Elkhart-South Bend Aquatic Community Monitoring

Annual Report
2010

City of Elkhart
Public Works and Utilities
Dick Moore, Mayor

Clean river Healthy neighborhoods

ELKHART ▪ SOUTH BEND

Cover Photo: Dale Zielke with a large bowfin collected at Lexington Landing in Elkhart

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Dave Huntington with a big Elkhart River silver redhorse

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INTRODUCTION

In 2010, there were very few days within the month of June that the St. Joseph River and its tributaries were not very high and very muddy due to continuously wet weather. During high water conditions a vast amount of pollutants and sediment flush into our rivers and streams having an impact on fish, wildlife, recreation, and aesthetics. Impervious surfaces and point sources of pollution within our cities and poor drainage practices and non-point source pollution in upstream areas continue to contribute to this problem. Fortunately, in recent years, we have seen many developments and initiatives by government agencies and watershed organizations to improve water quality. In 2010, the Aquatics Program initiated the 13th year of biological community monitoring on the rivers and streams of Elkhart and St. Joseph County. Since the start of the Program, the health of the biological communities in area streams has improved. Although unstable drainage conditions are still a major issue in our watershed, we are learning to manage our runoff more appropriately. With continued effort, it is our hope that the rivers and streams will only get better.

In 2010, 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 that was gathered has been 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 past or long-term disturbance. 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 six years (1998-2003), Elkhart's Aquatics Program established core fish sampling sites on the St. Joseph River and many of the primary tributaries in the Elkhart area. For three consecutive years, data were collected from these sites and a baseline of information 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 staff, establishing a unique biological monitoring partnership between municipalities. As with the Elkhart area, core sampling sites were determined and similar baselines were established for the South Bend area for a six year period (2001-2006). This year (2010) was the fourth year that the initial sites had been sampled since the baseline period, providing the stakeholders of South Bend with data to determine whether water quality in their area is improving or diminishing.

In 2007, the City of Mishawaka signed on to partner with the interlocal aquatics team. Baseline monitoring work was completed in 2009 providing a thorough picture of stream integrity across the Indiana section of the St. Joseph River. Although Mishawaka has since terminated their agreement with the City of Elkhart, since the baseline monitoring is complete, they will be well positioned to reevaluate stream conditions in the future.

This year (2010) marked the second year in which the Aquatics team provided monitoring services for the Elkhart River Restoration Association (ERRA). As part of a Section 319 Grant, the ERRA hired the Aquatics Program to monitor seven sites in and around the City of Goshen. This partnership proved to be mutually beneficial as it provided additional stream quality data on upper sections of the Elkhart River Watershed, while satisfying the water quality monitoring requirements of the ERRA's Watershed Management Plan.

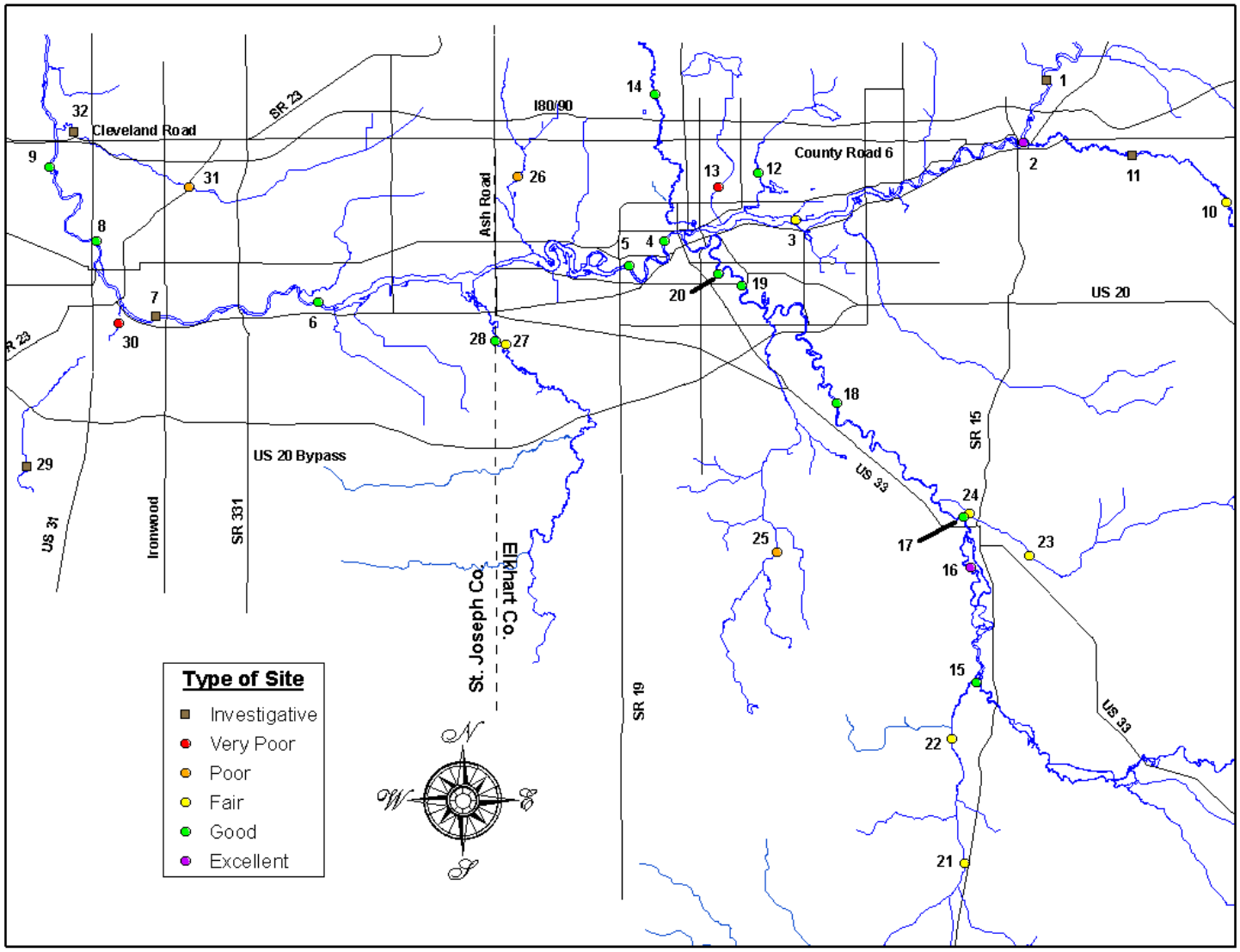
The Aquatics Program consists of more than just traversing through local streams collecting fish data. A considerable portion of the Program is education. The biologist travels to local schools and watershed stakeholder group meetings, giving presentations and demonstrations, in an effort to increase awareness of, and promote conservation for, the bountiful aquatic resources we have in this area. The biologist also plays an active role in local conservations groups such as the Friends of the St. Joe River, the ERRA, and the Michiana Walleye Association.

Indices

The Index of Biotic Integrity (IBI) is the system that is used to assess the local fish communities.

Figure 1. MBI biologist setting a Hester-Dendy sampler in Juday Creek.

Figure 2: Fish sampling sites in Elkhart and St. Joseph Counties and associated fish community condition for 2010



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 three 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 three 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 one of five classifications (very poor, poor, fair, good, or excellent), which describes the overall condition of the fish community being monitored.

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, Elkhart 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 six 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 where

Table 1: Fish sampling sites in Elkhart and St. Joseph Counties, 2010

Site Number	Stream	Site	Type of Site	County	Method	IBI Scores 2010	ICI Scores 2010	QHEI Scores 2010
1	St. Joseph River	Trout Creek Mouth (Above)	Investigative	Elkhart	Boat			78
2	St. Joseph River	SR 15 (Bristol)	Index	Elkhart	Boat	55	52	79
3	St. Joseph River	Homan Ave.	Index	Elkhart	Boat	40		62
4	St. Joseph River	Sherman Street	Index	Elkhart	Boat	53	52	80
5	St. Joseph River	Nappanee Street	Index	Elkhart	Boat	51		77
6	St. Joseph River	Capital Avenue	Index	St. Joseph	Boat	51	54	78
7	St. Joseph River	Veterans Park (Above)	Investigative	St. Joseph	Boat			71
8	St. Joseph River	Michigan Street	Index	St. Joseph	Boat	50	52	81
9	St. Joseph River	Pinhook Park (B)	Index	St. Joseph	Boat	49	46	76
10	Little Elkhart River*	County Road 10	Index	Elkhart	Tote Barge	45	42	77
11	Little Elkhart River*	Bonneyville Mill	Investigative	Elkhart	Tote Barge			52
12	Putterbaugh Creek*	County Road 8	Index	Elkhart	Tote Barge	48	50	74
13	Lily Creek	Reckell Ave.	Index	Elkhart	Back Pack	24		48
14	Christiana Creek	County Road 4	Index	Elkhart	Tote Barge	52	46	76
15	Elkhart River	State Road 15 (B)	Index	Elkhart	Boat	50	Impaired#	74
16	Elkhart River	Shanklin Park	Index	Elkhart	Boat	55		84
17	Elkhart River	Rogers Park (B)	Index	Elkhart	Boat	49	Impaired#	79
18	Elkhart River	Oxbow Park	Index	Elkhart	Boat	48		76
19	Elkhart River	Indiana Ave.	Index	Elkhart	Boat	49		83
20	Elkhart River	Middlebury St.	Index	Elkhart	Boat	49	52	77
21	Turkey Creek	County Road 50	Index	Elkhart	Tote Barge	45		70
22	Turkey Creek	County Road 142	Index	Elkhart	Tote Barge	42	Impaired#	63
23	Rock Run Creek	Monroe Street	Index	Elkhart	Tote Barge	38		53
24	Rock Run Creek	1st Street	Index	Elkhart	Tote Barge	42	Impaired#	55
25	Yellow Creek	CR 32	Index	Elkhart	Tote Barge	30		59

*** denotes a cool/cold water site**
 # denotes a macroinvertebrate assessment that was conducted following the IDEM mIBI protocols
Underlined values are indicative of impaired aquatic communities

Table 1: Fish sampling sites in Elkhart and St. Joseph Counties, 2010 (continued)

Site Number	Stream	Site	Type of Site	County	Method	IBI Scores 2010	ICI Scores 2010	QHEI Scores 2010
26	Cobus Creek*	CR 8	Index	Elkhart	Tote Barge	31	48	77
27	Baugo Creek	Restoration Site	Index	Elkhart & St. Joseph	Tote Barge	44	36	74
28	Baugo Creek	Restoration Site (B)	Index	Elkhart & St. Joseph	Tote Barge	46		75
29	Auten Ditch	Kern Road	Investigative	St. Joseph	Back Pack			41
30	Bowman Creek	Ravina Park	Index	St. Joseph	Back Pack	13	Fair	41
31	Juday Creek*	SR 23	Index	St. Joseph	Tote Barge	35	52	68
32	Juday Creek*	Brookwood Drive	Investigative	St. Joseph	Tote Barge			73

improvements to habitat are needed to help improve the overall health of our riverine systems.

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). Eighteen (18) sites were sampled in 2010 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 graphed and classified the same as the IBI scores. This combination of fish, habitat, and macroinvertebrate monitoring provides the cities of Elkhart and South Bend with the most comprehensive view of the health of our streams.

The Indiana Department of Environmental Management (IDEM) has established guidelines to determine if a body of water is being impaired or if its condition is supportive of aquatic life (IDEM 2008) for the IBI and QHEI. 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*) populations are monitored from previous tagging events in cooperation with the Indiana Department of Natural Resources (IDNR). Tissue from seven fish species was collected and analyzed for mercury and polychlorinated biphenyl (PCB) content. This information was added to the existing tissue database for the basin. The current Indiana Fish Consumption Advisory (FCA) (Table 5) 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 last 13 years, the Aquatics staff has used two collection protocols (investigative sampling and index sampling) to quickly catalog the major fish species and to quantify water 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 sam-

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

Table 2: Macroinvertebrate Sampling Sites, 2010

Site Number	Stream	Location	Site Number	Stream	Location
1	St. Joseph River	SR 15 (B).	10	Elkhart River	Rogers Park (B)
2	St. Joseph River	Sherman Street	11	Elkhart River	Oxbow (B)
3	St. Joseph River	Capital Ave.	12	Elkhart River	Middlebury
4	St. Joseph River	Michigan Ave.	13	Turkey Creek	CR 142
5	St. Joseph River	Pinhook (B)	14	Rock Run Creek	1st Street
6	Little Elkhart River	CR 10	15	Cobus Creek	CR 8
7	Putterbaugh Creek	CR 8	16	Baugo Creek	Restoration Site
8	Christiana Creek	CR 4	17	Juday Creek	SR 23
9	Elkhart River	SR 15 (B)	18	Bowman Creek	Ravina Park

pled twice during the season, with a minimum five week "rest" period between sampling events. Individual species maximum and minimum lengths are recorded, all fish are counted, and game fish are weighed and measured individually, while non-game fish are mass weighed.

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 one or two 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 2010, six index and three investigative sites were sampled in St. Joseph County and 20 index and two investigative sites were sampled in Elkhart County. Two index sites on Baugo Creek were located right on the Elkhart/St. Joe County border. (Figure 2 and Table 1). As previously noted, seven of the index sites in Elkhart County were for a unique, short-term project for the ERRA. IBI scores were calculated for each of the index sites and an average from the two visits was obtained to give the final score (Table 1).

Fish were collected from all sites using either boat mounted, 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 three 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.

At all sites sampled, stream habitat information was methodically collected using the QHEI as developed by Ohio EPA (Rankin 1989). All field staff assessed the available habitat at fish sampling sites each time the site was visited. All scores were then averaged to give one final score (Table 1).

In early July, 2010, 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).

Thirteen (13) of the 14 samplers were successfully retrieved approximately seven 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 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.

Macroinvertebrate community assessments were also performed at four of the seven ERRA sites. Because these sites were investigated in cooperation with IDEM, it was necessary to assess the sites in accordance with IDEM protocols. Thus, the assessments followed the newly developed IDEM multi-habitat sampling method, which is similar to the qualitative sampling method described previously. This approach involved sampling a 50 meter stretch of stream with a D-frame dip net. All habitat types including aquatic plants, woody material, depositional zones, and substrate were sampled to form a composite sample. A one meter kick sample was taken within a typical riffle/run/glide area and added to the composite. The sample was then elutriated a minimum of five times through a 500 µm sieve. It was then spread across a tray and a 15 minute pick in the field ensued to obtain as many different species as possible. Following the 15 minute pick, the sample was scanned to obtain any rare organisms that were not taken in the 15 minute pick. The processed sample was stored in 95% ethyl alcohol and transported to the lab for identification to the lowest practical taxonomic group. At these sites, macroinvertebrate communities were assessed using the newly developed Indiana mIBI (IDEM 2009). Similar to the fish IBI, a score of 36 or greater in-

Figure 4: Location of macroinvertebrate sampling sites for 2010

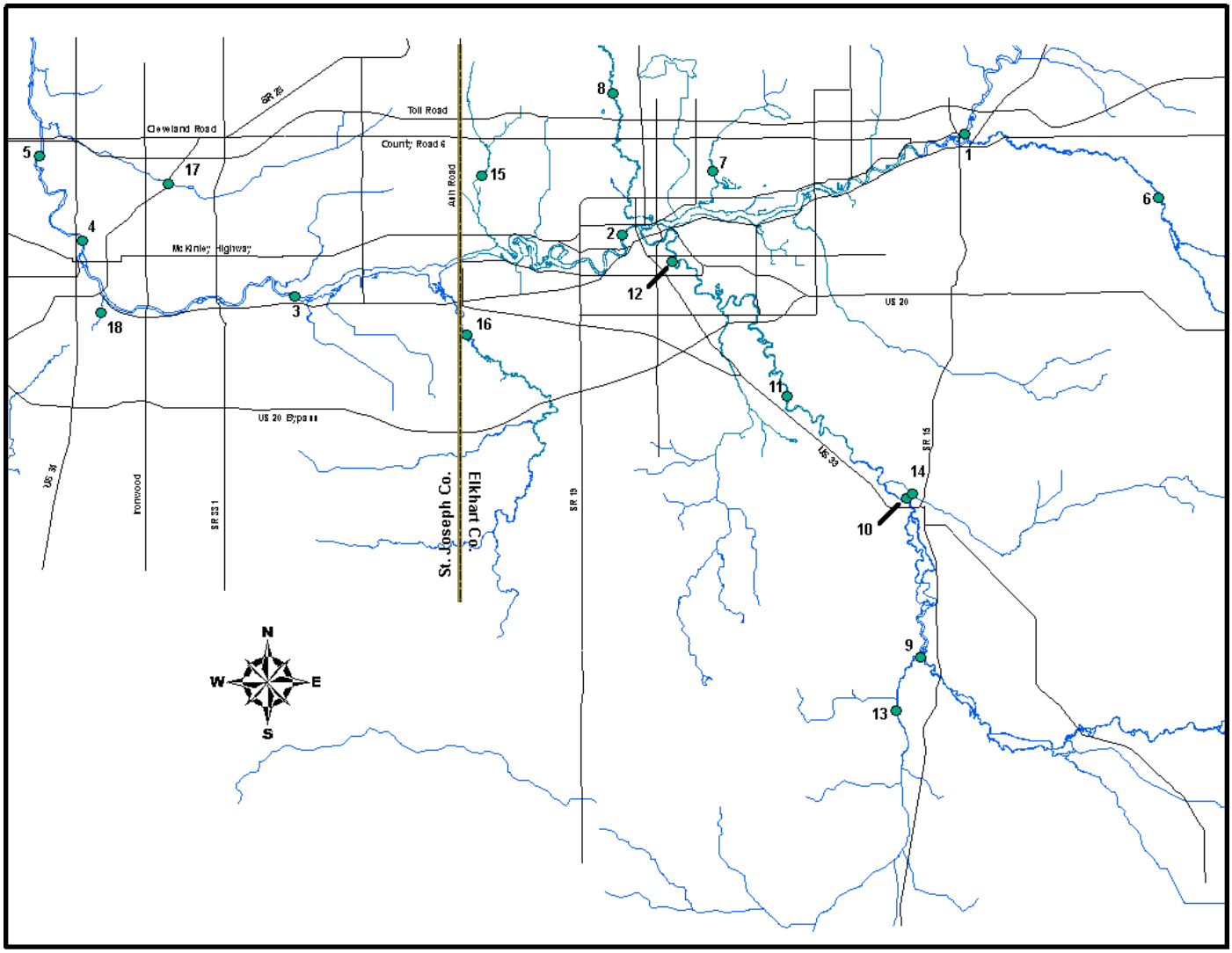


Figure 5: Location of fish tissue collection sites for 2010

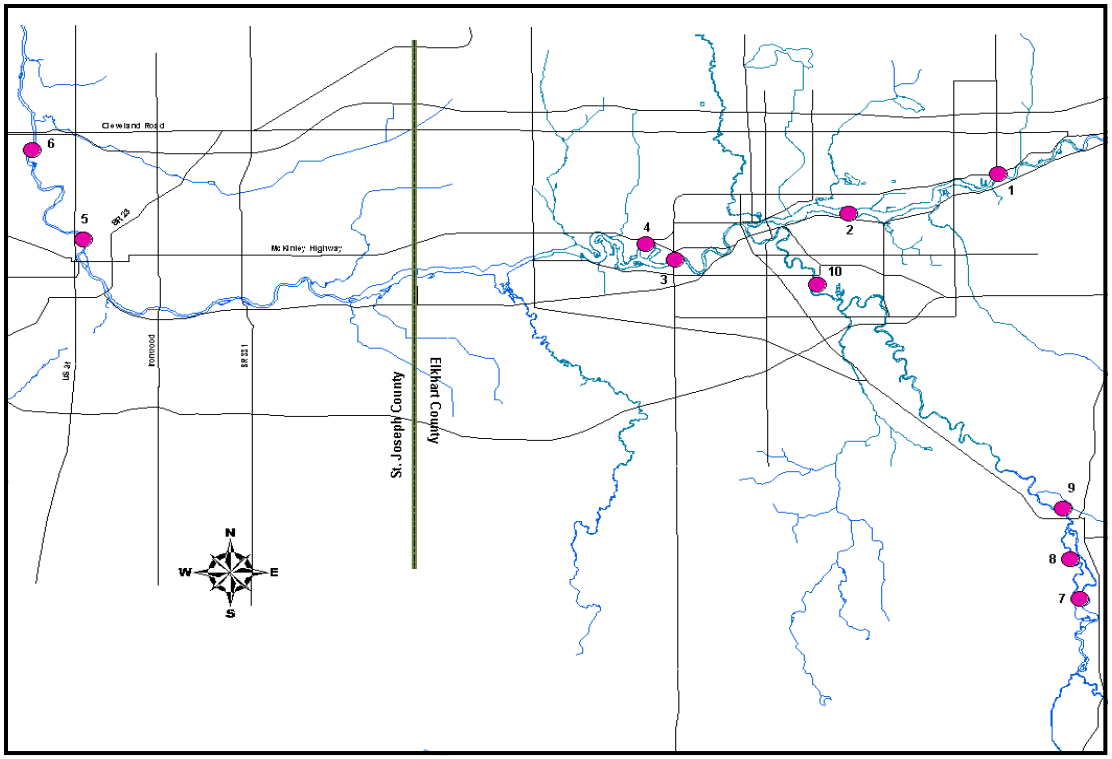


Table 3: Location of fish tissue collection sites for 2010

Site Number	Stream	Location
1	St. Joseph River	Six Span
2	St. Joseph River	Homan Ave.
3	St. Joseph River	Nappanee Street
4	St. Joseph River	Lexington Landing
5	St. Joseph River	Michigan Ave.
6	St. Joseph River	Pinhook (B)
7	Elkhart River	Goshen Pond
8	Elkhart River	Shanklin Park
9	Elkhart River	Rogers Park (B)
10	Elkhart River	Indiana Ave.

dicates that the site can support aquatic life according to IDEM criteria. Table 1 displays all ICI and mIBI scores or narrative ratings for 2010.

Fish tissue in the form of fillets was collected from bluegill (*Lepomis macrochirus*), golden redhorse (*Moxostoma erythrurum*), largemouth bass (*Micropterus salmoides*), rock bass (*Ambloplites* rupestris), smallmouth bass (*Micropterus dolomieu*), walleye (*Sander vitreus),* and white suckers *(Catostomus commersonii).* 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 three 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).

Results and Discussion

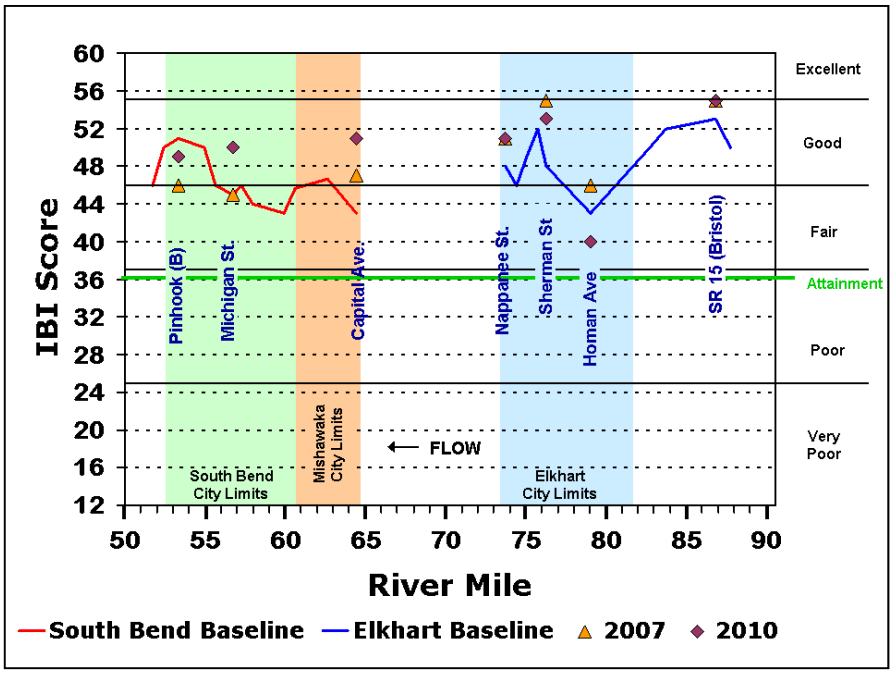
During the summer of 2010, a total of 18,827 fish, representing 17 families and 67 species, were collected in Elkhart County. The two sites along Baugo Creek accounted for 4,715 of the fish that were collected, with 1,433 of those being mimic shiners (*Notropis volucellus).* In St. Joseph County 3,665 fish, representing 13 families and 54 species, were collected. (See Appendix C for more detailed information). In total, 72 different species were captured from the two counties. Mimic shiners, white suckers, and rock bass were the most abundant species collected in Elkhart County, while Creek Chub (*Semotilus atromaculatus*), longear sunfish (*Lepomis megalotis*), and smallmouth bass were the most abundant in St. Joseph County. In Elkhart County more small tributary sites were sampled in 2010 than in St. Joseph County, which led to the high abundances of smaller non-game species such as mimic shiners and white suckers.

Indices

The IBI, ICI, and QHEI scores for 2010 are summarized in Table 1. Throughout this report, these data will be presented in graphical form to illustrate longitudinal and temporal changes on the different streams. The IBI and ICI graphs have an attainment line. Fish and benthic macroinvertebrate communities that score below this mark are considered impaired. There are many causes (thermal pollution, habitat degradation, chemical spills, etc.) that contribute to these impairments. Fish community conditions at the index sites ranged from very poor (13) at Ravina Park on Bowman Creek to excellent (55) at SR 15 (Bristol) on the St. Joseph River and Shanklin Park on the Elkhart River. Macroinvertebrate community scores ranged from fair at Ravina Park on Bowman Creek to excellent (54) at Capital Avenue on the St. Joseph River. Habitat quality at index sites ranged from poor (41) at Ravina Park on Bowman Creek and Kern Road on Auten Ditch to excellent (84) at Shanklin Park on the Elkhart River.

