

Elkhart Public Works & Utilities Fish Community Monitoring

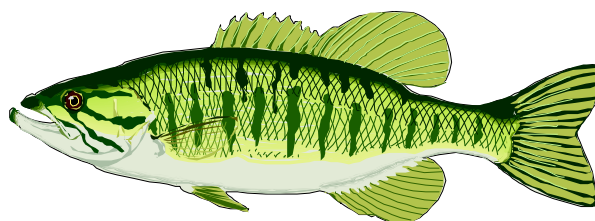


**Annual Report
1998**



Cover Photo: Longear sunfish.

ANNUAL REPORT



Fish Community Monitoring on the St. Joseph and Elkhart Rivers and Their Tributaries in Elkhart County, 1998.

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INTRODUCTION

For many years municipalities such as Elkhart have been required, through their NPDES (National Pollutant Discharge Elimination System) permits, to monitor chemical and microbiological levels of the rivers and streams to which they have any regulated discharges. This is done in an effort to protect the public and the aquatic communities that inhabit these waters, to determine the water quality in these areas, and to document the chemical and microbial contributions to these streams from these discharges. While this conventional monitoring is good at identifying the chemical and microbial components of the water being tested and may help protect the public, it provides little information about the condition of the aquatic communities that it is also intended to protect. Alone, chemical and microbial monitoring is not an effective indicator of aquatic community health and provides limited insight to overall water quality.

To get a better idea of the impacts discharges may have on a stream, or what impact various land uses have in a stream's watershed, a two-tiered sampling approach has been found to be most effective in monitoring and determining water quality in aquatic systems and protecting aquatic communities (Craddock 1990, Ohio EPA 1988). These approaches use conventional monitoring coupled with biological monitoring, sampling of the actual aquatic communities. It is important to remember that conventional monitoring can only reveal the chemical and microbial levels of the water at the time the sample is collected. The sporadic presence of a biologically harmful substance could easily go undetected by conventional monitoring alone. Since the aquatic communities are present 24 hours a day, seven days a week, they are the overall product of the chemical and physical interactions in these aquatic systems and, hence, are the best indicators of the water quality in a given area. The drawback to biological monitoring, however, is it merely acts as a "red flag" when there is a problem. Since conventional monitoring can identify any problem chemical(s) and help pinpoint sources of contamination, it is best to use both monitoring strategies to provide the greatest amount of protection for the public and aquatic communities.

With this knowledge, the City of Elkhart began the second step in its monitoring activities by sampling the fish communities of the St. Joseph and Elkhart Rivers and their tributaries in and around Elkhart during the summer of 1998. This sampling allows the City to document the condition of the fish communities, what impact an urban environment has on the rivers, and should reveal if any unknown problems exist. The tool that will be used to assess the water quality using the fish community information is the Index of Biotic Integrity (IBI) as modified by Thomas Simon (1997). This index was

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developed by James Karr (1981), and is most useful in translating complex fish community information into a more understandable format for non-biologists. In simplest terms, the IBI acts as a biological indicator much like the DOW Industrial Average acts as an economic indicator (Karr 1996). It is comprised of three broad categories (species composition, trophic composition, and fish condition) which are broken down into 12 individual metrics (Appendix A) to assess fish communities. These metrics are each given a score of 1 (low), 3, or 5 (high), and the total score for a site is in the range of 12 to 60. These scores can then be graphed and placed into one of five categories which describes the overall condition of the fish communities. The condition of the fish communities should be a reflection of the water

quality in a given area.

In addition to determining the water quality in a number of streams, sampling was conducted to determine the general diversity of the fish species in the Elkhart area. Smallmouth

bass (*Micropterus dolomieu*) and walleye (*Stizostedion vitreum*) were also tagged in an effort to assist the Indiana Department of Natural Resources (IDNR) in determining the movement patterns of these fish and to alert fishermen to the City's monitoring activities. Scale samples were taken from all walleye and smallmouth and largemouth bass over 75 mm long for age and growth analysis. However, to complete this report in a timely fashion, the age and growth analysis information will be completed at a later date and made available as a supplement to this report. Finally, tissue from eight species of fish was sampled and analyzed for mercury and pesticide content to compare to the state's fish consumption advisory for the St. Joseph and Elkhart Rivers. Presently several species are on this advisory in the Elkhart area (Table 1) and the City wanted to verify the state's findings.

METHODS

In an effort to identify the majority of fish species present and to determine initial water quality levels in the rivers and streams around Elkhart in the first year of the program, sites were sampled in two ways. Investigative sites were sampled only once and the length of the sample area was not measured. All fish collected at investigative sites were identified to species, the largest and smallest of each species were measured to the nearest millimeter (mm), the fish were counted, and then released. Index sites, on the other hand, were sampled twice at five-week intervals, and the length of the sample area was dependent on the stream's width. The length of these sites was 15 times the stream's width with a minimum length of 50 meters and a maximum length of 500 meters. Fish collected at index sites were studied more extensively. These fish were also identified to species and then were processed in two different ways. First, game fish (smallmouth bass, rock bass, bluegill, etc.) were measured by length to the nearest millimeter, individually weighed to the nearest gram (g), and then released. Non-game fish (suckers, darters, minnows, etc.) were counted, the largest and smallest of each species were measured to the nearest millimeter, species were mass weighed to the nearest gram, and then released. At each site a single specimen of the smaller species was retained for the Public Works & Utilities specimen museum, and larger specimens were photographed. This practice allows for the verification of the field and lab identifications if needed.

In the spring, United States Geological Survey quadrangle maps were used to identify bridges crossing tributary streams in Elkhart County, and a visual survey of 58 sites was conducted. Both types of sites were identified on most of the tributaries and sampled. In addition to these tributary sites, five index and five investigative

Table 1. Fish consumption information taken from the 1998 Indiana Fish Consumption Advisory.

Location	Species	Fish Size (inches)	Contaminant	Group
Elkhart River	Rock Bass	7-9	M,P	3
		9+	M,P	4
	Smallmouth Bass	5-6	P	3
	White Sucker	8-13	P	3
13+		P	4	
St. Joseph River	Black Redhorse	13-17	M	2
		17+	M	3
	Channel Catfish	20-24	P	3
		25-26	P	4
		26+	P	5
	Golden Redhorse	13-25	P	3
		25+	P	4
	Largemouth Bass	11-12	M	2
		12+	M	3
	Rock Bass	7-9	P	3
		9+	P	4
	Shorthead Redhorse	14-17	M,P	3
		17+	M,P	4
	Smallmouth Bass	9-13	M	2
		13+	M	3
	Walleye	16-17	M	3
17+		M	4	

M = Mercury
P = PCBs

Group 2 = 1 meal/week
Group 3 = 1 meal/month

Group 4 = 1 meal/2 months
Group 5 = DO NOT EAT

(Special restrictions apply to women and children. See advisory.)

sites were identified on the St. Joseph River and five index and four investigative sites on the Elkhart River. In all, 17 index and 20 investigative sites were sampled (Figures 1 & 2 & Table 2). This sampling strategy allowed the maximum number of streams and sites to be

Figure 1: Fish sampling sites in Elkhart County, 1998.

