eat***
	Rock Bass	Up to 8	PCBs	1 meal/week	*1 meal/month*
	Smallmouth Bass	Up to 12	PCBs & Hg	1 meal/week	*1 meal/month*
	Steelhead Trout	30+	PCBs	1 meal/2 months	***Do Not Eat***
	Yellow Bullhead	Up to 10	PCBs	1 meal/week	*1 meal/month*
Juday Creek	White Sucker	17+	PCBs	1 meal/month	***Do Not Eat***

Sensitive Population— *Women who are pregnant or are breastfeeding, women who plan to have children, or children under the age of 15, are considered to be part of the sensitive population. Future state fish consumption advisories will likely contain more conservative guidance by only referencing the sensitive population. 1 meal = 8 ounces*

site in 2014. Based on low levels of PCBs and Hg, the general population can consume unlimited meals of black crappie in this size range.

Northern Pike, up to 30 inches, are listed in the fish consumption advisory for the St. Joseph River in Elkhart County. The advisory does not place any restrictions on pike in this size range, with the exception of the sensitive population, where the guidance suggests limiting consumption to one meal per week. In 2013 and 2014, the Aquatics Program collected Northern Pike between 21 to 24 inches from the upper St. Joseph River in Elkhart. Concentrations of Hg in the sample collected from 2014 were slightly higher putting them in the range where recommended consumption would be no more than one meal per week for the general population and no more than one meal per month for the sensitive population. The Aquatics program will do follow up sampling with northern pike in the coming years.

Bluegill, less than 8 inches long, were collected from the Bridge Street site in Elkhart. Bluegill in this size range are covered in the FCA with recommended consumption of 1 meal per week for the sensitive population and no restrictions for the general population. Our findings in 2014 were consistent with the guidance in the FCA.

Bluegill in the 7 inch size range were collected from Michigan Street in South bend in 2014. Our data suggests that consumption of this species should be limited to one meal every 2 months for the general population and they should not be eaten by the sensitive population. These results concur with the state FCA.

Rock bass, approximately 8 inches in length, were collected from Sample Street and Darden Road on the St. Joseph River. Fish from both locations had low levels of PCBs warranting restriction to 1 meal per week for the general population and 1 meal per month for the sensitive population. This guidance is consistent with the current FCA.

The Aquatics Program collected shorthead redhorse from Michigan Street in South Bend. Our program has collected several tissue samples from this species previously, which have yielded relatively high PCB tissue concentrations. This years tissue results were no different, and using FCA guidance, shorthead redhorse should not be eaten by the general or sensitive populations from this section of the St. Joseph River. The FCA's current guidance for all redhorse species is 1 meal every month for the general population and DO NOT EAT guidance for the sensitive population. In 2013, we analyzed tissue from golden redhorse from three different sections of the St. Joseph River in South Bend. Our results for golden redhorse reflect lower concentrations in that species relative to shorthead redhorse. It's unknown as to why shorthead redhorse accumulate more PCBs than golden redhorse although it is likely related to their feeding behavior.

Figure 14: A shorthead redhorse (top) versus and golden redhorse (bottom). Note the relatively "short" head and the red tail on the shorthead redhorse

Steelhead were collected from Darden Road. Our program has collected steelhead on several of occasions because of their popularity as a sportfish that are often kept and consumed by local residents and visiting anglers. Guidance for steelhead over 30 inches in the state FCA is currently listed as one meal every 2 months for members of the general population and DO NOT EAT guidance for sensitive individuals. Although the fish collected by the Aquatics Program were slightly smaller than 30 inches in 2014, our results agree with the FCA.

Conclusion

Biological monitoring during the summer of 2014 suggests that the St. Joseph River continues to thrive. Urban sites along the St. Joseph River at Bridge Street in Elkhart and Angela Boulevard in South Bend have highly diverse communities of fish and insects reflecting the very high quality and value of the St. Joseph River for residents of both communities. As both communities continue to implement their Combined Sewer Overflow—Long Term Control Plans in the coming years, its important to recognize that other efforts are also

needed to help further improve the St. Joseph River. Local municipalities are also incrementally enhancing their stormwater programs to reduce non-point source pollution from roads, parking lots, and other impervious surfaces, which will also help improve water quality in the St. Joseph River Watershed.

Our biological monitoring data suggest that while the St. Joseph River is thriving and slightly improving, many of the tributaries to the St. Joseph River continue to be impaired and show little signs of improvement. The Elkhart River, for example, has excellent habitat and some sensitive species of fish and macroinvertebrates, but is continuously suppressed by significant fluctuations in water levels and flow following storm events. Baugo Creek is an extreme example of the same condition, a result of wetlands loss, and symptom of a watershed that has been highly modified for draining land quickly.

The solution to improving water quality in the St. Joseph River Watershed is not an easy one. It's going to take across the board recognition that what we do with our land affects the streams that drain it. As it stands, most of the tributaries of the St. Joseph River in both Counties are impaired by *E. coli* bacteria, limiting their safety for recreational use through contact with the water. We've come a long way in helping the St. Joseph River, but we still have a lot of work to do.

Acknowledgements

Thanks to the 2014 field crew of Nathan Hahaj, Jared Miller, Andrew Foy and Tyler Brenneman. Thanks also to the staff of Elkhart Public Works and Utilities and their counterparts at the City of South Bend for their continued support of the Aquatics Program. Recognition is also extended to local groups such as the Michiana Walleye Association, the Elkhart River Restoration Association, Friends of the St. Joe River, and the many other groups, schools, and people that support the work of the Aquatics Program and the improvement of the St. Joseph River Watershed.

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SUMMER 2014

Andy poses with a pike that just ate a big lunch

A pretty Elkhart River pumpkinseed

A juvenile brown trout collected from Cobus Creek

Tyler with an Elkhart River Walleye

A juvenile channel catfish from Christiana Creek

An nice collection of brown trout at the Elkhart Conservation Club on Cobus Creek

Jared hold huge carp underneath the Ironwood Drive bridge on the St. Joseph River.

Jared and Tyler pose with some nice Christiana Creek smallmouth bass

Nathan with a nice northern pike from Darden Road

Nathan with a little rainbow trout collected at CR 12 on Cobus Creek

Jared with a big silver redhorse collected at the Elkhart Conservation Club on Cobus Creek

Andy with an old, dark walleye at Angela Boulevard

Nathan with a beautiful steelhead from Darden Road

APPENDICES

Appendix A
Metrics for Biological Indices

The Northern Indiana Till Plain Index of Biotic Integrity metrics used to evaluate headwater stream (<20 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter/madtom/sculpin species
3. Percent headwater species
4. Number of minnow species
5. Number of sensitive species
6. Percent tolerant
7. Percent omnivores
8. Percent insectivores
9. Percent pioneer species (individuals)
10. Number of fish collected
11. Percent simple lithophils
12. Percent DELT anomalies

The Northern Indiana Till Plain Index of Biotic Integrity metrics used to evaluate wadeable stream (>20-<1,000 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter species
3. Number of sunfish species
4. Number of sucker species
5. Number of sensitive species
6. Percent tolerant
7. Percent omnivores
8. Percent insectivores
9. Percent carnivores
10. Number of fish collected
11. Percent simple lithophils
12. Percent DELT anomalies

Invertebrate Community Index categories and metrics used to evaluate sites in the St. Joseph River drainage:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayfly composition
6. Percent caddisfly composition
7. Percent tribe Tanytarsini midge composition
8. Percent other dipteran and non-insect composition
9. Percent tolerant organisms
10. Total number of qualitative EPT (mayflies, stoneflies and caddisflies) taxa

Qualitative Habitat Evaluation Index categories and metrics used to evaluate sites in the St. Joseph River drainage:

1. Substrate
    - type
    - number of types present
    - origin
    - silt cover
    - extent of embeddedness

2. Instream Cover
    - type
    - amount

3. Channel Morphology
    - sinuosity
    - development
    - channelization
    - stability

4. Riparian Zone and Bank Erosion
    - riparian width
    - floodplain quality
    - bank erosion

5. Pool/Glide and Riffle/Run Quality
    - maximum pool depth
    - pool/riffle morphology
    - pool/riffle/run current velocity
    - riffle/run depth
    - riffle/run substrate
    - riffle/run embeddedness

6. Gradient

The Coolwater Index of Biotic Integrity metrics used to evaluate sites in Indiana with less than or equal to 100 square miles drainage area:

1. Number of Native Species
2. Number of darter/madtom/sculpin species
3. Percent headwater species
4. Percent coolwater species
5. Percent sensitive and intolerant Species
6. Percent tolerant
7. Percent detritivore
8. Percent invertivore
9. Percent pioneer species
10. Number of fish collected (minus tolerant individuals)
11. Percent simple lithophils
12. Percent DELT anomalies

The Coolwater Index of Biotic Integrity metrics used to evaluate sites in Indiana with greater than 100 square miles drainage area:

1. Number of Native Species
2. Number of darter/madtom/sculpin species
3. Percent catostomidae (sucker family)
4. Percent coolwater species
5. Percent sensitive and intolerant Species
6. Percent tolerant
7. Percent detritivore
8. Percent invertivore
9. Percent carnivore
10. Number of fish collected (minus tolerant individuals)
11. Percent simple lithophils
12. Percent DELT anomalies

Appendix B

Fish tissue preparation and results

Materials needed:

- Reynolds aluminum foil
- freezer wrap
- deionized (DI) water
- 1/2 gallon, 1 gallon, and jumbo size freezer bags w/write-on labels
- skinners
- stainless steel fillet knives
- knife sharpener
- scalers
- ice
- cooler

A group of three fish per species was selected based on size. The smallest fish in each group was greater than or equal to 90% of the length of the largest fish in that group. The largest fish or fish that fell into a length range for species on the advisory were selected. The fish were kept as close in size as possible within a group because the tissue from the three fish in each group was composited (mixed together) before the analyses were completed.

All of the tissue was in the form of boneless fillets taken from the fish. All of the fish had skin-on fillets taken. Before the tissue was removed, the fillet knives, scalers and skinners were cleaned and rinsed with DI water, and freezer wrap was placed where the fish were to be processed. The knives, scalers and skinners were washed in river water and rinsed with DI water after each species was processed and new freezer wrap was placed before another species was processed. For skin-on samples, the scales were removed before the fillet was taken. It was important to be consistent with where the cut of the fillet ended and to not include any of the body cavity or viscera. Once the fillets were removed, they were rinsed in river water and then rinsed with DI water before being placed on aluminum foil. The foil was large enough to hold the three fillets for each species at a site. When all three fillets were placed on the foil, it was then wrapped and placed in a labeled freezer bag and placed on ice in a cooler. The fish tissue was placed in a freezer upon returning to the lab, and kept frozen until sent to the contract lab for analyses.