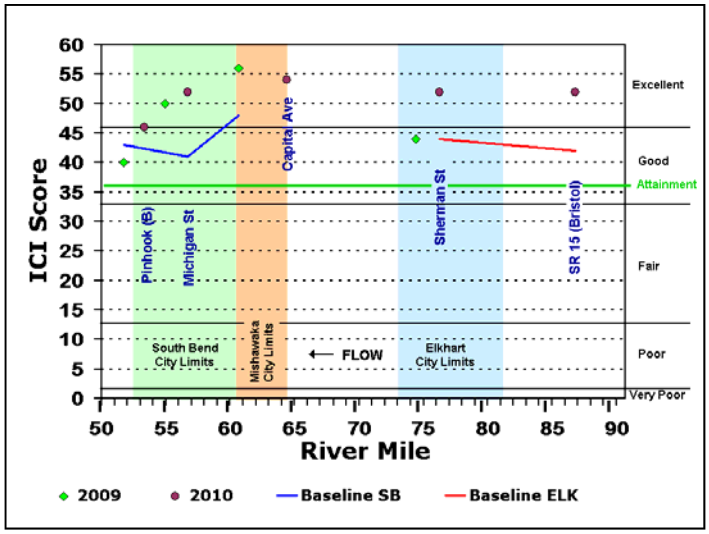
The longitudinal trends in fish community condition for the entire Indiana portion of the St. Joseph River are displayed in Figure 6. The Elkhart County portion of the river continues to support good fish communities. The most upstream site sampled in 2010, SR 15 (Bristol) had a fish IBI score of 55, which is considered excellent. All

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



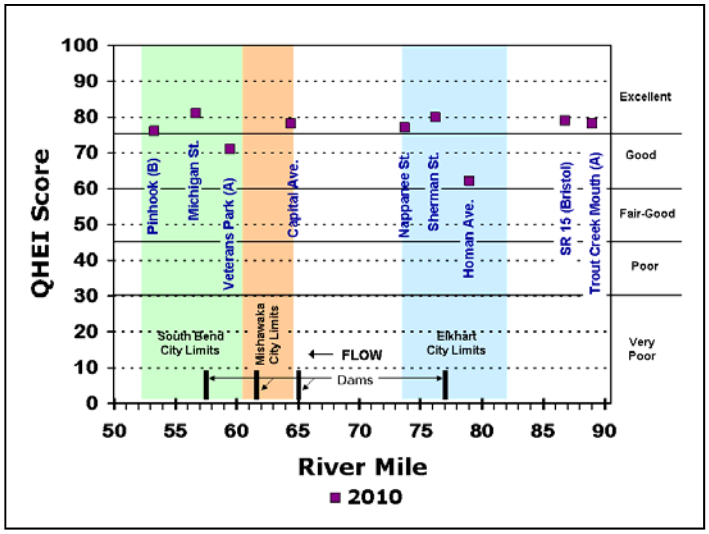
sites in Elkhart County, with the exception of Homan Avenue, had IBI scores above their respective baseline values. The Sherman Street IBI

Figure 7: ICI scores for the St. Joseph River, Elkhart and St. Joseph Counties



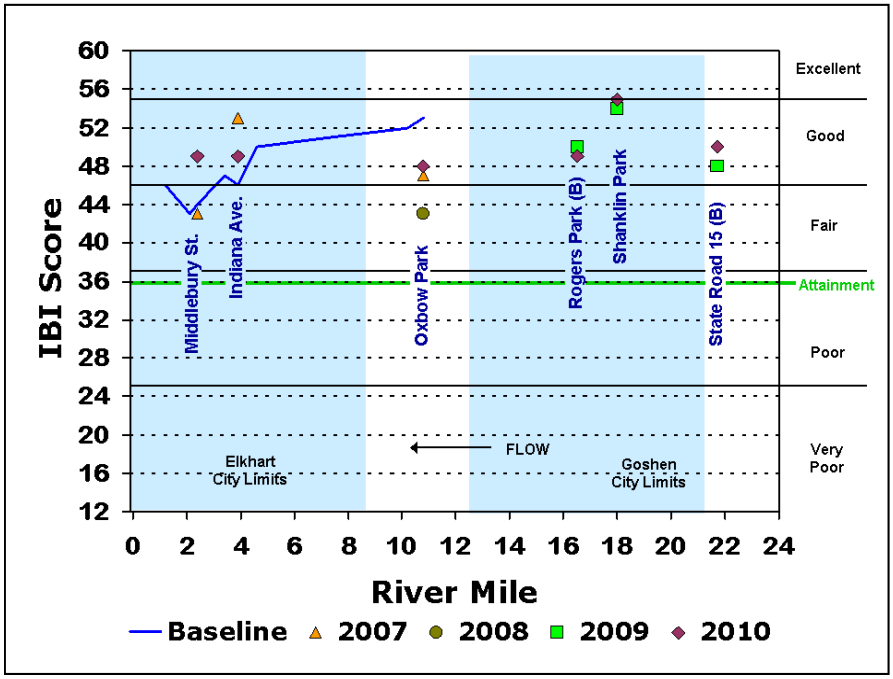
score (53) was well above the baseline score of 48. In addition, in 2007, this site scored 55, indicating that this section of the river has improved since baseline monitoring. The IBI score at Homan Avenue (40) was below the baseline score of 43. The observed drop at this site is likely due to when this site was sampled in 2010. In previous years, and during baseline monitoring, this site was sampled in late June and early August. However, due to muddy conditions in other sec-

Figure 8: QHEI scores for the St. Joseph River, Elkhart and St. Joseph Counties



tions of the watershed, the Aquatics team was forced to sample this site earlier in the season. This site is located within a deep impounded area of the river and during the summer months the predominate fish habitat is emerging aquatic vegetation. The time of year and the lack of adequate fish habitat within the sample zone likely had an impact on the IBI score at this site.

Figure 9: IBI scores for the Elkhart River, Elkhart County



State Road 15 (Bristol) and Sherman Street were the two St. Joseph River Elkhart County sites where macroinvertebrate communities were assessed in 2010 (Figure 7). ICI scores for both sites were significantly higher than established baseline scores and both sites fell into the excellent category. Habitat scores for the Elkhart County portion of the St. Joseph River were all in the excellent range with the exception of Homan Avenue (Figure 8). The reduced QHEI score at this site is strongly correlated with the reduced IBI score demonstrating the influence that the lack of habitat has on the fish community.

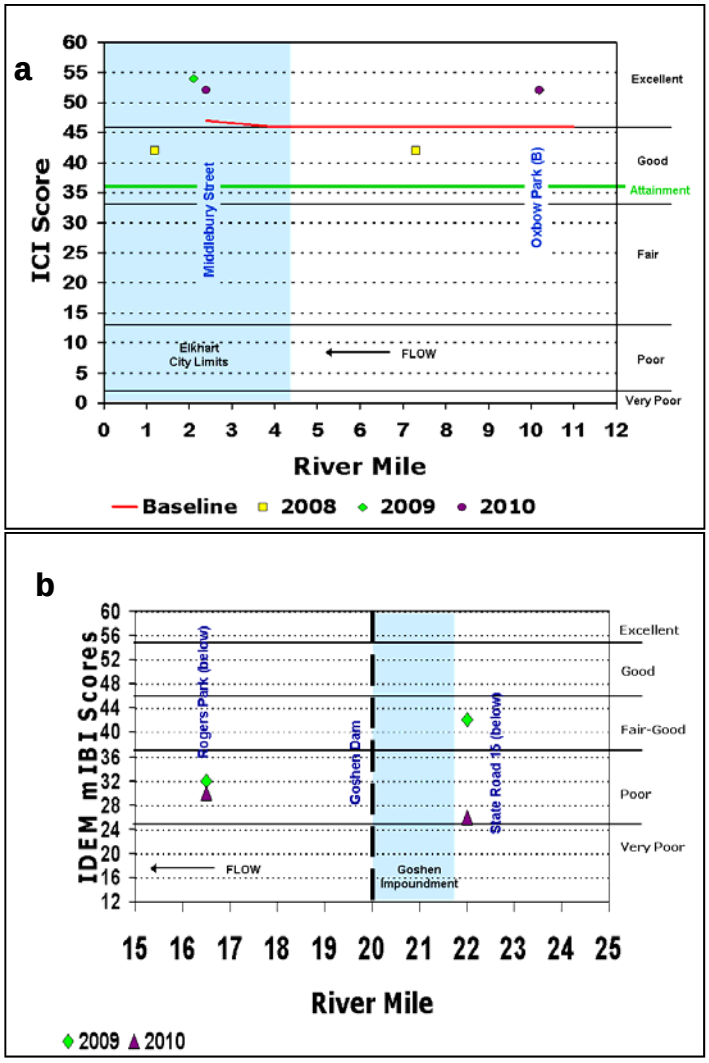
IBI scores for the St. Joseph River in the South Bend area continue to be promising (Figure 6). Pinhook (B) was the only site to fall below the baseline. This site had an IBI score of 49 while the baseline is 51; a two point drop is not considered to be significant and is likely attributed to the natural variability. In 2007, this site had an IBI score of 46, which is considered to be a significant drop from the baseline, so perhaps the 2010 score of 49 is a reflection of a recovery from disturbance. The other St. Joseph County sites scored well above baseline scores supporting a trend in water quality improvement that has been observed in the South Bend area over the last few years. Michigan Street had an IBI score of 50, which is five points above the baseline, and Capital Avenue had an IBI score of 51 which is eighth points above the baseline. ICI scores for the three South Bend sites that were sampled were also pretty impressive (Figure 7). Pinhook (B) had the lowest ICI score (46) of the three South Bend sites, which is still considered excellent. The Capital Avenue site saw a very impressive change in ICI scores since the last time that it was sampled in 2007. In 2007, the site had a score of 36, which is indicative of an almost impaired macroinvertebrate community. However, in 2010 this site had an ICI score of 54, which is the highest out of all sites sampled. Habitat scores at index sites in the South Bend area all fell within the excellent range (Figure 8). In 2010, an investigative survey was performed above Veterans' Park. Habitat at this site was almost excellent.

IBI scores on the two Elkhart River sites within Elkhart City limits were above their respective baseline scores (Figure 9). The IBI score at Middlebury Street was 49 which is well above the baseline value of 44. The ICI score for this site (52) was also well above the baseline value of 47 (Figure 10a). Unfortunately, the IBI score at Oxbow Park continues to remain well below the baseline. A drop in IBI scores was also observed at this site in 2007 and 2008. Kring (2009), attributed this drop to erosion and enrichment problems from upstream sources. Fish community scores from 2010 confirm a long-term impact to this site. A macroinvertebrate assessment was performed at the site just below Oxbow Park in 2010. The Oxbow (below) site was also sampled in 2009 (Figure 10a). The ICI score for this site was 52, which was the same score that was observed in 2009. The Oxbow (below) site also scored very well for fish in 2009 suggesting that the observed impacts do not continue downstream from the Oxbow Park site.

For the second straight year, Index sampling was conducted at three sites on the Elkhart River in the Goshen area. IBI scores in 2010 varied very slightly from 2009, and a small increase occurred at Shanklin Park pushing this site into the excellent category. Once again, IDEM macorinverte-

Figure 10a: ICI scores for the Elkhart River, Elkhart area

Figure 10b: mIBI for the Elkhart River, Goshen area

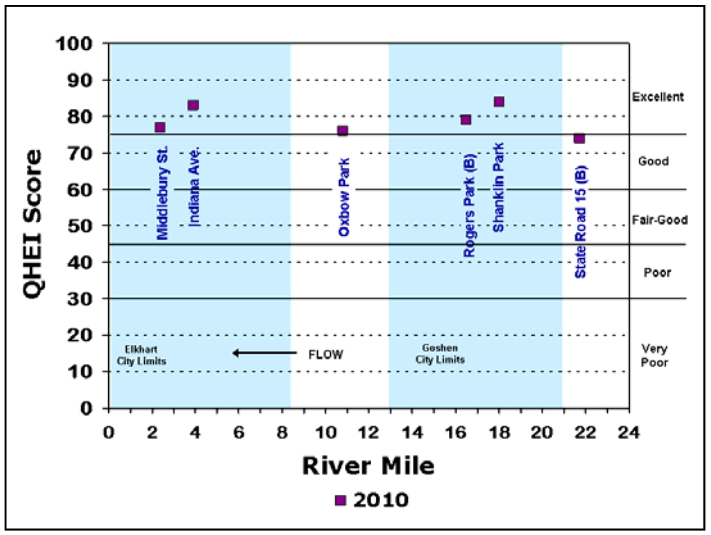


brate IBI scores were a lot less impressive for Elkhart River sites in Goshen (Figure 10b) illustrating how different groups of aquatic organisms react to stressors and the importance of sampling different groups concurrently. The mIBI score at SR 15 (B) plummeted in 2010. This site is located on the upstream side of the Goshen impoundment and at the confluence of Turkey Creek, an area that is impacted by significant sediment loading. The harsh muddy conditions that occurred in the summer of 2010 are likely responsible for this negative response by the macroinvertebrate community. QHEI scores indicate that habitat along the Elkhart River from Goshen to Elkhart is in the good to excellent range (Figure 11). The Elkhart River continues to maintain above average habitat for streams in the greater St. Joseph River Watershed.

While it is important to monitor the main stem of the St. Joseph and Elkhart Rivers, it is also important to monitor the tributaries of these streams. Assessing the tributaries provides more information on the observed conditions within the larger streams. Similar longitudinal views are presented for area tributaries and current results can be compared against past conditions.

Juday Creek and Bowman Creek are two tributaries of the St. Joseph River that flow through areas of South Bend. Both tributaries are heavily impacted by urban influences, but they are quite different from an ecological standpoint. Juday Creek is a cool/cold water stream that is capable of sup-

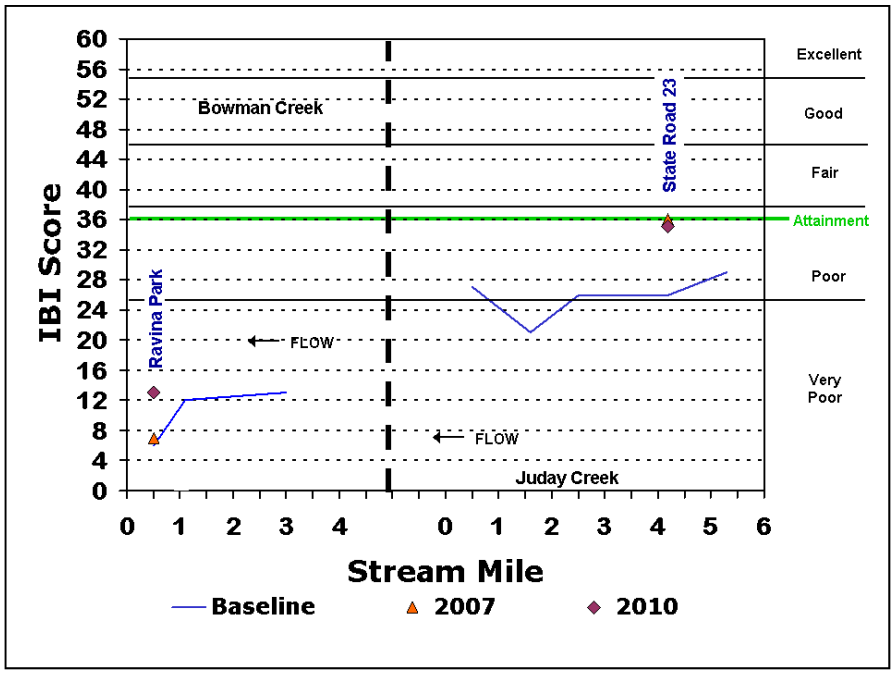
Figure 11: QHEI scores for the Elkhart River, Elkhart County



porting trout, whereas Bowman Creek is much warmer with historically impaired biological communities.

The IBI score at Ravina Park on Bowman Creek (13) was the highest since the initiation of monitoring at this site in 2001 (Figure 12). During the second sampling event in 2010, a total of 157 fish were collected. While the predominant fish species were juvenile creek chubs, three other species were collected at this site. Although the IBI scores for this site demonstrate that it is significantly impaired, the results from 2010 are encouraging, as on numerous occasions, no fish have been collected at this site during sampling. It is also not uncommon for this stream to run dry in the summer months. A macroinvertebrate assessment was completed at Ravina Park for the first time in 2010. Although the HD sampler and the back-up HD sampler that were set at Ravina Park were vandalized, a qualitative sample was collected. Based on the qualitative sample, Ravina Park fell in the fair/impaired category for macroinvertebrates.

Figure 12: IBI scores for Bowman Creek and Juday Creek, St. Joseph County



The IBI score for SR 23 on Juday Creek was 35 which is slightly below the attainment line (Figure 12). This site also had an IBI score of 36 the last time it was sampled in 2007. The baseline IBI score for this site is 26, so these results are very promising. In fact, with the exception of the Izaak Walton League site, all sites along Juday Creek have seen improvement above baseline scores in the last five years. Although many residential properties along Juday Creek at SR 23 have created stream diversion channels into their yards, the habitat along this creek continues to be in the good range (Figure 14). The ICI score at State Road 23 (52) fell within the excellent range (Figure 13). This is up significantly from 2007 when the site had an ICI score of 46. The ICI score is surprising given that the fish community is impaired at this site, however, this is just another indication of the fish community being more sensitive to ecological stressors within Juday Creek. The Aquatics staff has performed a preliminary investigation into the use of a coolwater IBI for Juday Creek (see Page 20 and Appendix F for additional information).

The IBI score at CR 32 on Yellow Creek (30) was well below the baseline score of 36 (Figure 15). This site had an IBI score of 31 in 2007 confirming a long-term decline in stream integrity at this site. This site, in the upper reaches of Yellow Creek is highly influenced by agricultural activity and perturbation (ecological disturbance) associated with unsteady stream flow. Yellow Creek is one of many Elkhart County regulated drains that has been significantly straightened and is highly influenced by drastic water level fluctuations. Despite the impaired fish community, the habitat at this site almost falls within the good range (Figure 16), indicating that water quality is the limiting factor at this site.

The IBI score for Lily Creek at Reckell Avenue (24) was significantly lower than the baseline score of 34 (Figure 15). Kring, 2008 reported that trees and stumps were removed from this section of

Figure 13: ICI Scores of Juday Creek, St. Jospeh County

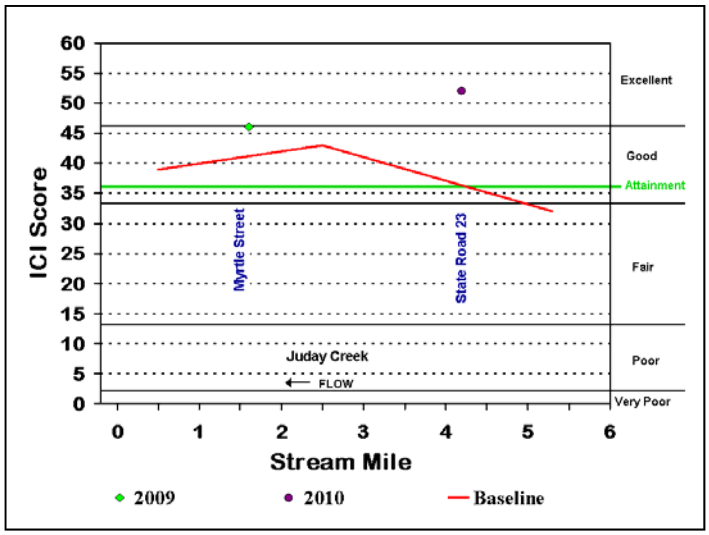


Figure 14: QHEI scores for Bowman Creek and Juday Creek, St. Joseph County

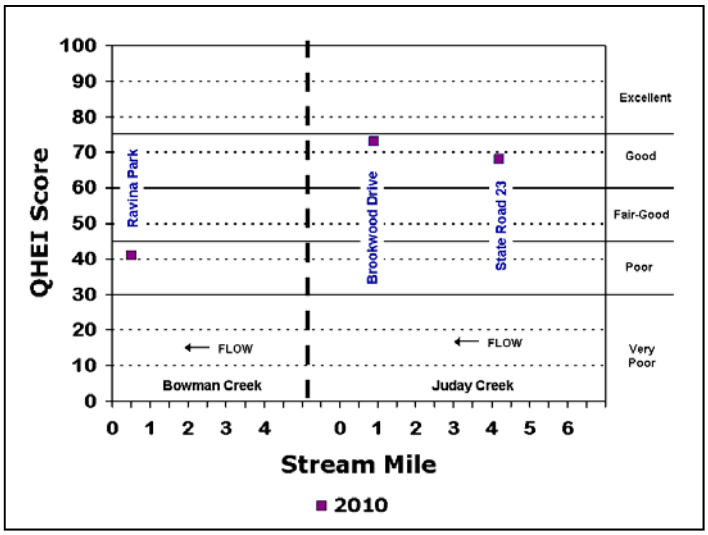


Figure 15: IBI scores for Lily Creek and Yellow Creek, Elkhart County

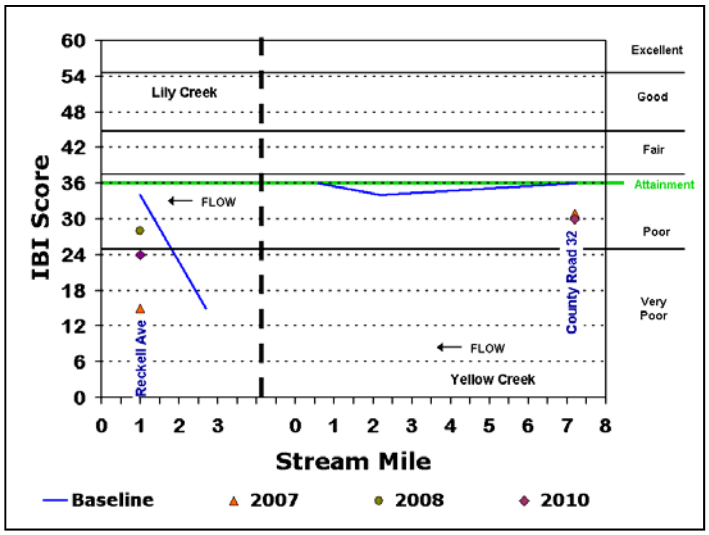
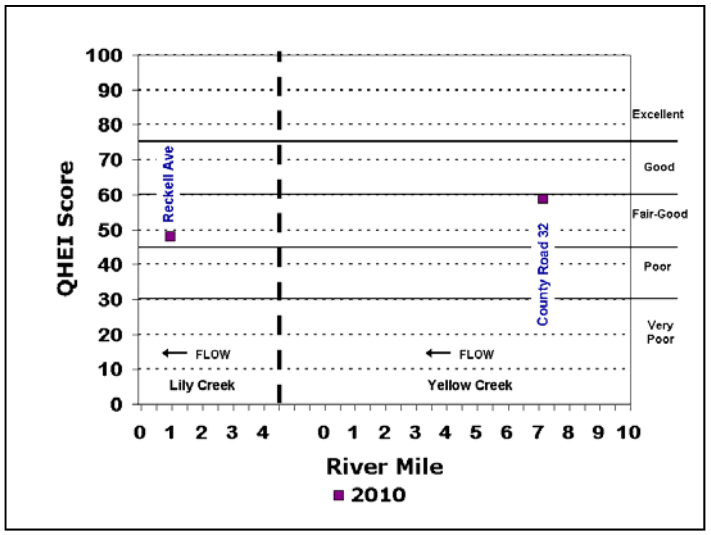


Figure 16: QHEI scores for Lily Creek and Yellow Creek, Elkhart County



stream sometime prior to 2007 causing a huge drop in the IBI to 15. The Aquatics Program sampled this site again in 2008, at which time some evidence of recovery was observed (the 2008 IBI score was 28). However, based on the results from 2010, this stretch of Lily Creek has not fully recovered, and more importantly continues to have impaired biological communities. Habitat, or the lack of it, is also a significant limitation (Figure 16). The other site at Park Six Drive on Lily Creek is in worse shape than Reckell Avenue, and will occasionally run dry in the hot summer months. Given the extent of modification to Lily Creek and that it continues to be "maintained" as a regulated drain, it is unlikely that this stream will be within attainment any time soon.

Christiana Creek at CR 4 had an IBI score of 52 in 2010, which was four points above the baseline (Figure 17). This site also scored above the baseline the last time it was sampled in 2007. While a four point increase is typically not considered to be significant and could be attributed to normal variables, based on monitoring results over the past few years, there appears to be a trend of increased fish community integrity along this stream. Although the fish community fared well in 2010, the ICI score at County Road 4 was 46 which is just slightly lower than the baseline score of 47 (Figure 18). Habitat scores for CR 4 continue to be in the excellent range (Figure 19).