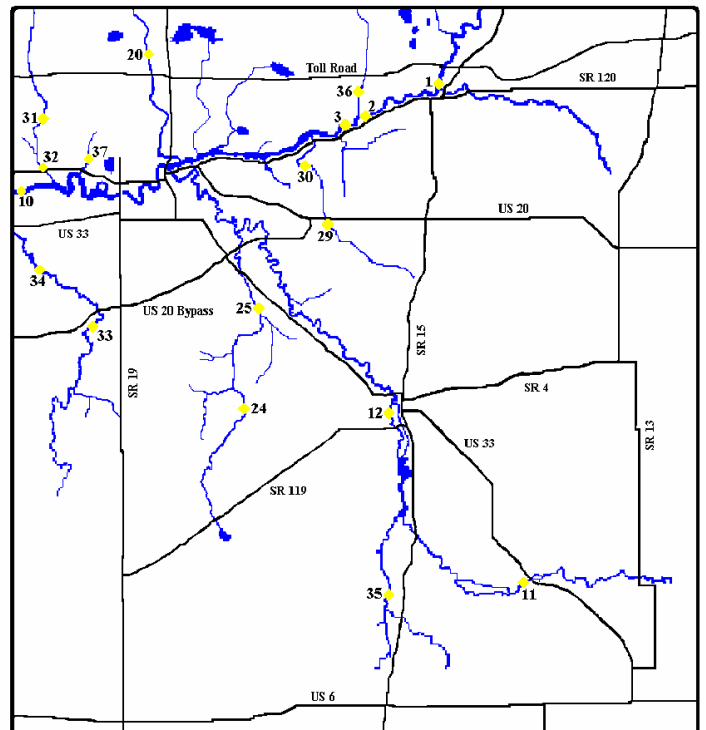


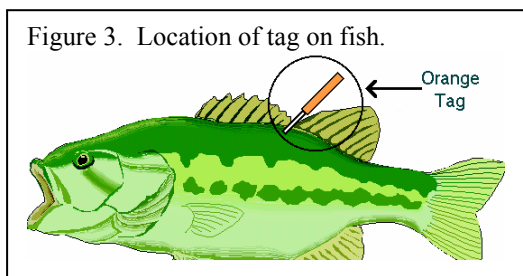
Table 2: Sites sampled, the method used to sample each, and their IBI score (Index sites only).

Site Number	Site Description	Type of Site (Index/Investigative)	Method	IBI Score		
				1st Pass	2nd Pass	Average
1	State Road 15 St. Joseph River	Index	Boat	54	52	53
2	Nibbyville St. Joseph River	Investigative	Boat	NA		
3	County Road 17 St. Joseph River	Index	Boat	50	56	53
4	County Road 13 St. Joseph River	Investigative	Boat	NA		
5	Mouth of Lily Creek St. Joseph River	Investigative	Boat	NA		
6	Sherman Street St. Joseph River	Index	Boat	46	46	46
7	Bridge Street St. Joseph River	Index	Boat	46	50	48
8	Nappanee Street St. Joseph River	Index	Boat	46	50	48
9	Elliot Park St. Joseph River	Investigative	Boat	NA		
10	Ash Road St. Joseph River	Investigative	Boat	NA		
11	US 33 Elkhart River	Investigative	Boat	NA		
12	Rogers Park (Goshen) Elkhart River	Investigative	Boat	NA		
13	Oxbow Park Elkhart River	Index	Boat	50	56	53
14	County Road 18 Elkhart River	Index	Boat	52	50	51
15	Environmental Center Elkhart River	Investigative	Boat	NA		
16	Indiana Avenue Elkhart River	Index	Boat	44	44	44
17	Middlebury Street Elkhart River	Index	Boat	44	42	43
18	American Park Elkhart River	Index	Boat	44	50	47
19	Jackson Street Elkhart River	Investigative	Boat	NA		
20	County Road 4 Christiana Creek	Index	Tote Barge	44	48	46
21	County Road 6 Christiana Creek	Investigative	Tote Barge	NA		
22	Willowdale Park Christiana Creek	Index	Tote Barge	42	50	46
23	N. Main Street Christiana Creek	Investigative	Tote Barge	NA		
24	County Road 32 Yellow Creek	Index	Tote Barge	36	36	36
25	County Road 13 (N. crossing) Yellow Creek	Investigative	Tote Barge	NA		
26	US 20 Bypass Yellow Creek	Index	Tote Barge	44	46	45
27	County Road 6 Puterbaugh Creek	Investigative	Tote Barge	NA		
28	County Road 8 Puterbaugh Creek	Index	Tote Barge	36	38	37
29	US 20 Bypass Pine Creek	Index	Tote Barge	34	32	33
30	Beck Drive Pine Creek	Investigative	Tote Barge	NA		
31	County Road 8 Cobus Creek	Index	Tote Barge	36	32	34
32	Old US 20 Cobus Creek	Investigative	Tote Barge	NA		
33	County Road 1 (N. crossing) Baugo Creek	Investigative	Tote Barge	NA		
34	County Road 3 (S. crossing) Baugo Creek	Investigative	Tote Barge	NA		
35	County Road 46 Turkey Creek	Investigative	Tote Barge	NA		
36	County Road 6 Washington Township Ditch	Investigative	Tote Barge	NA		
37	Lexington Industrial Park Manning Ditch	Investigative	Tote Barge	NA		

surveyed in the shortest amount of time due to the lesser amount of time invested at investigative sites. These sites were generally sampled for a shorter distance (less than 15 times the stream width) and game fish other than bass and walleye that were individually measured at index sites were not weighed at these sites. These two differences in sampling and processing allowed for two investigative sites to be sampled in a day versus one index site.