Fish Tissue Results

Station(s)	Species	Length Range (inches)	Advisory Length Range	Hg Advisory Group (PW)	Hg Advisory Group (state)	PCB Advisory Group (PW)	PCB Advisory Group (State)
Elkhart River Studebaker (A)	Walleye	14.3-15.1	25+	1	1	1	3
St. Joseph River Six Span	Black Crappie	10.2-10.8	NA	1	NA	1	NA
St. Joseph River Six Span	Northern Pike	22.8-23.2	Up to 30	2	1	1	1
St. Joseph River Bridge Street	Bluegill	7.3-7.4	Up to 8	1	1	1	1
St. Joseph River Sample Street	Rock Bass	7.5-7.9	Up to 8	1	1	2	2
St. Joseph River Michigan (B)	Shorthead Redhorse	17.4-18.3	All	2	1	5	3
St. Joseph River Michigan (B)	Bluegill	6.7-7.0	7+	1	1	2	4
St. Joseph River Darden Road	Steelhead	28.9-30.1	30+	1	1	3	4
St. Joseph River Darden Road	Rock Bass	7.8-8.2	Up to 8	1	1	2	2

Group	**Guidance**	Group 3	Limit consumption to 1 meal every month
Group 1	Unrestricted consumption	Group 4	Restrict consumption to 1 meal every 2 months
Group 2	Limit consumption to 1 meal per week	**Group 5**	**DO NOT EAT**

Appendix C

Summary of fish collected by county, 2014

Summary of species captured at index sites in Elkhart County, 2014

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Rock Bass	1,817	9.70	104,594	230.38	6.04
Bluegill	1,790	9.56	58,559	128.98	3.38
Striped Shiner	1,563	8.34	21,454	47.26	1.24
White Sucker	1,216	6.49	124,061	273.26	7.16
Creek Chub	1,208	6.45	11,855	26.11	0.68
Smallmouth Bass	1,105	5.90	114,579	252.38	6.62
Blacknose Dace	917	4.90	3,158	6.96	0.18
Bluntnose Minnow	882	4.71	2,499	5.50	0.14
Northern Hog Sucker	748	3.99	129,942	286.22	7.50
Stoneroller, Central	734	3.92	2,530	5.57	0.15
Longear Sunfish	733	3.91	17,610	38.79	1.02
Golden Redhorse	730	3.90	387,547	853.63	22.38
Spotfin Shiner	583	3.11	1,746	3.85	0.10
Hornyhead Chub	556	2.97	12,395	27.30	0.72
Mimic Shiner	472	2.52	782	1.72	0.05
Common Shiner	467	2.49	4,099	9.03	0.24
Rainbow Darter	352	1.88	449	0.99	0.03
Shorthead Redhorse	334	1.78	184,958	407.40	10.68
Mottled Sculpin	271	1.45	1,162	2.56	0.07
Johnny Darter	268	1.43	268	0.59	0.02
Steelcolor Shiner	232	1.24	686	1.51	0.04
Sand Shiner	195	1.04	388	0.85	0.02
Largemouth Bass	162	0.86	36,668	80.77	2.12
Orangethroat Darter	142	0.76	208	0.46	0.01
Logperch	140	0.75	1,090	2.40	0.06
Brown Trout	132	0.70	19,168	42.22	1.11
Chestnut Lamprey	115	0.61	928	2.04	0.05
Rosyface Shiner	77	0.41	236	0.52	0.01
Yellow Bullhead	76	0.41	6,178	13.61	0.36
Blackside Darter	61	0.33	176	0.39	0.01
Central Mudminnow	58	0.31	198	0.44	0.01
Common Carp	49	0.26	163,712	360.60	9.45
Grass Pickerel	47	0.25	1,031	2.27	0.06
Yellow Perch	46	0.25	641	1.41	0.04
Walleye	44	0.23	11,968	26.36	0.69
American Brook Lamprey	38	0.20	274	0.60	0.02
Silver Redhorse	37	0.20	60,400	133.04	3.49
River Redhorse	35	0.19	116,800	257.27	6.75
River Chub	27	0.14	739	1.63	0.04
Northern Pike	24	0.13	10,208	22.48	0.59
Bowfin	23	0.12	38,610	85.04	2.23
Black Crappie	23	0.12	3,642	8.02	0.21

Summary of species captured at index sites in Elkhart County, 2014 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Spotted Sucker	22	0.12	9,281	20.44	0.54
Redear Sunfish	18	0.10	912	2.01	0.05
Longnose Gar	15	0.08	6,957	15.32	0.40
Longnose Dace	15	0.08	57	0.13	0.00
Banded Killifish	14	0.07	47	0.10	0.00
Black Redhorse	13	0.07	8,300	18.28	0.48
Silverjaw Minnow	13	0.07	21	0.05	0.00
Greater Redhorse	10	0.05	30,929	68.13	1.79
Brown Bullhead	10	0.05	1,962	4.32	0.11
Green Sunfish	10	0.05	355	0.78	0.02
Stonecat	9	0.05	327	0.72	0.02
Brook Silverside	9	0.05	4	0.01	0.00
Quillback	7	0.04	8,000	17.62	0.46
Pumpkinseed	7	0.04	478	1.05	0.03
Greenside Darter	7	0.04	20	0.04	0.00
Channel Catfish	5	0.03	4,128	9.09	0.24
Rainbow Trout	5	0.03	1,341	2.95	0.08
Warmouth	3	0.02	63	0.14	0.00
Golden Shiner	3	0.02	5	0.01	0.00
Hybrid Sunfish	2	0.01	64	0.14	0.00
White Crappie	1	0.01	63	0.14	0.00
Tadpole Madtom	1	0.01	16	0.04	0.00
Silver Lamprey	1	0.01	14	0.03	0.00
Spotted Gar	1	0.01	2	0.00	0.00
Brook Stickleback	1	0.01	1	0.00	0.00
Fathead Minnow	1	0.01	1	0.00	0.00
Gizzard Shad	1	0.01	1	0.00	0.00
Totals	**18,733**	**100.00**	**1,731,545**	**3,813.98**	**100.00**

Summary of species captured at investigative sites in Elkhart County, 2014

Common Name	Total Number	% by Number
Bluntnose Minnow	252	31.46
Golden Redhorse	104	12.98
Common Shiner	67	8.36
White Sucker	49	6.12
Spotted Sucker	40	4.99
Smallmouth Bass	40	4.99
Rock Bass	35	4.37
Sand Shiner	32	4.00
Longear Sunfish	27	3.37
Northern Pike	19	2.37
Spotfin Shiner	17	2.12
Northern Hog Sucker	17	2.12
Striped Shiner	15	1.87
Largemouth Bass	14	1.75
Rosyface Shiner	11	1.37
Johnny Darter	10	1.25
Bluegill	9	1.12
Walleye	8	1.00 C-2 C.2
Chestnut Lamprey	6	0.75
Common Carp	4	0.50
Grass Pickerel	4	0.50
Bowfin	3	0.37
Black Crappie	3	0.37
Blackside Darter	3	0.37
Pirate Perch	2	0.25
Green Sunfish	2	0.25
Hornyhead Chub	2	0.25
Pumpkinseed	2	0.25
Blackstripe Topminnow	2	0.25
Greater Redhorse	1	0.12
Spotted Gar	1	0.12
Totals	801	100.00

Index Sites	18.873
Investigative Sites	801
Elkhart County Total	19,674

Summary of species captured at investigative sites in St. Joseph County, 2014

Common Name	Total Number	% by Number
Blacknose Dace	114	14.92
Smallmouth Bass	95	12.43
Black Redhorse	72	9.42
Longear Sunfish	68	8.90
Mottled Sculpin	63	8.25
Rock Bass	57	7.46
Golden Redhorse	49	6.41
Shorthead Redhorse	46	6.02
Creek Chub	41	5.37
White Sucker	26	3.40
Mimic Shiner	23	3.01
Northern Hog Sucker	18	2.36
Bluegill	15	1.96
Steelcolor Shiner	13	1.70
Largemouth Bass	11	1.44
Quillback	10	1.31
Walleye	7	0.92
Spotfin Shiner	6	0.79
Johnny Darter	6	0.79
Longnose Gar	5	0.65
Central Mudminnow	3	0.39
Green Sunfish	3	0.39
Logperch	3	0.39
River Redhorse	3	0.39
Redear Sunfish	3	0.39
Common Carp	1	0.13
Chestnut Lamprey	1	0.13
Yellow Bullhead	1	0.13
Greenside Darter	1	0.13
Totals	**764**	**100.00**

Summary of species captured at index sites in St. Joseph County, 2014

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Longear Sunfish	1,619	28.63	39,806	87.68	3.50
Rock Bass	960	16.98	48,621	107.09	4.27
Smallmouth Bass	765	13.53	113,307	249.57	9.95
Creek Chub	367	6.49	5,376	11.84	0.47
Golden Redhorse	326	5.77	286,000	629.96	25.13
Mimic Shiner	293	5.18	573	1.26	0.05
Mottled Sculpin	153	2.71	605	1.33	0.05
Black Redhorse	104	1.84	78,152	172.14	6.87
Blacknose Dace	97	1.72	411	0.91	0.04
Bluegill	85	1.50	4,353	9.59	0.38
Shorthead Redhorse	82	1.45	74,201	163.44	6.52
Bluntnose Minnow	80	1.41	226	0.50	0.02
Steelcolor Shiner	76	1.34	305	0.67	0.03
Chestnut Lamprey	61	1.08	530	1.17	0.05
Rainbow Trout	57	1.01	20,247	44.60	1.78
White Sucker	53	0.94	16,808	37.02	1.48
Northern Hog Sucker	52	0.92	22,405	49.35	1.97
Quillback	47	0.83	66,200	145.81	5.82
Spotted Sucker	47	0.83	29,830	65.70	2.62
Common Carp	44	0.78	229,800	506.17	20.19
Green Sunfish	43	0.76	744	1.64	0.07
Spotfin Shiner	40	0.71	222	0.49	0.02
Largemouth Bass	34	0.60	3,286	7.24	0.29
Walleye	24	0.42	18,882	41.59	1.66
Blackside Darter	22	0.39	102	0.22	0.01
Johnny Darter	16	0.28	27	0.06	0.00
Pumpkinseed	15	0.27	664	1.46	0.06
Yellow Bullhead	14	0.25	2,961	6.52	0.26
Silver Redhorse	11	0.19	26,400	58.15	2.32
Greater Redhorse	8	0.14	19,488	42.93	1.71
Logperch	8	0.14	201	0.44	0.02
Redear Sunfish	7	0.12	410	0.90	0.04
Brown Bullhead	6	0.11	3,471	7.65	0.30
Hybrid Sunfish	6	0.11	496	1.09	0.04
Orangethroat Darter	5	0.09	17	0.04	0.00
Central Mudminnow	4	0.07	9	0.02	0.00
Greenside Darter	4	0.07	6	0.01	0.00
River Redhorse	3	0.05	11,600	25.55	1.02
Rainbow Darter	3	0.05	6	0.01	0.00
Northern Pike	2	0.04	4,239	9.34	0.37
Striped Shiner	2	0.04	20	0.04	0.00

Summary of species captured at index sites in St. Joseph County, 2014 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Banded Killifish	2	0.04	8	0.02	0.00
Channel Catfish	1	0.02	4,000	8.81	0.35
Bowfin	1	0.02	2,200	4.85	0.19
Spotted Gar	1	0.02	299	0.66	0.03
Longnose Gar	1	0.02	241	0.53	0.02
Black Crappie	1	0.02	232	0.51	0.02
Black Bullhead	1	0.02	180	0.40	0.02
Brown Trout	1	0.02	101	0.22	0.01
Totals	**5,654**	**100.00**	**1,138,268**	**2,507.20**	**100.00**