In 2010, the IBI score at County Road 10 on the Little Elkhart River (45) was above the baseline score of 41 (Figure 17). This site also had an IBI score of 46 when it was previously sampled in

Figure 17: IBI scores for Christiana Creek and the Little Elkhart River, Elkhart County

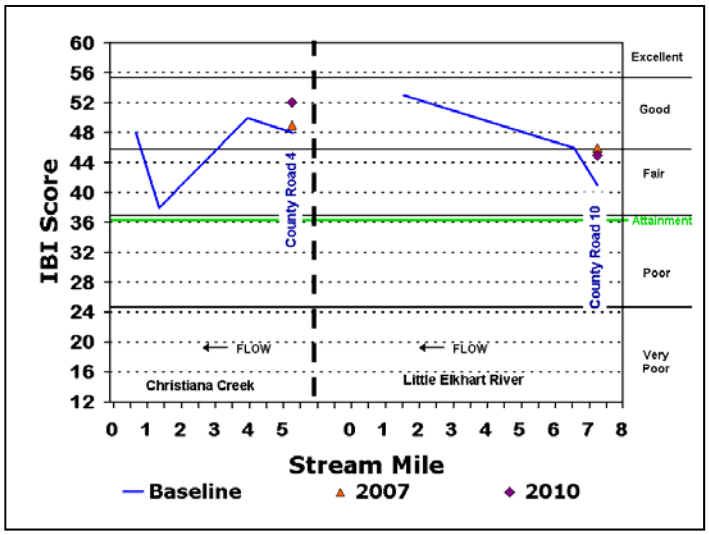
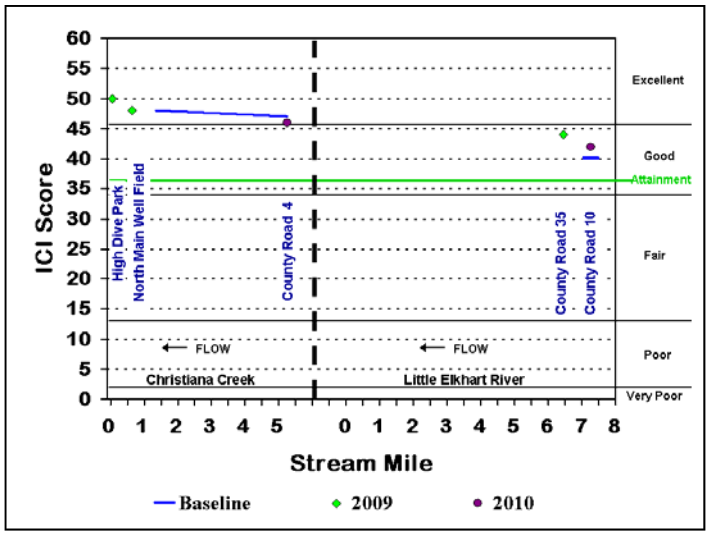
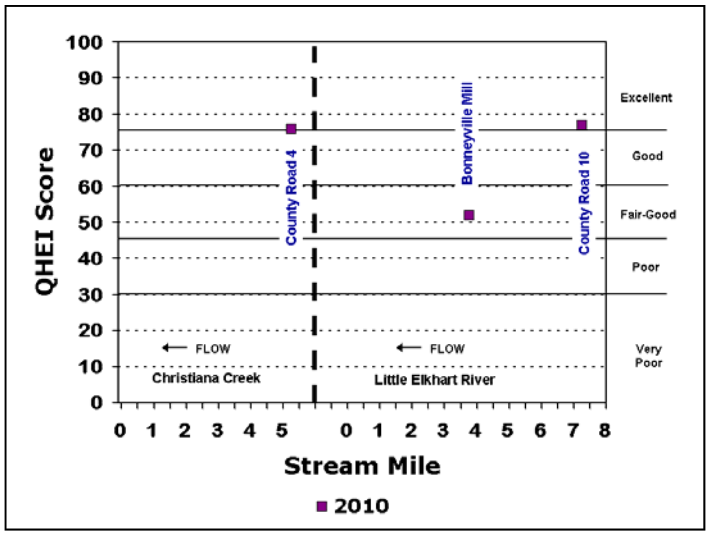


Figure 18: ICI scores for Christiana Creek and the Little Elkhart River, Elkhart County



2007. Similar trends in fish community improvement have also been observed at County Road 35 and at SR 120 in the past several years suggesting water quality improvements. The baseline depicted in Figure 17 demonstrates that IBI scores improve along the Little Elkhart as it moves downstream. The same phenomenon also occurs on Pine Creek, which is another Elkhart County coolwater tributary. Foy, 2001 suggested that this may be a result of proximity to the St. Joseph River as sites downstream may recruit warmwater species from the St. Joseph River. This is certainly a plausible explanation, but there is room to argue that it is a result of improved water quality. Within a coolwater system such as the Little Elkhart River, there is high groundwater infiltration into the stream. In upper reaches of the Little Elkhart the stream is significantly ditched and receives large influxes of agricultural runoff. However, as the stream flows towards the St. Joseph River, the habitat improves and non-point sources of contaminants are reduced. Based on increased drainage area/stream size and high groundwater infiltration in lower reaches, it is possible that contaminant concentrations are lower than in the lower reaches. In 2010 the ICI score at County Road 10 was 42, up slightly from the baseline score of 40 (Figure 18). The habitat score at County Road 10 remained within the excellent range. An investigative survery was performed above Bonneyville Mill on the Little Elkhart in 2010. While habitat at this site fell within the fair-

Figure 19: QHEI scores for Christiana Creek and the Little Elkhart River, Elkhart County



good range, which is uncharachteristic of the Little Elkhart River, the habitat at this site has been impacted by the damming of the river (Figure 19).

Results from fish, macroinvertebrate, and habitat

Figure 20: IBI scores for Rock Run Creek and Turkey Creek, Elkhart County

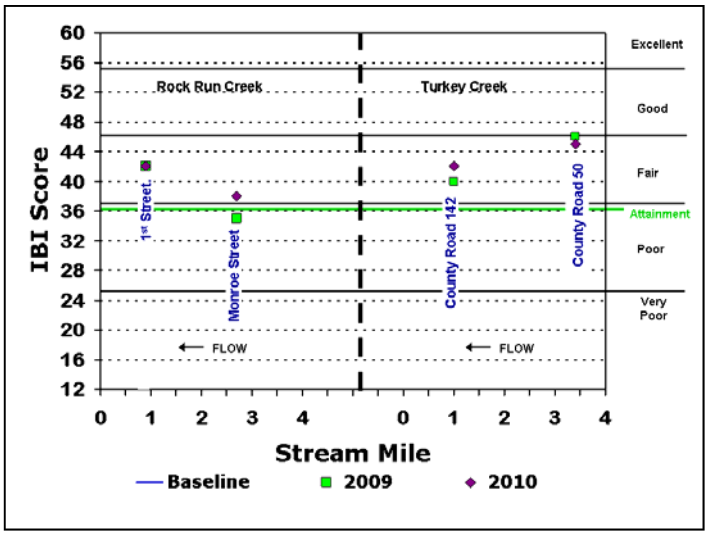
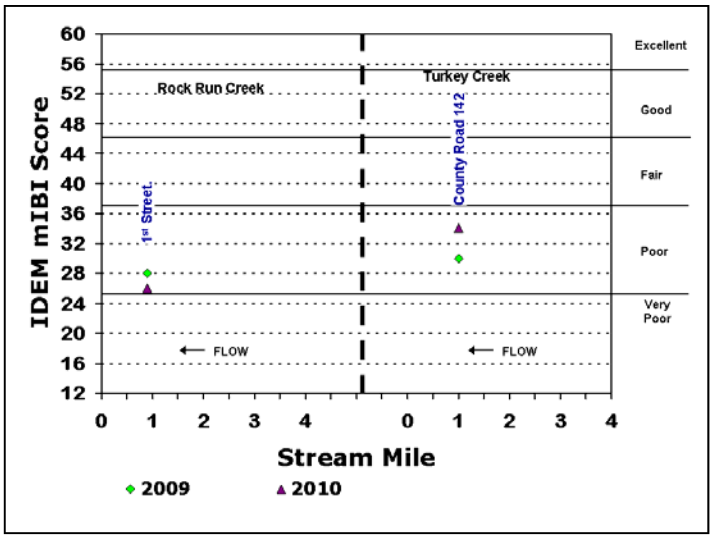


Figure 21: mIBI scores for Rock Run Creek and Turkey Creek, Elkhart County

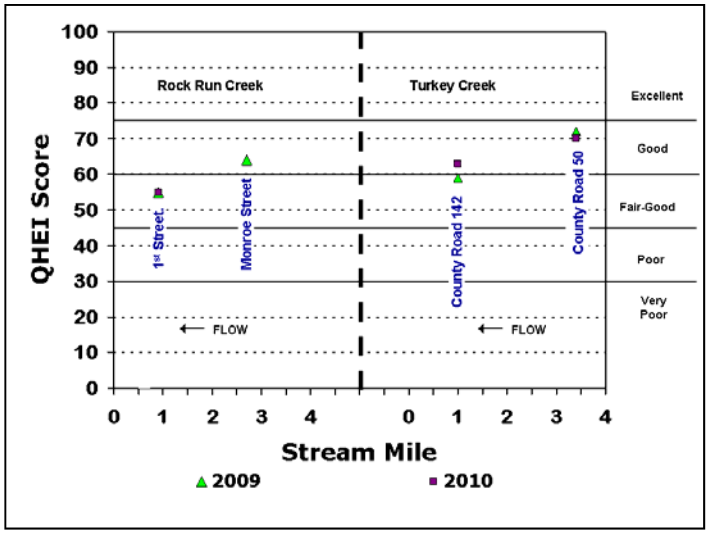


surveys on Turkey Creek and Rock Run Creek were similar to those observed in 2009 (see Figures 20, 21, and 22). Of the four Goshen area tributary sites, County Road 50 on Turkey Creek had the highest IBI score (45). The QHEI score (71) demonstrates the influence habitat has on this site. Although Turkey Creek has been straightened and modified for drainage purposes, the County Road 50 portion of Turkey Creek is a little less impacted and a little more sinuous than other areas along this stream. The site at County Road 142 had fish IBI and QHEI scores of 42 and 63 respectively. The lower IBI score is likely an artifact of reduced habitat availability associated with ditching practices. Stream straightening has a significant impact on instream morphology,

where dynamic complexes of riffles, runs, and pools can be reduced to a system with a uniform depth and a uniform substrate type. The mIBI score for CR 142 was 34. This score was up slightly from 2009 but still falls within the "impaired" range.

The Rock Run 1st Street site had comparable IBI scores to Turkey Creek County Road 142. For the second straight year, the fish IBI score for 1st Street (42) was within the "fair" range, while the mIBI (26) indicates that the macroinvertebrate

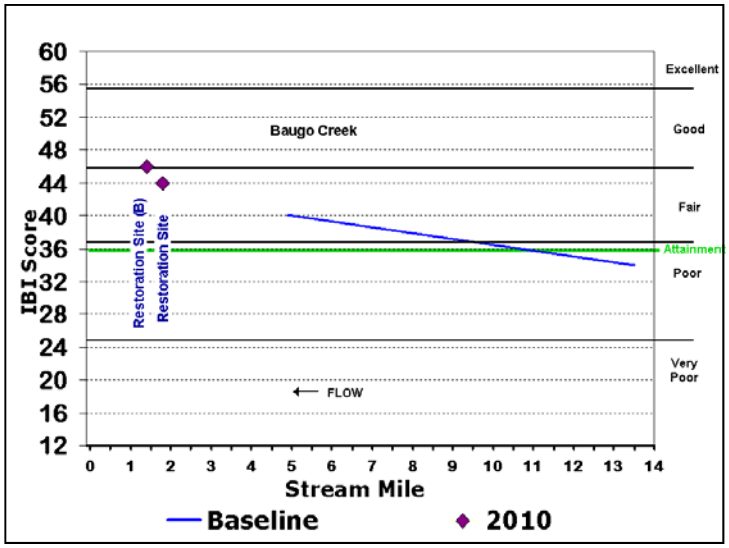
Figure 22: QHEI scores for Rock Run Creek and Turkey Creek, Elkhart County



community is impaired. The two year average QHEI score for the 1st Street site (55) was the lowest of the four Goshen tributary area sites, although it was still considered fair to good according to QHEI criteria. This portion of Rock Run has been significantly modified and straightened, and no riffle habitat was observed. The Rock Run Monroe Street site had a fish IBI score of (38). Although this site scored within the fair range, it is barely within attainment according to IDEM standards. The two year average QHEI score for this site (58.5) is slightly higher than the QHEI score at 1st Street, indicating that water quality may be more of a limiting factor at Monroe Street than at 1st Street. The Monroe Street site is located on the eastern side of Goshen's city limits and is highly influenced by intensive agricultural practices and associated surface water discharges.

In 2010, the Aquatics team initiated index sampling at two new sites on Baugo Creek. The Elkhart County Drainage Board is implementing stream restoration practices along several stretches of Baugo Creek. The two new sites that were chosen by the Aquatics Program were within

Figure 23: IBI scores for Baugo Creek, Elkhart and St. Joseph Counties



and downstream of the most significant restoration project, which is located right at the St. Joseph County line. The impetus for monitoring these sites is to determine the impact this restoration has on the biological communities within the stream. The Aquatics staff will also perform follow-up monitoring after the completion of the restoration efforts. The IBI score at the downstream site (46) was slightly higher than the restoration site (Figure 23). Both sites also had excellent habitat, which likely had a positive effect on the IBI scores at both sites (Figure 24). Fish abundance was very high at both sites; close to 2,000 fish were collected at the Restoration (Below) site during the second sampling pass. Although these high numbers may seem impressive, they are indicative of an enrichment problem on Baugo

Figure 24: QHEI scores for Baugo Creek, Elkhart and St. Joseph Counties

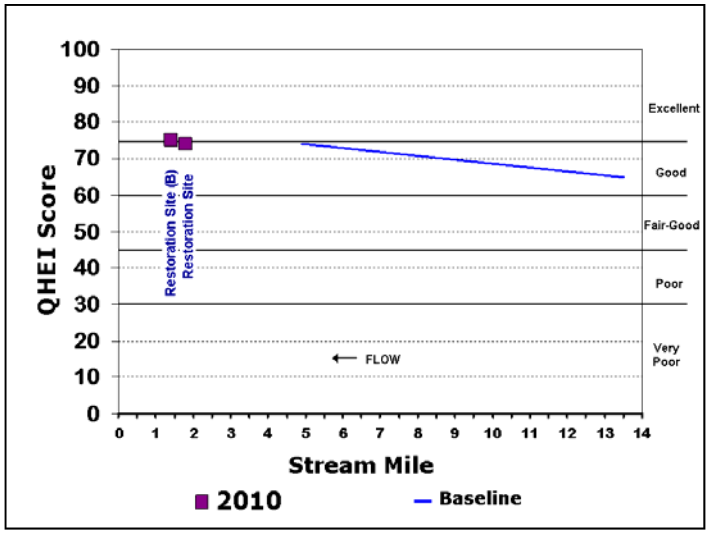
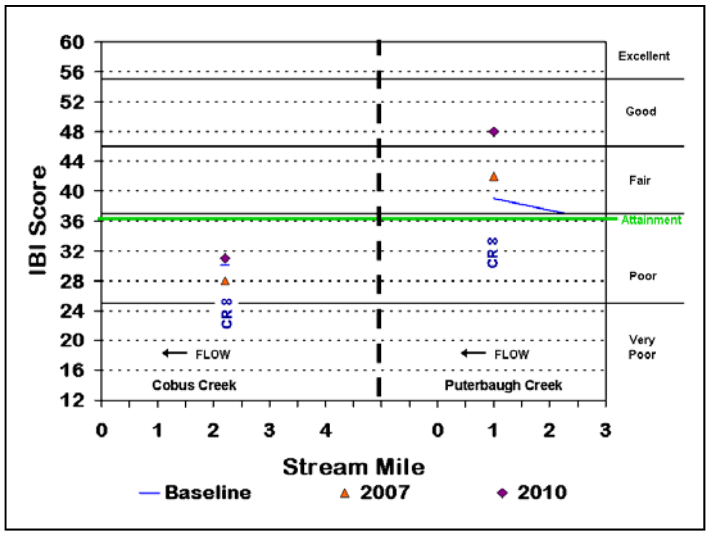


Figure 25: IBI Scores for Cobus Creek and Putterbaugh Creek, Elkhart County



Creek. The ICI score at the restoration site was 36, which is considered to be just within attainment. It will be interesting to see if restoration improvements have a significantly positive impact during follow-up biological assessments.

Putterbaugh Creek is another Elkhart County coolwater stream. While connecting Heaton Lake north of Elkhart with the St. Joseph River it expands less than four miles. This creek has several coldwater fish species, but recruits warmwater species from the larger bodies of water. In 2010, the fish IBI score was 48, which is the highest since the inception of monitoring at this site and considered good (Figure 25). The baseline IBI score for this site is 39, and the last time it was monitored in 2007 the site scored a 42. These data suggest a water quality improvement at this

Figure 27: QHEI Scores for Cobus Creek and Putterbaugh Creek, Elkhart County

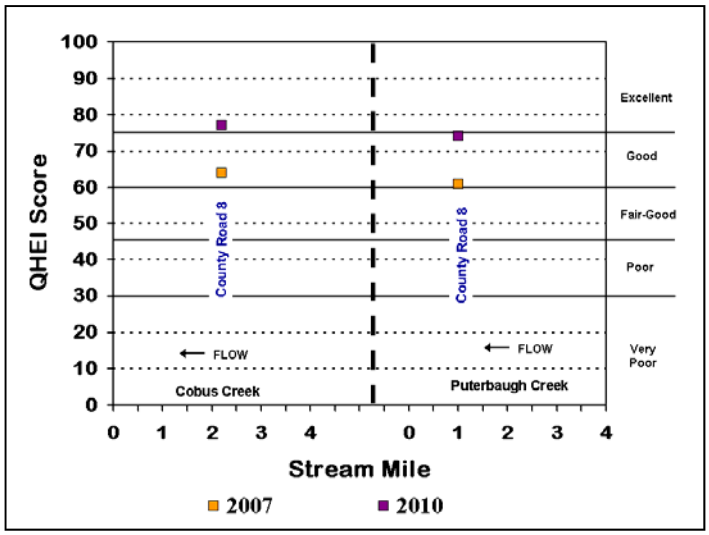
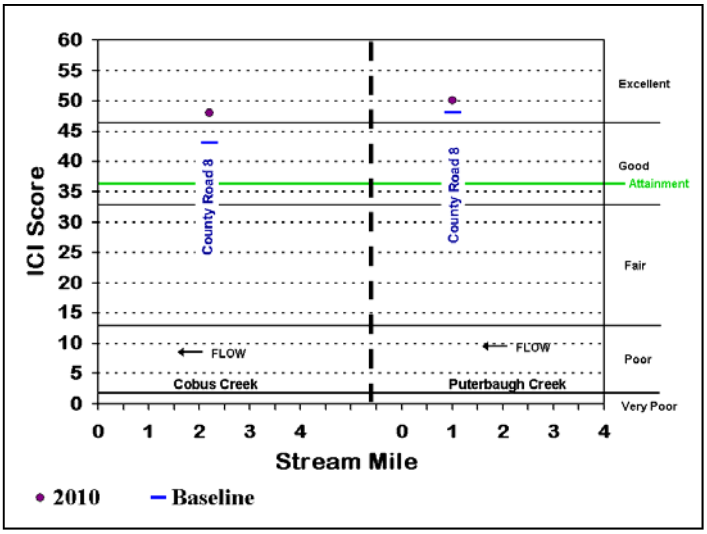


Figure 26: ICI Scores for Cobus Creek and Putterbaugh Creek, Elkhart County



site, although they may be a reflection of improved habitat. The 2010 QHEI score for this site was 74, putting it just outside of the excellent category (Figure 27). This site has wonderful forest/swamp floodplain that supports good instream habitat and an excellent macroinvertebrate community. Although the 2010 ICI score for this site (50) was not significantly higher than the baseline (Figure 26), it continues to be in the excellent range.

Cobus Creek at County Road 8 is another coldwater stream that supports a decent stocked brown trout population. The IBI score for this site (31) fell within the poor category (Figure 25) which was slightly above the baseline. Since the initiation of monitoring at this site, the IBI scores have remained very consistent. The habitat at this site scored in the excellent category in 2010 (Figure 27) suggesting that the poor fish community may be related to water quality issues. However, the ICI score for Cobus Creek in 2010 was 48 which is significantly higher than the baseline and considered excellent overall (Figure 26). Similar trends in fish and macroinvertebrate community conditions were also observed at Judy Creek in 2010, another area coolwater stream. The current IBI may need some tuning to properly assess coolwater ecosystems, which includes all of the cool/coldwater streams previously discussed. A preliminary analysis for Cobus Creek using a Coolwater IBI was conducted. (see Page 20 and Appendix F for additional information).

Tagging and Movement

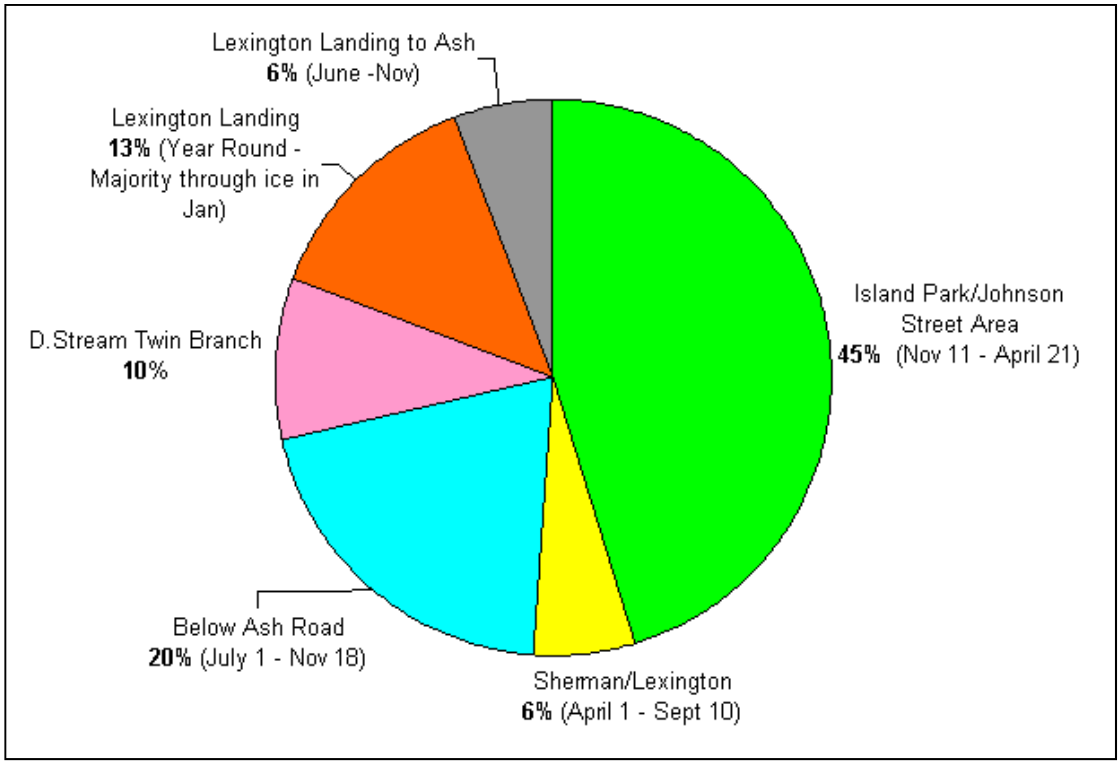
2010 marked the second year in which fish were

Table 4: Length, weight, and collection location for recaptured walleye in 2010

Tag Location	Tag Date	Length(in)/Weight(lbs)	Recapture Location	Recapture Date	Length(in)/Weight(lbs)
Elkhart River YMCA	3/23/2005	15.9/1.3	St Joseph River Lexington Landing	1/4/2010	19.0/-
Elkhart River YMCA	3/23/2004	22.1/4.3	St Joseph River Lexington Landing	1/13/2010	29.4/9.2
St. Joseph River Lexington	7/27/2006	16.1/1.5	St Joseph River Main Street	3/2/2010	19.0/-
Elkhart River YMCA	4/5/2006	19/2.2	St. Joseph River Johnson Street	3/18/2010	22/-
Elkhart River YMCA	4/3/2008	23.0/4.8	St. Joseph River Island Park	3/28/2010	25/-
St. Joseph River Baugo Bay	9/26/2007	16.5/1.4	St. Joseph River Island Park	4/1/2010	17.5/-
Elkhart River YMCA	3/23/2005	16.9/1.35	St. Joseph River Island Park	4/1/2010	21.5/-
Elkhart River YMCA	3/23/2005	17.9/1.6	St. Joseph River Lexington Landing	8/19/2010	19.9/2.4
Elkhart River YMCA	3/23/2004	16.7/1.6	St. Joseph River Bittersweet Bridge	10/25/2010	19.5/-

not tagged by the Aquatics Program. The City of Elkhart initiated fish tagging in 1998, but the tagging permit was not granted by the DNR following 2006. Under the tagging permit, the Aquatics Program tagged largemouth bass, smallmouth bass, and walleye. Since 2002, the Aquatics team has performed annual walleye sampling runs with the DNR near Johnson Street Dam and Island Park in Elkhart. During these occasions, large numbers of walleye were tagged and recaptured. The annual walleye sampling run was not completed in 2009 or 2010 due to time constraints, but the Aquatics staff is hopeful that these events will continue in the future.

Figure 28: A summary of recapture location data for 85 walleye that were tagged in downtown Elkhart during the spring sampling runs from 2002 to 2008.