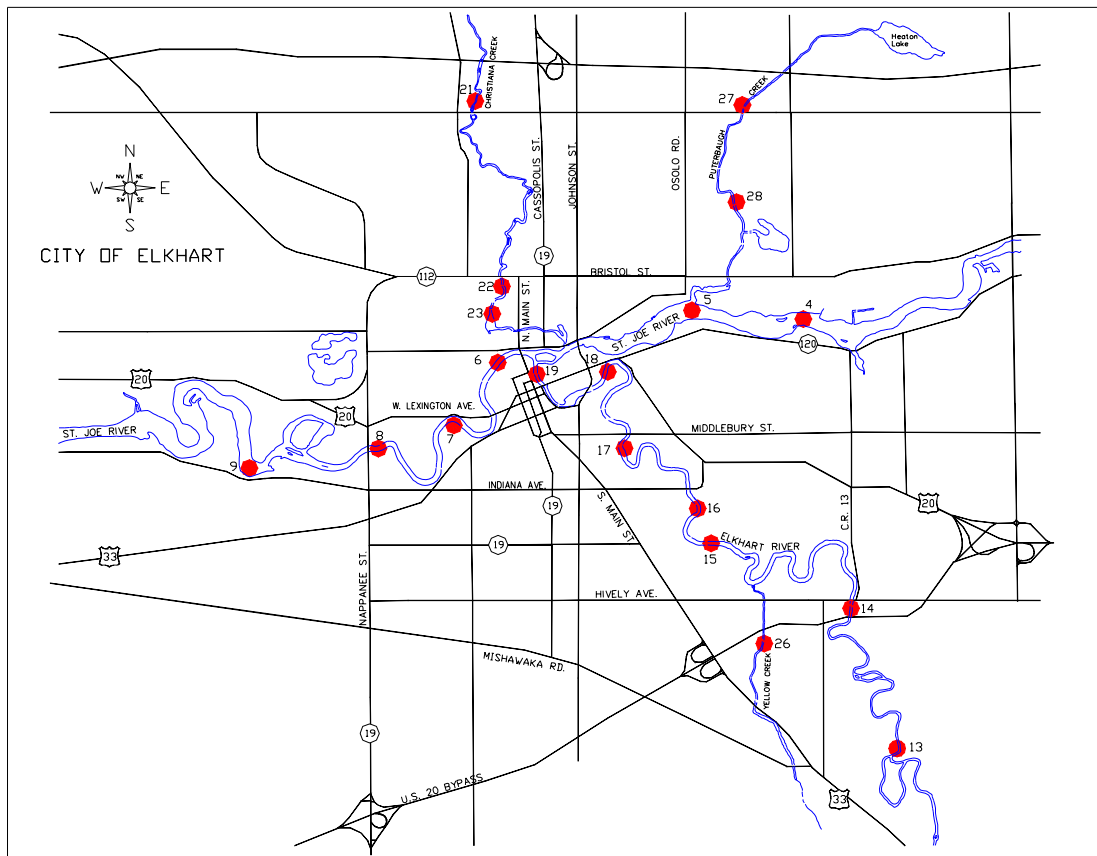
Both types of sites were sampled using either boat mounted or tote barge electrofishing gear depending on the depth of the stream. If the stream was wadeable for at least 80-90% of the area to be sampled, the tote barge equipment was used. All other areas were sampled utilizing the boat equipment. Output of the tote barge was 4-6 amperes, and 8-16 amperes for the boat.

Smallmouth bass greater than 10 inches and walleye greater than 12 inches in length also had an anchor tag applied under the left anterior edge of the dorsal fin (Figure 3). This tag was orange



in color and contained Elkhart Public Works & Utilities' phone number and a unique tag number. In addition to being tagged, the right pectoral fin of these fish was clipped to alert Public Works personnel to fish that had been tagged, but had

Figure 2: Fish sampling sites in Elkhart, IN, 1998.



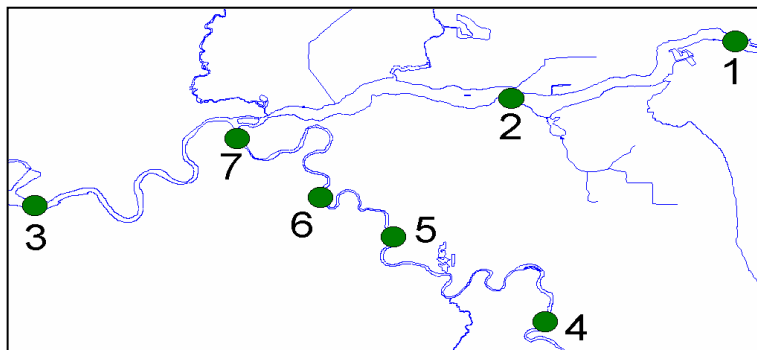
shed the tag. The biggest advantage of this tagging study is its ability to reveal important movement patterns of these fish and help the IDNR in its walleye stocking efforts on the St. Joseph River. If the success of this stocking program continues and grows, it could provide the Elkhart economy with additional revenue from non-local sport fishermen pursuing walleye in the Elkhart area.

Lastly, tissue in the form of fillets, was collected from common carp (*Cyprinus carpio*), smallmouth bass, largemouth bass (*Micropterus salmoides*), rock bass (*Ambloplites rupestris*), channel catfish (*Ictalurus punctatus*), golden redbreast (*Moxostoma erythrurum*), shorthead redbreast (*M. macrolepidotum*), and white sucker (*Catostomus commersoni*) in July and August. The tissue samples were collected from four sites on the Elkhart River and three sites on the St. Joseph River (Table 3 & Figure 4). Due to the presence of a dam just upstream of the Jackson Street site that effectively blocks upstream fish movements, the tissue samples at this site were treated as if they were fish from the St. Joseph River. The tissue samples were a composite of

Table 3: Fish tissue sites.

Site Number	River	Station
1	St. Joseph	Six-Span (CR 17)
2	St. Joseph	Bulldog Crossing (CR13)
3	St. Joseph	Below Nappanee St.
4	Elkhart	Hively Ave. (CR 18)
5	Elkhart	Indiana Ave.
6	Elkhart	Middlebury St.
7	Elkhart	Jackson St.

Figure 4: Location of fish tissue sites on the St. Joseph and Elkhart Rivers.



tissue from three fish of the same species at each site. 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).