Index Sites	5,654
Investigative Sites	764
St. Joseph County Total	6,418

Appendix D

Summary of fish collected by site, 2014
(Reference Table 1 for site numbers and locations)

Stream	St. Joseph River, Elkhart County, 2014					
Site	Toll Road (Bristol)		Six Span		Bridge Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey			X			
#Banded Killifish	X	X	X			
Black Crappie	X		X	X	X	X
~Black Redhorse	X	X	X		X	X
Blackside Darter			X	X		X
Bluegill	X	X	X	X	X	X
#Bluntnose Minnow	X	X	X	X	X	X
Bowfin	X	X	X	X		
#Brown Bullhead				X		X
#Channel Catfish						X
Chestnut Lamprey	X		X	X		
#Common Carp	X	X	X	X	X	X
#Gizzard Shad				X		
~Golden Redhorse	X	X	X	X	X	X
Grass Pickerel		X				
~Greater Redhorse					X	
#Green Sunfish					X	X
~Hornyhead Chub	X					
Hybrid Sunfish					X	
Johnny Darter	X					
Largemouth Bass	X	X	X	X	X	X
~Logperch		X		X		X
~Longear Sunfish	X	X	X	X	X	X
#Longnose Gar		X		X	X	X
~Mimic Shiner	X	X	X	X	X	X
~Northern Hog Sucker	X	X	X	X	X	X
Northern Pike	X	X	X	X		
Pumpkinseed	X				X	X
#Quillback					X	
Redear Sunfish		X		X	X	
~River Redhorse			X	X	X	X
~Rock Bass	X	X	X	X	X	X
~Rosyface Shiner		X	X	X		X
~Sand Shiner			X			X
~Shorthead Redhorse	X	X	X	X	X	X
~Silver Redhorse	X	X	X	X	X	X
~Smallmouth Bass	X	X	X	X	X	X
Spotfin Shiner	X		X	X	X	X
Spotted Gar				X		
Spotted Sucker	X	X	X	X		

Stream	St. Joseph River, Elkhart County, 2014					
Site	Toll Road (Bristol)		Six Span		Bridge Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Steelcolor Shiner	X	X		X	X	X
Striped Shiner	X	X	X	X	X	
Walleye		X	X		X	X
Warmouth					X	
#White Sucker		X		X	X	
#Yellow Bullhead		X	X		X	X
Yellow Perch	X	X	X			

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Stream	St. Joseph River, St. Joseph County, 2014								
Site	Ironwood Drive		Sample Street		Michigan Street (Below)	Angela Blvd.		Darden Road	
	1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass
#Banded Killifish	X								X
#Black Bullhead			X						
Black Crappie				X					
~Black Redhorse					X	X	X	X	X
Blackside Darter	X	X		X			X		X
Bluegill	X	X	X	X	X	X	X	X	X
#Bluntnose Minnow	X	X		X		X	X	X	X
Bowfin									X
#Brown Bullhead	X	X	X	X					
#Central Mudminnow								X	
#Channel Catfish				X					
Chestnut Lamprey	X		X		X	X		X	X
#Common Carp	X	X	X	X	X	X			X
~Golden Redhorse	X	X	X	X	X	X	X	X	X
~Greater Redhorse			X	X					
#Green Sunfish	X	X				X	X	X	
~Greenside Darter		X		X	X		X		X
Hybrid Sunfish	X						X		X
Johnny Darter									X
Largemouth Bass	X	X	X		X		X		X
~Logperch					X		X		X
~Longear Sunfish	X	X	X	X	X	X	X	X	X
#Longnose Gar		X			X				
~Mimic Shiner	X	X	X		X	X	X	X	X
~Northern Hog Sucker	X				X	X	X	X	X
Northern Pike				X					X
Pumpkinseed	X	X		X			X	X	
#Quillback	X	X	X	X	X	X	X	X	X
~Rainbow Darter									X
Rainbow Trout	X		X					X	X
Redear Sunfish					X	X			X
~River Redhorse				X	X		X		
~Rock Bass	X	X	X	X	X	X	X	X	X
~Shorthead Redhorse	X	X	X	X	X	X	X	X	X
~Silver Redhorse	X		X				X	X	X
~Smallmouth Bass	X	X	X	X	X	X	X	X	X
Spotfin Shiner	X			X	X	X	X	X	
Spotted Gar		X							
Spotted Sucker	X	X	X	X				X	X
Steelcolor Shiner		X			X	X	X		X
Striped Shiner			X						

Stream	St. Joseph River, St. Joseph County, 2014								
Site	Ironwood Drive		Sample Street		Michigan Street (Below)	Angela Blvd.		Darden Road	
	1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass
Walleye	X	X		X	X	X	X	X	X
Warmouth	X								
#White Sucker	X	X	X	X		X		X	X
#Yellow Bullhead	X	X	X	X	X				X

Tributaries of St. Joseph River, Elkhart County, 2014								
Stream	Christiana Creek							
Site	Wellfield (Below)		Main Street (Above)		Cassopolis Street (A)		Cassopolis Street (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey		X						
Bluegill	X	X	X	X	X	X	X	X
#Bluntnose Minnow				X				
#Brown Bullhead	X					X		
Chestnut Lamprey			X					
#Creek Chub	X	X		X				X
~Golden Redhorse	X	X	X			X	X	
Grass Pickerel		X						
Largemouth Bass		X						
~Logperch	X	X	X	X		X		X
~Northern Hog Sucker	X	X	X	X	X	X	X	X
~Orangethroat Darter		X		X				
~Rainbow Darter		X				X		
~Rock Bass	X	X	X	X	X	X	X	X
~Shorthead Redhorse	X		X	X	X		X	
~Silver Redhorse	X							
~Smallmouth Bass	X	X	X	X	X	X	X	X
Spotfin Shiner		X	X	X			X	X
Steelcolor Shiner							X	X
~Stonecat		X		X				X
Striped Shiner	X	X	X	X				X
#White Sucker	X	X		X				
#Yellow Bullhead		X				X		X

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Tributaries of St. Joseph River, Elkhart County, 2014												
Stream	Trout Creek		Little Elkhart River		Pine Creek		Puterbaugh Creek		Yellow Creek		Baugo Creek	
Site	CR 2		SR 120		US 20 Bypass		Reedy Drive		US 20 By-pass		Restoration Site	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey			X	X								
#Banded Killifish											X	
Black Crappie			X								X	
#Blacknose Dace				X	X	X			X	X	X	X
Blackside Darter			X	X					X		X	X
Bluegill	X	X	X	X	X		X	X	X	X	X	
#Bluntnose Minnow				X					X	X	X	X
~Brook Stickleback										X		
Brown Trout			X	X								
#Central Mudminnow			X	X	X	X						X
Chestnut Lamprey			X	X					X			
Common Shiner									X	X	X	
#Creek Chub			X	X	X	X			X	X	X	X
#Fathead Minnow										X		
~Golden Shiner											X	
Grass Pickerel			X				X	X				
#Green Sunfish				X								
~Greenside Darter	X			X								X
~Hornyhead Chub	X	X	X						X	X		
Johnny Darter			X	X			X	X	X	X	X	X
Largemouth Bass	X	X		X		X		X		X	X	X
~Logperch			X	X							X	X
~Longear Sunfish	X	X	X			X					X	
~Longnose Dace									X		X	X
~Mimic Shiner												X
Mottled Sculpin			X	X	X	X	X	X				
~Northern Hog Sucker	X	X	X	X								
Northern Pike				X	X	X		X				
~Orangethroat Darter	X						X		X	X	X	X
~Rainbow Darter	X		X	X				X	X	X	X	X
Rainbow Trout			X	X								
Redear Sunfish	X	X										
~Rock Bass	X	X	X	X					X	X	X	X
~Rosyface Shiner									X			
~Sand Shiner											X	X
~Shorthead Redhorse			X									
Silverjaw Minnow											X	X

Tributaries of St. Joseph River, Elkhart County, 2014												
Stream	Trout Creek		Little Elkhart River		Pine Creek		Puterbaugh Creek		Yellow Creek		Baugo Creek	
Site	CR 2		SR 120		US 20 Bypass		Reedy Drive		US 20 By-pass		Restoration Site	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~Smallmouth Bass	X	X	X	X					X	X	X	
Spotfin Shiner	X	X										X
~Stonecat				X								
Stoneroller, Central			X						X	X	X	X
Striped Shiner	X	X		X				X	X		X	X
Walleye											X	
Warmouth				X								
#White Sucker			X	X	X	X		X	X	X	X	X
#Yellow Bullhead	X							X				
Yellow Perch	X	X					X	X				

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Tributaries of St. Joseph River, Elkhart County, 2014										
Stream	Christiana Creek									
Site	CR 6		Willowdale Park		NMWF		High Dive Park (A)		High Dive Park (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey				X						
Black Crappie										X
Bluegill			X	X	X	X	X	X	X	X
#Bluntnose Minnow	X	X	X		X	X		X	X	X
Bowfin	X	X				X		X		X
~Brook Silverside			X							
#Brown Bullhead								X		
#Central Mudminnow			X							
#Channel Catfish		X	X							
Chestnut Lamprey	X	X	X		X	X	X	X	X	X
#Common Carp			X		X	X			X	
Common Shiner								X		
#Creek Chub		X	X	X		X		X		X
~Golden Redhorse	X	X	X	X	X	X	X	X	X	X
Grass Pickerel				X		X		X		X
#Green Sunfish					X					X
~Greenside Darter									X	
~Hornyhead Chub	X	X			X	X			X	
Largemouth Bass		X		X	X	X	X	X	X	X
~Logperch			X	X	X	X	X	X	X	X
~Longear Sunfish							X	X	X	X
#Longnose Gar					X				X	
~Mimic Shiner									X	X
~Northern Hog Sucker	X	X	X	X	X	X	X	X	X	X
~Orangethroat Darter	X	X	X	X	X		X		X	X
Pumpkinseed					X					
~Rainbow Darter	X	X		X	X	X	X	X	X	X
Redear Sunfish						X				
~River Chub	X	X								
~Rock Bass	X	X	X	X	X	X	X	X	X	X
~Sand Shiner						X			X	X
~Shorthead Redhorse	X		X		X	X	X		X	

Tributaries of St. Joseph River, Elkhart County, 2014										
Stream	Christiana Creek									
Site	CR 6		Willowdale Park		NMWF		High Dive Park (A)		High Dive Park (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~Silver Redhorse					X	X	X		X	X
~Smallmouth Bass	X	X	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X	X		X	X
Steelcolor Shiner	X	X	X			X	X	X	X	X
~Stonecat				X						X
Stoneroller, Central									X	
Striped Shiner	X	X	X	X	X	X		X	X	X
~Tadpole Madtom	X									
Walleye					X	X	X		X	X
#White Sucker	X	X	X	X	X	X	X	X		X
#Yellow Bullhead	X	X	X	X	X	X	X	X	X	X

