IV. Identifying Problems… Known Surface Water Quality Problems in the Deep River/ Turkey Creek Watershed

The Indiana Department of Environmental Management (IDEM) and the Indiana Department of Natural Resources (IDNR) are the primary agencies involved in surface water quality monitoring and assessment in the state of Indiana. In conjunction with the requirements of the Clean Water Act and the State's goals for protecting its natural and recreational resources, IDEM and IDNR operate several monitoring programs designed to monitor and assess the chemical, physical, and biological conditions of Indiana's waters. In addition, several volunteer water quality monitoring programs have been actively conducting chemical and biological monitoring within the Deep River/ Turkey Creek watershed.

The following section provides a summary of historical water quality monitoring efforts within the Lake George, Deep River, and the Turkey Creek watersheds, summarizes historical 305(b) waterbody assessments, and identifies impairments documented through other reports and studies.

Historical Surface Water Quality Monitoring

IDEM 2000 Basin Survey

The Indiana Department Environmental Management (IDEM) Surveys Section has conducted many water quality monitoring surveys within the Deep River/ Turkey Creek Watershed throughout the past several decades. However, for the purpose of this project, it was determined that since significant improvements in wastewater collection and treatment infrastructure had occurred in the watershed within the past five years, chemical water monitoring data no older than five years would be used to evaluate water quality in the watershed. Consequently, the Surveys Section's data from the 2000 Great Lakes Basin Survey provided the most current chemical water quality for evaluating water quality.

The sites monitored by IDEM in the Deep River/ Turkey Creek watershed are illustrated in **Figure 4-1**. In all, the IDEM monitored seven sites within the watershed for a variety of bacteriological, chemical, and physical indicators of water quality. Two monitoring programs operated by the Surveys Section were involved in data collection within the watershed: The Watershed Monitoring Program and the E.coli Monitoring Program.

Although the Watershed Monitoring Program collects data that provides a more in-depth chemical analysis of water quality at each site, the program only monitored one site within the Deep River watershed. In contrast, the E.coli. Monitoring Program provided

the most spatially complete data set within the watershed, but the program only collects data for E. coli bacteria (five samples/ 30 days) and associated field data parameters. As a result, data from the E. coli monitoring program provided the primary historical data set by which the watershed could be evaluated (See **Figure 4-2**).

IDEM Basin Monitoring Summary

In summary, although the IDEM's chemical monitoring dataset for the Deep River/ Turkey Creek watershed is very limited in spatial extent, depth, and duration, it provides the most current water quality monitoring data available for the Deep River/ Turkey Creek Watershed. The data indicates a general concern regarding violations of state water quality standards for E.coli bacteria (WQS = 125cfu/ 100ml). The data indicates exceedances at most monitoring locations throughout the watershed.

In addition, field data collected by the IDEM's monitoring programs identified consistently elevated observations of specific conductance. Elevated specific conductance values can be used as an indicator of other physical, chemical or metallic ions (cations or anions) in the water column. Although specific conductance data collected by IDEM appears to indicate elevated ionic concentrations within stream samples throughout the watershed, especially within Turkey Creek, no additional data is available to identify the type of ions present.

Hobart High School – Water Analysis Class

Hobart High School Biology teacher, Mr. Jerry Kousen, has been working with his students to identify and correct water quality problems within the community. On January 15, 2002, Mr. Kousen's "Water Analysis" class conducted a presentation summarizing their water quality monitoring activities to the Steering Committee for the Deep River/ Turkey Creek Watershed Plan. Monitoring locations for the class are listed in **Figure 4-3** and data summaries from this presentation are included in **Appendix 4-1**.

The students provided monitoring results and conclusions that identified water quality concerns for both Turkey Creek and Deep River, including elevated nutrient values, fecal coliform levels, and illegal dumping. Additional information regarding Mr. Kousen's Water Analysis Class is located at www.hobart.k12.in.us/jkousen/Biology/classinfo.html. This site contains information about the watershed, including monitoring site photos, monitoring data, and class information.