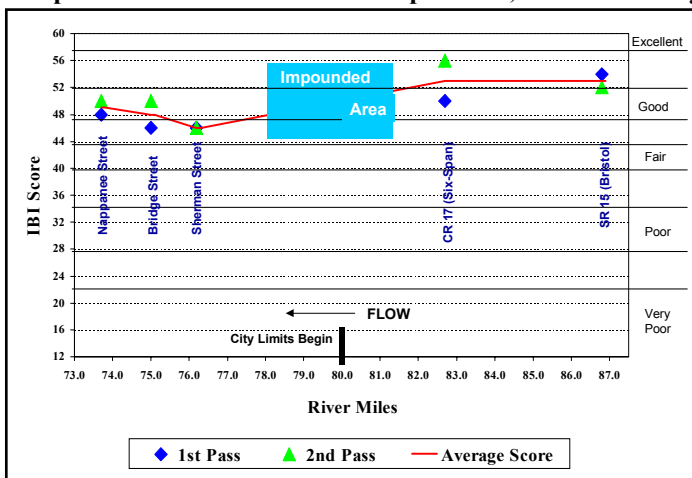
RESULTS & DISCUSSION

A total of 20,542 fish was collected from the index and investigative sites in 1998, and represented 68 species from fourteen families (Tables 4 & 5). One state endangered species, greater redhorse (*Moxostoma valenciennesi*), and one species of special concern, river redhorse (*Moxostoma carinatum*), were found during this sampling. These species were known to exist here, but not to the extent that this study found. Creek chub (*Semotilus atromaculatus*), sand shiner (*Notropis stramineus*), and white sucker were the top three species collected while Cyprinidae (minnows and shiners), Catostomidae (suckers and redhorse), and Centrarchidae (sunfish and black bass) were the top three families represented. A breakdown of the species collected at each site is presented in Appendix C.

INDICIES

The IBI scores are summarized in Table 2. The average score of the two passes will be compared to the average score in future years at the same sites. These average scores varied from a low of 33 (poor) at Pine Creek, US 20 Bypass to a high of 53 (excellent-good) at CR 17 and SR 15 on the St. Joseph River and at Oxbow Park on the Elkhart River. The longitudinal IBI trends on the Elkhart and St. Joseph Rivers are revealed in Graphs 1 & 2. The IBI scores for Yellow Creek and Christiana Creek are shown on Graph 3. It is important to remember that the IBI scores for the St. Joseph River (drainage basin >2,000 square miles) are only approximate because the metrics that were used were developed for rivers and streams in this area that have a drainage basin <1,000 square miles. When metrics are developed for the St. Joseph River, the information collected this year will be used to recalculate a more accurate IBI score. Index sites also could not be established in the impounded area of the St. Joseph River because the metrics

Graph 1: IBI scores for the St. Joseph River, Elkhart County.



were developed for flowing waters. The make-up of the fish community is greatly different in impounded areas due to the very slow current.

The IBI scores for the St. Joseph River (46-53) fall into the good-fair to excellent-good categories. The trend of higher scores above Elkhart versus below is normal for an urban area like this. It would be unrealistic to believe that a city the size of Elkhart would not have some kind of impact on the streams that flow through it.

Table 4: Summary of species captured at index sites.

COMMON NAME	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Sand Shiner	1,502	10.14	2,064	4.55	0.10
Striped Shiner	1,155	7.80	23,573	51.92	1.13
Creek Chub	1,076	7.26	12,549	27.64	0.60
White Sucker	1,067	7.20	186,284	410.32	8.96
Golden Redhorse	942	6.36	399,387	879.71	19.21
Smallmouth Bass	927	6.26	121,740	268.15	5.85
Bluntnose Minnow	790	5.33	2,528	5.57	0.12
Blacknose Dace	734	4.96	3,018	6.65	0.15
Rock Bass	608	4.10	43,459	95.72	2.09
Logperch	567	3.83	3,764	8.29	0.18
Mottled Sculpin	548	3.70	1,847	4.07	0.09
Bluegill	492	3.32	11,160	24.58	0.54
Hornyhead Chub	473	3.19	9,507	20.94	0.46
Northern Hog Sucker	416	2.81	92,861	204.54	4.47
Silverjaw Minnow	347	2.34	1,141	2.51	0.05
Central Stoneroller	331	2.23	2,682	5.91	0.13
Common Shiner	240	1.62	4,039	8.90	0.19
Shorthead Redhorse	238	1.61	131,698	290.08	6.33
River Redhorse	229	1.55	288,869	636.28	13.89
Rainbow Darter	225	1.52	343	0.76	0.02
Spotfin Shiner	199	1.34	1,059	2.33	0.05
Green Sunfish	172	1.16	2,758	6.07	0.13
Largemouth Bass	132	0.89	16,720	36.83	0.80
Greater Redhorse	121	0.82	162,441	357.80	7.81
Johnny Darter	106	0.72	169	0.37	0.01
Common Carp	90	0.61	360,656	794.40	17.34
Spottail Shiner	87	0.59	278	0.61	0.01
Blackside Darter	74	0.50	261	0.57	0.01
Yellow Bullhead	70	0.47	3,834	8.44	0.18
Spotted Sucker	65	0.44	24,047	52.97	1.16
Orangethroat Darter	61	0.41	70	0.15	0.00
Fathead Minnow	60	0.41	170	0.37	0.01
Central Mudminnow	55	0.37	254	0.56	0.01
Grass Pickerel	52	0.35	1,750	3.85	0.08
Yellow Perch	52	0.35	856	1.89	0.04
Chestnut Lamprey	46	0.31	499	1.10	0.02
Mimic Shiner	46	0.31	99	0.22	0.00
Silver Redhorse	46	0.31	70,356	154.97	3.38
Channel Catfish	44	0.30	31,393	69.15	1.51
Black Crappie	38	0.26	3,081	6.79	0.15
Brown Trout	32	0.22	1,037	2.28	0.05
Stonecat	28	0.19	313	0.69	0.02
Rosyface Shiner	26	0.18	66	0.15	0.00
Hybrid Sunfish	23	0.16	1,843	4.06	0.09
Walleye	23	0.16	2,909	6.41	0.14
Pumpkinseed	22	0.15	1,022	2.25	0.05
Longear Sunfish	19	0.13	806	1.78	0.04
Northern Pike	19	0.13	8,884	19.57	0.43
Tadpole Madtom	17	0.11	95	0.21	0.00
Bowfin	16	0.11	23,340	51.41	1.12
Longnose Gar	15	0.10	7,474	16.46	0.36
American Brook Lamprey	13	0.09	62	0.14	0.00
Steelcolor Shiner	7	0.05	77	0.17	0.00
Black Redhorse	5	0.03	4,314	9.50	0.21
Brown Bullhead	5	0.03	3,271	7.20	0.16
Pirate Perch	4	0.03	40	0.09	0.00
Blackchin Shiner	3	0.02	3	0.01	0.00
Redear Sunfish	3	0.02	132	0.29	0.01
Golden Shiner	2	0.01	23	0.05	0.00
Black Bullhead	1	0.01	45	0.10	0.00
Greenside Darter	1	0.01	1	0.00	0.00
Iowa Darter	1	0.01	1	0.00	0.00
Lake Chubsucker	1	0.01	42	0.09	0.00
Rainbow Trout	1	0.01	315	0.69	0.02
Warmouth	1	0.01	57	0.13	0.00
White Crappie	1	0.01	154	0.34	0.01
TOTAL	14,812	100.00	2,079,590	4,580.59	100.00