The tagging program has been very successful since its inception, and almost 12% of the fish have been recaptured either by the Aquatics staff or anglers. Several fish have even been recaptured 3 times or more. The information provided by anglers has been essential to the success of the tagging program. In 2010, 10 walleye were recaptured on the St. Joseph River (Table 4). No largemouth bass or smallmouth bass were

Table 5: Fish consumption information taken from the 2010 Indiana Fish Consumption Advisory

Location	Species	Fish Size (inches)	Contaminant	Group
Elkhart River *Elkhart County (Goshen to CR 18 in Elkhart)*	Golden Redhorse	Up to 17		1
	Rock Bass	Up to 7		1
	White Sucker	Up to 16		1
Elkhart River *Elkhart County (CR 18 to downtown Elkhart)*	Rock Bass	9+	PCBs	3
	Smallmouth Bass	17+	PCBs	3
	White Sucker	16+	PCBs	3
Christiana Creek *Elkhart County*	Northern Hogsucker	Up to 14		1
	Rock Bass	Up to 7		1
	Yellow Bullhead	Up to 9		1
St. Joseph River *Elkhart County*	Bluegill	Up to 8		1
	Channel Catfish	All	PCBs	3
	Common Carp	Up to 25	PCBs	3
		25+	PCBs	4
	Northern Hogsucker	15+	PCBs	3
	Rockbass	Up to 7		1
	Redhorse Species	17+	PCBs	3
	Walleye	25+	PCBs	3
	White Sucker	Up to 14		1
St. Joseph River *St. Joseph County (Baugo Bay Area to Petro Park)*	Bluegill	Up to 8		1
	Channel Catfish	Up to 22	PCBs	3
		22+	PCBs	4
	Largemouth Bass	Up to 13		1
	Rock Bass	Up to 8		1
	Spotted Sucker	Up to 17		1
	White Sucker	Up to 14		1
St. Joseph River *St. Joseph County (Petro Park to Indiana State Line)*	Bluegill	7+	PCBs	4
	Channel Catfish	All	PCBs	4
	Common Carp	15-20	PCBs	3
		20-25	PCBs	4
		25+	PCBs	**5**
	Chinook Salmon	28+	PCBs	4
	Carpsucker species (Quilback)	Up to 19	PCBs	4
		19+	PCBs	**5**
	Rock Bass	Up to 7	PCBs	2
	Smallmouth Bass	Up to 16	PCBs & Mercury	2
	Steelhead Trout	30+	PCBs	4
	Yellow Bullhead	Up to 10	PCBs	2
Juday Creek	White Sucker	17+	PCBs	3

Table 6: Indiana State Fish Consumption Advisory (FCA) Groupings

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

recaptured. Since the black basses have not been tagged since 2006, it is unlikely that a lot of bass recaptures will be reported in the future.

The tagging data that was received in 2010 continues to provide valuable information on walleye movement within the St. Joseph River. It is quite evident, that many walleye occupy backwater channels throughout the year; three of the 10 walleye were recaptured in the Lexington Landing channel, while 1 was initially captured and tagged in the same location. It should also be noted that two of the walleye that were recaptured at Lexington Landing were caught by anglers during the ice fishing season indicating that the St. Joseph River also provides a decent hard-water walleye fishery.

Several fish were recaptured in downtown Elkhart. Three of the five fish that were recaptured in downtown Elkhart were actually tagged in the downtown area. The Aquatics Program has witnessed this for many years as the walleye return upstream to the Johnson Street Dam area in the late winter/early spring to spawn. The most travelled 2010 recapture was tagged in downtown Elkhart in 2004, but was recaptured by an angler at the Bittersweet Bridge in Mishawaka, a distance of approximately 10.2 river miles. Another long-distance traveler was initially tagged in Baugo Bay in 2007 and was recaptured in downtown Elkhart in the Spring of 2010, a distance of 8.5 river miles.

Figure 28 summarizes the recapture location and time of the year for all fish that were tagged in downtown Elkhart during spring sampling events. In total, 85 walleye were tagged in downtown Elkhart from 2002 to 2008 by the Aquatics Program. A significant portion of those fish (45%) were recaptured in downtown Elkhart during their annual spawning run. While these data are limited to 85 fish, they do provide some information on walleye migratory patterns and angler effort based on location and time of the year.

Fish Tissue

In 2010, tissue was collected from fish in both Elkhart and St. Joseph Counties. Collections were based on the current Indiana Fish Consumption Advisory (FCA) for area streams and potential data gaps within the FCA. Fish were also collected on the Elkhart River in Goshen for the Elkhart River Restoration Association. The FCA provides guidance on the rate of consumption of local wild fishes (Table 5). Based on PCB or mercury concentrations, fish species within a certain size range will be placed within a FCA Grouping. Table 6 summarizes each grouping and the associated guidance. 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 breastfeeding, 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, the State FCA should be reviewed.

On the Elkhart River in Goshen, PCB and mercury concentrations in fish tissues varied slightly from 2009 for rock bass and white suckers. In 2009, rock bass (6.8-7.2") fell into the Advisory's Group 1 for both contaminant types meaning that it is safe to consume an unlimited amount of these species. However, results from 2010 showed slightly higher levels of PCBs, and rock bass larger than 7.5" fell into Group 2 for PCBs. The FCA recommends restricting meals to once per week for fish that fall into Group 2. White suckers were also in Group 1 for both contaminant types in 2009, but in 2010 fell into Group 2 for mercury. The white suckers collected in 2010 were also slightly larger than those collected in 2009 which could be the reason for the elevated contaminant concentrations. Performing fish tissue analysis on the same species, from the same area, in back to back years proved to be a good idea as the results did vary. Based on the data from 2010, the FCA may need to be amended once again for the Goshen area for rock bass and white suckers.

For the second straight year Golden redhorse fell into Group 2 for mercury and smallmouth bass

fell into group 1 for both contaminant types. Despite the fact that three species in 2010 fell into Group 2, contaminant concentrations are still relatively low in fish from the Goshen area, and fish should be considered safe to eat as long as they are consumed in moderation and as recommended in the FCA.

In addition to the fish collected in Goshen, the Aquatics team also collected rock bass, smallmouth bass and white suckers from the Elkhart River in Elkhart (Indiana Avenue). Rock bass in the 7" size range fell in Group 1 for both contaminants. The FCA currently places rock bass in the 9" size range in Group 3 for PCBs. Given that 7" rock bass are more abundant in the Elkhart River, the FCA may need to be amended to include these data. Smallmouth bass in the 12-13" size range and white suckers in the 16" range fell in Group 2 for both PCBs and Mercury. The white sucker results do not agree with the FCA, but that is not unexpected given the variables associated with working with wild fish. The FCA currently lists smallmouth bass in the 17" range from the Elkhart area of the Elkhart River in Group 3 for PCBs. However, the 12-13" fish are more abundant in the Elkhart river, and the FCA may also need to be adjusted to include these data.

In 2010, the Aquatics Program collected bluegill and largemouth bass from the St. Joseph River above the Johnson Street Dam in Elkhart. Bluegill in the 7" size range fell in Group 1 for both contaminants, while largemouth bass in the 13.5" size range fell into Group 2 for mercury. Given that largemouth bass are a very popular game fish species in the Elkhart area, these data should be included in the FCA.

Smallmouth bass in the 12.5" size range and walleye in the 15" range were also collected in the Elkhart area below the Johnson Street Dam. The smallmouth bass fell in group 2 for mercury. However, the walleye fell in Group 1 for both contaminant types. The FCA currently lists Walleye in the 25"+ size range in Group 3 for PCBs. While 25" walleye are not uncommon, smaller walleye are more abundant and more frequently captured and kept for consumption. Therefore, the FCA may need to be amended to include smaller walleye for the Elkhart area.

Walleye tissue was collected again in St. Joseph County even though it is not on the FCA. Since this species is a well sought after sport fish, the Aquatics staff feels it's important to keep anglers informed on the contaminant levels in this species. Walleye (15.2-16.7") fell in Group 1 for Mercury and Group 2 for PCBs. In previous years, walleye were in Group 2 for mercury and Group 3 for PCBs, but those fish were a lot larger. Smallmouth bass in the 12-13" size range were also collected in the South Bend area, and fell in Group 2 for mercury and Group 3 for PCBs. The FCA currently lists smallmouth bass up to 16" in Group 2 for PCBs.

Preliminary Analysis of Indiana's Coolwater IBI

In 2007, the Indiana Biological Survey developed a statewide coolwater IBI. The Aquatics staff has long felt the need for a Coolwater IBI to adequately assess fish communities in our coolwater streams. In an effort to determine if the Coolwater IBI is appropriate for use in our area, the Little Elkhart River, Juday Creek, and Cobus Creek were analyzed and compared using the current IBI and the Coolwater IBI. Results from the analysis vary for the three streams. The Coolwater IBI provides almost identical results for Juday Creek, while significantly reducing IBI scores for the Little Elkhart River, and significantly increasing IBI scores on Cobus Creek. Inconsistencies in how the two different IBI types relate to each other and react to fish assemblages calls into question the appropriateness of using the Coolwater IBI in the St. Joseph River Basin. The Coolwater IBI is a broad-based index that has not been calibrated for each specific ecoregion within the State. Another potential issue is the definition of a coolwater stream. Many local streams are coolwater in nature, where they have significant groundwater infiltration, but they also have warmwater influences as a result of natural or anthropogenic activity. In addition, water temperatures in coolwater streams vary from stream to stream, but the Coolwater IBI is not set up to account for different water temperatures. At this time, the current IBI is providing a meaningful longitudinal and temporal analysis of all of our local streams. In coming years, the Aquatics Program will further evaluate the Coolwater IBI for potential use.

A detailed review of the preliminary Coolwater IBI analysis on the Little Elkhart River, Juday Creek, and Cobus Creek is presented in Appendix F.

Surface Water Chemistry

The City of Elkhart's Laboratory staff have been performing surface water quality monitoring on select sites of the St. Joseph and Elkhart Rivers on a weekly basis for many years. River samples have been analyzed for *E. Coli*, total suspended

solids (TSS), carbonaceous biochemical oxygen demand (CBOD5), dissolved oxygen (DO), pH, phosphorus (PO4), ammonia, and seven metals. The sites that were sampled include: Six-Span Bridge, Johnson Street, Main Street, and Ash Road on the St. Joseph River, and County Road 18 and Jackson Boulevard on the Elkhart River. Three of the sites were strategically placed to consider the impact of the Elkhart River on the St. Joseph River (see Figure 29 for site locations). Given the many years and frequency of sampling, a large data set containing a long-term picture of surface water pollutant characteristics has been obtained in the Elkhart area.

Results from 1998 to 2011 reveal that most parameters (CBOD5, ammonia, and the seven metals) are low to non-detect on the Elkhart and St. Joseph Rivers. DO concentrations generally ranged between eight to 10 milligrams per liter (mg/L) at the six sites that were sampled, while average concentrations were slightly higher at those sites that are in close proximity and on the downstream side of dams. Values of pH remained close to eight at all sites that were sampled. The remaining parameters, *E. coli*, TSS, and PO4, were detected at all sites and in high concentrations in some instances.

Total suspended solids (TSS) is a measure of the amount of particles in water. In the St. Joseph River system, most of the solids are made up of sediment from erosion activity and unstable hydrology. Although sediment itself is an inert material, it can have significant impacts on aquatic organisms when present in heavy loads. For example, sediment can cover fish nests and spawning substrate, it can impair an aquatic animals ability to find food, and it can carry pollutants that are bound to it. Phosphorus (PO4) is an essential nutrient in the aquatic environment, but can cause serious problems, such as algae blooms and fish kills at high concentrations. PO4 is also responsible for over-enrichment of our aquatic systems which can impact recreational activity through excessive weed growth. *E. coli* is bacteria that is derived from the fecal matter of humans and other animals. The presence of *E. coli* at high levels is an indicator of pathogenic activity that might be harmful to humans during swimming or contact with the water.

From 1998 to 2011, average (mean) concentrations of TSS, *E. coli* and PO4 follow similar trends (Figures 30, 31, 32). At Six Span Bridge and Johnson Street average concentrations of these contaminants are much lower than those at downstream sites (Main Street and Ash Road). It is quite evident that the Elkhart River

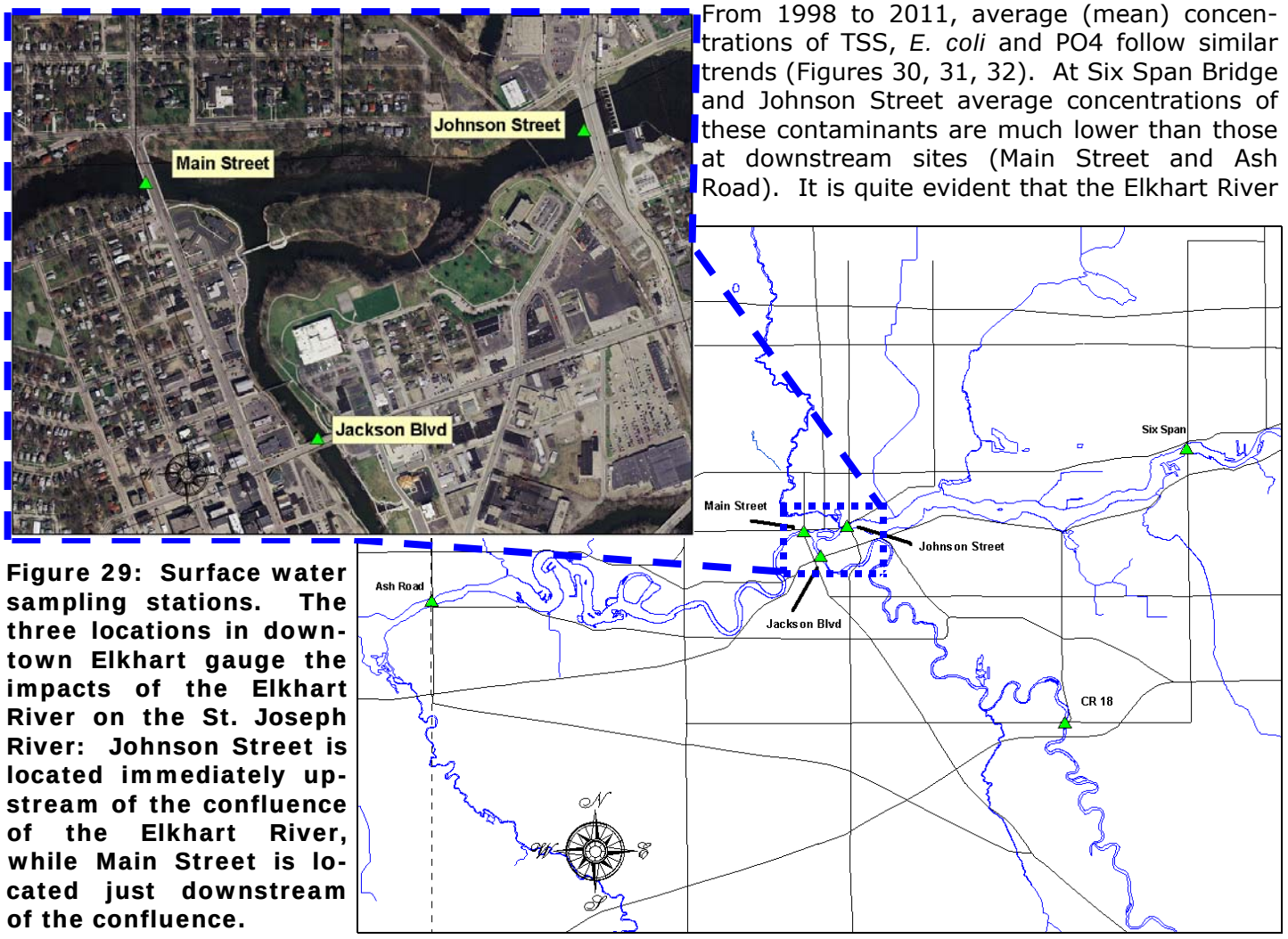
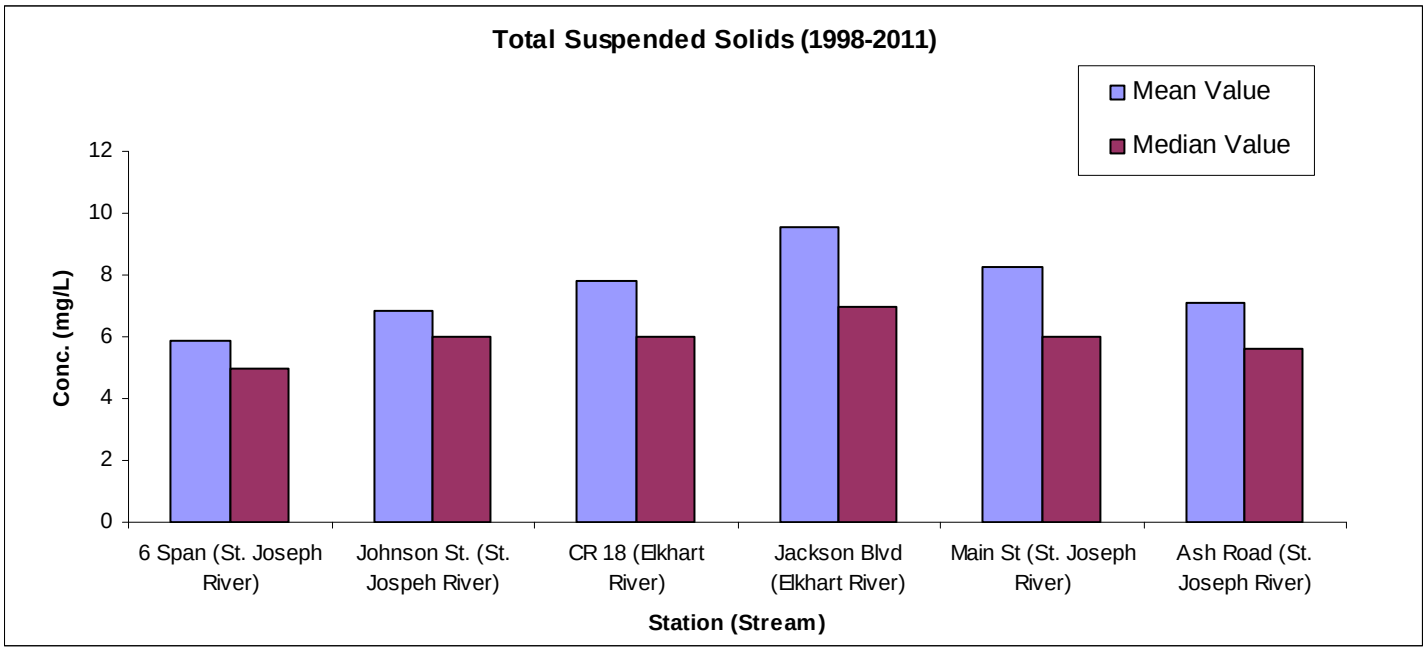


Figure 29: Surface water sampling stations. The three locations in downtown Elkhart gauge the impacts of the Elkhart River on the St. Joseph River: Johnson Street is located immediately upstream of the confluence of the Elkhart River, while Main Street is located just downstream of the confluence.

Figure 30: Mean and Median Total Suspended Solid Concentrations



is a significant contributor of contaminants to the St. Joseph River. The impacts of the Elkhart River on the St. Joseph River are seen all the way to Ash Road where contaminant concentrations remain higher than those at Johnson Street and Six Span. It is also very possible that other urban sources in Elkhart are contributing to the contaminant concentrations at Ash Road.

Another interesting aspect that is revealed by these data is the difference in contaminant concentrations between County Road 18 and Jackson Boulevard on the Elkhart River. It is possible that urban influences in Elkhart City limits are contributing to the elevated concentrations at Jackson Boulevard, but another likely source is Yellow Creek which enters the Elkhart River between the 2 sampling points.

Figures 30, 31, and 32 summarize the average (mean) and median concentrations of contaminants at all sites. The mean concentrations ade-

Figure 31: Mean and Median *E. Coli* Concentrations

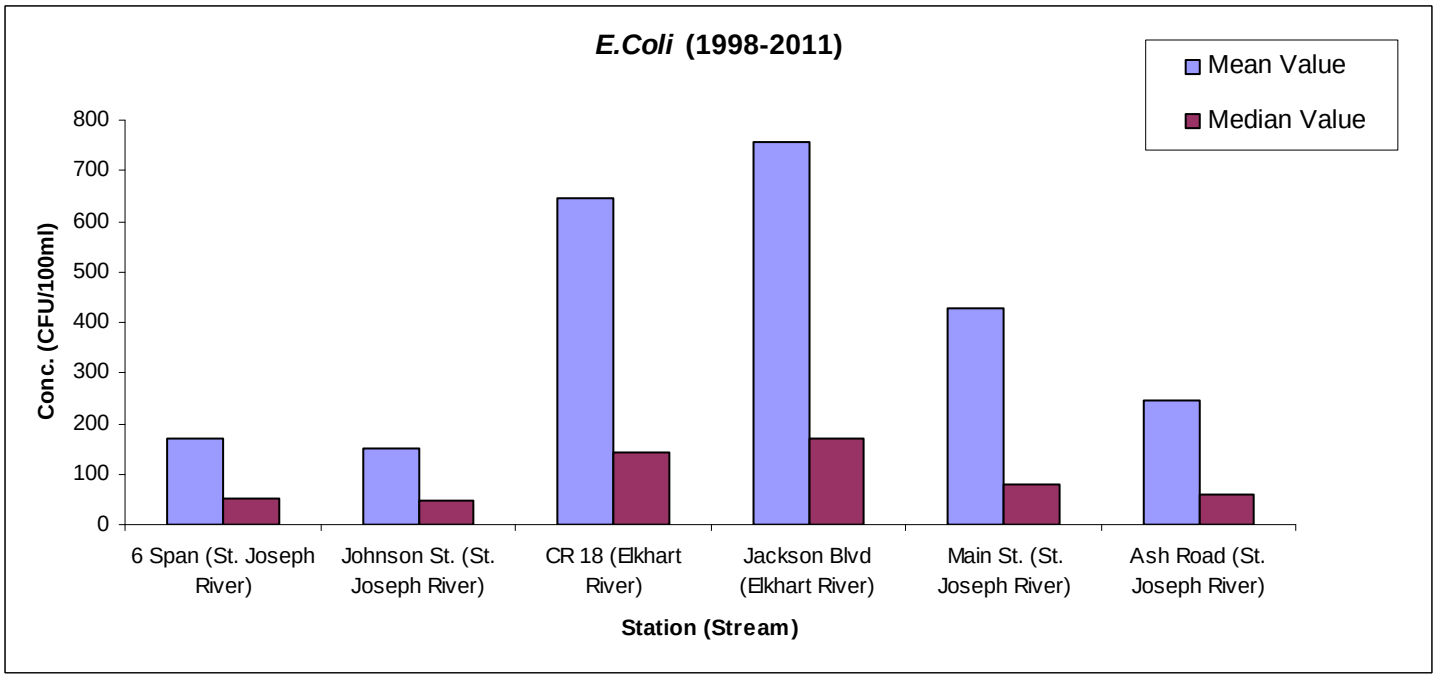
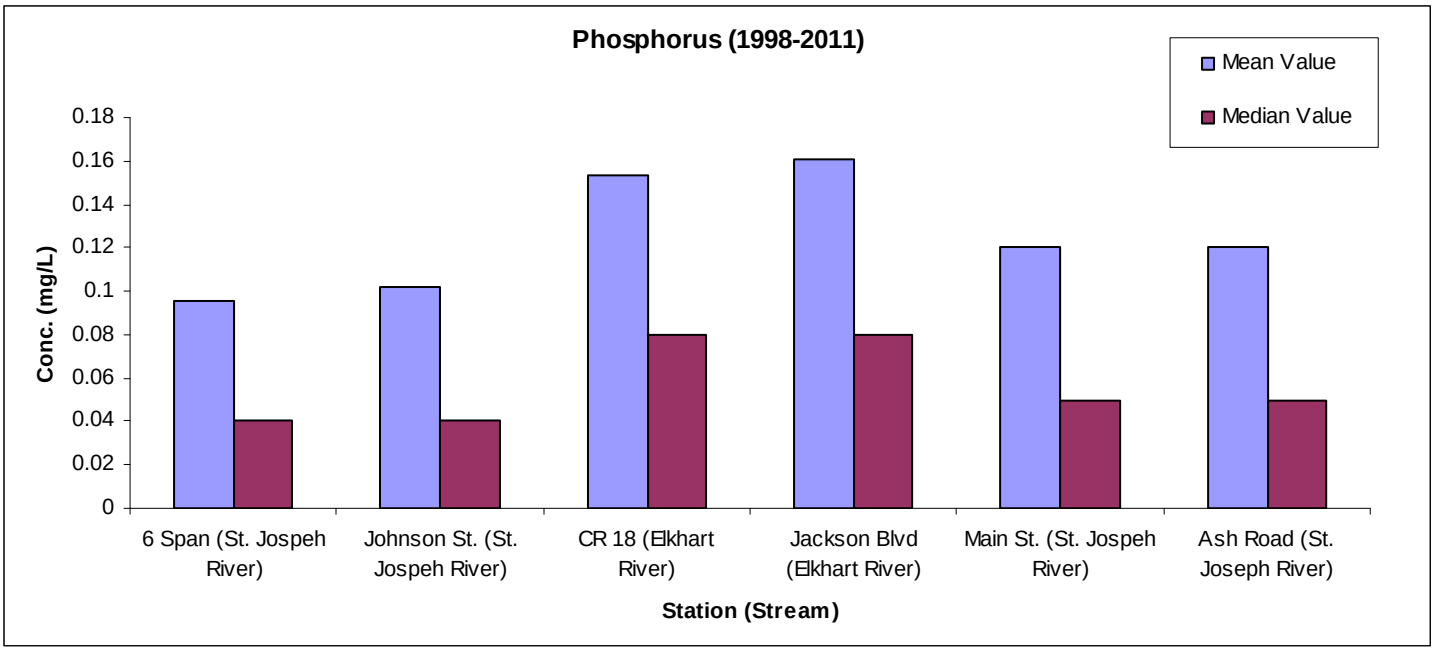


Figure 32: Mean and Median Phosphorus Concentrations

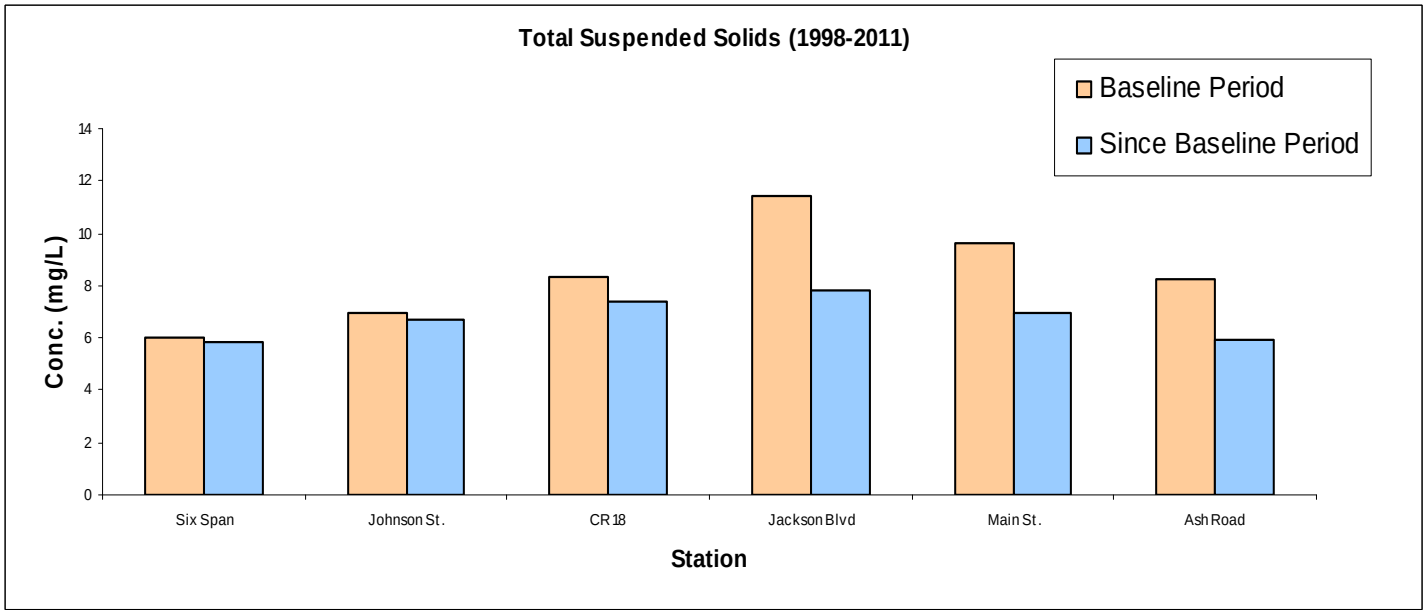


quately depict the extent of the problem. However, in many cases the median concentrations are far lower than the mean indicating that concentrations fluctuate significantly. Although water discharge data have not been compared to chemical data, it is generally understood that contaminant concentration spikes are attributed to rain events and unstable hydrological conditions.