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Tributaries to St. Joseph River, Elkhart County, 2014								
Stream	Elkhart River							
Site	State Road 15 (Below)	Shanklin Park	Hively Avenue (CR 18)		Studebaker Park (A)		American Park	
			1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey			X	X	X			
Black Crappie	X	X		X		X		X
Blackside Darter	X		X		X	X		
#Blackstripe Topminnow	X							
Bluegill	X	X	X	X	X	X	X	X
#Bluntnose Minnow	X		X	X	X	X		X
Bowfin	X	X		X				
Chestnut Lamprey		X	X	X	X	X	X	X
#Common Carp	X							
Common Shiner	X	X				X		X
#Creek Chub				X				
~Golden Redhorse	X	X	X	X	X	X	X	X
#Golden Shiner			X	X				
Grass Pickerel	X							
~Greater Redhorse		X						X
#Green Sunfish	X	X						X
~Hornyhead Chub		X	X	X	X	X	X	X
Johnny Darter	X					X		
Largemouth Bass	X		X	X		X		X
~Longear Sunfish	X	X	X	X	X	X	X	X
~Mimic Shiner						X		
~Northern Hog Sucker	X	X	X	X	X	X	X	X
Northern Pike	X	X	X	X		X		X
Pirate Perch	X							
Pumpkinseed	X							
Redear Sunfish				X				
~River Redhorse			X	X	X			X
~Rock Bass	X	X	X	X	X	X	X	X
~Rosyface Shiner	X	X	X	X	X	X		
~Sand Shiner	X		X	X	X	X		
Silver Lamprey				X				
~Smallmouth Bass	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X	X	X
Spotted Gar	X							
Spotted Sucker	X	X		X	X			X
Steelcolor Shiner								X
~Stonecat						X		
Striped Shiner		X	X	X	X	X	X	X

Tributaries to St. Joseph River, Elkhart County, 2014								
Stream	Elkhart River							
Site	State Road 15 (Below)	Shanklin Park	Hively Avenue (CR 18)		Studebaker Park (A)		American Park	
			1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Walleye	X	X	X	X	X	X		
#White Sucker	X	X	X	X	X	X	X	X
#Yellow Bullhead			X			X		X

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Tributaries of St. Joseph River, Elkhart County, 2014								
Stream	Cobus Creek							
Site	CR 6		CR 8		CR 12		Conservation Club	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey			X	X	X		X	X
#Blacknose Dace	X	X	X	X	X	X	X	X
Blackside Darter								X
Bluegill					X	X	X	X
#Brown Bullhead							X	X
Brown Trout				X	X	X	X	X
#Central Mudminnow	X			X				
Chestnut Lamprey			X					
#Creek Chub	X	X	X	X				X
Grass Pickerel		X			X	X	X	X
~Greenside Darter		X						
Johnny Darter								X
~Logperch								X
~Longear Sunfish							X	X
~Longnose Dace								X
Mottled Sculpin	X	X	X	X	X	X		X
~Northern Hog Sucker							X	
Northern Pike								X
~Orangethroat Darter								X
~Rainbow Darter							X	X
Rainbow Trout					X			
~Rock Bass	X			X		X	X	X
~Sand Shiner							X	
~Shorthead Redhorse							X	
~Silver Redhorse							X	
~Smallmouth Bass						X	X	
Spotfin Shiner							X	X
Steelcolor Shiner								X
Striped Shiner						X	X	X
Walleye							X	
#White Sucker	X	X	X	X	X	X	X	X
#Yellow Bullhead								X

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Tributaries to St. Joseph River, St. Joseph County, 2014						
Stream	Juday Creek					
Site	Trinity Park-way	Windingbrook Drive	Kintz Avenue		Izaak Walton League	
			1st Pass	2nd Pass	1st Pass	2nd Pass
#Blacknose Dace	X	X	X	X	X	X
Bluegill	X	X	X			
Brown Trout						X
#Central Mudminnow	X	X				
#Creek Chub	X	X	X	X	X	X
#Green Sunfish	X		X	X		
Johnny Darter	X	X	X	X		X
Largemouth Bass			X			
Mottled Sculpin	X	X	X	X	X	X
~Orangethroat Darter					X	X
~Rainbow Darter			X			
Rainbow Trout			X	X	X	X
~Rock Bass			X	X		
~Smallmouth Bass			X	X		
#White Sucker	X	X	X	X	X	X

Tributaries to St. Joseph River, St. Joseph County, 2014					
Stream	Auten Ditch		Bowman Creek		
Site	Locust Road (South)		Main Street	Studebaker Golf Course	
	1st Pass	2nd Pass		1st Pass	2nd Pass
#Central Mudminnow		X			
#Creek Chub	X	X	X		X
#Green Sunfish	X	X	X		
Largemouth Bass			X		X

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Appendix E

Summary of macroinvertebrates (insects) collected by site, 2014

Macroinvertebrates were collected in two ways to calculate the Invertebrate Community Index (ICI). The first method employed a sampling device known as a Hester-Dendy multi-plate sampler (HD sampler). Macroinvertebrates collected using this method were identified and counted (Quantitative column in the following tables). The second method was a sweep with a net of all the available habitat types in the area of the Hester-Dendy in an effort to identify other macroinvertebrates in the stream that may not colonize the HD samplers. Macroinvertebrates collected in this way were identified and simply counted as being present (Qualitative column).

Site: St. Joseph River - Six Span

Date Collected: 08/15/14 Site #: 1

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	27		Nilotanypus fimbriatus	7	
Oligochaeta	0	+	Thienemannimyia group	0	+
Gammarus fasciatus	5		Corynoneura lobata	9	
Hyalella azteca	0	+	Nanocladius (N.) crassicornus or N. (N.)	3	
Crangonyx sp	0	+	Thienemanniella xena	3	
Plauditus dubius or P. virilis	7	+	Dicrotendipes neomodestus	6	
Baetis flavistriga	3		Endochironomus nigricans	23	+
Baetis intercalaris	12	+	Glyptotendipes (G.) sp	0	+
Labiobaetis propinquus	1	+	Polypedilum (Uresipedilum) flavum	14	+
Iswaeon anoka	23		Polypedilum (P.) fallax group	0	+
Procloeon viridoculare	0	+	Polypedilum (P.) illinoense	8	+
Isonychia sp	51	+	Polypedilum (Tripodura) scalaenum	3	
Leucrocuta sp	1		Rheotanytarsus pellucidus	3	
Stenacron sp	386	+	Rheotanytarsus sp	116	+
Maccaffertium exiguum	365	+	Tanytarsus glabrescens group sp 7	3	
Maccaffertium mediopuncta-	573		Tanytarsus sepp	14	+
Leptophlebia sp or Paralepto-	1	+	Chrysops sp	0	+
Teloganopsis sp	16		Elimia sp	6	+
Tricorythodes sp	204	+	Ferrissia sp	4	
Coenagrionidae	0	+	Corbicula fluminea	1	+
Argia sp	1		Dreissena polymorpha	0	+
Boyeria vinosa	0	+	Anthopotamus sp	0	+
Pteronarcys sp	0	+	Sparbarus sp	0	+
Acroneuria internata	2		Phaenopsectra punctipes	0	+
Paragnetina sp	0	+	Corynoneura floridaensis	0	+
Neoplea sp	0	+	Procloeon sp	1	
Neureclipsis sp	26	+	Ablabesmyia simpsoni	3	
Polycentropus sp	27	+	Pentaneura inconspicua	20	
Cheumatopsyche sp	353	+	Microtendipes rydalensis	6	
Ceratopsyche morosa group	3				
Hydropsyche phalerata	7	+	No. Quantitative Taxa:	45	
Limnephilidae	0	+	No. Qualitative Taxa:	44	
Neophylax sp	0	+	Total Taxa:	67	
Mystacides sp	0	+	Number of Organisms:	2373	
Macronychus glabratus	17	+	Qual EPT:	20	
Stenelmis sp	8	+	**ICI:**	**50**	
Simulium sp	1	+			
Ablabesmyia mallochi	0	+			

Site: St. Joseph River - Bridge Street
Date Collected: 08/16/14 Site #: 2

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Hydra sp	0	+	Parachironomus sp	0	+
Turbellaria	327		Polypedilum (Uresipedilum)	29	
Oligochaeta	0	+	Polypedilum (P.) illinoense	0	+
Spongillidae	0	+	Tribelos fuscicorne	0	+
Orconectes (Procericambarus)	0	+	Rheotanytarsus sp	2419	
Caecidotea sp	0	+	Tanytarsus sp	0	+
Crangonyx sp	0	+	Hemerodromia sp	96	
Hydrachnidia	0	+	Elimia sp	0	+
Plauditus dubius or P. virilis	3	+	Ferrissia sp	16	
Baetis flavistriga	1		Corbicula fluminea	2	
Baetis intercalaris	58		Dreissena polymorpha	0	+
Labiobaetis propinquus	0	+	Limnephilidae	0	+
Isonychia sp	85	+	Maccaffertium sp	0	+
Stenacron sp	192	+	Gammarus sp	0	+
Maccaffertium exiguum	214		Paludicella articulata	3	
Maccaffertium mediopuncta-	214		Leptoceridae	1	
Maccaffertium terminatum	85				
Teloganopsis sp	32				
Tricorythodes sp	36	+			
Coenagrionidae	0	+	No. Quantitative Taxa:	30	
Agnetina capitata complex	4		No. Qualitative Taxa:	36	
Nyctiophylax sp	0	+	Total Taxa:	55	
Polycentropus sp	19	+	Number of Organisms:	5372	
Cheumatopsyche sp	1159	+	Qual EPT:	15	
Ceratopsyche morosa group	22		**ICI:**	**52**	
Hydropsyche aerata	216	+			
Hydropsyche phalerata	87	+			
Macrostemum zebratum	13	+			
Hydroptila sp	2				
Brachycentrus numerosus	2	+			
Nectopsyche diarina	0	+			
Psephenus herricki	0	+			
Ancyronyx variegata	0	+			
Macronychus glabratus	3	+			
Stenelmis sp	0	+			
Simulium sp	16				
Paramerina fragilis	0	+			
Corynoneura lobata	16				
Dicrotendipes neomodestus	0	+			