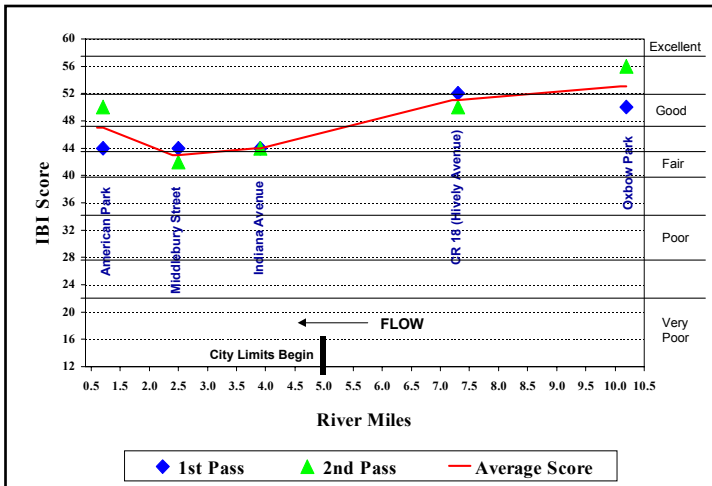
Table 5: Summary of species captured at investigative sites.

COMMON NAME	Total Number	% by Number
Creek Chub	597	10.42
White Sucker	489	8.53
Blacknose Dace	396	6.91
Golden Redhorse	383	6.68
Smallmouth Bass	353	6.16
Bluegill	339	5.92
Mottled Sculpin	297	5.18
Logperch	281	4.90
Bluntnose Minnow	215	3.75
Johnny Darter	206	3.60
Striped Shiner	191	3.33
Rock Bass	181	3.16
Spottail Shiner	165	2.88
Northern Hog Sucker	160	2.79
Brown Trout	146	2.55
Common Carp	94	1.64
Spotted Sucker	93	1.62
Largemouth Bass	84	1.47
Sand Shiner	81	1.41
Mimic Shiner	78	1.36
Spotfin Shiner	77	1.34
Hornyhead Chub	59	1.03
Green Sunfish	57	0.99
Silver Redhorse	56	0.98
Walleye	56	0.98
Shorthead Redhorse	52	0.91
Rainbow Darter	48	0.84
Longear Sunfish	46	0.80
Yellow Bullhead	38	0.66
Blackside Darter	33	0.58
Silverjaw Minnow	31	0.54
Stoneroller, Central	31	0.54
Channel Catfish	30	0.52
Central Mudminnow	29	0.51
Brook Silverside	23	0.40
Grass Pickerel	22	0.38
Greater Redhorse	22	0.38
Hybrid Sunfish	21	0.37
Yellow Perch	19	0.33
Pirate Perch	18	0.31
Orangethroat Darter	15	0.26
River Chub	15	0.26
Black Crappie	14	0.24
Pumpkinseed	13	0.23
Northern Pike	12	0.21
River Redhorse	12	0.21
Common Shiner	11	0.19
Tadpole Madtom	8	0.14
Rosyface Shiner	6	0.10
Chestnut Lamprey	4	0.07
Longnose Gar	4	0.07
Quillback	4	0.07
American Brook Lamprey	2	0.03
Brown Bullhead	2	0.03
Fathead Minnow	2	0.03
Redear Sunfish	2	0.03
Stonecat	2	0.03
Black Bullhead	1	0.02
Black Redhorse	1	0.02
Bowfin	1	0.02
Steelcolor Shiner	1	0.02
Warmouth	1	0.02
TOTAL	5,730	100.00

The types of impacts are many: street and parking lot run-off, lawn fertilizers, combined sewer overflows, seawalls (or any shoreline development), the wastewater treatment plant discharge, boating activities, etc. With all of these impacts in mind, however, the condition of the fish community as reflected in the IBI scores is above average for a river flowing through an urban area as industrialized as Elkhart.

The Elkhart River had IBI scores that ranged from excellent-good (53) to fair (43). This river is much smaller (average discharge = 688 ft³/sec) than the St. Joseph River (average discharge = 3,937 ft³/sec), and flows through a highly

Graph 2: IBI scores for the Elkhart River, Elkhart County.



agricultural area upstream of Elkhart. These two factors may have contributed to the fish communities' lower tolerance for the urban impacts that they encountered within Elkhart. The fish communities again reveal that they are in better condition above Elkhart than within the city limits. This is not to say, however, that these communities are in trouble. It merely shows that there is room for improving the "health" of this river through better stewardship activities.

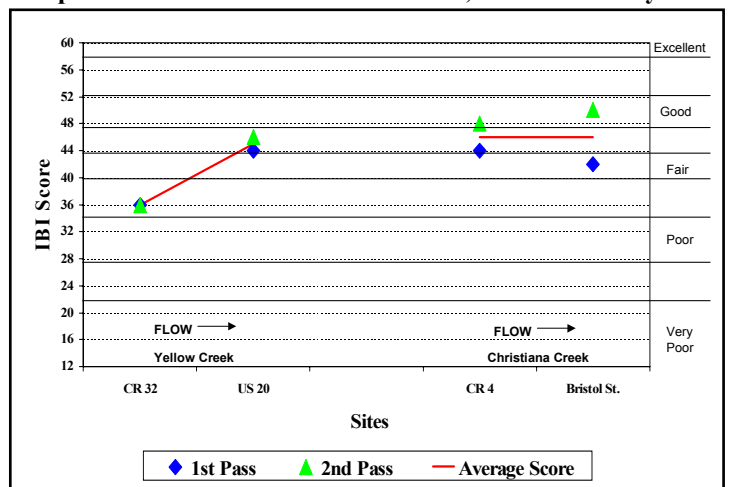
Yellow Creek (tributary to the Elkhart River) and Christiana Creek (tributary to the St. Joseph River) were the largest tributaries sampled and each had two index sites. The low score (36) (Graph 3) on Yellow Creek at CR 32 was a true reflection of the poor water quality for this stream. Yellow Creek is highly impacted by agricultural runoff and stream channel modifications (ie. snagging and dredging), which

account for the high amount of sediments it moves and the color it turns (tan) after a hard rain. This site has tall, steep slopes and very little overhanging vegetation. In contrast, the US 20 Bypass site reveals how a fish community can recover from most disturbances if left alone. This site has a great deal of overhead canopy and the stream channel has not been modified. Both of these stream characteristics allow for a more diversified fish assemblage.