Data also suggest that contaminant concentrations have fallen since the Aquatics Program completed baseline aquatic community monitoring in 2003 (Figure 33). These data correspond with biological monitoring data that also suggest some stream improvements in the Elkhart area.

These contaminant data were analyzed statistically to determine if there are significant differences among sites. More information on the statistical analysis is presented in Appendix G. More information regarding contaminant data can be obtained by contacting the City of Elkhart Public Works Laboratory.

Figure 33: Mean and Median Phosphorus Concentrations



Conclusion

Long-term biological monitoring in the Indiana portion of the St. Joseph River watershed continues to provide us with valuable information on the condition of the aquatic communities inhabiting our area waterways.

Conditions in the St. Joseph River and most of its tributaries appear to be gradually improving. For the past three years most fish and macroinvertebrate scores have been either at or above baseline values on the St. Joseph River. Tributaries that also stand out include the Elkhart River, Christiana Creek, the Little Elkhart River, Pine Creek, Juday Creek, and Putterbaugh Creek. Christiana Creek leads the way in being the areas highest quality stream, hosting diverse communities of fish and macroinvertebrates and a high percentage of sensitive organisms.

Streams that continue to host impaired biological communities include Yellow Creek, Rock Run Creek, Lily Creek and Bowman Creek. These tributaries along with the Elkhart River, Turkey Creek and Baugo Creek are hydrologically unstable and contribute a significant amount of sediment and pollutants to the St. Joseph River.

Performing concurrent assessments of fish and macroinvertebrates continues to provide a more rigorous analysis of local stream quality. In several streams, like the Elkhart River and Turkey Creek in Goshen, fish communities appear to be doing well while the macroinvertebrate communities indicate stream quality problems. On the other hand, streams like Cobus Creek and Juday Creek have impaired fish communities, but excellent macroinvertebrate communities. While a healthy stream will have healthy communities of fish and macroinvertebrates, an impaired stream may have impaired fish communities, or impaired macroinvertebrate communities, or both. By looking at both groups of organisms, we are finding impairment and attainment where it otherwise would have been missed if only looking at one type of organism.

The 2010 report also includes some surface water chemical data for the Elkhart area. The Aquatics Program will continue to look at more ways to incorporate chemical data in our future reports. Having chemical data in addition to looking at fish and macroinvertebrates in area streams will strengthen our analysis of stream quality.

Acknowledgements

I thank the 2010 Crew: Camry Hess, Dave Huntington, and Dale Zielke. Their efforts made it a fun and efficient summer. Many thanks to the former Aquatic Biologists Len Kring and Joe Foy who continue to provide guidance. Lynn Brabec deserves most of the credit for the continued success of the program. Without Lynn's guidance, support and management, the program would be non-existent. Thanks go to the cities of Elkhart and South Bend for their leadership in the area of aquatic resource protection. Through the establishment of an interlocal agreement between the Cities, the fish communities of the entire Indiana section of the St. Joseph River have been and will continue to be monitored.

A special thanks go to the administration and support staff of Elkhart's Public Works & Utilities for their continued assistance and support of this program and their true dedication to environmental protection. Individuals that make a significant contribution to the Program are: Laura Kolo, Barry Abell, Matt Heineman, Travis Meyer, Megan Kolaczyk, Angie Banet, Tim Cataldo and Dan Pasternak.

Thanks are also extended to local groups such as the Michiana Walleye Association, The Elkhart River Restoration Association, and The Friends of the St. Joe River. The work by these groups and others is helping improve water quality throughout the watershed.

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SUMMER 2010

Dale with a pretty spotted gar downstream of Pinhook Park in South Bend

Dave with a giant South Bend Muskie

Camry with a very nice walleye at Shanklin Park in Goshen

Dave with a greater redhorse at Indiana Avenue on the Elkhart River

Daragh with a couple of nice largemouth bass collected above Trout Creek on the St. Joe River

Three nice channel cats at SR 15 on the St. Joe River in Bristol

Camry and Dale with a couple of big northern pike collected from the Goshen Pond on the Elkhart River

APPENDICES

Appendix A

Index of Biotic Integrity metrics

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

Indiana's newly adopted macroinvertebrate IBI metrics (used for sites that were performed on behalf of the ERRA):

1. Total number of taxa
2. Total Abundance
3. Number of EPT taxa (mayflies, stoneflies and caddisflies)
4. Percent Orthoclad and tanytarsini
5. Percent of non-insects (not including crayfish)
6. Number of Dipteran Taxa
7. Percent Intolerant Taxa
8. Percent Tolerant Taxa
9. Percent Predators
10. Percent Shredders & Scrapers
11. Percent Collectors/Filterers
12. Percent Sprawlers

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

St. Joseph River

Station	Species	Length Range	Advisory Length Range	Hg Advisory Group (ours)	Hg Advisory Group (state)	PCB Advisory Group (PW)	PCB Advisory Group (State)
Six-Span	Largemouth Bass	13.3-13.7	NA	2	-	1	-
Homan Avenue	Bluegill	6.8-7.3	Up to 8	1	1	1	1
McNaughton Park	Smallmouth Bass	12.2-12.6	NA	1	-	1	-
Lexington Landing	Walleye	15.0-15.4	25+	1	-	1	3
Michigan Street	Smallmouth Bass	12.2-12.8	Up to 16	2	2	3	2
Michigan Street	Rock Bass	7.9-8.2	Up to 7	1	1	2	2
Pinhook Park (B)	Walleye	15.2-16.7	NA	1	-	2	-

Elkhart River

Station	Species	Length Range	Advisory Length Range	Hg Advisory Group (ours)	Hg Advisory Group (state)	PCB Advisory Group (PW)	PCB Advisory Group (State)
Shanklin Park	Smallmouth Bass	11.7-12.8	-	1	-	1	-
Rogers Park - Below (Goshen)	Rock Bass	7.7-7.9	Up to 7	1	1	2	1
Rogers Park - Below (Goshen)	Golden Redhorse	16.7-16.9	Up to 17	2	1	1	1
Rogers Park - Below (Goshen)	White Sucker	16.1-16.7	Up to 16	2	1	1	1
Indiana Ave.	Smallmouth Bass	11.9-13.1	17+	2	-	2	3
Indiana Ave.	Rock Bass	7.1-7.2	9+	1	-	1	3
Indiana Ave.	White Sucker	15.6-16.9	16+	2	-	2	3

Appendix C

Summary of fish collected by county, 2010

Summary of species captured at index sites in Elkhart County, 2010

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Mimic Shiner	2372	12.93	3143	6.93	0.19
White Sucker	1593	8.68	266555	587.64	16.08
Rock Bass	1432	7.81	109929	242.35	6.63
Bluntnose Minnow	1026	5.59	2966	6.54	0.18
Creek Chub	1009	5.50	16340	36.02	0.99
Smallmouth Bass	866	4.72	109457	241.31	6.60
Striped Shiner	816	4.45	10957	24.16	0.66
Johnny Darter	653	3.56	830	1.83	0.05
Spotfin Shiner	634	3.46	2510	5.53	0.15
Blacknose Dace	594	3.24	1654	3.65	0.10
Bluegill	584	3.18	26556	58.54	1.60
Golden Redhorse	577	3.15	316162	697.01	19.07
Stoneroller, Central	511	2.79	4758	10.49	0.29
Longear Sunfish	496	2.70	16586	36.57	1.00
Northern Hog Sucker	485	2.64	119697	263.88	7.22
Common Shiner	444	2.42	7936	17.50	0.48
Rainbow Darter	406	2.21	561	1.24	0.03
Mottled Sculpin	403	2.20	1875	4.13	0.11
Shorthead Redhorse	399	2.18	165125	364.03	9.96
Hornyhead Chub	309	1.68	8630	19.03	0.52
Green Sunfish	300	1.64	3827	8.44	0.23
Logperch	300	1.64	2161	4.76	0.13
Central Mudminnow	245	1.34	1581	3.49	0.10
Orangethroat Darter	211	1.15	282	0.62	0.02
Sand Shiner	207	1.13	384	0.85	0.02
Largemouth Bass	203	1.11	37878	83.51	2.28
Grass Pickerel	161	0.88	5624	12.40	0.34
Rosyface Shiner	112	0.61	278	0.61	0.02
Longnose Dace	102	0.56	376	0.83	0.02
Blackside Darter	96	0.52	352	0.78	0.02
Chestnut Lamprey	78	0.43	870	1.92	0.05
Silverjaw Minnow	71	0.39	173	0.38	0.01
Pirate Perch	54	0.29	241	0.53	0.01
Steelcolor Shiner	53	0.29	232	0.51	0.01
Spotted Sucker	50	0.27	9940	21.91	0.60
Walleye	49	0.27	11762	25.93	0.71
Silver Redhorse	45	0.25	78340	172.71	4.73
Northern Pike	44	0.24	24336	53.65	1.47
Yellow Bullhead	44	0.24	5700	12.57	0.34
Common Carp	40	0.22	137798	303.79	8.31
Longnose Gar	37	0.20	12722	28.05	0.77
American Brook Lamprey	35	0.19	224	0.49	0.01
Brown Trout	30	0.16	2511	5.54	0.15
Redear Sunfish	22	0.12	2867	6.32	0.17
Bowfin	20	0.11	36779	81.08	2.22
Pumpkinseed	19	0.10	498	1.10	0.03

Summary of species captured at index sites in Elkhart County, 2010 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Black Crappie	16	0.09	1917	4.23	0.12
River Redhorse	13	0.07	34900	76.94	2.11
Channel Catfish	11	0.06	21987	48.47	1.33
Greater Redhorse	9	0.05	17550	38.69	1.06
Banded Killifish	9	0.05	38	0.08	0.00
Hybrid Sunfish	8	0.04	278	0.61	0.02
Quillback	7	0.04	9500	20.94	0.57
Brook Stickleback	6	0.03	4	0.01	0.00
Stonecat	5	0.03	236	0.52	0.01
Greenside Darter	4	0.02	11	0.02	0.00
Tadpole Madtom	3	0.02	38	0.08	0.00
Rainbow Trout	2	0.01	644	1.42	0.04
Warmouth	2	0.01	118	0.26	0.01
Yellow Perch	2	0.01	62	0.14	0.00
YOY Suckers (Unid.)	2	0.01	2	0.00	0.00
Brown Bullhead	1	0.01	456	1.01	0.03
Black Redhorse	1	0.01	84	0.19	0.01
Gizzard Shad	1	0.01	40	0.09	0.00
Golden Shiner	1	0.01	4	0.01	0.00
Blackstripe Topminnow	1	0.01	3	0.01	0.00
Brook Silverside	1	0.01	1	0.00	0.00
Total	**18,342**	**100**	**1,657,836**	**3,655**	**100**

Summary of species captured at investigative sites in Elkhart County, 2010

Common Name	Total Number	% byNumber
Bluegill	80	16.49
White Sucker	58	11.96
Golden Redhorse	48	9.90
Sand Shiner	41	8.45
Smallmouth Bass	36	7.42
Mottled Sculpin	32	6.60
Northern Hog Sucker	29	5.98
Striped Shiner	17	3.51
Spotfin Shiner	14	2.89
Mimic Shiner	14	2.89
Rock Bass	14	2.89
Longear Sunfish	12	2.47
Largemouth Bass	10	2.06
Yellow Perch	10	2.06
Johnny Darter	9	1.86
Spotted Sucker	7	1.44
Chestnut Lamprey	5	1.03
Common Shiner	5	1.03
Grass Pickerel	5	1.03
Rosyface Shiner	5	1.03
Shorthead Redhorse	4	0.82
Steelcolor Shiner	3	0.62
Common Carp	3	0.62
Silver Redhorse	3	0.62
Green Sunfish	2	0.41
Hornyhead Chub	2	0.41
Rainbow Trout	2	0.41
Central Mudminnow	2	0.41
Bluntnose Minnow	2	0.41
Black Crappie	2	0.41
Black Redhorse	2	0.41
Greater Redhorse	1	0.21
Northern Pike	1	0.21
Longnose Gar	1	0.21
Creek Chub	1	0.21
Brown Bullhead	1	0.21
Blackside Darter	1	0.21
Logperch	1	0.21
Total	**485**	**100**

Index Sites	18,342
Investigative Sites	485
Elkhart County Total	18,827

Summary of species captured at index sites in St. Joseph County, 2010

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Smallmouth Bass	306	10.63	47,485	104.68	8.08
Longear Sunfish	294	10.22	9,778	21.56	1.66
Mimic Shiner	271	9.42	414	0.91	0.07
Green Sunfish	258	8.96	2,705	5.96	0.46
Rock Bass	246	8.55	19,955	43.99	3.40
Spotfin Shiner	239	8.30	1,083	2.39	0.18
Creek Chub	189	6.57	1,349	2.97	0.23
Golden Redhorse	183	6.36	126,248	278.32	21.49
Bluegill	177	6.15	5,811	12.81	0.99
Shorthead Redhorse	104	3.61	76,407	168.45	13.01
Northern Hog Sucker	72	2.50	20,930	46.14	3.56
Mottled Sculpin	69	2.40	364	0.80	0.06
Black Redhorse	66	2.29	46,624	102.79	7.94
Logperch	51	1.77	505	1.11	0.09
White Sucker	44	1.53	15,984	35.24	2.72
Pumpkinseed	41	1.42	1,552	3.42	0.26
Largemouth Bass	40	1.39	6,379	14.06	1.09
Bluntnose Minnow	25	0.87	59	0.13	0.01
Common Carp	24	0.83	120,700	266.09	20.55
Quillback	22	0.76	30,400	67.02	5.18
Steelcolor Shiner	17	0.59	60	0.13	0.01
Walleye	16	0.56	8,010	17.66	1.36
Johnny Darter	16	0.56	24	0.05	0.00
Silver Redhorse	14	0.49	26,250	57.87	4.47
Greenside Darter	12	0.42	36	0.08	0.01
Chestnut Lamprey	9	0.31	112	0.25	0.02
Yellow Bullhead	8	0.28	1,156	2.55	0.20
Hybrid Sunfish	7	0.24	395	0.87	0.07
Spotted Sucker	6	0.21	1,606	3.54	0.27
Redear Sunfish	6	0.21	291	0.64	0.05
Blackside Darter	5	0.17	14	0.03	0.00
Gizzard Shad	4	0.14	1,880	4.14	0.32
Longnose Gar	4	0.14	1,875	4.13	0.32
Blacknose Dace	4	0.14	9	0.02	0.00
Spotted Gar	3	0.10	1,832	4.04	0.31
Stonecat	3	0.10	208	0.46	0.04
Warmouth	3	0.10	175	0.39	0.03
Rainbow Darter	3	0.10	10	0.02	0.00
Brook Silverside	3	0.10	7	0.02	0.00
River Redhorse	2	0.07	4,900	10.80	0.83
Brown Trout	2	0.07	1,265	2.79	0.22
Northern Pike	2	0.07	1,084	2.39	0.18
Spottail Shiner	2	0.07	3	0.01	0.00
Channel Catfish	1	0.03	1,258	2.77	0.21
Black Crappie	1	0.03	166	0.37	0.03
Rainbow Trout	1	0.03	131	0.29	0.02
Striped Shiner	1	0.03	5	0.01	0.00
Golden Shiner	1	0.03	4	0.01	0.00
Fathead Minnow	1	0.03	4	0.01	0.00
Total	**2,878**	**100**	**587,502**	**1,295**	**100**

Summary of species captured at investigative sites in St. Joseph County, 2010

Common Name	Total Number	% by Number
Creek Chub	181	23.00
Mottled Sculpin	94	11.94
Longear Sunfish	67	8.51
Rock Bass	67	8.51
Blacknose Dace	58	7.37
White Sucker	53	6.73
Central Mudminnow	50	6.35
Smallmouth Bass	34	4.32
Mimic Shiner	30	3.81
Green Sunfish	20	2.54
Pumpkinseed	15	1.91
Common Carp	15	1.91
Brook Silverside	14	1.78
Golden Redhorse	11	1.40
Quillback	8	1.02
Johnny Darter	7	0.89
Yellow Bullhead	7	0.89
Sand Shiner	7	0.89
Rainbow Trout	6	0.76
Rainbow Darter	6	0.76
Largemouth Bass	5	0.64
Spotfin Shiner	4	0.51
Shorthead Redhorse	4	0.51
Bluegill	4	0.51
Hybrid Sunfish	4	0.51
Spotted Sucker	3	0.38
Greater Redhorse	3	0.38
Orangethroat Darter	3	0.38
Logperch	1	0.13
Northern Pike	1	0.13
Goldfish	1	0.13
Stonecat	1	0.13
Walleye	1	0.13
River Redhorse	1	0.13
Blackside Darter	1	0.13
Total	**787**	**100**

Index Sites	2,878
Investigative Sites	787
St. Joseph County Total	3,665

Appendix D

Summary of fish collected by site, 2010
(Reference Table 2 for site numbers and locations)

Stream	St. Jospeh River, Elkhart County								
Site	Homan Ave.		Sherman Street		Nappanee Street		State Road 15 (Bristol)		Trout Creek Mouth (A)
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
#Banded Killifish	X	X	X						
Black Crappie			X	X	X	X	X	X	X
~Black Redhorse									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	X	X
Bowfin					X	X	X	X	
#Brown Bullhead	X								X
#Channel Catfish			X		X		X		
Chestnut Lamprey		X	X	X	X	X	X	X	X
#Common Carp		X	X	X	X	X	X	X	X
Common Shiner			X			X	X		X
#Gizzard Shad			X						
~Golden Redhorse	X	X	X	X	X	X	X	X	X
Golden Shiner			X						
Grass Pickerel			X	X				X	X
~Greater Redhorse				X					X
#Green Sunfish			X	X	X	X		X	
~Hornyhead Chub					X	X		X	X
Hybrid Sunfish		X	X	X					
Johnny Darter						X			
Largemouth Bass	X	X	X	X	X	X	X	X	X
~Logperch	X	X	X	X	X	X	X	X	X
~Longear Sunfish	X	X	X	X	X	X	X	X	X
#Longnose Gar	X	X	X	X	X		X	X	
~Mimic Shiner	X	X	X	X	X	X	X	X	X
Mottled Sculpin							X		
~Northern Hog Sucker			X	X	X	X	X	X	X
Northern Pike	X	X	X	X		X	X	X	X
Orangethroat Darter					X	X			
Pumpkinseed		X					X	X	
#Quillback			X		X				
~Rainbow Darter	X			X			X		
Redear Sunfish							X		
~River Redhorse			X	X	X	X			
~Rock Bass	X	X	X	X	X	X	X	X	X
~Rosyface Shiner	X	X	X	X	X		X	X	X
~Sand Shiner					X				X
~Shorthead Redhorse	X	X	X	X	X	X	X	X	X
~Silver Redhorse	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

Stream	St. Jospeh River, Elkhart County								
Site	Homan Ave.		Sherman Street		Nappanee Street		State Road 15 (Bristol)		Trout Creek Mouth (A)
	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	X	X
Spotfin Shiner		X	X	X	X	X	X	X	X
Spotted Sucker					X	X		X	X
Steelcolor Shiner	X				X				X
Striped Shiner		X	X	X	X	X	X	X	X
Walleye			X	X	X	X			
Warmouth						X			
#White Sucker	X	X	X	X	X	X	X	X	
#Yellow Bullhead		X		X				X	
Yellow Perch							X		X

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Stream	St. Jospeh River, St. Joseph County						
Site	Capital Ave.		Michigan Street		Pinhook (B)		Veteran's Park (A)
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Black Crappie		X					
~Black Redhorse			X	X	X	X	
Blackside Darter	X		X		X	X	X
Bluegill	X	X		X	X	X	X
#Bluntnose Minnow	X			X		X	
~Brook Silverside	X						X
#Channel Catfish	X						
Chestnut Lamprey	X		X		X	X	
#Common Carp	X	X	X			X	X
#Gizzard Shad			X				
~Golden Redhorse	X	X	X	X	X	X	X
Golden Shiner	X						
#Goldfish							X
~Greater Redhorse							X
#Green Sunfish	X	X	X		X	X	X
~Greenside Darter		X	X	X		X	
Hybrid Sunfish	X	X			X		X
Johnny Darter						X	
Largemouth Bass	X	X		X	X	X	X
~Logperch	X	X	X	X			X
~Longear Sunfish	X	X	X	X	X	X	X
#Longnose Gar			X			X	
~Mimic Shiner	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	X
#Quillback	X	X	X	X	X		X
~Rainbow Darter		X		X			
Rainbow Trout	X						
Redear Sunfish						X	
~River Redhorse			X		X		X
~Rock Bass	X	X	X	X	X	X	X
~Sand Shiner							X
~Shorthead Redhorse	X	X	X	X	X	X	X
~Silver Redhorse	X	X		X	X	X	
~Smallmouth Bass	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X	X
Spottail Shiner				X		X	
#Spotted Gar		X	X	X	X	X	
Spotted Sucker	X	X				X	X

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Stream	St. Jospeh River, St. Joseph County						
Site	Capital Ave.		Michigan Street		Pinhook (B)		Veteran's Park (A)
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Steelcolor Shiner				X			
~Stonecat	X		X	X			X
Striped Shiner	X	X			X		
Walleye	X		X	X		X	X
Warmouth	X	X			X	X	
#White Sucker	X	X				X	X
#Yellow Bullhead						X	X

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Stream	Little Elkhart River			Putterbaugh Creek		Lily Creek		Christiana Creek	
Site	CR 10		Bonneyville Mill	CR 8		Reckell Ave.		CR 4	
	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey	X	X		X	X				
Black Crappie		X							
Blacknose Dace	X	X				X	X		
#Blackside Darter		X			X				
Bluegill	X	X	X	X	X	X			X
#Bluntnose Minnow	X	X		X	X			X	X
Bowfin								X	X
Brown Trout	X	X							
#Central Mudminnow	X	X	X	X		X	X	X	X
Chestnut Lamprey	X	X						X	
#Common Carp			X					X	
Common Shiner	X	X	X						
#Creek Chub	X	X	X	X	X	X	X		
~Golden Redhorse								X	X
Grass Pickerel	X	X	X	X	X	X	X	X	X
#Green Sunfish	X	X	X		X			X	
~Hornyhead Chub		X						X	X
Hybrid Sunfish		X			X				
Johnny Darter	X	X	X	X		X	X		
Largemouth Bass		X	X	X	X			X	X
~Logperch	X	X			X				X
Mottled Sculpin	X	X	X	X	X				
~Northern Hog Sucker	X	X	X					X	X
~Orangethroat Darter		X		X	X			X	X
Pirate Perch						X	X		
Pumpkinseed	X	X					X		
~Rainbow Darter		X			X		X	X	X
Rainbow Trout	X		X						
Redear Sunfish				X					
~Rock Bass	X							X	X
~Shorthead Redhorse								X	X
~Silver Redhorse	X		X						
~Smallmouth Bass		X	X					X	X
Spotfin Shiner		X							X
Steelcolor Shiner								X	
Stonecat									X
Stoneroller, Central				X	X		X		

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Stream	Little Elkhart River			Putterbaugh Creek		Lily Creek		Christiana Creek	
Site	CR 10		Bonneyville Mill	CR 8		Reckell Ave.		CR 4	
	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Striped Shiner				X				X	X
Tadpole Madtom								X	
Walleye									X
Warmouth	X								
#White Sucker	X	X	X	X	X		X	X	X
#Yellow Bullhead								X	X
Yellow Perch					X				