Figure 4-1

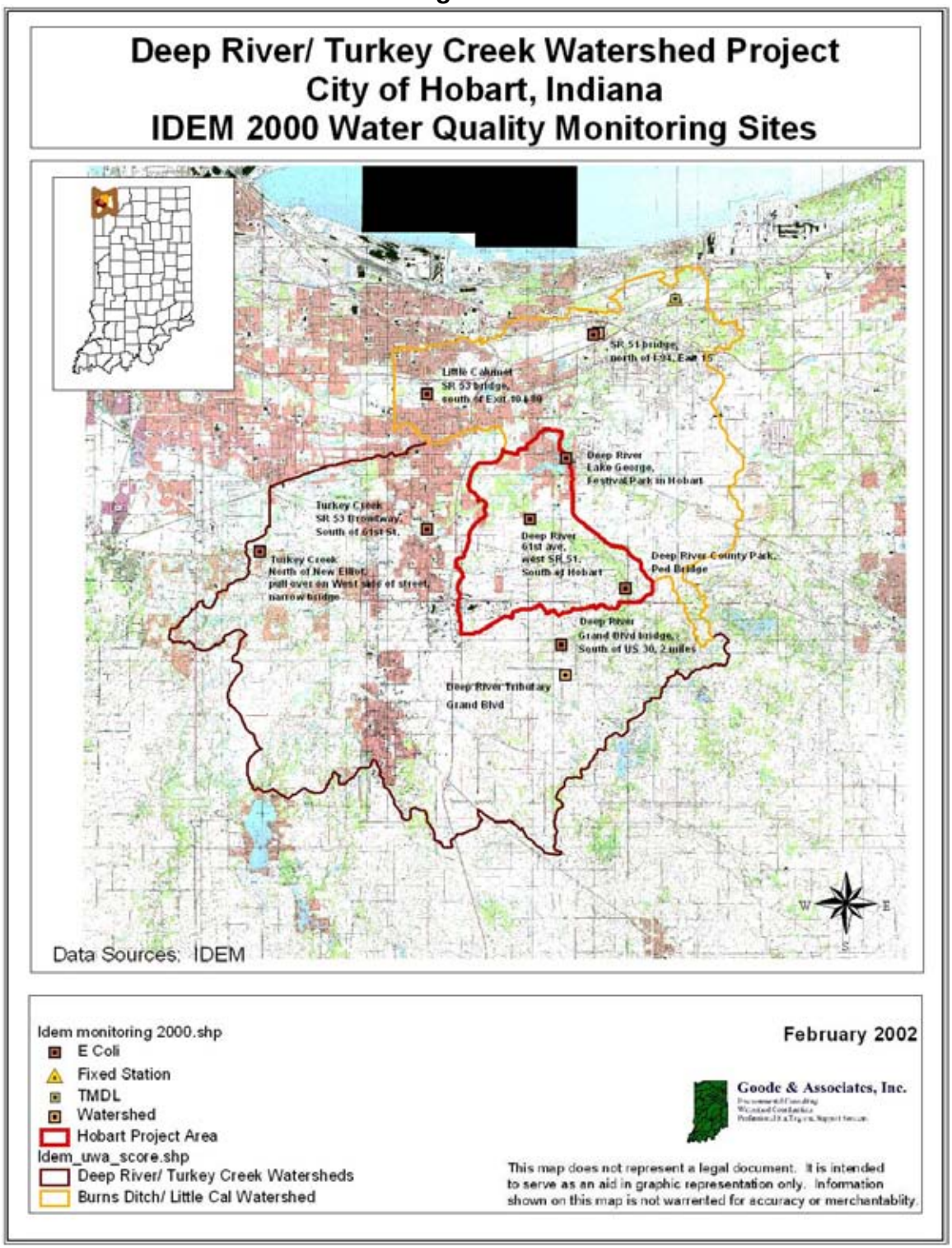

Deep River/ Turkey Creek Watershed Project
City of Hobart, Indiana
IDEM 2000 Water Quality Monitoring Sites
Little Calumet
SR 53 bridge,
Deep River
Lake George,
Festival Park in Hobart
Turkey Creek
SR 53 Broadway,
South of 61st St.
Deep River
61st ave,
west SR 51,
South of Hobart
Deep River County Park,
Ped Bridge
Deep River
Grand Blvd bridge,
South of US 30, 2 miles
Deep River Tributary
Grand Blvd
Data Sources: IDEM
Idem monitoring 2000.shp
E Coli
Fixed Station
TMDL
Watershed
Hobart Project Area
Idem_uwa_score.shp
Deep River/ Turkey Creek Watersheds
Burns Ditch/ Little Cal Watershed
February 2002
Goode & Associates, Inc.
This map does not represent a legal document. It is intended to serve as an aid in graphic representation only. Information shown on this map is not warrented for accuracy or merchantablity.