Christiana Creek, on the other hand, has a lot of overhead canopy along its course and does not flow through highly agricultural lands. This stream does, however, have a lot of residential development along its banks. While development is great for the landowners, certain actions could cause less of an impact to the stream. Fewer seawalls, buffer zones (unmowed grass), properly working septic or sewer service, and less lawn chemicals used would help this stream greatly. The scores for the sites on this stream (46 and 46) (Graph 3) are good, but could be improved.

The three remaining streams that each had an index site, Puterbaugh Creek, Pine Creek, and Cobus Creek, had fairly low IBI scores (37, 33, 34)(Table 2). All three of these streams had a good variety of habitats available, however, they maintained water temperatures that would classify them as cool or cold water streams. This is important to know because the IBI was developed and modified for use on warmwater streams. Cool or cold water streams tend to have fewer species and not as many fish as warmwater

Graph 3: IBI scores for various streams, Elkhart County.



streams. When the IBI is used to assess cool or cold water streams, it generally scores them lower.

TAGGING & MOVEMENT

In 1998, Elkhart Public Works & Utilities tagged 282 fish (Table 6). Of those tagged, 17 fish were recaptured (one fish was even recaptured twice) giving a recapture rate of 6.0%. This is a good recapture rate and should increase as more fishermen become aware of this tagging program and recognize tags on fish.

Most of the recaptured fish were caught within the area from which they were released, but seven of the recaptured fish moved from their release point (Table 7). All of the smallmouth bass that moved upstream, however, were merely returning to the area from which they were captured. When

Table 6: Summary of tagged and recaptured fish.

Species	Number Tagged	Recaptures (Fishermen)	Recaptures (Elkhart PW&U)
Smallmouth Bass	245	8	5
Walleye	37	4	0

a shoreline area for processing the fish was not present near the sampling zone, the fish were moved to a different location for processing and then released. These smallmouth bass liked where they were and went to great trouble to return to their original area.

The tagged walleye that moved upstream were not recaptured in the areas from which they were initially collected. The one walleye that moved

15 miles was tagged at Bulldog Crossing (CR 13) and was recaptured by a fisherman below the

Table 7: Summary of recaptured fish movements.

Species	Direction Moved	Stream	Date Tagged	Time at Large (Weeks)	Distance Traveled (miles)
Smallmouth Bass	Upstream	Elkhart River	6/98	7	2.9
	Upstream	St. Joseph River	7/98	10	1.0
Smallmouth Bass	Upstream	Elkhart River	8/98	3	4.1
	Downstream	Elkhart River	8/98	1	.6
Walleye	Upstream	St. Joseph River	7/98	12	15.0
	Upstream	St. Joseph River	10/98	2	2.9
Walleye	Downstream	St. Joseph River	6/98	1	.7

Mottville, Michigan dam. The other walleye was released at McNaughton Park and was recaptured below the Johnson Street dam. These fish may have moved farther if these dams had not been present.

FISH TISSUE

The fish tissue results revealed PCB and mercury levels were generally lower than the state had found in the past (Table 8). Detailed results can be found in Appendix B. If another year of tissue sampling finds similar results, Elkhart will petition the state for an adjustment to the consumption advisory in this area.

Smallmouth bass larger than the advisory group were sampled on the Elkhart River. These larger fish had lower PCB levels but slightly higher mercury levels than the smaller fish that the state had sampled. The higher mercury levels were not

Table 8: Fish tissue comparison.

Stream	Species	Fish size (inches)	State Results		PW & U Results	
			Contaminant	Advisory Group	Contaminant	Advisory Group
St. Joseph	Carp	25+	M,P	5	M,P	3
	Golden Redhorse	13-25	P	3	P	2
	Shorthead Redhorse	14-17	M,P	3	P	2
	Channel Catfish	<20	NA	NA	P	2
	Largemouth Bass	12+	M	3	M	2
	Smallmouth Bass	9-13	M	2	M,P	2
Elkhart	White Sucker	13+	P	4	M,P	2
	Rock Bass	7-9	M,P	3	P	2
	Smallmouth Bass	12+	NA	NA	M,P	2

M = Mercury
P = PCBs
Group 2 = 1 meal/week
Group 3 = 1 meal/month
Group 4 = 1 meal/2 months
Group 5 = DO NOT EAT
(Special restrictions apply to women and children. See advisory.)

unexpected due to the larger size of these fish (12-16 inches), and the lower PCB levels may be due to the length of time (>10 years) that has passed since the state last sampled this river. The rock bass tissue had mercury levels that would place it in a group 1 advisory, and PCB levels that would place it in a group 2 advisory. White sucker tissue had group 2 PCB levels and group 2 mercury levels. The state had found group 4 PCB levels and group 1 mercury levels when it completed its last tissue survey in 1988 on the Elkhart River.

The results from the St. Joseph River were more complex due to the greater number of species sampled, but still exposed a general trend of lower mercury and PCB levels. The carp tissue had much lower levels of both mercury and PCBs than the state had listed in the advisory, and the other species' tissue had mercury and PCB levels no higher than group 2. This was a decrease for all species except smallmouth bass. The one smallmouth bass sample that had group 2 PCB levels was collected from the Jackson Street site on the Elkhart River. The tissue from this site had been compared to the St. Joseph River findings because of an upstream dam that blocked movement up the Elkhart River. Interestingly, all of the tissue samples collected from this site had group 2 or 3 PCB levels. Perhaps the overall PCB levels are higher in the Elkhart River due to the high amount of sediments this river carries and the ability of PCBs to attach to these sediments. Channel catfish 16-18 inches long were also found to have group 2 PCB levels. The state had no advisory on channel catfish of this size, but they did have a group 3 advisory on catfish 20-24 inches long. Because the larger fish had moderate PCB levels, it was not surprising to find these smaller fish had slightly lower PCB levels as well.

CONCLUSION

The condition of the fish communities in the Elkhart and St. Joseph Rivers near Elkhart is fair to good as determined by the Index of Biotic Integrity. This indicates that the water quality in the same area is good, but could still be improved. Christiana Creek has good water quality as well, while Yellow Creek has room for improvement.

Keep in mind that Yellow Creek's primary use is drainage of agricultural lands, and the fish community that was found may be the best that this type of stream can support.

Tagging efforts appear to be uncovering some of the mysteries as to where smallmouth bass and walleye prefer to live. Smallmouth bass tend to be real homebodies while walleye move as far as they can through the river system. This movement information will help the state with its continued stocking efforts of walleye in the St. Joseph River. These continued stockings could prove to be important to the local economy given the amount of money fishermen spend while fishing for prized species like walleye. Recaptured, tagged fish have also given Elkhart the opportunity to inform many fishermen about this new monitoring program.