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Stream	Elkhart River, Goshen Area					
Site	SR 15 (B)		Shanklin Park		Rogers Park (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Black Crappie		X				X
Blackside Darter		X	X	X		
Blackstripe Topminnow	X		X			
Bluegill		X	X	X	X	X
#Bluntnose Minnow		X	X	X	X	X
Bowfin	X	X	X		X	
#Central Mudminnow		X	X	X		X
Chestnut Lamprey	X		X	X	X	X
#Common Carp	X	X				
Common Shiner	X		X	X	X	X
#Creek Chub				X		
~Golden Redhorse	X	X	X	X	X	X
Grass Pickerel	X	X	X	X	X	X
~Greater Redhorse			X	X		X
#Green Sunfish		X	X	X		X
~Hornyhead Chub		X	X	X	X	X
Johnny Darter	X	X	X	X		
Largemouth Bass	X	X	X	X	X	X
~Longear Sunfish	X	X	X	X	X	X
~Mimic Shiner		X		X	X	
~Northern Hog Sucker	X	X	X	X	X	X
Northern Pike		X	X	X	X	X
Pirate Perch			X	X	X	
Pumpkinseed			X	X		
~Rainbow Darter						X
~Rock Bass	X	X	X	X	X	X
~Rosyface Shiner	X	X	X	X	X	X
~Sand Shiner	X	X	X	X		
~Silver Redhorse	X	X				
~Smallmouth Bass	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	
Spotted Sucker	X	X	X	X	X	X
Steelcolor Shiner		X		X	X	
Striped Shiner		X	X	X	X	X
Walleye				X		
#White Sucker	X	X	X	X	X	X
#Yellow Bullhead	X		X	X		X

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Stream	Elkhart River, Elkhart Area					
Site	Oxbow Park		Indiana Ave.		Middlebury Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey			X	X	X	X
~Black Redhorse						X
#Blacknose Dace	X					
Blackside Darter		X		X		
Bluegill	X	X	X	X	X	X
#Bluntnose Minnow	X		X	X		
Chestnut Lamprey	X	X	X		X	X
Common Shiner		X	X	X	X	X
~Golden Redhorse	X	X	X	X	X	X
Grass Pickerel	X	X		X	X	X
~Greater Redhorse		X	X			
#Green Sunfish	X	X	X		X	X
~Hornyhead Chub	X	X	X	X	X	X
Largemouth Bass		X	X	X	X	X
~Logperch						X
~Longear Sunfish	X	X		X	X	X
~Northern Hog Sucker	X	X	X	X	X	X
Northern Pike	X	X	X		X	X
~Orangethroat Darter						X
~Rainbow Darter				X		X
Redear Sunfish			X	X	X	X
~River Redhorse			X			
~Rock Bass	X	X	X	X	X	X
~Rosyface Shiner	X	X	X	X	X	X
~Sand Shiner					X	
~Smallmouth Bass	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	
Spotted Sucker	X	X		X		X
Steelcolor Shiner	X		X		X	
~Stonecat	X			X		X
Striped Shiner	X	X	X	X	X	X
#White Sucker	X	X	X	X	X	X
#Yellow Bullhead		X			X	X

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Stream	Turkey Creek				Rock Run Creek			
Site	CR 50		CR 142		Monroe Street		1st Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey								X
#Blacknose Dace					X	X	X	X
Blackside Darter	X	X	X	X				
Bluegill	X	X	X	X	X		X	
#Bluntnose Minnow	X	X	X	X	X		X	
~Brook Silverside			X					
Brook Stickleback					X	X		
#Central Mudminnow	X	X	X	X	X	X	X	X
Chestnut Lamprey		X						
Common Shiner	X	X	X	X	X		X	X
#Creek Chub	X	X	X	X	X	X	X	X
~Golden Redhorse	X		X					
Grass Pickerel	X	X	X	X				
#Green Sunfish	X	X	X	X	X	X	X	X
~Hornyhead Chub	X	X		X		X	X	X
Johnny Darter	X	X	X	X	X	X	X	X
Largemouth Bass		X		X	X	X	X	X
~Logperch	X							
~Northern Hog Sucker	X	X	X	X				X
Northern Pike	X							
~Orangethroat Darter	X	X	X	X	X			X
Pirate Perch		X	X	X				
~Rainbow Darter		X	X	X	X	X	X	X
~Rock Bass	X	X	X	X	X		X	X
~Sand Shiner	X	X		X				
Silverjaw Minnow	X				X			
~Smallmouth Bass	X	X	X		X	X	X	X
Spotfin Shiner				X				
Stoneroller, Central						X		
Striped Shiner		X	X	X			X	
Tadpole Madtom	X							
#White Sucker	X	X	X	X	X	X	X	X
#Yellow Bullhead		X						

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Stream	Yellow Creek		Cobus Creek		Baugo Creek			
Site	CR 32		CR 8		Restoration		Restoration (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey				X				
#Banded Killifish					X	X		
#Blacknose Dace	X	X	X	X	X	X	X	X
Blackside Darter						X	X	X
Bluegill	X		X	X	X		X	
#Bluntnose Minnow	X	X			X	X	X	X
Brown Trout			X	X		X		
#Central Mudminnow	X	X		X	X			
#Channel Catfish								X
Chestnut Lamprey					X		X	
Common Shiner	X	X			X	X	X	X
#Creek Chub	X	X	X	X	X	X	X	X
Grass Pickerel		X	X	X				
#Green Sunfish	X	X	X	X	X	X	X	X
~Greenside Darter						X	X	
Johnny Darter	X	X			X	X	X	X
Largemouth Bass						X	X	X
~Logperch					X	X	X	X
~Longnose Dace					X	X	X	X
~Mimic Shiner					X	X	X	X
Mottled Sculpin			X	X				
~Northern Hog Sucker					X			
~Orangethroat Darter					X	X	X	X
Pirate Perch						X		X
Pumpkinseed						X	X	X
~Rainbow Darter					X	X	X	X
Rainbow Trout				X				
~Rock Bass			X		X	X	X	X
~Sand Shiner					X		X	
~Shorthead Redhorse					X	X	X	
~Silver Redhorse	X	X						X
Silverjaw Minnow					X	X	X	X
~Smallmouth Bass					X	X	X	X
Spotfin Shiner	X				X	X	X	X
Steelcolor Shiner		X			X	X	X	X
Stoneroller, Central		X			X	X	X	X
Striped Shiner					X	X	X	X
Walleye	X	X	X	X	X		X	X
#White Sucker					X	X	X	X

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Stream	Auten Ditch	Bowman Creek		Juday Creek		
Site	Kern Road	Ravina Park		SR 23		Brookwood Drive
		1st Pass	2nd Pass	1st Pass	2nd Pass	
#Blacknose Dace				X	X	X
Bluegill				X	X	
Brown Trout				X	X	
#Central Mudminnow	X					
#Creek Chub	X	X	X	X	X	X
#Fathead Minnow			X			
#Green Sunfish	X		X	X	X	X
Hybrid Sunfish					X	X
Johnny Darter					X	X
Largemouth Bass	X		X	X		X
Mottled Sculpin				X		X
~Orangethroat Darter						X
~Rainbow Darter						X
Rainbow Trout						X
~Rock Bass				X	X	X
~Smallmouth Bass				X	X	
#White Sucker				X	X	X
#Yellow Bullhead					X	

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Appendix E

Summary of macroinvertebrates (insects) collected by site, 2010

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).

In 2010, the Aquatics Program performed macroinvertebrate sampling for the Elkhart River Restoration Association (ERRA) at four sites in the Elkhart River Watershed (Elkhart River SR 15 (B), Elkhart River Rogers Park (B), Turkey Creek CR142, and Rock Run Creek 1st Street). The work performed for the ERRA was funded through a Section 319 Grant, which is administered by IDEM. Based on IDEM's oversight of the ERRA project, sampling and analysis protocols followed IDEMs macroinvertebrate Index of Biological Integrity. In accordance with these protocols, a HD sampler was not used, and the sampling approach was very similar to the qualitative approach described above. However, macroinvertebrates collected using this approach were analyzed in a quantitative manner. Therefore, for these sites, results appear in the Quantitative Column, but do not appear in the Qualitative Column.

Site: St. Josph River, State Road 15 (Bristol)

Collection Date: 8/15/10 Site Number: 1

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	19	+	F
Caecidotea sp	0	+	MT
Hyalella azteca	10	+	F
Gammarus fasciatus	1	+	F
Orconectes (Procericambarus) rusticus	0	+	F
Hydracarina	4		F
Baetis tricaudatus	12	+	MI
Baetis intercalaris	288	+	F
Pseudocloeon propinquum	0	+	I
Plauditus punctiventris	19		MI
Isonychia sp	171	+	MI
Stenacron sp	0	+	F
Stenonema exiguum	41	+	I
Stenonema mediopunctatum	2	+	I
Stenonema terminatum	115	+	MI
Serratella sp	113	+	I
Tricorythodes sp	8	+	MI
Caenis sp	0	+	F
Anthopotamus sp	0	+	MI
Hetaerina sp	5		F
Coenagrionidae	0	+	MT
Gomphus sp	0	+	F
Neurocordulia sp	0	+	MI
Pteronarcys sp	1	+	I
Acroneuria internata	7	+	MI
Paragnetina sp	9		I
Agnetina capitata complex	1		I
Belostoma sp	0	+	F
Corydalus cornutus	4		MI
Chimarra obscura	204	+	MI
Neureclipsis sp	1	+	MI
Cheumatopsyche sp	72	+	F
Ceratopsyche sparna	30	+	MI
Hydropsyche depravata group	2		F
Hydropsyche phalerata	129	+	MI
Macrostemum zebratum	108	+	I
Hydroptila sp	168	+	F
Brachycentrus numerosus	1		MI
Neophylax sp	0	+	I
Pycnopsyche sp	0	+	MI
Lepidostoma sp	2	+	MI
Helicopsyche borealis	0	+	MI

Taxa Name	Quantitative	Qualitative	Tolerance
Dineutus sp	2	+	F
Gyrinus sp	0	+	F
Peltodytes sp	0	+	MT
Psephenus herricki	0	+	MI
Macronychus glabratus	8	+	MI
Stenelmis sp	3	+	F
Simulium sp	42	+	F
Nilotanypus fimbriatus	23	+	MI
Pentaneura sp	32		F
Thienemannimyia group	5	+	F
Cricotopus (C.) bicinctus	5		MT
Nanocladius (N.) spiniplenus	5		MI
Thienemanniella xena	12		F
Tvetenia discoloripes group	5		I
Microtendipes pedellus group	0	+	MI
Polypedilum (Uresipedilum) flavum	123	+	F
Polypedilum (P.) illinoense	0	+	T
Rheotanytarsus sp	123	+	MI
Atherix lantha	1		MI
Elimia sp	5	+	MI
Sphaerium sp	0	+	F

No. Quantitative Taxa:	44
No. Qualitative Taxa:	49
Total Taxa:	63
Number of Organisms:	1941
Qual EPT:	25
ICI:	**52**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: St. Josph River, Sherman Street

Collection Date: 8/15/10 Site Number: 2

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	280		F
Oligochaeta	0	+	T
Gammarus fasciatus	1	+	F
Orconectes (Procericambarus) rusticus	0	+	F
Hydracarina	0	+	F
Plauditus dubius or P. virilis	0	+	I
Baetis intercalaris	100	+	F
Pseudocloeon propinquum	0	+	I
Plauditus punctiventris	20		MI
Isonychia sp	189	+	MI
Stenacron sp	2	+	F
Stenonema exiguum	70	+	I
Stenonema mediopunctatum	40	+	I
Stenonema terminatum	249	+	MI
Serratella sp	126	+	I
Tricorythodes sp	64	+	MI
Coenagrionidae	0	+	MT
Acroneuria internata	0	+	MI
Chimarra obscura	19		MI
Polycentropus sp	3	+	MI
Cheumatopsyche sp	898	+	F
Ceratopsyche morosa	56	+	MI
Hydropsyche phalerata	53	+	MI
Macrostemum zebratum	270	+	I
Hydroptila sp	207		F
Brachycentrus numerosus	8	+	MI
Neophylax sp	0	+	I
Pycnopsyche sp	0	+	MI
Lepidostoma sp	1		MI
Oecetis persimilis	7		MI
Triaenodes injustus	0	+	MI
Petrophila sp	2		I
Dineutus sp	1		F
Peltodytes sp	0	+	MT
Macronychus glabratus	5	+	MI
Simulium sp	4	+	F
Ablabesmyia peleensis	0	+	
Corynoneura sp	4		MI
Tvetenia discoloripes group	67		I
Chironomus sp	0	+	T
Glyptotendipes (G.) sp	4		MT
Polypedilum (Uresipedilum) flavum	134		F
Polypedilum (Tripodura) scalaenum	8		F
Stenochironomus sp	0	+	F
Stictochironomus sp	0	+	F
Rheotanytarsus sp	105		MI
Hydrobiidae	0	+	MT
Elimia sp	17	+	MI
Physella sp	0	+	T
Ferrissia sp	8		F
Corbicula fluminea	0	+	MI
Dreissena polymorpha	0	+	F

No. Quantitative Taxa:	33
No. Qualitative Taxa:	37
Total Taxa:	52
Number of Organisms:	3022
Qual EPT:	20
ICI:	**52**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: St. Josph River, Capital Avenue

Collection Date: 8/13/10 Site Number: 3

Taxa Name	Quantitative	Qualitative	Tolerance		
Turbellaria	628		F	No. Quantitative Taxa:	33
Plumatella sp	3		F	No. Qualitative Taxa:	23
Caecidotea sp	0	+	MT	Total Taxa:	43
Gammarus fasciatus	0	+	F	Number of Organisms:	7082
Baetis tricaudatus	1		MI	Qual EPT:	13
Plauditus dubius or P. virilis	10		I	**ICI:**	**54**
Baetis intercalaris	129		F		
Pseudocloeon propinquum	4		I		
Isonychia sp	222	+	MI	Tolerance	
Stenacron sp	0	+	F	F = Facultative	
Stenonema exiguum	421	+	I	I = Intolerant	
Stenonema mediopunctatum	154	+	I	MI = Moderately Intolerant	
Stenonema pulchellum	50		MI	MT = Moderately Tolerant	
Stenonema terminatum	263	+	MI	T = Tolerant	
Serratella sp	1		I	VT = Very Tolerant	
Tricorythodes sp	49	+	MI		
Chimarra obscura	13	+	MI		
Cyrnellus fraternus	17		F		
Neureclipsis sp	84		MI		
Cheumatopsyche sp	2506	+	F		
Hydropsyche orris	299	+	MI		
Hydropsyche phalerata	54	+	MI		
Hydropsyche simulans	2		MI		
Macrostemum zebratum	24	+	I		
Hydroptila sp	340	+	F		
Brachycentrus numerosus	1		MI		
Pycnopsyche sp	0	+	MI		
Ceraclea sp	1		MI		
Oecetis persimilis	2		MI		
Macronychus glabratus	0	+	MI		
Stenelmis sp	0	+	F		
Simulium sp	18		F		
Hayesomyia senata or Thienemannimyia norena	47		F		
Chironomus sp	0	+	T		
Dicrotendipes sp	16		F		
Parachironomus sp	16		F		
Polypedilum (Uresipedilum) flavum	78		F		
Rheotanytarsus sp	1564	+	MI		
Hemerodromia sp	64		F		
Elimia sp	0	+	MI		
Corbicula fluminea	1	+	MI		
Dreissena polymorpha	0	+	F		
Sphaerium sp	0	+	F		

Site: St. Josph River, Michigan Avenue

Collection Date: 8/14/10 Site Number: 4

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	330	+	F
Nemertea	16		F
Oligochaeta	4	+	T
Caecidotea sp	0	+	MT
Gammarus fasciatus	26	+	F
Plauditus dubius or P. virilis	18		I
Baetis intercalaris	376	+	F
Plauditus punctiventris	54	+	MI
Isonychia sp	89	+	MI
Stenacron sp	183	+	F
Stenonema exiguum	51	+	I
Stenonema mediopunctatum	3		I
Stenonema terminatum	62	+	MI
Tricorythodes sp	61	+	MI
Argia sp	16		F
Chimarra obscura	322		MI
Cyrnellus fraternus	3		F
Neureclipsis sp	71	+	MI
Cheumatopsyche sp	104	+	F
Hydropsyche orris	131		MI
Hydropsyche phalerata	107	+	MI
Macrostemum zebratum	550	+	I
Hydroptila sp	69		F
Brachycentrus numerosus	10		MI
Nectopsyche sp	0	+	MI
Oecetis persimilis	5		MI
Petrophila sp	59		I
Macronychus glabratus	16		MI
Stenelmis sp	0	+	F
Simulium sp	0	+	F
Ablabesmyia rhamphe group	2		MT
Hayesomyia senata or Thienemannimyia norena	1		F
Nilotanypus fimbriatus	1		MI
Cricotopus (C.) bicinctus	12		MT
Cricotopus (C.) or Paratrichocladius sp	5		
Eukiefferiella devonica group	2		MI
Tvetenia discoloripes group	11		I
Chironomus sp	0	+	T
Dicrotendipes neomodestus	0	+	F
Polypedilum (Uresipedilum) flavum	59		F
Rheotanytarsus sp	31		MI

Taxa Name	Quantitative	Qualitative	Tolerance
Hemerodromia sp	10		F
Elimia sp	15	+	MI
Physella sp	0	+	T
Ferrissia sp	2		F
Corbicula fluminea	16	+	MI
Dreissena polymorpha	0	+	F
Sphaerium sp	10		F

No. Quantitative Taxa:	40
No. Qualitative Taxa:	24
Total Taxa:	48
Number of Organisms:	2913
Qual EPT:	12
ICI:	**52**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: St. Josph River, Pinhook (B)

Collection Date: 8/14/10 Site Number: 5

Taxa Name	Quantitative	Qualitative	Tolerance		
Turbellaria	4	+	F	No. Quantitative Taxa:	28
Caecidotea sp	0	+	MT	No. Qualitative Taxa:	21
Crangonyx sp	0	+	MT	Total Taxa:	39
Gammarus fasciatus	2	+	F	Number of Organisms:	751
Orconectes (Procericambarus) rusticus	0	+	F	Qual EPT:	10
Baetis intercalaris	139	+	F	**ICI:**	**46**
Plauditus punctiventris	0	+	MI		
Isonychia sp	48		MI		
Stenacron sp	162	+	F	Tolerance	
Stenonema exiguum	60	+	I	F = Facultative	
Stenonema mexicanum integrum	8		MI	I = Intolerant	
Stenonema pulchellum	20		MI	MI = Moderately Intolerant	
Stenonema terminatum	0	+	MI	MT = Moderately Tolerant	
Tricorythodes sp	5	+	MI	T = Tolerant	
Argia sp	3		F	VT = Very Tolerant	
Cyrnellus fraternus	16		F		
Neureclipsis sp	8		MI		
Cheumatopsyche sp	44		F		
Hydropsyche phalerata	7	+	MI		
Macrostemum zebratum	52	+	I		
Hydroptila sp	27		F		
Ochrotrichia sp	0	+	MI		
Brachycentrus numerosus	0	+	MI		
Oecetis persimilis	5		MI		
Petrophila sp	10		I		
Macronychus glabratus	49	+	MI		
Stenelmis sp	0	+	F		
Tanypodinae	0	+			
Ablabesmyia rhamphe group	1		MT		
Conchapelopia sp	1		F		
Pentaneura sp	1		F		
Cricotopus (C.) bicinctus	1		MT		
Polypedilum (Uresipedilum) flavum	1		F		
Polypedilum (P.) fallax group	1		F		
Rheotanytarsus pellucidus	11		MI		
Empididae	2		F		
Elimia sp	63	+	MI		
Corbicula fluminea	0	+	MI		
Dreissena polymorpha	0	+	F		

Site: Little Elkhart River, County Road 10

Collection Date: 8/15/10 Site Number: 6

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	0	+	F
Oligochaeta	2	+	T
Caecidotea sp	10	+	MT
Gammarus pseudolimnaeus	31	+	
Orconectes sp	1	+	F
Baetis tricaudatus	0	+	MI
Baetis flavistriga	46	+	F
Baetis intercalaris	2	+	F
Pseudocloeon propinquum	0	+	I
Stenacron sp	21	+	F
Stenonema exiguum	17		I
Stenonema terminatum	58	+	MI
Stenonema vicarium	100	+	MI
Tricorythodes sp	0	+	MI
Calopteryx sp	0	+	F
Boyeria sp	0	+	F
Sialis sp	0	+	F
Lype diversa	6		MI
Polycentropus sp	0	+	MI
Cheumatopsyche sp	143	+	F
Ceratopsyche morosa	18		MI
Ceratopsyche sparna	5	+	MI
Brachycentrus numerosus	4		MI
Neophylax sp	0	+	I
Leptoceridae	0	+	MI
Ancyronyx variegata	2		MI
Macronychus glabratus	7	+	MI
Optioservus sp	2		MI
Stenelmis sp	1		F
Simulium sp	1	+	F
Conchapelopia sp	31		F
Nilotanypus fimbriatus	8		MI
Procladius (Holotanypus) sp	0	+	MT
Corynoneura lobata	33		MI
Cricotopus (C.) or Paratrichocladius sp	8		
(N.) crassicornus or N. (N.) "rectinervis"	8		F
Parametriocnemus sp	39		MI
Rheocricotopus (Psilocricotopus) robacki	16		MI
Thienemanniella xena	12		F
Tvetenia bavarica group	31		MI
Microtendipes pedellus group	23	+	MI
Paratendipes albimanus or P. duplicatus	0	+	MI
Polypedilum (P.) fallax group	47		F
Paratanytarsus n.sp 1	8		MI
Rheotanytarsus sp	403		MI
Hemerodromia sp	4		F
Physella sp	0	+	T
Ferrissia sp	46		F
Corbicula fluminea	0	+	MI

No. Quantitative Taxa:	35
No. Qualitative Taxa:	28
Total Taxa:	49
Number of Organisms:	1194
Qual EPT:	13
ICI:	**42**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Putterbaugh Creek, County Road 8

Collection Date: 8/15/10 Site Number: 7

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	8		F
Oligochaeta	0	+	T
Gammarus pseudolimnaeus	15	+	
Orconectes sp	0	+	F
Hydracarina	0	+	F
Baetis flavistriga	3		F
Pseudocloeon propinquum	3		I
Stenacron sp	70	+	F
Stenonema exiguum	33	+	I
Stenonema terminatum	75	+	MI
Stenonema vicarium	264	+	MI
Leptophlebia sp or Paraleptophlebia sp	8		MI
Caenis sp	0	+	F
Boyeria sp	0	+	F
Ranatra sp	0	+	F
Lype diversa	4		MI
Polycentropus sp	4		MI
Cheumatopsyche sp	124	+	F
Ceratopsyche sparna	5		MI
Hydropsyche depravata group	17	+	F
Brachycentrus numerosus	9	+	MI
Neophylax sp	0	+	I
Helicopsyche borealis	8		MI
Macronychus glabratus	16	+	MI
Optioservus sp	1	+	MI
Simulium sp	1		F
Conchapelopia sp	20		F
Thienemannimyia group	0	+	F
Pagastia sp	0	+	MI
Corynoneura n.sp 1	4		MI
Corynoneura lobata	53		MI
Nanocladius (N.) spiniplenus	0	+	MI
Parametriocnemus sp	20	+	MI
Thienemanniella xena	12		F
Tvetenia bavarica group	4		MI
Microtendipes pedellus group	4		MI
Microtendipes rydalensis	42		MI
Polypedilum (Uresipedilum) aviceps	30		MI
Polypedilum (Uresipedilum) flavum	10	+	F
Rheotanytarsus pellucidus	2		MI
Rheotanytarsus sp	18	+	MI
Hemerodromia sp	1		F
Elimia sp	38	+	MI
Ferrissia sp	3		F
Corbicula fluminea	0	+	MI

No. Quantitative Taxa:	34
No. Qualitative Taxa:	25
Total Taxa:	45
Number of Organisms:	929
Qual EPT:	9
ICI:	**50**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Christiana Creek, County Road 4

Collection Date: 8/14/10 Site Number: 8

Taxa Name	Quantitative	Qualitative	Tolerance
Hydra sp	4	+	F
Turbellaria	22	+	F
Gammarus fasciatus	12	+	F
Gammarus pseudolimnaeus	2		
Baetis tricaudatus	3		MI
Baetis flavistriga	3	+	F
Pseudocloeon dardanum	0	+	MI
Baetis intercalaris	39		F
Pseudocloeon propinquum	0	+	I
Plauditus punctiventris	23		MI
Procloeon irrubrum	0	+	MI
Stenacron sp	108	+	F
Stenonema exiguum	127	+	I
Stenonema mediopunctatum	30	+	I
Stenonema pulchellum	170	+	MI
Stenonema terminatum	57	+	MI
Serratella sp	28		I
Tricorythodes sp	73	+	MI
Caenis sp	0	+	F
Anthopotamus sp	0	+	MI
Coenagrionidae	1	+	MT
Argia sp	1		F
Pteronarcys sp	1		I
Acroneuria internata	2	+	MI
Corydalus cornutus	3		MI
Chimarra obscura	1	+	MI
Cyrnellus fraternus	1		F
Polycentropus sp	0	+	MI
Cheumatopsyche sp	5		F
Hydropsyche phalerata	5	+	MI
Hydropsyche venularis	1		MI
Hydroptila sp	1	+	F
Brachycentrus numerosus	1		MI
Neophylax sp	0	+	I
Lepidostoma sp	3	+	MI
Helicopsyche borealis	13	+	MI
Mystacides sp	0	+	MI
Nectopsyche diarina	0	+	MI
Nectopsyche pavida	1		I
Oecetis persimilis	17	+	MI
Stenelmis sp	0	+	F
Simulium sp	0	+	F

Taxa Name	Quantitative	Qualitative	Tolerance
Clinotanypus pinguis	0	+	T
Nilotanypus fimbriatus	0	+	MI
Thienemannimyia group	31		F
Corynoneura lobata	40		MI
Cricotopus (C.) sp	176	+	F
Cricotopus (C.) bicinctus	13		MT
Thienemanniella taurocapita	34		I
Thienemanniella xena	4		F
Dicrotendipes neomodestus	13		F
Polypedilum (Uresipedilum) flavum	57	+	F
Polypedilum (P.) fallax group	4		F
Polypedilum (Tripodura) scalaenum	0	+	F
Tribelos jucundum	0	+	F
Cladotanytarsus vanderwulpi group	0	+	MI
Rheotanytarsus sp	26		MI
Tanytarsus sp	0	+	MI
Hemerodromia sp	0	+	F
Physella sp	10	+	T
Ferrissia sp	10		F
Corbicula fluminea	0	+	MI
Dreissena polymorpha	0	+	F
Sphaerium sp	0	+	F