Figure 4-2

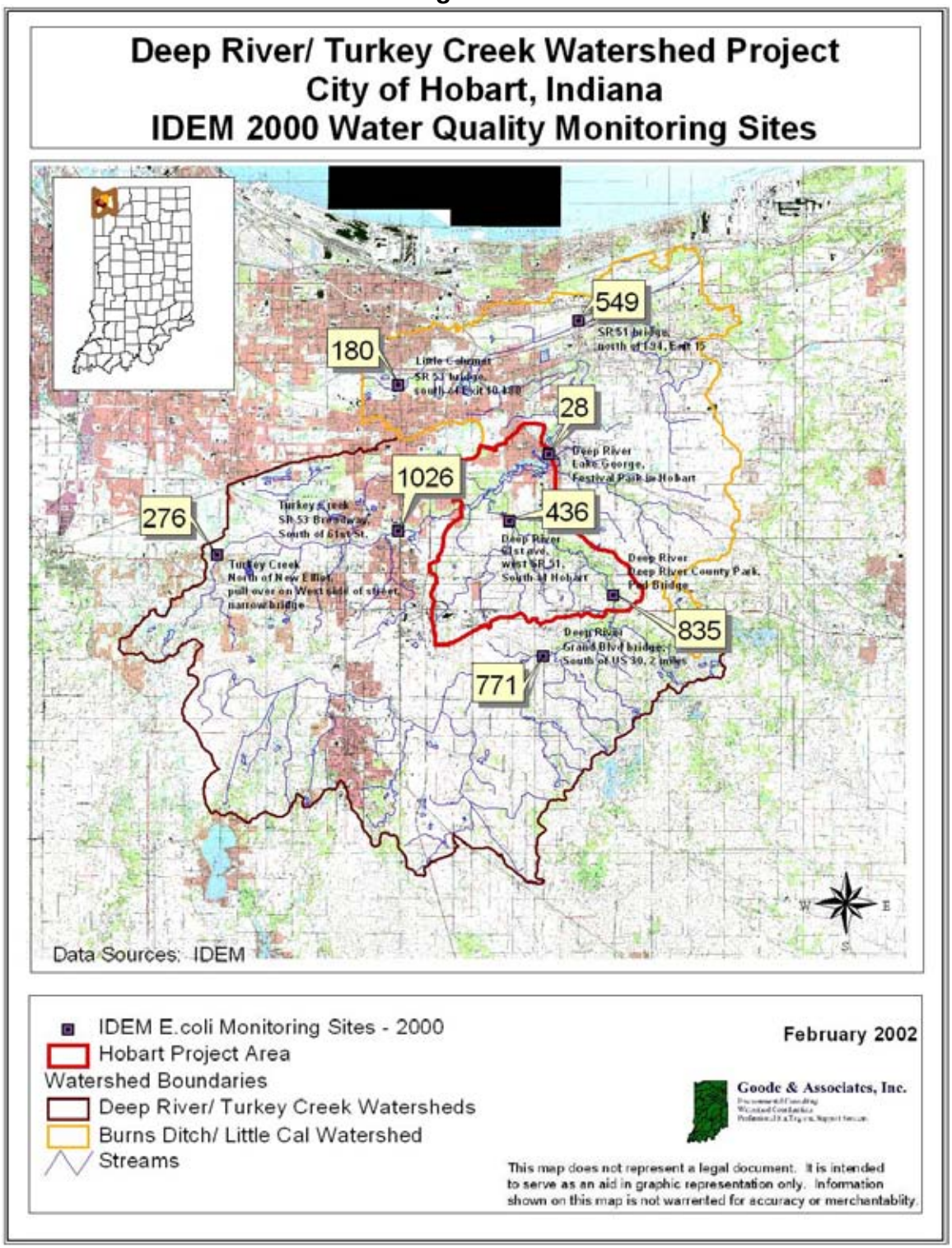

Deep River/ Turkey Creek Watershed Project
City of Hobart, Indiana
IDEM 2000 Water Quality Monitoring Sites
549
180
28
1026
436
276
835
771
Data Sources: IDEM
IDEM E.coli Monitoring Sites - 2000
Hobart Project Area
Watershed Boundaries
Deep River/ Turkey Creek Watersheds
Burns Ditch/ Little Cal Watershed
Streams
February 2002
Goode & Associates, Inc.
This map does not represent a legal document. It is intended to serve as an aid in graphic representation only. Information shown on this map is not warrented for accuracy or merchantablity.

Figure 4-3: Hobart High School Water Quality Monitoring Sites

Site Number	Location	City/ Town
1	Brookview Subdivision	Hobart
2	Glenwood Subdivision	Hobart
3	Devonshire Subdivision	Merrillville
4	Brookwood Subdivision	Merrillville
5	Hidden Lake Park	Merrillville
6	Hendricks Road	Merrillville
7	Oak Ridge County Park	Griffith
8	Joliet Road & Cline Ave.	Schererville
9	US 30 and Cline Ave.	Schererville
10	Hobart Middle School	Hobart
11	Deep River County Park	Hobart
12	Winfield & 101 Street	Crown Point
13	Madison Street	Crown Point
14	Main Street	Crown Point
15	105th Street	Crown Point
16	Lake George Dam	Hobart
17	Old Sewage Plant	Hobart
18	Riverview Park	Lake Station
19	Memorial Park	Lake Station

Macroinvertebrate Surveys

The Indiana Department Environmental Management (IDEM) Biological Studies Section and Indiana Department of Natural Resources (IDNR) Hoosier RiverWatch volunteers conducted several macroinvertebrate surveys within Lake George and the Deep River/ Turkey Creek Watershed throughout the 1990's and into the 2000's. At the stream sampling sites, IDEM and Hoosier RiverWatch volunteers utilized a variety of biological