Site: St. Joseph River - Angela Boulevard

Date Collected: 08/16/14 Site #: 3

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	587	+	Cricotopus (C.) trifascia	10	
Ectoprocta	0	+	Nanocladius (N.) crassicor-	10	
Oligochaeta	0	+	Tvetenia discoloripes group	81	
Placobdella sp	0	+	Chironomus (C.) decorus	10	+
Gammarus sp	0	+	Dicrotendipes neomodestus	20	
Caecidotea sp	0	+	Polypedilum (Uresipedilum)	152	
Crangonyx sp	0	+	Rheotanytarsus sp	536	+
Hydrachnidia	8		Hemerodromia sp	4	
Baetis flavistriga	9	+	Elimia sp	18	+
Baetis intercalaris	525	+	Fossaria sp	0	+
Iswaeon anoka	59		Physella sp	0	+
Isonychia sp	587	+	Ferrissia sp	40	+
Stenacron sp	441	+	Corbicula fluminea	0	+
Maccaffertium exiguum	293		Maccaffertium sp	0	+
Teloganopsis sp	8		Spongillidae	2	
Tricorythodes sp	200	+	Hydropsyche bidens or H.	1	
Chimarra obscura	113				
Polycentropus sp	1				
Cheumatopsyche sp	3287	+	No. Quantitative Taxa:	35	
Hydropsyche aerata	150	+	No. Qualitative Taxa:	31	
Hydropsyche phalerata	335	+	Total Taxa:	50	
Macrostemum zebratum	49	+	Number of Organisms:	7673	
Protoptila sp	0	+	Qual EPT:	12	
Hydroptilidae	17		**ICI:**	**54**	
Helicopsyche borealis	0	+			
Oecetis persimilis	16				
Petrophila sp	23	+			
Macronychus glabratus	0	+			
Stenelmis sp	0	+			
Tipula sp	0	+			
Simulium sp	12	+			
Ceratopogonidae	8				
Hayesomyia senata or Thiene-	51				
Cricotopus (C.) bicinctus	10				

Site: St. Joseph River - Darden Road

Date Collected: 08/16/14 Site #: 4

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	376	+	Labrundinia sp	1	
Oligochaeta	8	+	Larsia sp	3	
Erpobdella microstoma	0	+	Nilotanypus fimbriatus	5	
Orconectes (Procericambarus) rusticus	0	+	Thienemannimyia group	1	
Gammarus fasciatus	66	+	Cricotopus (C.) sp	5	
Caecidotea sp	0	+	Cricotopus (C.) trifascia	3	
Hydrachnidia	2		Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	7	
Plauditus dubius or P. virilis	1		Thienemanniella xena	14	+
Baetis flavistriga	0	+	Tvetenia discoloripes group	1	
Baetis intercalaris	66	+	Cryptochironomus sp	0	+
Iswaeon anoka	3	+	Glyptotendipes (G.) sp	1	
Isonychia sp	39	+	Polypedilum (Uresipedilum) flavum	5	
Leucrocuta sp	0	+	Polypedilum (P.) fallax group	0	+
Stenacron sp	419	+	Polypedilum (P.) illinoense	0	+
Maccaffertium exiguum	74	+	Stenochironomus sp	5	
Ephemerellidae	10		Xenochironomus xenolabis	1	
Tricorythodes sp	93	+	Rheotanytarsus pellucidus	1	
Calopteryx sp	2		Rheotanytarsus sp	12	+
Coenagrionidae	0	+	Tanytarsus sp	1	
Argia sp	19	+	Hemerodromia sp	6	
Chimarra obscura	35		Hydrobiidae	25	
Neureclipsis sp	12	+	Elimia sp	182	+
Polycentropus sp	10		Menetus (Micromenetus) dilatatus	0	+
Cheumatopsyche sp	150	+	Planorbella (Pierosoma) pilsbryi	0	+
Hydropsyche aerata	0	+	Ferrissia sp	11	+
Hydropsyche phalerata	16	+	Corbicula fluminea	0	+
Macrostemum zebratum	71	+	Perlidae	1	
Hydroptila sp	75		Nectopsyche exquisita	1	
Brachycentrus numerosus	0	+	Planorbidae	3	
Helicopsyche borealis	0	+	Pentaneura inconspicua	36	
Oecetis persimilis	10		Nanocladius (N.) minimus	1	
Psephenus herricki	0	+	No. Quantitative Taxa:	51	
Macronychus glabratus	19	+	No. Qualitative Taxa:	37	
Stenelmis sp	0	+	Total Taxa:	68	
Tipula sp	1		Number of Organisms:	1915	
Simulium sp	5	+	Qual EPT:	15	
Ablabesmyia mallochi	1		**ICI:**	**46**	

Site: Little Elkhart River - State Road 120

Date Collected: 08/15/14 Site #: 5

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	5	+	Cardiocladius obscurus	32	+
Oligochaeta	0	+	Cricotopus (C.) sp	11	
Gammarus sp	5	+	Parametriocnemus sp	0	+
Orconectes sp	0	+	Thienemanniella xena	116	+
Caecidotea sp	0	+	Tvetenia bavarica group	107	
Hyalella azteca	0	+	Chironomus (C.) decorus group	0	+
Hydrachnidia	0	+	Microtendipes "caelum" (sensu Simpson & Bode, 1980)	0	+
Baetis flavistriga	62	+	Paratendipes albimanus or P. duplicatus	0	+
Baetis intercalaris	9		Phaenopsectra obediens group	0	+
Labiobaetis propinquus	0	+	Polypedilum (P.) fallax group	11	
Procloeon viridoculare	0	+	Polypedilum (P.) illinoense	0	+
Leucrocuta sp	0	+	Rheotanytarsus pellucidus	118	
Stenacron sp	14	+	Rheotanytarsus sp	750	
Maccaffertium exiguum	57	+	Tanytarsus sp	0	+
Maccaffertium mediopunctatum	11		Atherix lantha	0	+
Maccaffertium terminatum	5		Hemerodromia sp	12	
Maccaffertium vicarium	33	+	Elimia sp	0	+
Calopteryx sp	0	+	Physella sp	0	+
Boyeria vinosa	0	+	Ferrissia sp	3	
Pteronarcys sp	0	+	Pisidium sp	0	+
Acroneuria internata	2		Baetisca sp	0	+
Paragnetina sp	6	+	Cryptotendipes pseudotener	0	+
Lype diversa	1	+	Ablabesmyia simpsoni	0	+
Cheumatopsyche sp	157	+	Stilocladius sp	0	+
Ceratopsyche morosa group	129	+	Cladopelma sp	0	+
Ceratopsyche sparna	439	+	Curculionidae	1	
Hydropsyche depravata group	24	+			
Brachycentrus numerosus	24	+	No. Quantitative Taxa:	31	
Neophylax sp	0	+	No. Qualitative Taxa:	53	
Helicopsyche borealis	0	+	Total Taxa:	65	
Oecetis persimilis	2	+	Number of Organisms:	2188	
Helichus sp	0	+	Qual EPT:	19	
Macronychus glabratus	5	+	**ICI:**	**48**	
Optioservus sp	0	+			
Stenelmis sp	0	+			
Antocha sp	2	+			
Simulium sp	35	+			
Ablabesmyia mallochi	0	+			
Paramerina fragilis	0	+			

Site: Christiana Creek - County Road 6

Date Collected: 08/17/14 Site #: 6

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Hydra sp	2		Oecetis persimilis	0	+
Turbellaria	26	+	Petrophila sp	3	
Oligochaeta	4		Psephenus herricki	5	+
Orconectes (Procericambarus)	0	+	Scirtidae	0	+
Gammarus fasciatus	68	+	Macronychus glabratus	25	+
Caecidotea sp	1	+	Stenelmis sp	20	+
Baetis flavistriga	3	+	Simulium sp	0	+
Baetis intercalaris	70	+	Hayesomyia senata or Thienemannimyia norena	3	
Labiobaetis propinquus	0	+	Helopelopia sp	3	
Iswaeon anoka	0	+	Meropelopia sp	5	
Stenacron sp	453	+	Nilotanypus fimbriatus	5	
Maccaffertium exiguum	0	+	Thienemannimyia group	0	+
Maccaffertium mediopunctatum	63	+	Corynoneura sp	3	
Maccaffertium pulchellum	63		Cricotopus (C.) sp	8	
Leptophlebia sp or Paraleptophlebia sp	4		Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	3	
Ephemerellidae	15		Parametriocnemus sp	18	
Tricorythodes sp	33	+	Rheocricotopus (Psilocricotopus) robacki	5	
Caenis sp	6		Tvetenia discoloripes group	5	
Hetaerina sp	0	+	Cryptochironomus sp	0	+
Coenagrionidae	2		Microtendipes "caelum" (sensu Simpson & Bode, 1980)	0	+
Argia sp	4	+	Microtendipes pedellus group	5	
Libellula sp	0	+	Polypedilum (Uresipedilum) flavum	5	+
Acroneuria internata	1	+	Polypedilum (P.) fallax group	10	
Sialis sp	0	+	Polypedilum (P.) illinoense	0	+
Corydalus cornutus	1	+	Cladotanytarsus vanderwulpi group	3	
Chimarra obscura	4	+	Rheotanytarsus sp	3	
Neureclipsis sp	4	+	Tanytarsus sepp	8	
Polycentropus sp	0	+	Hemerodromia sp	9	
Cheumatopsyche sp	5	+	Elimia sp	3	+
Hydropsyche phalerata	2	+	Ferrissia sp	9	
Brachycentrus numerosus	11		Corbicula fluminea	0	+
Neophylax sp	0	+	Dreissena polymorpha	0	+
Helicopsyche borealis	3	+	Sphaerium sp	0	+
Mystacides sp	0	+	Anthopotamus sp	0	+
Nectopsyche diarina	0	+	Heptagenia sp	0	+
Oecetis sp	10				

Site: Christiana Creek - County Road 6 (continued)
Date Collected: 08/17/14 Site #: 6

Taxa Name	Quantitative	Qualitative
Lepidostomatidae	0	+
Helobdella stagnalis	0	+
Stylurus sp	0	+
Placobdella ornata	0	+
Oecetis avara	9	+
Helichus sp	0	+
Tabanidae	0	+
Nemertea	5	
Hydropsyche venularis	3	
Cricotopus (Isocladius) intersectus group	3	
Tribelos jucundum	8	

No. Quantitative Taxa:	53
No. Qualitative Taxa:	51
Total Taxa:	82
Number of Organisms:	1052
Qual EPT:	23
ICI:	**50**

Site: Christiana Creek - High Dive Park (Below)
Date Collected: 08/16/14 Site #: 7

Taxa Name	Quantitative	Qualitative
Turbellaria	46	
Oligochaeta	20	+
Gammarus fasciatus	0	+
Hydrachnidia	0	+
Plauditus dubius or P. virilis	0	+
Baetis flavistriga	0	+
Baetis intercalaris	203	+
Labiobaetis propinquus	0	+
Iswaeon anoka	0	+
Isonychia sp	11	
Stenacron sp	93	+
Maccaffertium exiguum	120	+
Maccaffertium mediopunctatum	133	+
Ephemerellidae	48	+
Tricorythodes sp	24	+
Caenis sp	0	+
Argia sp	0	+
Acroneuria internata	0	+
Corydalus cornutus	1	
Chimarra obscura	142	+
Cheumatopsyche sp	772	+
Ceratopsyche morosa group	241	
Ceratopsyche sparna	45	+
Hydropsyche depravata group	129	+
Hydropsyche phalerata	100	
Macrostemum zebratum	7	
Brachycentrus numerosus	1	+
Helicopsyche borealis	0	+
Mystacides sepulchralis	0	+
Nectopsyche diarina	0	+
Oecetis persimilis	0	+
Psephenus herricki	0	+
Macronychus glabratus	3	
Optioservus sp	0	+
Stenelmis sp	13	+
Simulium sp	10	+
Cardiocladius obscurus	14	
Parametriocnemus sp	10	
Tvetenia discoloripes group	5	
Microtendipes "caelum" (sensu Simpson & Bode, 1980)	2	
Microtendipes pedellus group	0	+
Polypedilum (Uresipedilum) flavum	10	+
Tribelos jucundum	0	+
Rheotanytarsus sp	169	
Tanytarsus sp	0	+
Hemerodromia sp	65	
Elimia sp	1	+
Ferrissia sp	17	
Corbicula fluminea	1	
Baetisca sp	0	+
Limnephilidae	0	+
Lepidostoma sp	0	+
Ablabesmyia simpsoni	0	+
Hydropsyche venularis	2	