No. Quantitative Taxa:	43
No. Qualitative Taxa:	42
Total Taxa:	64
Number of Organisms:	1176
Qual EPT:	23
ICI:	**46**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Elkhart River, State Road 15 (Below)

Collection Date: 8/15/10 Site Number: 9

Taxa Name	Tolerance	Quantitative
Oligochaeta	T	1
Placobdella ornata	F	1
Caecidotea sp	MT	1
Gammarus fasciatus	F	36
Gammarus pseudolimnaeus		18
Pseudocloeon propinquum	I	4
Stenonema exiguum	I	4
Stenonema mexicanum integrum	MI	4
Stenonema terminatum	MI	5
Stylurus sp	MI	1
Perlesta placida complex	F	4
Corixidae	F	2
Palmacorixa sp	F	2
Trichocorixa sp	F	1
Ceratopsyche sparna	MI	12
Brachycentrus sp	MI	1
Nectopsyche diarina	MI	1
Microtendipes pedellus group	MI	1
Physella sp	T	2

No. Quantitative Taxa: 19

Number of Organisms: 101

mIBI: 26

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Elkhart River, Rogers Park (Below)

Collection Date: 8/15/10 Site Number: 10

Taxa Name	Tolerance	Quantitative
Oligochaeta	T	1
Caecidotea sp	MT	2
Gammarus fasciatus	F	11
Gammarus pseudolimnaeus		19
Orconectes sp	F	4
Pseudocloeon propinquum	I	2
Leucrocuta sp	I	1
Stenonema exiguum	I	1
Stenonema terminatum	MI	3
Perlesta placida complex	F	1
Belostoma sp	F	1
Trichocorixa sp	F	1
Neureclipsis sp	MI	1
Ceratopsyche morosa group	MI	9
Nectopsyche diarina	MI	1
Lype diversa	MI	1
Triaenodes injustus	MI	1
Brachycentrus sp	MI	19
Optioservus sp	MI	1
Macronychus glabratus	MI	3
Cryptochironomus sp	F	1
Phaenopsectra obediens group	F	2
Polypedilum (Tripodura) halterale group	F	1
Polypedilum (P.) illinoense	T	1
Pisidium sp	F	1

No. Quantitative Taxa: 25

Number of Organisms: 89

mIBI: 30

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Elkhart River, Oxbow Park (Below)

Collection Date: 8/15/10 Site Number: 11 #

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	10	+	F
Oligochaeta	0	+	T
Caecidotea sp	0	+	MT
Crangonyx sp	0	+	MT
Gammarus pseudolimnaeus	6	+	
Orconectes (Procericambarus) rusticus	0	+	F
Baetis flavistriga	14	+	F
Baetis intercalaris	12	+	F
Isonychia sp	38		MI
Leucrocuta sp	4		I
Stenacron sp	44	+	F
Stenonema exiguum	37	+	I
Stenonema terminatum	168	+	MI
Serratella sp	36	+	I
Tricorythodes sp	3	+	MI
Caenis sp	1		F
Coenagrionidae	0	+	MT
Argia sp	4		F
Boyeria vinosa	0	+	F
Pteronarcys sp	0	+	I
Agnetina capitata complex	8		I
Corydalus cornutus	1		MI
Chimarra obscura	7		MI
Neureclipsis sp	16	+	MI
Polycentropus sp	18		MI
Cheumatopsyche sp	46	+	F
Ceratopsyche morosa	16		MI
Ceratopsyche sparna	5		MI
Hydropsyche depravata group	3		F
Hydropsyche phalerata	26	+	MI
Protoptila sp	0	+	I
Hydroptila sp	6	+	F
Brachycentrus numerosus	9		MI
Neophylax sp	0	+	I
Pycnopsyche sp	3		MI
Lepidostoma sp	1	+	MI
Oecetis sp	2		MI
Ancyronyx variegata	0	+	MI
Macronychus glabratus	6	+	MI
Stenelmis sp	0	+	F
Antocha sp	1		MI
Simulium sp	2		F
Ablabesmyia sp	1		
Hayesomyia senata or T. norena	3		F
Procladius (Holotanypus) sp	0	+	MT
Corynoneura lobata	32		MI
Cricotopus (C.) sp	1		F
Cricotopus (C.) bicinctus	2		MT
Cricotopus (C.) or Paratrichocladius sp	1		
Rheocricotopus (Psilocricotopus) robacki	2		MI
Thienemanniella xena	8		F
Tvetenia discoloripes group	6		I
Cryptochironomus sp	0	+	F
Cryptotendipes sp	0	+	MI
Microtendipes pedellus group	8		MI
Microtendipes rydalensis	2		MI
Phaenopsectra sp or Tribelos sp	2		
Polypedilum (Uresipedilum) flavum	3		F
Polypedilum (P.) fallax group	7		F
Polypedilum (P.) illinoense	2	+	T
Polypedilum (Tripodura) scalaenum gp.	2		F
Stenochironomus sp	1		F
Micropsectra sp	1		F
Rheotanytarsus sp	24	+	MI
Tanytarsus sp	2		MI
Chrysops sp	0	+	F
Hemerodromia sp	4		F
Elimia sp	10	+	MI
Ferrissia sp	2		F
Corbicula fluminea	0	+	MI

No. Quantitative Taxa:	54
No. Qualitative Taxa:	34
Total Taxa:	70
Number of Organisms:	679
Qual EPT:	15
ICI:	**52**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Elkhart River, Middlebury Street

Collection Date: 8/13/10 Site Number: 12

Taxa Name	Quantitative	Qualitative	Tolerance
Turbellaria	25		F
Oligochaeta	4		T
Caecidotea sp	0	+	MT
Crangonyx sp	0	+	MT
Gammarus fasciatus	7		F
Gammarus pseudolimnaeus	31	+	
Orconectes sp	1		F
Orconectes (Procericambarus) rusticus	0	+	F
Hydracarina	28		F
Baetis flavistriga	0	+	F
Baetis intercalaris	31	+	F
Plauditus punctiventris	0	+	MI
Procloeon irrubrum	0	+	MI
Isonychia sp	93	+	MI
Leucrocuta sp	3	+	I
Stenacron sp	81	+	F
Stenonema exiguum	136		I
Stenonema terminatum	217	+	MI
Serratella sp	13	+	I
Tricorythodes sp	88	+	MI
Calopteryx sp	0	+	F
Pteronarcys sp	0	+	I
Agnetina capitata complex	3	+	I
Sialis sp	0	+	F
Neureclipsis sp	14		MI
Nyctiophylax sp	2		MI
Polycentropus sp	2		MI
Cheumatopsyche sp	78	+	F
Ceratopsyche morosa	2	+	MI
Hydropsyche phalerata	6	+	MI
Hydroptila sp	30		F
Brachycentrus numerosus	5	+	MI
Neophylax sp	0	+	I
Pycnopsyche sp	1	+	MI
Lepidostoma sp	1		MI
Helicopsyche borealis	1		MI
Hydroporus sp	0	+	F
Dubiraphia sp	4		F
Dubiraphia vittata group	0	+	F
Macronychus glabratus	22		MI
Stenelmis sp	0	+	F
Curculionidae	4		
Ablabesmyia peleensis	1		
Nilotanypus fimbriatus	5		MI
Rheopelopia paramaculipennis	1		MI
Corynoneura lobata	10		MI
Cricotopus (C.) bicinctus	4		MT
Thienemanniella xena	5		F
Chironomus sp	2		T
Dicrotendipes neomodestus	9		F
Microtendipes pedellus group	1		MI
Polypedilum (Uresipedilum) flavum	14		F
Polypedilum (P.) fallax group	2		F
Polypedilum (P.) illinoense	2		T
Polypedilum (Tripodura) scalaenum	2		F
Tribelos jucundum	2		F
Rheotanytarsus sp	4		MI
Hemerodromia sp	5		F
Hydrobiidae	1		MT
Elimia sp	15	+	MI
Corbicula fluminea	0	+	MI
Sphaerium sp	0	+	F

No. Quantitative Taxa:	47
No. Qualitative Taxa:	30
Total Taxa:	62
Number of Organisms:	1018
Qual EPT:	18
ICI:	**52**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Turkey Creek, County Road 142

Collection Date: 8/15/10 Site Number: 13

Taxa Name	Tolerance	Quantitative
Gammarus fasciatus	F	1
Gammarus pseudolimnaeus		15
Caecidotea sp	MT	2
Orconectes (Procericambarus) rusticus	F	3
Baetis flavistriga	F	1
Baetis intercalaris	F	1
Baetis tricaudatus	MI	3
Pseudocloeon propinquum	I	2
Stenacron sp	F	5
Stenonema exiguum	I	1
Stenonema mexicanum integrum	MI	6
Stenonema mediopunctatum	I	1
Boyeria sp	F	1
Lype diversa	MI	1
Ceratopsyche morosa group	MI	15
Ceratopsyche sparna	MI	4
Hydropsyche depravata group	F	4
Pycnopsyche sp	MI	1
Nectopsyche diarina	MI	1
Brachycentrus sp	MI	2
Peltodytes sp	MT	1
Corynoneura lobata	MI	1
Microtendipes pedellus group	MI	5
Polypedilum (P.) illinoense	T	2
Paratanytarsus sp	F	1
Physella sp	T	3
Corbicula fluminea	MI	1

No. Quantitative Taxa:	27
Number of Organisms:	84
mIBI:	**34**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Rock Run Creek, 1st Street

Collection Date: 8/15/10 Site Number: 14 #

Taxa Name	Tolerance	Quantitative
Turbellaria	F	1
Oligochaeta	T	1
Gammarus pseudolimnaeus		41
Caecidotea sp	MT	9
Orconectes sp	F	4
Baetis intercalaris	F	1
Baetis tricaudatus	MI	9
Leucrocuta sp	I	1
Caenis sp	F	1
Boyeria sp	F	1
Ceratopsyche morosa group	MI	6
Hydropsyche depravata group	F	5
Simulium sp	F	1
Procladius sp	MT	1
Prodiamesa olivacea	F	5
Eukiefferiella sp		1
Chironomus (C.) sp	T	2
Cryptochironomus sp	F	1
Microtendipes pedellus group	MI	1
Phaenopsectra obediens group	F	12
Polypedilum (P.) illinoense	T	2
Physella sp	T	1
Dreissena polymorpha	F	1
Corbicula fluminea	MI	3

No. Quantitative Taxa:	24
Number of Organisms:	111
mIBI:	**26**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Cobus Creek, County Road 8

Collection Date: 8/14/10 Site Number: 15

Taxa Name	Quantitative	Qualitative	Tolerance
Hydra sp	8		F
Turbellaria	0	+	F
Oligochaeta	8		T
Caecidotea sp	1	+	MT
Gammarus pseudolimnaeus	27	+	
Baetis tricaudatus	25	+	MI
Baetis flavistriga	111	+	F
Baetis intercalaris	103	+	F
Pseudocloeon propinquum	0	+	I
Stenacron sp	205	+	F
Stenonema exiguum	54		I
Stenonema terminatum	123		MI
Stenonema vicarium	81		MI
Ranatra sp	0	+	F
Lype diversa	12		MI
Cheumatopsyche sp	448	+	F
Ceratopsyche sparna	33		MI
Hydropsyche depravata group	193	+	F
Brachycentrus numerosus	9		MI
Neophylax sp	0	+	I
Helicopsyche borealis	4	+	MI
Macronychus glabratus	48		MI
Optioservus sp	5	+	MI
Simulium sp	20	+	F
Conchapelopia sp	8		F
Hayesomyia senata or Thienemanni-myia norena	32		F
Pagastia sp	0	+	MI
Corynoneura n.sp 1	4		MI
Corynoneura lobata	40		MI
Cricotopus (C.) bicinctus	4		MT
Parametriocnemus sp	24		MI
Thienemanniella xena	8	+	F
Tvetenia bavarica group	97		MI
Polypedilum (Uresipedilum) aviceps	24		MI
Polypedilum (Uresipedilum) flavum	12		F
Rheotanytarsus sp	205		MI
Hemerodromia sp	4		F
Ferrissia sp	130	+	F
Corbicula fluminea	0	+	MI

No. Quantitative Taxa:	33
No. Qualitative Taxa:	19
Total Taxa:	39
Number of Organisms:	2110
Qual EPT:	9
ICI:	**48**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Baugo Creek, Restoration Site

Collection Date: 8/13/10 Site Number: 16 #

Taxa Name	Quantitative	Qualitative	Tolerance		
Hydra sp	8	+	F	No. Quantitative Taxa:	28
Turbellaria	19	+	F	No. Qualitative Taxa:	28
Oligochaeta	48	+	T	Total Taxa:	43
Mooreobdella sp	0	+	T	Number of Organisms:	6407
Gammarus pseudolimnaeus	0	+		Qual EPT:	4
Baetis tricaudatus	0	+	MI	**ICI:**	**36**
Baetis intercalaris	265	+	F		
Anax sp	0	+	T		
Boyeria grafiana	0	+	MI	Tolerance	
Neoplea sp	0	+	F	F = Facultative	
Neureclipsis sp	2		MI	I = Intolerant	
Cheumatopsyche sp	816	+	F	MI = Moderately Intolerant	
Ceratopsyche morosa	41	+	MI	MT = Moderately Tolerant	
Hydropsyche depravata group	15		F	T = Tolerant	
Hydroptila sp	28		F	VT = Very Tolerant	
Antocha sp	115		MI		
Tipula sp	0	+	F		
Anopheles sp	0	+	F		
Ablabesmyia mallochi	0	+	F		
Conchapelopia sp	235		F		
Labrundinia pilosella	24		MI		
Corynoneura lobata	24		MI		
Cricotopus (C.) bicinctus	0	+	MT		
Cricotopus (C.) tremulus group	282		F		
Cricotopus (C.) trifascia	0	+	F		
Cricotopus (C.) or Paratrichocladius sp	235				
Rheocricotopus sp	47				
Thienemanniella xena	16		F		
Cryptochironomus sp	0	+	F		
Dicrotendipes neomodestus	94	+	F		
Microtendipes pedellus group	47		MI		
Polypedilum (Uresipedilum) flavum	799	+	F		
Polypedilum (P.) fallax group	141		F		
Polypedilum (P.) illinoense	47	+	T		
Cladotanytarsus vanderwulpi group	0	+	MI		
Paratanytarsus sp	141		F		
Rheotanytarsus sp	2631	+	MI		
Tanytarsus sp	0	+	MI		
Tanytarsus curticornis group	0	+	MI		
Tanytarsus glabrescens group sp 7	141		MI		
Hemerodromia sp	34	+	F		
Physella sp	1	+	T		
Ferrissia sp	111	+	F		

Site: Juday Creek, State Road 23

Collection Date: 8/14/10 Site Number: 17 #

Taxa Name	Quantitative	Qualitative	Tolerance
Hydra sp	24		F
Turbellaria	179	+	F
Oligochaeta	24		T
Gammarus pseudolimnaeus	56	+	
Orconectes (Procericambarus) rusticus	0	+	F
Hydracarina	152	+	F
Baetis tricaudatus	3	+	MI
Baetis flavistriga	46	+	F
Baetis intercalaris	104	+	F
Plauditus punctiventris	2		MI
Stenacron sp	13	+	F
Stenonema exiguum	4		I
Stenonema terminatum	2	+	MI
Stenonema vicarium	4		MI
Tricorythodes sp	1	+	MI
Caenis sp	0	+	F
Neureclipsis sp	1		MI
Cheumatopsyche sp	66	+	F
Ceratopsyche morosa	46		MI
Ceratopsyche sparna	2		MI
Hydropsyche depravata group	341	+	F
Hydroptila sp	345	+	F
Brachycentrus numerosus	21		MI
Pycnopsyche sp	1		MI
Leptoceridae	1		MI
Mystacides sepulchralis	0	+	MI
Nectopsyche diarina	0	+	MI
Dubiraphia sp	0	+	F
Macronychus glabratus	4	+	MI
Antocha sp	10		MI
Simulium sp	1		F
Ablabesmyia mallochi	0	+	F
Helopelopia sp	0	+	F
Thienemannimyia group	273		F
Corynoneura lobata	32		MI
Cricotopus (C.) bicinctus	328	+	MT
Cricotopus (C.) or Paratrichocladius sp	55		
Nanocladius sp	0	+	
Orthocladius (O.) sp	55		F
Parametriocnemus sp	55		MI
Rheocricotopus (Psilocricotopus) robacki	655	+	MI
Tvetenia bavarica group	164		MI
Cryptotendipes sp	0	+	MI
Microtendipes pedellus group	55		MI
Polypedilum (P.) illinoense	0	+	T
Paratanytarsus sp	55	+	F
Rheotanytarsus sp	3492	+	MI
Tanytarsus sp	0	+	MI
Hemerodromia sp	2		F
Physella sp	3	+	T
Planorbella sp	16		T
Planorbella (Pierosoma) trivolvis	0	+	VT
Ferrissia sp	24		F
Corbicula fluminea	0	+	MI

No. Quantitative Taxa:	42
No. Qualitative Taxa:	31
Total Taxa:	55
Number of Organisms:	6733
Qual EPT:	12
ICI:	**52**

Tolerance

F = Facultative

I = Intolerant

MI = Moderately Intolerant

MT = Moderately Tolerant

T = Tolerant

VT = Very Tolerant

Site: Bowman Creek, Ravina Park

Collection Date: 7/4/10 Site Number: 18 #

Taxa Name	Quantitative	Qualitative	Tolerance		
Turbellaria	0	+	F	No. Quantitative Taxa:	0
Oligochaeta	0	+	T	No. Qualitative Taxa:	14
Caecidotea sp	0	+	MT	Total Taxa:	14
Baetis tricaudatus	0	+	MI	Number of Organisms:	0
Baetis flavistriga	0	+	F	Qual EPT:	4
Cheumatopsyche sp	0	+	F	**ICI:**	**F**
Hydropsyche depravata group	0	+	F		
Simulium sp	0	+	F	Tolerance	
Thienemannimyia group	0	+	F	F = Facultative	
Diamesa sp	0	+	F	I = Intolerant	
Parametriocnemus sp	0	+	MI	MI = Moderately Intolerant	
Polypedilum (Uresipedilum) flavum	0	+	F	MT = Moderately Tolerant	
Polypedilum (Tripodura) scalaenum group	0	+	F	T = Tolerant	
Physella sp	0	+	T	VT = Very Tolerant	

Appendix F

A Preliminary Analysis of Indiana's Coolwater IBI on the Little Elkhart River, Juday Creek, and Cobus Creek

In Elkhart and St. Joseph Counties a significant percentage of the tributaries to the St. Joseph River are coolwater streams. Coolwater streams have different assemblages of fishes consisting of species that thrive in cooler water temperatures. In general, coolwater streams are considered to have less energy which can result in less species diversity and/or reduced abundances of individuals. The Aquatics Program is currently using an IBI that has been specifically developed for our ecoregion (the Northern Indiana Till Plain). However, this IBI is not calibrated for coolwater systems and is more suited for our warmwater streams. The current IBI does provide a meaningful analysis of the coolwater streams and it will demonstrate improvements or impairments in stream quality overtime. Although it has been the best alternative in assessing stream integrity in our area, an IBI that has been specifically modified to account for coolwater characteristics is preferred.

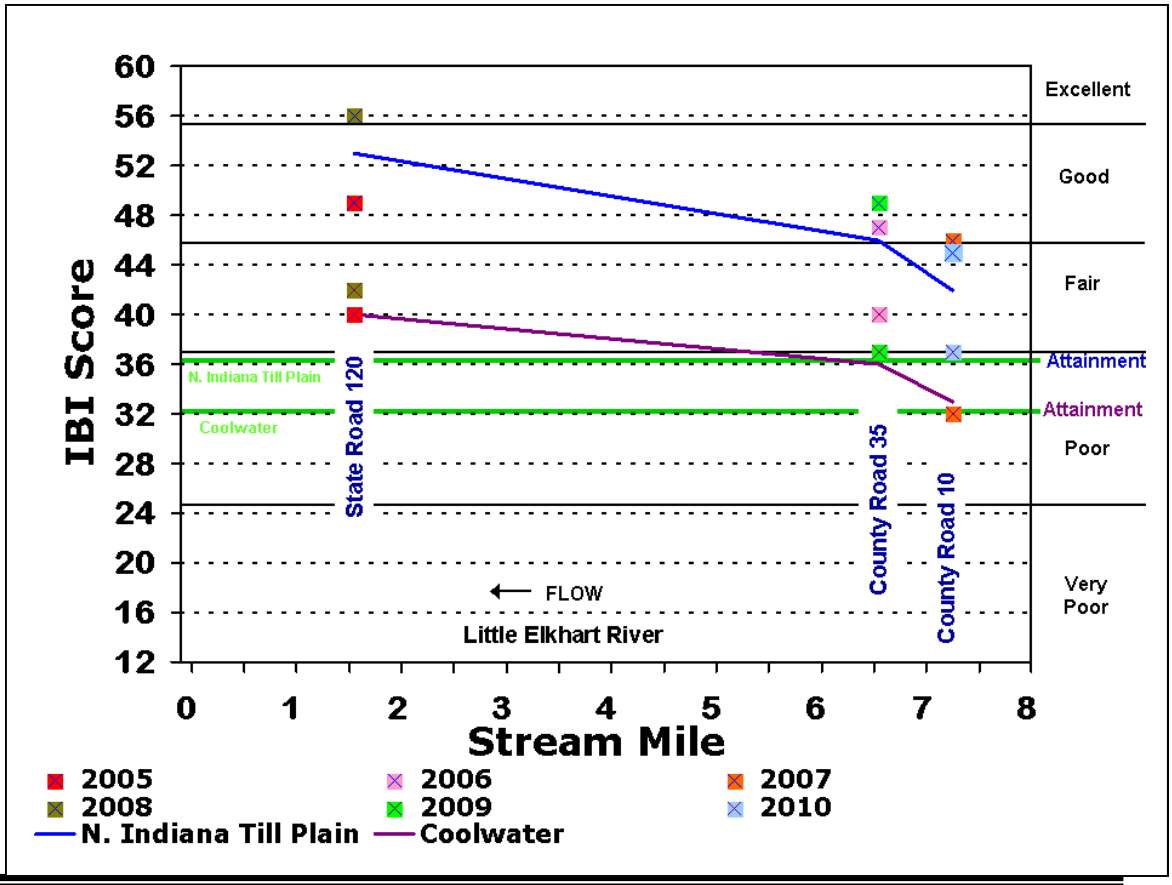
Addressing the need for a coolwater calibration, the Indiana Biological Survey developed a statewide coolwater IBI in 2007. Unfortunately, this system is broad-based and has not been calibrated for specific ecoregions within the State. In an effort to determine if the coolwater calibration is appropriate for use within the Nothern Indiana Till Plain Ecoregion, a preliminary analysis of fish assemblage data from Juday Creek and the Little Elkhart River and Cobus Creek was performed.

Similar to the conventional IBI, the metrics within the coolwater calibration differ based on drainage area. Streams with a drainage area of less than or equal to 100 square miles have slightly different metrics than those with a drainage area greater than 100 square miles (see Appendix A). The Little Elkhart River has a drainage area greater than 100 square miles, while Juday Creek and Cobus Creek have a drainage area less then 100 square miles.

The Little Elkhart River

Fish assemblage data were compared using the current IBI and Coolwater IBI. A review of baseline data revealed similarities between the two different IBI systems (Figure F1). Using both IBIs, stream integrity increases moving from upstream at County Road 10 to downstream at State Road 120. It is obvious, however, that under the Coolwater IBI, the Little Elkhart River has significantly lower IBI scores compared to when it is assessed using the conventional IBI. During the development of the coolwater index, the Indiana Biological Survey noted that by using the Coolwater IBI, approximately 75% of sites scored lower by at least 4 points, and consequently suggested that the attainment line be adjusted 4 points lower for coolwater streams. The impetus for developing

Figure F1: A graphical comparison of the 2 IBI systems. N. Indiana Till Plain IBI baseline is blue and Coolwater IBI baseline is purple.



the Coolwater IBI was to appropriately assess coolwater streams that were being misclassified as degraded warmwater streams (Indiana Biological Survey, 2007). In the case of the Little Elkhart River, aquatic life is closer to non-attaining when assessed with the coolwater IBI.

Although the baselines for the two different IBIs have a similar relationship, the recent monitoring data (2005-2010) show different results (Figure F1). For example, at SR 120, the 2005 IBI score with the coolwater system remained the same as the baseline. However, using the N. Indiana Till Plain IBI, the 2005 score fell below the baseline. In 2005, slightly less diversity was observed at SR 120, which resulted in the lower IBI score. The N. Till Plain IBI appears to be more sensitive to slight assemblage changes than does the coolwater calibration.

Figure F2: IBI scores for Juday Creek using the N. Indiana Till Plain IBI.