indices, including the family-level Hilsenhoff Biotic Index (FBI) (Hilsenhoff, 1988) and a macroinvertebrate Index of Biotic Integrity (mIBI) (IDEM, unpublished), to evaluate the biological health of the invertebrate community. Indices of biotic integrity are valuable because aquatic biota integrates cumulative effects of sediment and nutrient pollution (Ohio EPA, 1999). In conjunction with their macroinvertebrate surveys, IDEM also assessed habitat at stream survey locations using the Qualitative Habitat Evaluation Index (QHEI) (Rankin, 1989).

IDEM Surveys

In September of 1990, IDEM conducted three macroinvertebrate surveys in the Deep River/ Turkey Creek Watershed following a specific sampling and subsampling protocol (See **Figure 4-4**). IDEM assessed the data using the family-level Hilsenhoff biotic index. IDEM biologists calculate the FBI by multiplying the number of organisms collected, or sub-sampled, by their family tolerance value, summing the products, and dividing by the total number of organisms collected, or sub-sampled (Hilsenhoff, 1988). Organisms of greater tolerance to organic pollution are assigned a greater value from 1-9; therefore, the higher FBI value, the greater the extent of organic pollution in the stream.

Table 4-1 presents the FBI scores for each sampling site in the watershed. **Table 4-2** correlates the FBI score with water quality and degree of organic pollution. By this measure, Deep River at the County Park and Turkey Creek 1 at S.R. 55 exhibited "Fair" water quality and Turkey Creek 2 at S.R. 55 exhibited "Good" water quality in 1990. Streams classified as "Fair" likely possess fairly substantial organic pollution while streams classified as "Good" probably possess some organic pollution.