Tissue sampling has revealed that the fish consumption advisory for the Elkhart area may need to be adjusted. Many fish on the advisory were found to have lower levels of mercury and PCBs than were previously found by the state. This sampling will help insure that the citizens of Elkhart will be properly informed in a timely manner of the mercury and PCB levels in the fish from area rivers.

The City of Elkhart wants to ensure that the health of these aquatic resources is not compromised, and would like to promote better stewardship throughout the watershed. Elkhart will do its part by continuing to monitor these aquatic resources to get a better understanding of their complexities and to help protect them for future generations.

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Appendix A

Index of Biotic Integrity metrics

Appendix A

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. % Headwater species
4. Number of minnow species
5. Number of sensitive species
6. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Pioneer species (individuals)
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

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. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Carnivores
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

Appendix B

Fish tissue preparation and results

Appendix B

Fish tissue preparation for PCB and metals analysis.

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
- scalars
- ice
- cooler

A group of three fish per species was selected based on size. In every case but one, the smallest fish in a group was greater than or equal to 90% of the length of the largest fish in that group. In the one instance the smallest fish was greater than 75% of the length of the largest fish as called for in the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory"(1993). 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, except for a few carp and redhorse groups, had skin-on fillets taken. The few exceptions had skin-on fillets taken from one side of each fish and skin-off fillets taken from the opposite side. These skin-on composites were analyzed separate from the skin-off composites to note the differences that may occur due to the different preparations.

Before the tissue was removed, the fillet knives, scalars and skinners were cleaned and rinsed with DI water, and freezer wrap was placed where the fish were to be processed. The knives, scalars 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. For skin-off samples, the skin was scored around the edge of the fillet and then 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.

Appendix B

Tissue results and comparison.

Stream	Station	Species	Length Range (PW&U)	Advisory Length Range (State)	Mercury Group (PW&U)	Advisory Mercury Group (State)	PCB Group (PW&U)	Advisory PCB Group (State)
Elkhart River								
Hively Ave. (CR 18)								
		Rock Bass	7.0-7.3	7-9	1	2	2	3
		Smallmouth Bass	15.0-15.6	5-6	2	1	2	3
		White Sucker	15.0-15.6	13+	1	1	2	4
Indiana Ave.								
		Rock Bass	6.9-7.3	7-9	1	2	1	3
		Smallmouth Bass	11.9-14.0	5-6	2	1	2	3
		White Sucker	15.2-15.6	13+	1	1	2	4
Middlebury St.								
		Rock Bass	7.2-7.6	7-9	1	2	1	3
		Smallmouth Bass	15.6-16.7	5-6	2	1	2	3
		White Sucker	14.1-14.7	13+	2	1	2	4
St. Joseph River								
Bulldog Crossing (CR 13)								
		Common Carp	27.6-29.5	25+	2	5	3	5
		Golden Redhorse	16.1-16.8	13-25	1	1	1	3
		Smallmouth Bass	10.7-10.8	9-13	1	2	1	1
Jackson St.								
		Channel Catfish	16.3-17.7	NA	1	1	2	1
		Common Carp	25.6-26.1	25+	1	5	3	5
		Shorthead Redhorse	15.5-16.9	14-17	1	2	2	3
		Smallmouth Bass	10.0-10.2	9-13	1	2	2	1
Nappanee St.								
		Common Carp	26.2-27.1	25+	1	5	3	5
		Golden Redhorse	15.2-15.7	13-25	1	1	2	3
		Smallmouth Bass	11.2-11.6	9-13	2	2	1	1
Six-Span (CR 17)								
		Common Carp	31.1-32.1	25+	2	5	2	5
		Golden Redhorse	15.6-15.9	13-25	1	1	1	3
		Largemouth Bass	12.9-13.2	12+	2	3	1	1

Appendix C

Location and species of fish caught at all sites in Elkhart County, 1998

Appendix C

Stream Site Number	St. Joseph River																
	1		2	3		4		5	6		7		8		9	10	
	1st Pass	2nd Pass		1st Pass	2nd Pass	Day	Night		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass		Day	Night
Chestnut Lamprey	X								X			X					
Longnose Gar	X	X		X	X	X			X	X	X	X	X				X
Bowfin	X			X	X	X							X				
Central Mudminnow		X															
Grass Pickerel	X	X										X			X		
Northern Pike		X					X		X								X
Common Carp	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hornyhead Chub														X			
Creek Chub		X								X							
Rosyface Shiner		X		X						X							
Striped Shiner		X		X						X					X		
Common Shiner															X		
Spottail Shiner			X	X	X	X	X			X		X	X	X	X		X
Steelcolor Shiner				X							X						
Spotfin Shiner	X	X	X	X	X				X	X	X	X	X	X	X	X	X
Sand Shiner	X		X	X	X	X			X	X	X	X	X	X	X	X	X
Mimic Shiner		X					X										
Bluntnose Minnow	X	X		X	X		X	X		X			X	X		X	
Stoneroller																	
Quillback																X	
Silver Redhorse		X	X		X	X	X	X	X	X		X	X	X		X	X
Black Redhorse	X									X	X	X					
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Shorthead Redhorse	X	X	X	X	X	X		X	X	X	X	X	X	X	X		
Greater Redhorse	X			X	X				X	X	X	X	X	X	X		X
River Redhorse			X	X	X		X		X	X	X	X	X	X		X	X
Northern Hog Sucker	X	X	X	X	X				X	X	X	X	X	X	X		
White Sucker	X	X		X			X		X	X	X	X	X	X		X	X
Spotted Sucker	X	X	X	X		X	X	X	X						X	X	X
Channel Catfish	X		X			X			X	X	X	X	X	X	X		X
Yellow Bullhead			X		X					X		X					
Brown Bullhead	X					X											X
Pirate Perch	X	X			X												
Brook Silverside							X	X									X
Black Crappie		X			X		X					X			X	X	X
Rock Bass	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Largemouth Bass	X	X		X	X	X	X	X	X			X	X	X	X	X	X
Warmouth							X										
Green Sunfish									X	X	X	X			X		
Hybrid Sunfish		X							X	X		X	X				X
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish	X			X	X						X	X			X		X
Redear Sunfish																	
Pumpkinseed	X				X		X	X	X			X	X	X		X	
Walleye		X	X	X		X	X		X	X	X	X	X	X	X		X
Yellow Perch	X	X		X	X		X	X					X	X			X
Blackside Darter	X	X		X	X		X							X			
Logperch	X	X		X	X	X	X		X	X	X	X	X	X	X		X
Johnny Darter	X	X					X										
Greenside Darter														X			
Rainbow Darter		X			X												X
Mottled Sculpin		X															