No. Quantitative Taxa:	32
No. Qualitative Taxa:	38
Total Taxa:	54
Number of Organisms:	2458
Qual EPT:	24
ICI:	**46**

Site: Elkhart River - County Road 18 (Hively Avenue)
Date Collected: 08/15/14 Site #: 8

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	3	+	Optioservus sp	0	+
Ectoprocta	1		Antocha sp	1	
Oligochaeta	2	+	Tipula sp	1	
Spongillidae	0	+	Simulium sp	0	+
Orconectes sp	0	+	Conchapelopia sp	2	
Gammarus fasciatus	29		Clinotanypus pinguis	0	+
Caecidotea sp	0	+	Nilotanypus fimbriatus	2	
Crangonyx sp	3		Corynoneura lobata	12	
Hydrachnidia	2	+	Cricotopus (C.) sp	2	
Baetis flavistriga	0	+	Thienemanniella xena	12	
Baetis intercalaris	31	+	Tvetenia discoloripes group	6	
Labiobaetis propinquus	0	+	Cryptochironomus sp	2	
Iswaeon anoka	0	+	Microtendipes pedellus group	2	+
Isonychia sp	29	+	Polypedilum (Uresipedilum) flavum	26	
Stenacron sp	99	+	Polypedilum (P.) illinoense	17	
Maccaffertium exiguum	36		Stenochironomus sp	6	
Maccaffertium mediopunctatum	0	+	Rheotanytarsus sp	91	+
Maccaffertium pulchellum	0	+	Tanytarsus sp	0	+
Maccaffertium terminatum	8	+	Tanytarsus glabrescens group sp 7	6	
Maccaffertium vicarium	68		Tanytarsus sepp	4	
Ephemerellidae	2		Hemerodromia sp	4	
Tricorythodes sp	3	+	Hydrobiidae	3	
Hetaerina sp	1	+	Elimia sp	5	+
Coenagrionidae	2	+	Physella sp	2	
Argia sp	6	+	Planorbella (Pierosoma) pilsbryi	0	+
Neurocordulia sp	0	+	Ferrissia sp	20	+
Pteronarcys sp	0	+	Sphaerium sp	0	+
Paragnetina sp	0	+	Gammarus sp	0	+
Sialis sp	0	+	Acroneuria lycorias	1	
Corydalus cornutus	2		Leptoceridae	2	
Lype diversa	39		Cryptotendipes pseudotener	0	+
Cheumatopsyche sp	50	+			
Ceratopsyche sparna	1	+	No. Quantitative Taxa:	46	
Brachycentrus numerosus	0	+	No. Qualitative Taxa:	41	
Neophylax sp	0	+	Total Taxa:	70	
Petrophila sp	0	+	Number of Organisms:	653	
Psephenus herricki	0	+	Qual EPT:	16	
Ancyronyx variegata	1		**ICI:**	**40**	
Macronychus glabratus	6				

Site: Elkhart River - American Park

Date Collected: 08/15/14 Site #: 9

Taxa Name	Quantitative	Qualitative
Hydra sp	12	
Turbellaria	9	
Oligochaeta	36	
Spongillidae	0	+
Gammarus sp	0	+
Gammarus fasciatus	40	
Caecidotea sp	1	
Hyalella azteca	2	
Baetis flavistriga	10	+
Baetis intercalaris	88	+
Labiobaetis propinquus	0	+
Procloeon sp (w/ hindwing	0	+
Isonychia sp	40	+
Leucrocuta sp	1	
Stenacron sp	259	+
Maccaffertium exiguum	125	+
Maccaffertium pulchellum	43	
Tricorythodes sp	66	+
Argia sp	2	+
Agnetina capitata complex	4	
Corydalus cornutus	1	
Lype diversa	16	
Cheumatopsyche sp	74	+
Ceratopsyche sparna	4	
Pycnopsyche sp	0	+
Nectopsyche diarina	0	+
Triaenodes injustus	0	+
Peltodytes sp	0	+
Macronychus glabratus	16	
Stenelmis sp	0	+
Antocha sp	4	
Ablabesmyia sp	0	+
Conchapelopia sp	37	
Corynoneura lobata	56	
Dicrotendipes neomodestus	61	+
Microtendipes "caelum" (sensu Simpson &	0	+
Microtendipes pedellus group	12	
Polypedilum (Uresipedilum) flavum	98	
Polypedilum (P.) fallax group	12	
Polypedilum (P.) illinoense	37	+
Rheotanytarsus pellucidus	12	
Rheotanytarsus sp	612	
Tanytarsus glabrescens group sp 7	122	
Tanytarsus sepp	24	
Hemerodromia sp	4	
Hydrobiidae	1	
Elimia sp	5	+
Physella sp	0	+
Ferrissia sp	33	
Cryptotendipes pseudotener	0	+
Polycentropodidae	4	

No. Quantitative Taxa:	38
No. Qualitative Taxa:	24
Total Taxa:	51
Number of Organisms:	1983
Qual EPT:	12
ICI:	**40**

Site: Yellow Creek - US 20 Bypass

Date Collected: 08/17/14 Site #: 10

Taxa Name	Quantitative	Qualitative
Hydra sp	16	
Turbellaria	18	
Oligochaeta	24	+
Erpobdella punctata punctata	0	+
Gammarus fasciatus	8	+
Caecidotea sp	21	+
Hydrachnidia	16	+
Baetis tricaudatus	72	+
Baetis flavistriga	29	+
Baetis intercalaris	99	+
Stenacron sp	19	+
Calopteryx sp	1	+
Coenagrionidae	0	+
Boyeria vinosa	0	+
Corixidae	0	+
Cheumatopsyche sp	87	+
Ceratopsyche morosa group	58	+
Hydropsyche depravata group	329	+
Pycnopsyche sp	0	+
Ancyronyx variegata	1	+
Macronychus glabratus	12	
Optioservus sp	0	+
Stenelmis sp	4	+
Tipula sp	0	+
Anopheles sp	0	+
Simulium sp	52	+
Nanocladius (N.) spiniplenus	56	
Rheocricotopus (Psilocricotopus)	19	
Tvetenia bavarica group	37	+
Cryptochironomus sp	0	+
Dicrotendipes neomodestus	0	+
Microtendipes "caelum" (sensu	0	+
Paratendipes albimanus or P. dupli-	0	+
Polypedilum (Uresipedilum) flavum	74	+
Stictochironomus sp	19	+
Paratanytarsus sp	56	+
Rheotanytarsus sp	1451	+
Tanytarsus sp	0	+
Hemerodromia sp	4	
Planorbella (Pierosoma) trivolvis	0	+
Ferrissia sp	60	
Corbicula fluminea	0	+
Sphaerium sp	1	+

No. Quantitative Taxa:	28
No. Qualitative Taxa:	36
Total Taxa:	43
Number of Organisms:	2643
Qual EPT:	8
ICI:	**40**

Site: Baugo Creek - Restoration Site

Date Collected: 08/16/14 Site #: 11

Taxa Name	Quantitative	Qualitative
Hydra sp	8	
Oligochaeta	1	+
Erpobdella punctata punctata	0	+
Spongillidae	0	+
Caecidotea sp	1	+
Crangonyx sp	0	+
Hydrachnidia	0	+
Baetis flavistriga	44	+
Baetis intercalaris	113	+
Stenacron sp	0	+
Caenis sp	0	+
Calopteryx sp	2	+
Coenagrionidae	0	+
Boyeria vinosa	0	+
Cheumatopsyche sp	65	
Ceratopsyche morosa group	1260	+
Hydropsyche depravata group	179	+
Macrostemum zebratum	0	+
Hydroptilidae	1	
Mystacides sepulchralis	0	+
Ancyronyx variegata	5	
Stenelmis sp	0	+
Antocha sp	166	
Tipula sp	0	+
Conchapelopia sp	30	
Nilotanypus fimbriatus	15	
Cricotopus (C.) bicinctus	0	+
Nanocladius (N.) spiniplenus	15	
Parametriocnemus sp	135	
Rheocricotopus	45	
Tvetenia bavarica group	60	
Tvetenia discoloripes group	0	+
Dicrotendipes neomodestus	45	
Microtendipes "caelum" (sensu Simpson & Bode, 1980)	60	+
Microtendipes pedellus group	135	
Polypedilum (Uresipedilum) flavum	75	
Polypedilum (P.) fallax group	15	
Stictochironomus sp	0	+
Paratanytarsus sp	105	
Rheotanytarsus sp	433	
Tanytarsus glabrescens group sp 7	164	
Tanytarsus sepp	15	
Hemerodromia sp	8	
Elimia sp	1	+
Physella sp	0	+
Planorbella (Pierosoma) trivolvis	0	+
Ferrissia sp	147	+
Cladotanytarsus vanderwulpi group sp 2	0	+
Cricotopus (C.) or Orthocladius (O.) sp	15	

No. Quantitative Taxa:	31
No. Qualitative Taxa:	28
Total Taxa:	49
Number of Organisms:	3363
Qual EPT:	8
ICI:	**38**

Site: Bowman Creek - Studebaker Golf Course

Date Collected: 08/17/14 Site #: 12

Taxa Name	Quantitative	Qualitative
Hydra sp	4	
Turbellaria	53	+
Oligochaeta	62	+
Erpobdella punctata punctata	4	+
Caecidotea sp	2	+
Crangonyx sp	6	
Hydrachnidia	0	+
Baetis tricaudatus	0	+
Baetis flavistriga	21	+
Calopteryx sp	0	+
Coenagrionidae	0	+
Anax sp	0	+
Cheumatopsyche sp	24	
Hydropsyche depravata group	42	+
Hydroptila sp	26	+
Peltodytes sp	0	+
Tropisternus sp	0	+
Stenelmis sp	58	+
Simulium sp	23	+
Ceratopogonidae	4	
Conchapelopia sp	34	
Corynoneura lobata	32	
Cricotopus (C.) bicinctus	11	+
Cricotopus (C.) tremulus group	28	+
Nanocladius (N.) crassicornus or N. (N.) "rectinervis"	6	
Parametriocnemus sp	67	
Thienemanniella xena	4	+
Paratendipes albimanus or P. duplicatus	0	+
Polypedilum (Uresipedilum)	0	+
Polypedilum (P.) fallax group	95	+
Stenochironomus sp	6	
Stictochironomus sp	0	+
Paratanytarsus sp	290	
Rheotanytarsus sp	6	
Tanytarsus glabrescens group	11	
Tanytarsus sepp	39	+
Hemerodromia sp	6	
Pisidiidae	0	+
Gammarus sp	0	+
Erythemis simplicicollis	0	+
Tipulidae	0	+
Agabus sp	0	+
Endochironomus nigricans	0	+