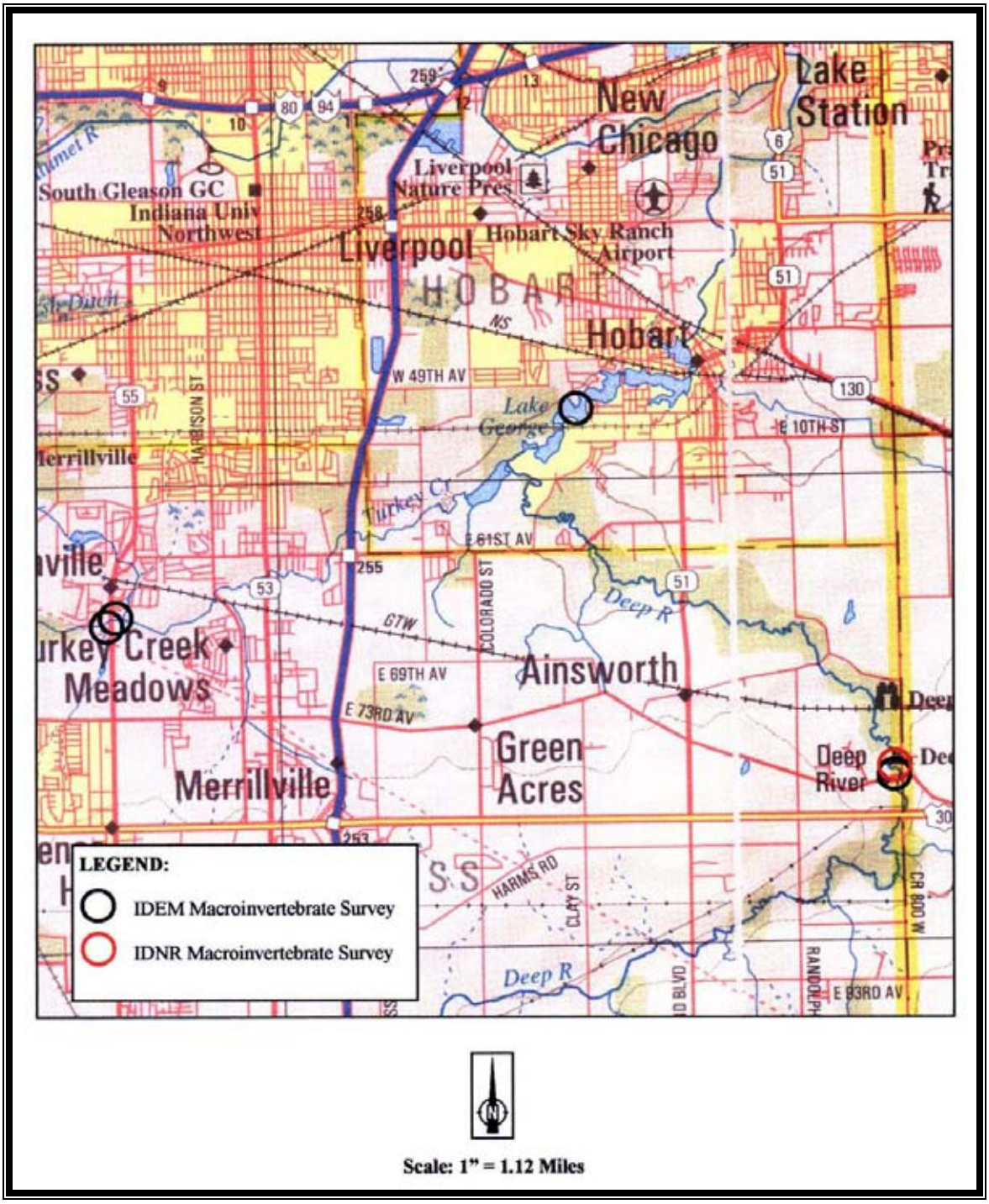
Table 4-1: Family-level Hilsenhoff Biotic Index at three survey sites

Site	FBI
Deep River (Co. Park)	5.65
Turkey Creek 1 (S.R.55)	5.21
Turkey Creek 2 (S.R.55)	4.76

TABLE 4-2: Water Quality Correlation to Hilsenhoff Biotic Index Score

Family Biotic Index	Water Quality	Degree of Organic Pollution
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

FIGURE 4-4: Macroinvertebrate survey sites in the Deep River/ Turkey Creek Watershed



In addition to the FBI, IDEM analyzed macroinvertebrate data using the mIBI (IDEM, unpublished). **Table 4-3** lists the ten scoring metrics along with classification scoring ranges for each metric. The metrics include family-level FBI, number of taxa, number of individuals, percent dominant taxa, EPT Index, EPT count, EPT count to total number of individuals, EPT count to chironomid count, chironomid count, and total number of individuals to number of square sorted. (EPT stands for the Ephemeroptera, Plecoptera, and Trichoptera orders.) To calculate the mIBI, biologists assign the invertebrate community a classification score for each metric. Biologists then average the classification scores to obtain a mean score that equals the mIBI. MIBI scores of 0-2 indicate the sampling site is severely impaired; scores of 2-4 indicate the site is moderately impaired; scores of 4-6 indicate the site is slightly impaired; and scores of 6-8 indicate that the site is non-impaired. IDEM developed the classification criteria based on five years of wadeable riffle-pool data collected in Indiana.