Appendix C

Stream Site Number	Elkhart River													
	11	12	13		14		15	16		17		18		19
			1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Chestnut Lamprey			X	X	X	X		X	X	X	X	X	X	
American Brook Lamprey									X					
Grass Pickerel		X	X			X								
Northern Pike		X	X	X	X	X			X		X		X	X
Common Carp	X	X					X							X
Hornyhead Chub		X	X	X	X	X		X	X	X	X	X	X	
Creek Chub				X										
Rosyface Shiner	X	X		X		X		X	X	X	X	X	X	
Striped Shiner		X	X	X	X	X	X	X	X	X	X	X	X	X
Common Shiner	X		X	X		X		X	X					
Steelcolor Shiner							X							
Spotfin Shiner	X	X	X	X			X	X	X	X		X		
Sand Shiner											X		X	X
Silverjaw Minnow											X		X	
Fathead Minnow				X										
Bluntnose Minnow	X	X	X	X		X								
Silver Redhorse														X
Black Redhorse														X
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Shorthead Redhorse														X
Greater Redhorse		X	X	X	X	X				X		X		
River Redhorse		X		X	X		X							
Northern Hog Sucker	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White Sucker	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotted Sucker	X	X	X	X	X	X	X		X					
Channel Catfish														X
Yellow Bullhead	X					X	X	X	X	X		X		
White Crappie						X								
Black Crappie	X	X	X	X	X	X								
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Largemouth Bass	X	X	X	X		X	X	X	X		X		X	
Warmouth					X									
Green Sunfish	X	X	X			X	X				X		X	X
Hybrid Sunfish		X	X		X	X	X	X	X	X	X	X	X	
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish	X	X			X	X								
Redear Sunfish							X		X					X
Pumpkinseed		X		X				X						
Walleye														X
Yellow Perch	X													
Blackside Darter	X	X	X	X	X	X		X	X					
Logperch														X
Johnny Darter	X			X										
Rainbow Darter	X													

Appendix C

Stream Site Number	Christiana Creek						Yellow Creek					Puterbaugh Creek		
	20		21	22		23	24		25	26		27	28	
	1st Pass	2nd Pass	1st Pass	1st Pass	2nd Pass	1st Pass	1st Pass	2nd Pass	1st Pass	1st Pass	2nd Pass	1st Pass	1st Pass	2nd Pass
Chestnut Lamprey	X	X	X			X				X				
American Brook Lamprey												X	X	X
Bowfin		X												
Central Mudminnow		X		X			X					X		X
Grass Pickerel	X	X		X	X	X						X	X	X
Common Carp		X		X		X								
Golden Shiner							X							
Hornyhead Chub	X	X	X		X	X	X	X	X	X	X			
River Chub			X											
Creek Chub			X				X	X	X	X	X	X	X	X
Blacknose Dace							X	X	X	X	X			
Striped Shiner	X	X	X		X	X	X		X	X	X		X	
Common Shiner								X						
Spotfin Shiner		X			X	X								
Sand Shiner											X			
Mimic Shiner													X	
Silverjaw Minnow							X	X			X			
Fathead Minnow							X	X	X	X				
Bluntnose Minnow	X	X	X	X		X	X	X	X	X	X			
Stoneroller							X	X	X			X	X	X
Silver Redhorse						X								
Golden Redhorse	X	X	X	X	X	X					X			
Shorthead Redhorse			X											
Northern Hog Sucker	X	X	X	X	X	X				X	X			
White Sucker	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Spotted Sucker												X		
Lake Chubsucker	X													
Yellow Bullhead	X	X	X	X	X	X						X		
Brown Bullhead	X													
Black Bullhead							X		X					
Stonecat	X		X		X	X								
Tadpole Madtom	X	X	X											
Pirate Perch												X		
Brook Silverside						X								
Black Crappie							X	X	X	X	X			
Rock Bass	X	X	X	X	X	X								
Smallmouth Bass	X	X	X	X	X	X				X	X	X		
Largemouth Bass	X	X	X	X		X	X	X	X	X	X	X		X
Green Sunfish						X	X	X	X	X	X	X		X
Hybrid Sunfish				X		X					X			
Bluegill			X	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish						X								
Redear Sunfish								X						
Pumpkinseed				X		X		X		X	X			
Yellow Perch	X	X				X								
Blackside Darter										X	X		X	X
Logperch			X	X	X							X	X	X
Johnny Darter		X				X	X	X	X	X	X	X	X	X
Iowa Darter														X
Rainbow Darter	X	X	X	X	X	X						X	X	X
Orangethroat Darter	X	X	X		X	X						X	X	X
Mottled Sculpin												X	X	X

Appendix C

Stream	Pine Creek			Cobus Creek			Baugo Creek		Turkey Creek	Washington Township Ditch	Manning Ditch
	29	30		31	32		33	34	35	36	37
	1st Pass	2nd Pass		1st Pass	2nd Pass						
Chestnut Lamprey									X		
American Brook Lamprey					X	X					
Brown Trout			X	X	X	X				X	
Rainbow Trout				X							
Central Mudminnow	X	X	X	X	X				X		
Grass Pickerel				X	X	X	X		X		X
Northern Pike									X		
Common Carp								X	X		
Hornyhead Chub									X		
Creek Chub	X	X	X	X	X		X	X	X		X
Blacknose Dace	X	X	X	X	X		X	X	X		X
Striped Shiner							X	X			
Blackchin Shiner				X							
Spotfin Shiner								X			
Sand Shiner							X	X			
Silverjaw Minnow							X				
Fathead Minnow							X				
Bluntnose Minnow							X	X	X		
Stoneroller							X	X	X		X
Quillback								X			
Silver Redhorse								X			
Golden Redhorse								X	X		
Northern Hog Sucker									X		
White Sucker	X	X	X	X	X	X	X	X	X	X	X
Spotted Sucker									X		
Channel Catfish								X			
Yellow Bullhead							X				
Pirate Perch									X		
Rock Bass				X			X	X	X		
Smallmouth Bass						X		X	X		
Largemouth Bass				X	X		X	X	X		
Green Sunfish			X	X	X	X	X	X	X		
Bluegill				X				X	X		
Blackside Darter							X		X		
Logperch						X	X	X	X		
Johnny Darter	X	X					X	X	X		
Rainbow Darter									X		X
Orangethroat Darter											X
Mottled Sculpin	X	X	X			X					