No. Quantitative Taxa:	27
No. Qualitative Taxa:	30
Total Taxa:	43
Number of Organisms:	964
Qual EPT:	4
ICI:	**34**

Site: Juday Creek - Kintz Avenue

Date Collected: 08/16/14 Site #: 13

Taxa Name	Quantitative	Qualitative
Turbellaria	12	+
Oligochaeta	1	
Gammarus sp	0	+
Gammarus fasciatus	11	
Crangonyx sp	6	
Hydrachnidia	16	+
Baetis tricaudatus	0	+
Baetis flavistriga	24	+
Baetis intercalaris	7	+
Stenacron sp	50	+
Maccaffertium exiguum	45	+
Maccaffertium vicarium	70	+
Tricorythodes sp	0	+
Calopteryx sp	8	+
Boyeria vinosa	2	+
Chimarra obscura	2	+
Neureclipsis sp	10	
Cheumatopsyche sp	37	
Ceratopsyche morosa group	85	+
Ceratopsyche sparna	19	+
Macrostemum zebratum	0	+
Brachycentrus numerosus	1	+
Oecetis persimilis	8	
Macronychus glabratus	5	+
Optioservus sp	2	
Stenelmis sp	3	+
Simulium sp	71	+
Ceratopogonidae	0	+
Conchapelopia sp	41	
Hayesomyia senata or Thiene-	21	
Nilotanypus fimbriatus	21	
Corynoneura sp	0	+
Corynoneura lobata	40	
Cricotopus (C.) sp	21	
Cricotopus (C.) tremulus group	41	
Parametriocnemus sp	411	+
Rheocricotopus (Psilocricotopus) robacki	164	
Tvetenia bavarica group	21	
Microtendipes pedellus group	21	
Polypedilum (Uresipedilum) flavum	21	
Polypedilum (P.) illinoense	123	+
Polypedilum (P.) laetum group	41	
Cladotanytarsus vanderwulpi group	21	
Paratanytarsus sp	21	
Rheotanytarsus sp	535	
Rheotanytarsus pellucidus	21	+
Tanytarsus sp	21	
Tanytarsus sepp	21	
Hemerodromia sp	40	
Physella sp	0	+
Ferrissia sp	2	
Corbicula fluminea	0	+
Orconectes sp	0	+
Leptoceridae	1	+
Lopescladius sp	0	+
Plecoptera	1	

No. Quantitative Taxa:	46
No. Qualitative Taxa:	30
Total Taxa:	56
Number of Organisms:	2166
Qual EPT:	13
ICI:	**48**

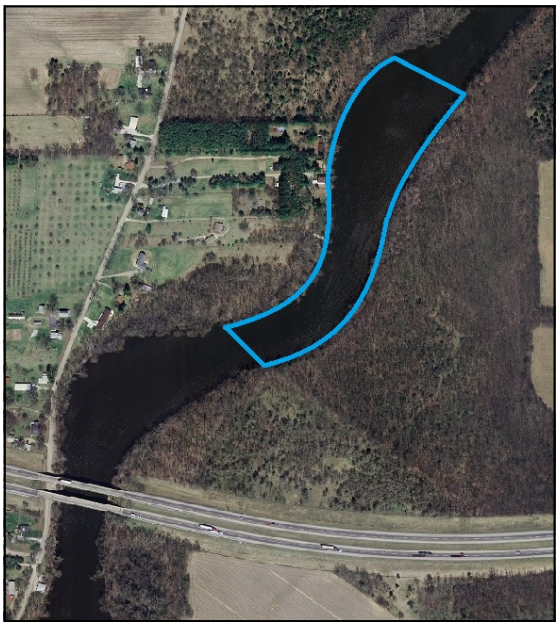
Site: Juday Creek - Izaak Walton League
Date Collected: 08/16/14 Site #: 14

Taxa Name	Quantitative	Qualitative
Turbellaria	100	+
Oligochaeta	2	+
Crangonyx sp	0	+
Baetis tricaudatus	1	
Baetis flavistriga	1	+
Baetis intercalaris	1	
Stenacron sp	9	+
Maccaffertium terminatum	38	
Maccaffertium vicarium	307	+
Calopteryx sp	0	+
Boyeria vinosa	0	+
Chimarra obscura	64	+
Cheumatopsyche sp	33	+
Ceratopsyche morosa group	53	+
Ceratopsyche sparna	583	+
Hydropsyche depravata group	40	+
Brachycentrus numerosus	2	
Oecetis persimilis	4	+
Macronychus glabratus	52	
Optioservus sp	3	+
Stenelmis sp	4	+
Tipula sp	5	+
Simulium sp	114	+
Corynoneura lobata	16	
Parametriocnemus sp	290	+
Thienemanniella xena	16	
Tvetenia bavarica group	124	+
Rheotanytarsus sp	3857	+
Hemerodromia sp	33	
Physella sp	0	+
Corbicula fluminea	0	+
Orconectes sp	0	+
Stylurus sp	0	+
Pagastia orthogonia	0	+
Gammaridae	1	

No. Quantitative Taxa:	27
No. Qualitative Taxa:	26
Total Taxa:	35
Number of Organisms:	5753
Qual EPT:	9
ICI:	**46**

Appendix F

Aerial Site Location Maps



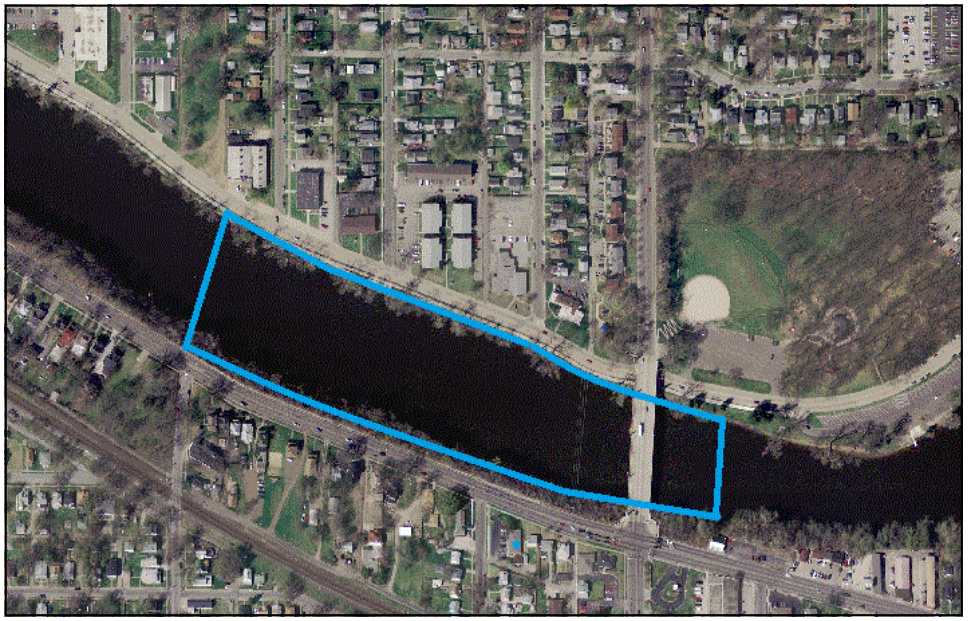
Site #1: St. Joseph River Toll Road (Bristol)

Site #2: St. Joseph River CR 17 (Six Span)

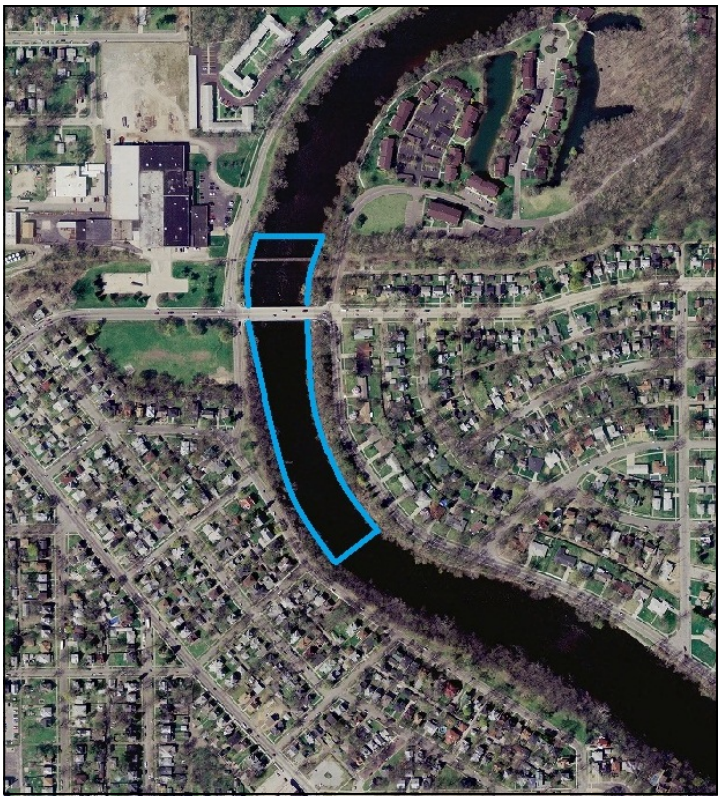
Site #3: St. Joseph River Bridge Street

Site #4: St. Joseph River Ironwood Drive

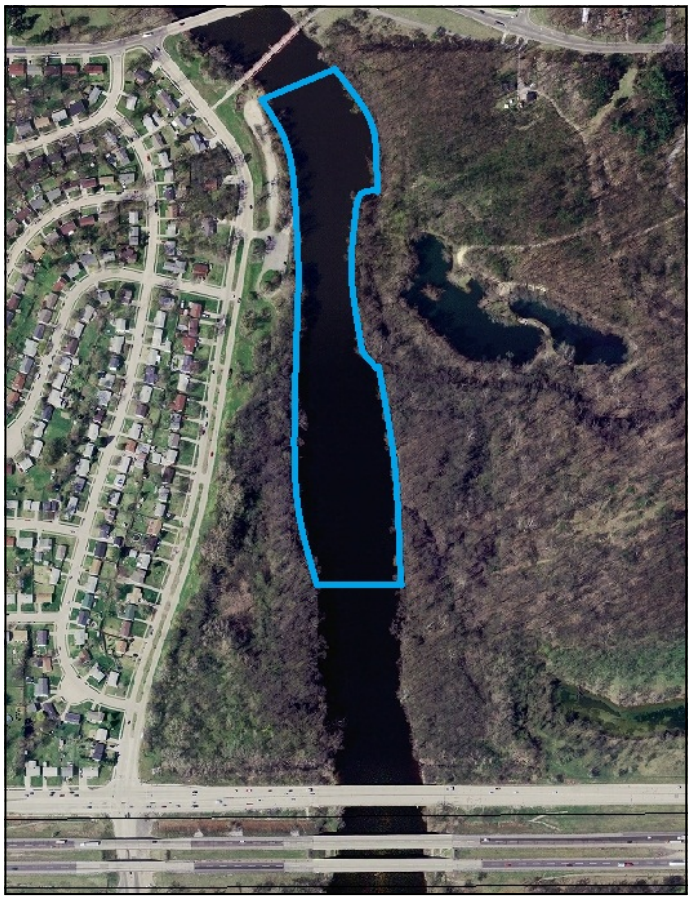
Site #5: St. Joseph River Sample Street



Site #6: St. Joseph River Michigan Street (B)



Site #7: St. Joseph River Angela Blvd.