Table 4-3: Benthic macroinvertebrate scoring metrics and classification scores used by IDEM in evaluation of riffle-pool streams in Indiana

SCORING CRITERIA FOR THE FAMILY LEVEL MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY (mIBI) USING PENTASECTION AND CENTRAL TENDENCY ON THE LOGARITHMIC TRANSFORMED DATA DISTRIBUTIONS OF THE 1990-1995 RIFFLE KICK SAMPLES					
	CLASSIFICATION SCORE				
	0	2	4	6	8
Family Level HBI	←5.63	5.62- 5.06	5.05-4.55	4.54-4.09	≤4.08
Number of Taxa	≤7	8-10	11-14	15-17	←18
Number of Individuals	≤79	129-80	212-130	349-213	←350
Percent Dominant Taxa	←61.6	61.5-43.9	43.8-31.2	31.1-22.2	≤22.1
EPT Index	≤2	3	4-5	6-7	←8
EPT Count	≤19	20-42	43-91	92-194	←195
EPT Count To Total Number of Individuals	≤0.13	0.14-0.29	0.30-0.46	0.47-0.68	←0.69
EPT Count To Chironomid Count	≤0.88	0.89-2.55	2.56-5.70	5.71-11.65	←11.66
Chironomid Count	←147	146-55	54-20	19-7	≤6
Total Number of Individuals To Number of Squares Sorted	≤29	30-71	72-171	172-409	←410

Where 0-2 = Severely Impaired; 2-4 = Moderately Impaired; 4-6 = Slightly Impaired; 6-8 = Non-impaired

Table 4-4 presents the mIBI scores for each of the three sampling sites. In general, the scores indicate that the three sites possess very similar macroinvertebrate communities. The survey revealed each site supported a similar number of families and individuals. The Deep River site supported more members of the intolerant Ephemeroptera, Plecoptera, and Trichoptera orders than the Turkey Creek sites. At the same time, more chironomids, a tolerant family, inhabited the Deep River site compared to the Turkey Creek sites. IDEM biologists collected more tolerant organisms at the Deep River site than at the Turkey Creek site resulting in a lower Hisenhoff FBI score at Deep River compared to Turkey Creek. Taken together, these slight differences in macroinvertebrate community suggest Turkey Creek possesses slightly better water quality and habitat than the Deep River site.

Table 4-4: Classification scores and mIBI score for sampling sites in the Deep River/ Turkey Creek Watershed

	Deep River (Co. Park)	Turkey Creek 1 (S.R. 55)	Turkey Creek 2 (S.R. 55)
HBI	0	2	4
Number of Taxa (families)	2	2	2
Number of Individuals	4	4	4
% Dominant Taxa	2	2	2
EPT Index	4	2	0
EPT Count	2	4	4
EPT Count/Total Count	2	6	6
EPT Count/Chironomid Count	2	4	4
Chironomid Count	6	4	4
Total Count/Number Squares Sorted	4	2	4
mIBI Score	2.8	3.2	3.4

To assist in differentiating the influence of water quality from the influence of habitat on the macroinvertebrate community, the IDEM evaluated the habitat at each of its three sites using the Qualitative Habitat Evaluation Index (QHEI). The Ohio Environmental Protection Agency (Ohio EPA) developed the QHEI for streams and rivers in Ohio (Rankin 1989, 1995). The QHEI is a physical habitat index designed to provide an empirical, quantified evaluation of the general lotic macrohabitat (Ohio EPA, 1989). While the Ohio EPA originally developed the QHEI to evaluate fish habitat in streams, IDEM and other agencies routinely utilize the QHEI as a measure of general “habitat” health. The QHEI is composed of six metrics including substrate composition, in-stream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle-run

quality, and map gradient. Each metric is scored individually then summed to provide the total QHEI score. The best possible score is 100.