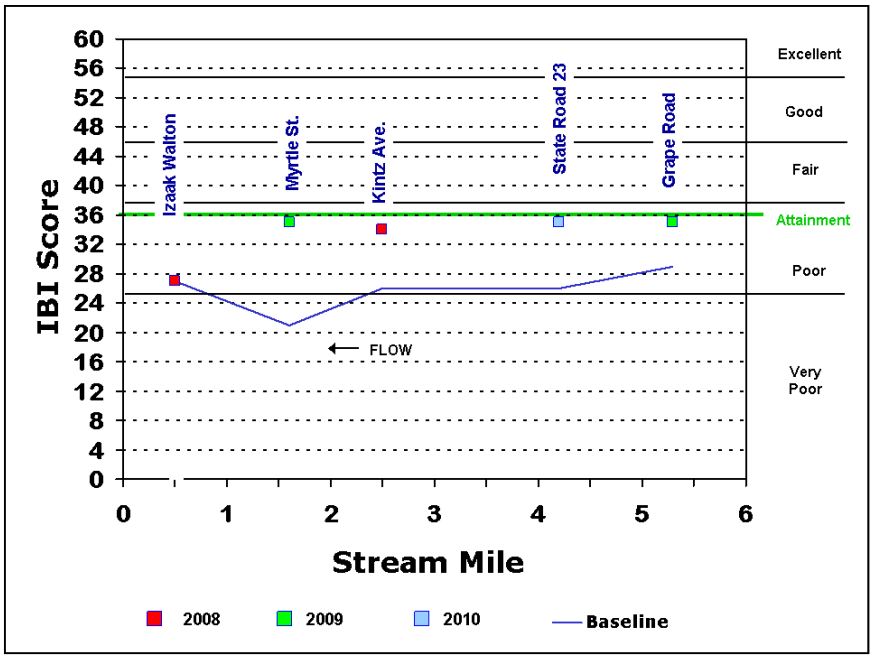
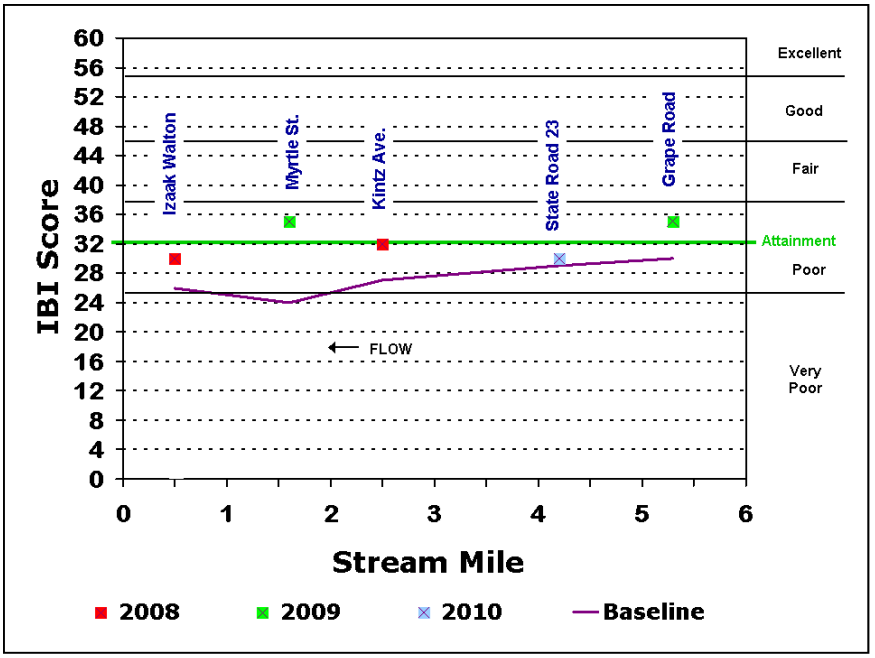


Figure F3: IBI scores for Juday Creek using the coolwater IBI.



Juday Creek

IBI scores for the current and Coolwater IBI systems were very similar overall. Baseline data appeared to correspond with a slight increase in baseline IBI scores at State Road 23, Kintz Avenue and Myrtle Street occurring with the Coolwater IBI (Figure F2 and Figure F3). Recent IBI scores (2008-2010) were also similar at all sites. With the current IBI, all sites fell below the attainment line. However, with the Coolwater IBI, Myrtle Street, Kintz Avenue, and Grape Road all scored above the attainment line (note that the attainment has been lowered to 32 with the coolwater system).

With both IBI models, significant increases in IBI scores occurred at Mytrle Street and Grape Road in 2009. A slight increase in diversity was observed at Myrtle Street in 2009, with two new coolwater species (rainbow and orangethroat darters) being collected. This had a positive impact on several metrics within each IBI system. At the Grape Road site, species diversity did not increase, but a stronger representative assemblage of fishes was collected. This also had a positive impact on several metrics within each IBI calibration.

Cobus Creek

The Aquatics Program has monitored one site on Cobus Creek at County Road 8 since 1998. IBI scores for this site increase significantly using the coolwater calibration (Figure F4). Using the Coolwater IBI, the baseline for this site increases by six

points. In general, 2004 and 2010 IBI scores were fairly consistent with the baselines for each calibration. However, the 2007 score varied significantly between the two calibrations. Using the N. Indiana Till Plain IBI, the 2007 score fell 2 points below the baseline, while using the Coolwater IBI, the 2007 score was 4 points above the baseline. Metrics in the Coolwater IBI (% Coolwater Species, % Headwater Species, % Detritivores Species, % Invertivores Species, %Pioneer Species), which are not included in the N. Indiana Till Plain IBI scored high and resulted in the higher score.

Of most importance, using the Coolwater IBI, Cobus Creek at County Road 8 would now be considered an attaining stream as opposed to non-attaining.

Use of the Coolwater IBI

Preliminary analysis of the Coolwater IBI suggests potential issues with its use on coolwater streams in Elkhart and St. Joseph Counties. This analysis has reveled similarities between each calibration. In particular, results were very similar on Juday Creek. In addition, a correlation analysis reveals a statistically significant positive relationship between the N. Indiana Till Plain IBI and the Coolwater IBI for Juday Creek and the Little Elkhart River (Figure F5; Pearson R = 0.9124; P = 0.000). For example, as N. Indiana Till Plain IBI scores increase, coolwater scores also increase. However, although the data are limited, there is not a significant correlation between both IBI types when looking at Cobus Creek data (Figure F6; Pearson R = 0.1964; P = 0.7091)

While the coolwater system appears to have positively changed the results for Juday Creek and Cobus Creek, it reflects more impaired fish communities within the Little Elkhart River. The Little Elkhart River continues to host diverse assemblages of fishes and has exceptional habitat as demonstrated by the excellent IBI scores that it has received over the years. Inconsistencies in how the two IBI types relate to each other and react to fish assemblages in the 3 streams also raises a concern. While the Nothern Indiana Till Plain IBI does not allow for modifications to accommodate coolwater streams, the Coolwater IBI is not specific for ecoregion. The "coolwater dilemma" is further complicated when considering significant variability in stream size/drainage area and because water temperatures among coolwater streams vary from stream to stream.

The Aquatics Program will continue to assess the Coolwater IBI and its use within Elkhart and St. Joseph Counties. This system may provide a more accurate portrayal of Juday Creek, Cobus Creek and streams of similar size. For the time being, however, the N. Indiana Till Plain IBI appears to be providing meaningful longitudinal and temporal comparisons of all stream types.

Figure F4: A graphical comparison of IBI scores at the Cobus Creek County Road 8 Site.

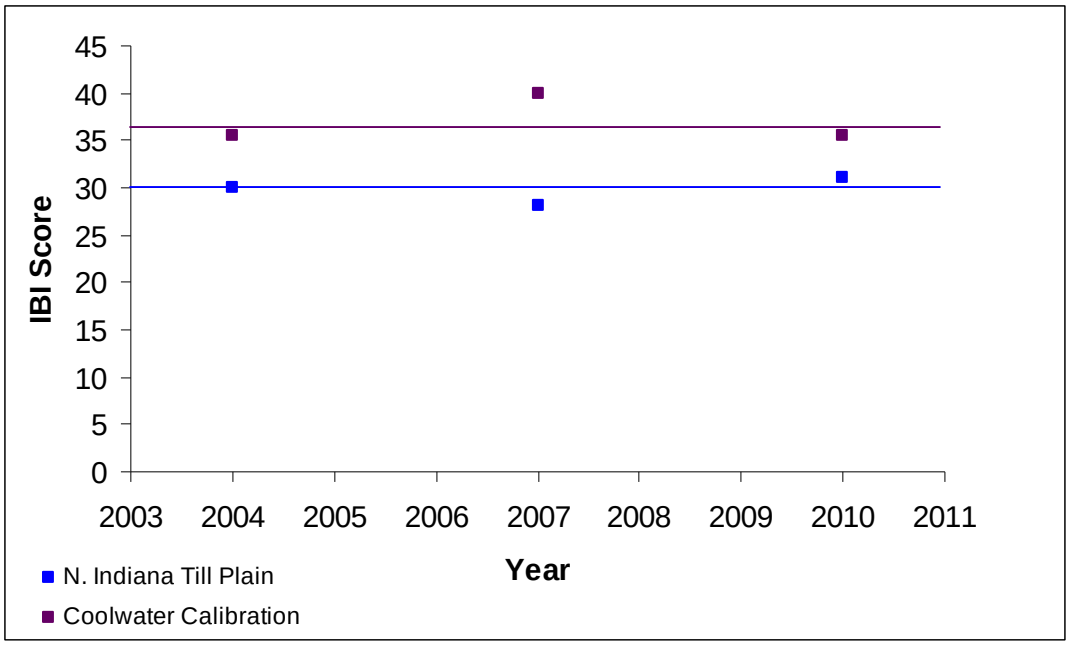


Figure F5: Correlation between N. Indiana Till Plain IBI scores and Coolwater IBI scores for the Little Elkhart River between 1998 and 2010.

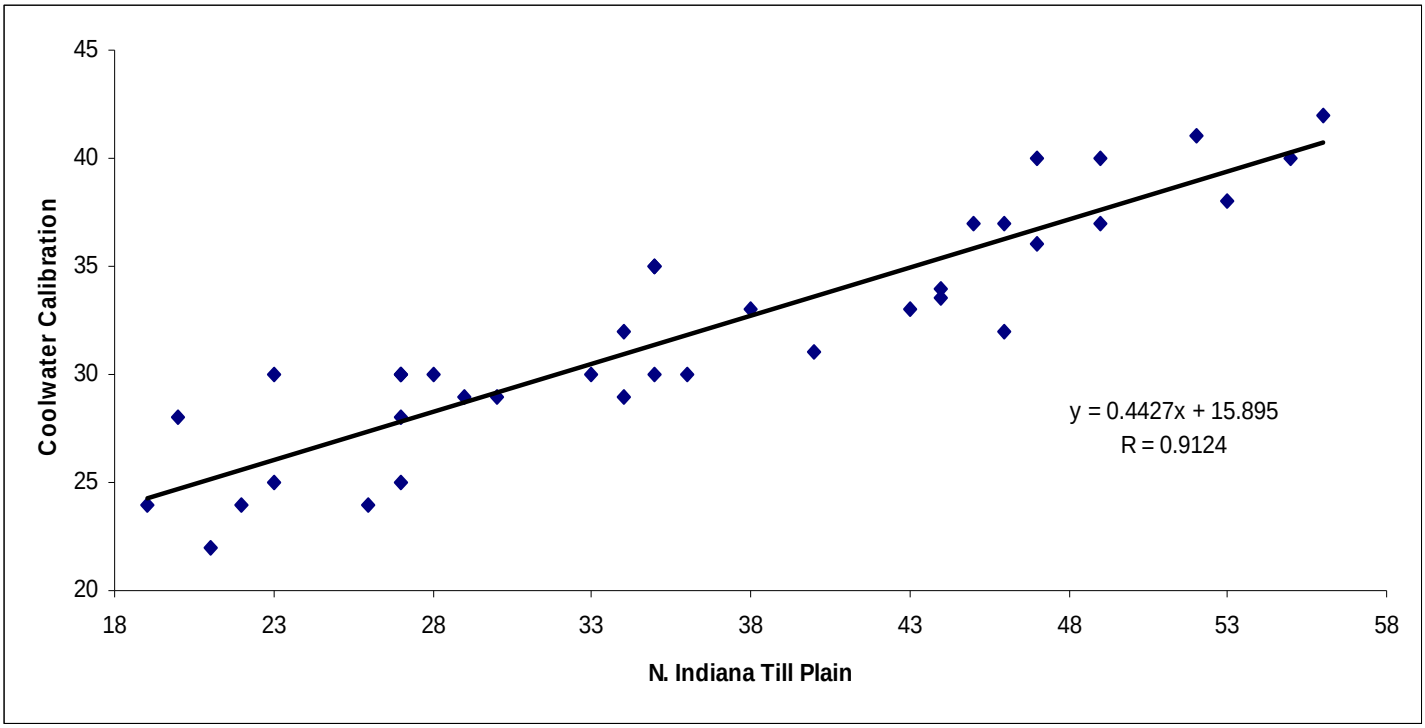
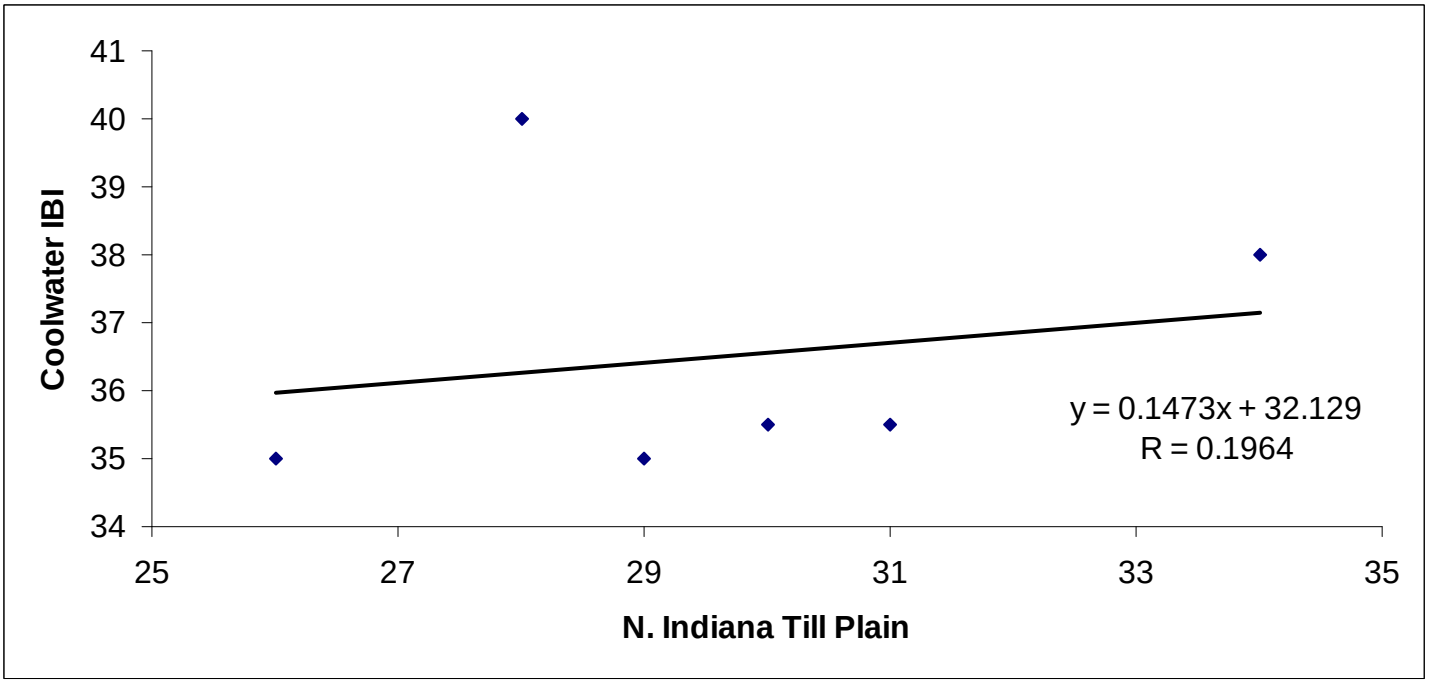


Figure F6: Correlation between N. Indiana Till Plain IBI scores and Coolwater IBI scores for the Cobus Creek at County Road 8



Appendix G

Statistical Analysis of Surface Water Quality Monitoring Data

The following graphs summarize surface water quality sampling results for the Elkhart and St. Joseph Rivers. *E.coli*, total suspended solids, and phosphorus results were analyzed statistically using Statistix9 ® software. Data analysis was performed using the non-parametric Kruskil-Wallis test due to violations of normality or heteroscedacity among all data sets.

Figure G1: Summary of mean and median phosphorus concentrations. Mean concentrations with different letters differ significantly. n = number of data points for each station.

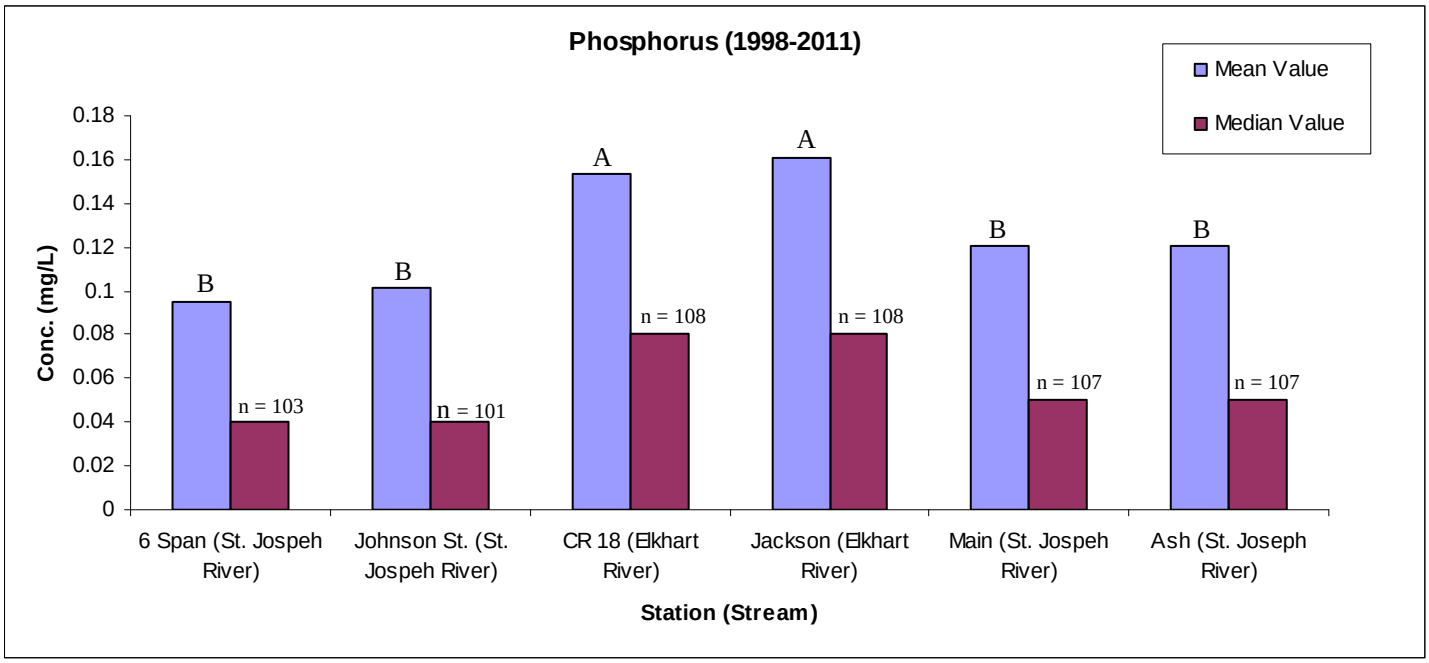


Figure G2: Summary of mean and median *E. coli* concentrations. Mean concentrations with different letters differ significantly. n = number of data points for each station.

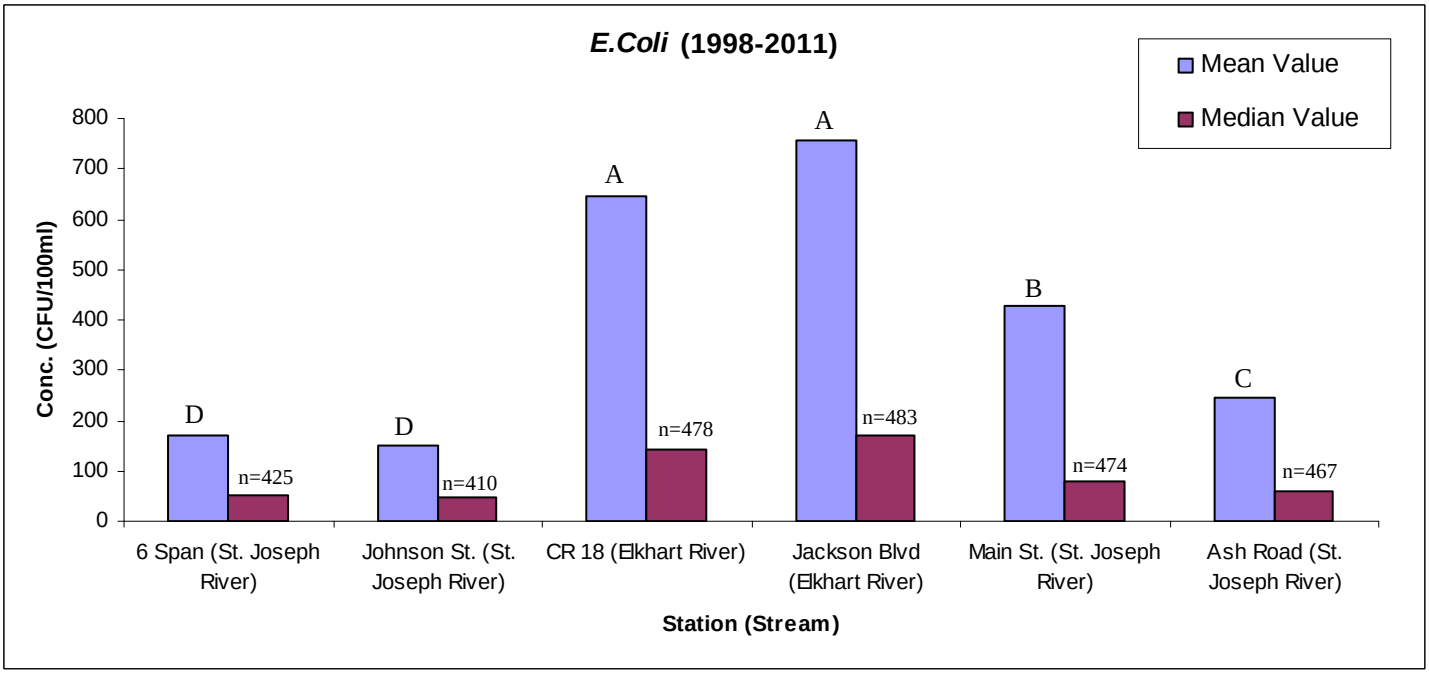


Figure G3: Summary of mean and median total suspended solid concentrations. Mean concentrations with different letters differ significantly. n = number of data points for each station.

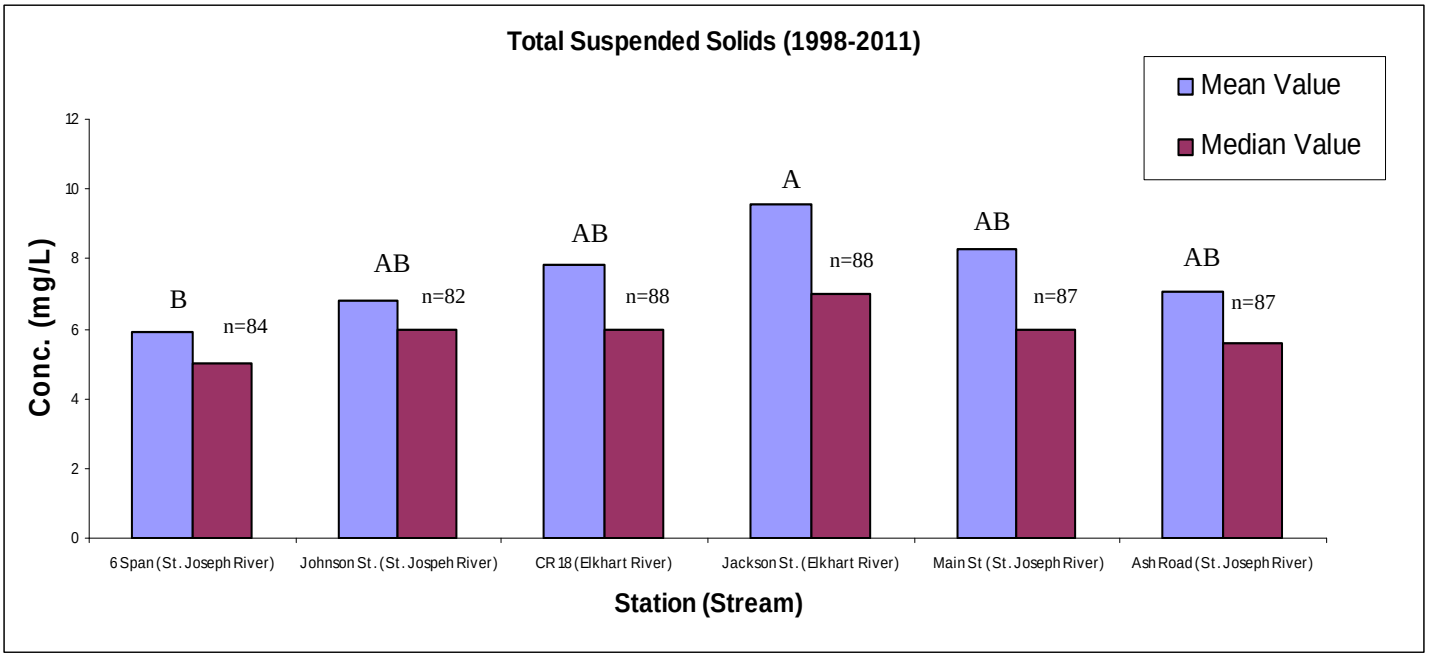


Figure G4: Comparison of mean total suspended solid (TSS) concentrations before and after baseline fish community assessment sampling. Mean TSS concentrations did not differ significantly between the two time periods at any station. n = number of data points.