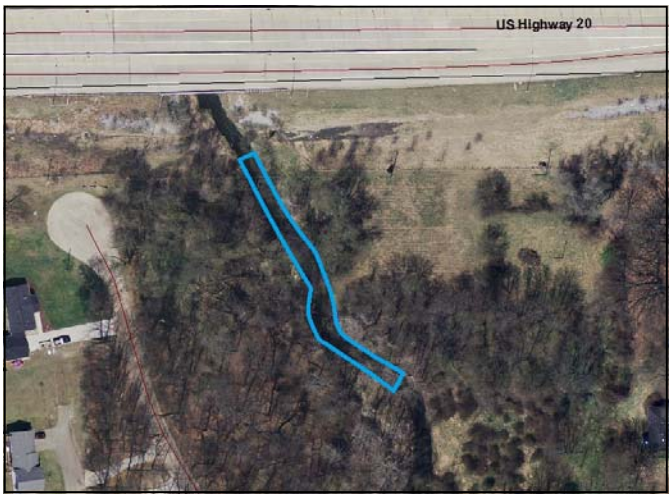


Site #8: St. Joseph River Darden Road

Site #9: Trout Creek CR 2

Site #10: Little Elkhart River SR 120

Site #11: Pine Creek US 20 Bypass



Site #12: Puterbaugh Creek Reedy Drive

Site #13: Christiana Creek CR6

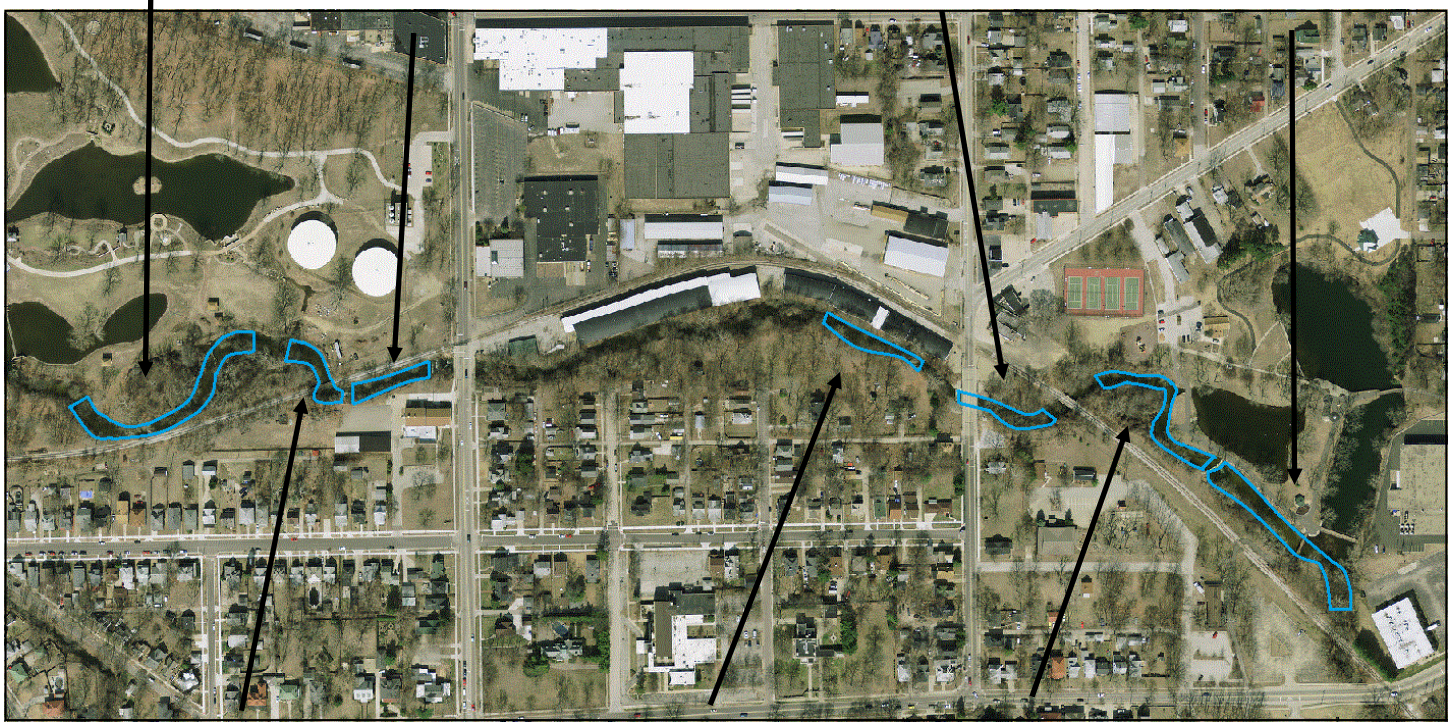
Site #14: Christiana Creek Willowdale Park

Site #15: North Main Wellfield

Site #17: Main Street (Above)

Site #19: Cassopolis (Below)

Site #21: High Dive (Below Dam)



Site #16: Wellfield Below

Site #18: Cassopolis (Above)

Site #20: High Dive (Above Dam)

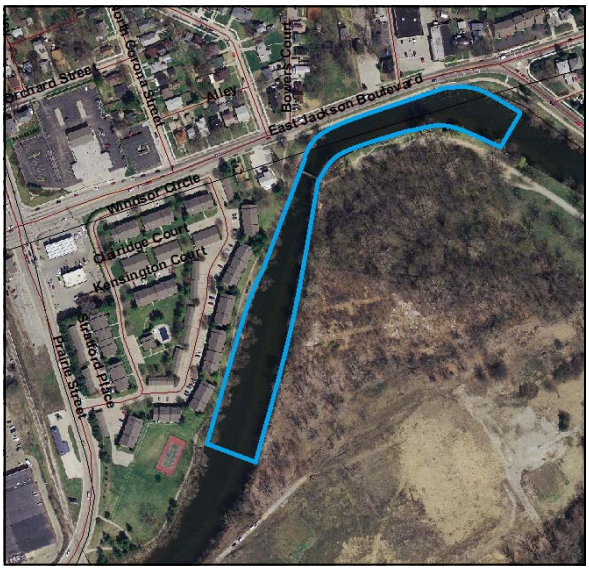
Site #22: Elkhart River SR 15 (B)

Site #23: Elkhart River Indiana Avenue

Site #24: Elkhart River Middlebury Street

Site #25: ER Studebaker Park

Site #27: Yellow Creek US 20 Bypass



Site #26: ER American Park

Site #28: Cobus CR 6

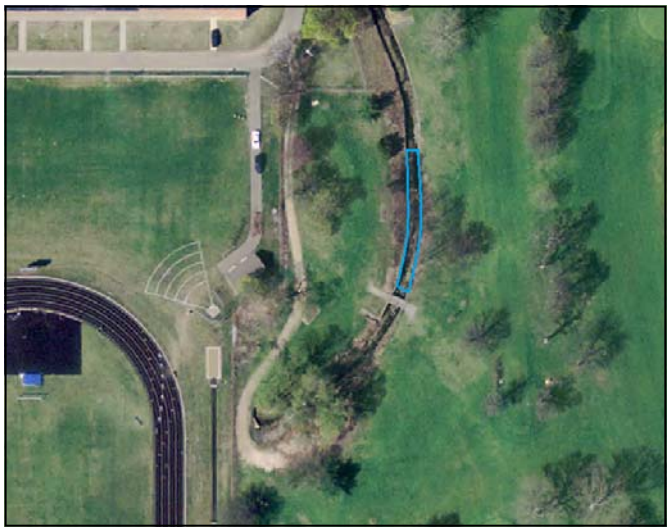
Site #29: Cobus Creek CR 8

Site #30: Cobus Creek CR 12

Site #31: Cobus Creek Elkhart Conservation Club

Site #32 Baugo Creek Restoration Site

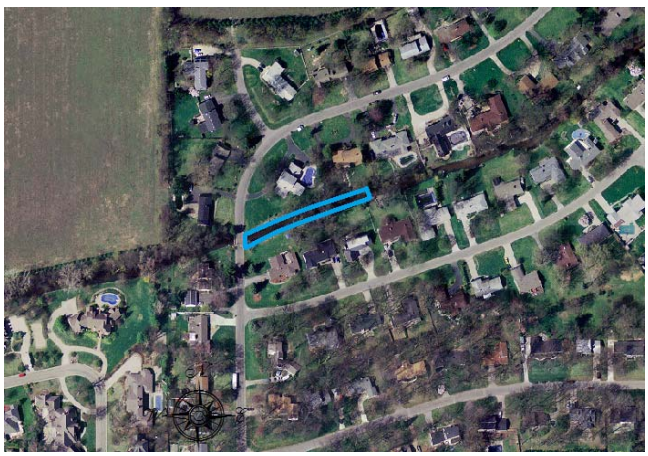
Site #33: Bowman Creek Main Street



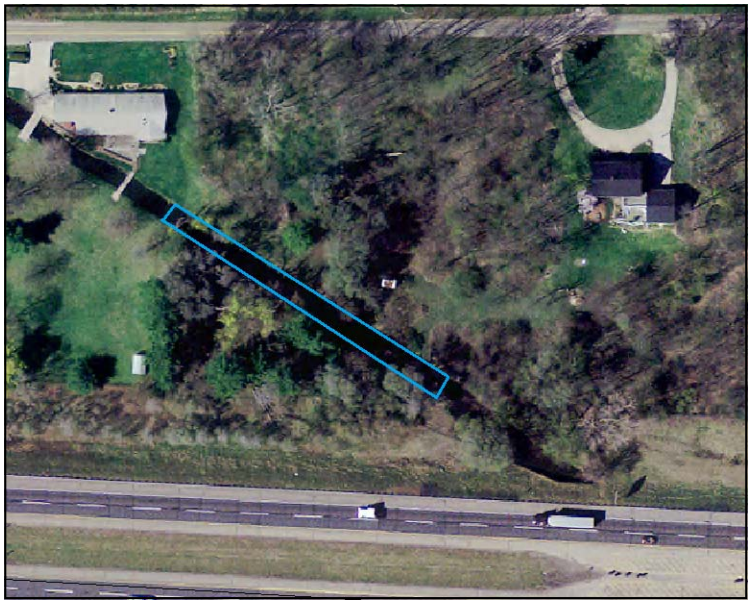
Site #34: Bowman Creek Studebaker Golf Course

Site #35: Auten Ditch Locust Road (South)

Site #35: Juday Creek Trinity Parkway



Site #36: Juday Creek Windingbrook Drive



Site #38: Juday Creek Kintz Ave.

Site #39: Juday Creek Izaak Walton League