The QHEI evaluates the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of stream segments in Ohio have indicated that values greater than 60 are generally conducive to the existence of warmwater faunas. Scores greater than 75 typify habitat conditions that have the ability to support exceptional warmwater faunas (Ohio EPA, 1999).

Table 4-5 lists the QHEI scores for the Deep River and Turkey Creek sites. (Due to the proximity of the two sites, IDEM combined the two Turkey Creek sites for the QHEI calculation.) The Deep River site received a score of 73, while the Turkey Creek site received a score of 57. The Deep River site scored better in each of the six QHEI metrics. **Table 4-5** also shows that substrate composition and channel morphology account for the greatest difference in habitat between the two sites. Turkey Creek possesses a silty, shifting substrate and a highly channelized morphology at the sampling site compared to the gravelly substrate and more natural, meandering channel morphology at the Deep River site. Turkey Creek's low QHEI score suggests that this reach may not be capable of supporting a healthy aquatic invertebrate community.

Combining the mIBI and QHEI scores at the two sites helps determine whether water quality or habitat quality is limiting the aquatic community at each site. Because the Deep River site scored above 60 and close to 75, habitat at the Deep River site is likely sufficient to support an aquatic invertebrate community of at least moderate quality. The Deep River mIBI's score was low. Collectively, these data suggest that water quality as opposed to habitat quality may be limiting the ability of the Deep River site to support an aquatic invertebrate community of moderate quality. In contrast, Turkey Creek scored low on the QHEI. It is likely that both water quality and habitat limit the establishment of a moderately healthy aquatic invertebrate community in Turkey Creek.

Table 4-5: QHEI scores for sampling sites on Deep River (County Park) and Turkey Creek (S.R. 55)

Site	Substrate Score	Cover Score	Channel Score	Riparian Score	Pool Score	Riffle Score	Gradient Score	Total Score
Maximum Possible Score	20	20	20	10	12	8	10	100

Deep River (County Park)	19	13	17	7	7	4	6	73
Turkey Creek 1 and 2 (S.R. 55)	14	12	13	5	5	4	4	57

IDEM Lake Survey

In the summer of 2000, the IDEM conducted a macroinvertebrate survey in Lake George (See **Figure 4-4**). Two hundred fifty five individuals insects representing 15 families and two classes were identified as documented in **Table 4-6**. An assessment index equivalent to the mIBI and other invertebrate biotic index indices does not exist for Indiana lakes. In general, tolerant taxa dominated the lake macroinvertebrate community. While IDEM biologists collected several organisms from mayfly and caddisfly orders, which are typically associated with healthy aquatic systems, two thirds of the mayflies and caddis flies belonged to the tolerant Caenidae family. The lake survey species list also included members from the Coenagrionidae and Corixidae families and the Oligochaeta order. Members of these taxa are very tolerant of degraded habitat and water quality conditions. Many remaining individuals belong to fairly tolerant taxa; very few organisms collected represented intolerant families. Lake's George's poor invertebrate community reflects the lake's poor water quality (high turbidity) and lack of suitable habitat (rooted plants).

TABLE 4-6. Macroinvertebrate species from sites within the Deep River-Lake George Watershed

Order or Class	Family	Deep River (County Park) (IDEM, 1990)	Turkey Creek 1 (S.R. 55) (IDEM, 1990)	Turkey Creek 2 (S.R. 55) (IDEM, 1990)	Lake George (IDEM, 2000)	Deep River (County Park) (IDNR, 1990)
Ephemeroptera						1
	Heptageniidae	4	1			
	Baetidae	10	1		4	
	Caenidae	2			56	
	Leptophlebiidae				1	

Odonata						1
	Corduliidae				1	
	Coenagrionidae				9	
Hemiptera						
	Corixidae				46	
	Notonectidae				1	
Trichoptera						1
	Hydropsychidae	8	62	91		
	Hydroptilidae				14	
	Leptoceridae				3	
Coleoptera						
	Elmidae	5				
	Scirtidae				4	
Diptera						
	Ceratopagonidae			1		
	Empididae		3			
	Simulidae	81	2	5		
	Chironomidae	19	20	20	55	
Arthropoda						
	Asellidae	3	21	12		
	Acarina					
	Hyalellidae				5	
Decapoda						
	Palamonidae				6	
Gastropoda						
	Planorbidae				7	
	Lymnae				6	
Turbellaria			1	2		
Oligochaeta		9	21	24	35	1
Hydrozoa					2	
TOTALS	**9 Families**	**9 Families**	**7 Families**	**15 Families**	**4 Orders**	**2 Classes**

Hoosier RiverWatch Survey

In April of 2001, Hoosier RiverWatch volunteers conducted a macroinvertebrate survey on the Deep River within Deep River County Park (**Figure 4-4**). The volunteers collected macroinvertebrates from riffle habitat using the Kicknet Seine Method. The

volunteers identified organisms from four orders, Ephemeropterans (mayflies), Trichopterans (caddisflies), Odonates (dragnonflies), and Oligochaetes (aquatic worms). To evaluate the macroinvertebrate community, volunteers utilized the Hoosier RiverWatch's own Pollution Tolerance Index (PTI). RiverWatch volunteers calculate the PTI by placing each organism collected into one of four pollution tolerance groups (PT groups). Volunteers then sum the number of taxa in each PT group and multiply that sum by the PT group's weighting factor. To obtain a PTI rating, the volunteers sum the weighted totals from each of the four PT groups. Because the index weights intolerant PT groups more than tolerant PT groups, a higher PTI score indicates a more intolerant (usually higher quality) macroinvertebrate community. **Table 4-7** correlates PTI score to macroinvertebrate community quality. (See the Indiana Hoosier RiverWatch for more details on the program and its PTI. www.HoosierRiverWatch.com) Based on the 2001 Hoosier RiverWatch survey of the site, the Deep River site received a score of 14 indicating that the reach supported a fair macroinvertebrate community.

Table 4-7: Indiana Hoosier RiverWatch Pollution Tolerance Index score and the corresponding quality of the macroinvertebrate community in Deep River.

Pollution Tolerance Index Score	Macroinvertebrate Community Quality
10 or less	Poor
11-16	Fair
17-22	Good
23 or more	Excellent

Macroinvertebrate Summary

The results of the various macroinvertebrate community studies indicate that the streams in the Deep River/ Turkey Creek watershed support poor to fair macroinvertebrate communities. Pollution tolerant species generally dominated the communities at each site; as IDEM and Hoosier RiverWatch volunteers collected few intolerant species at each site. Poor water quality likely played a larger role than degraded habitat in shaping the poor macroinvertebrate community found at the Deep River site. The Deep River's QHEI score was 73 suggesting the site is physically capable of supporting a macroinvertebrate community of at least moderate quality. Both poor water quality and degraded habitat likely influence the macroinvertebrate community at the Turkey Creek site. Turkey Creek received a QHEI score of 59 suggesting sufficient habitat degradation was present to impair the creek's macroinvertebrate community. In addition, poor water quality may be at least partially responsible for the dominance of tolerant species in the Lake George macroinvertebrate survey.

Lake George Fishery Survey

One survey has been conducted to assess the fishery of Lake George (Robertson, 1971). In August of 1970, the Indiana Department of Natural Resources (IDNR) used a combination of electrofishing and gillnets to survey the fish community within the lake. The survey resulted in the collection of 445 fish representing six families and 15 species (See **Table 4-8**). Common carp (Cyprinus carpio) dominated the sampling effort by number (58%), followed by white crappie (Pomoxis annularis) (14%), brown bullhead (Ameiurus nebulosus) (10%), and yellow bullhead (Ameiurus natalis) (8%). The following species were also observed but collectively accounted for less than 10% of the total sample: black bullhead (Ameiurus melas), pumpkinseed (Lepomis gibbosus), largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus), black crappie (Pomoxis nigromaculatus), warmouth (Lepomis gulosus), white sucker (Catostomus commersoni), bowfin (Amia calva), yellow perch (Perca flavescens) and green sunfish (Lepomis cyanellus). One hybrid sunfish was also collected during the survey.

TABLE 4-8. Species list and number of each species sampled from Lake George in 1970.

Common Name	Scientific Name	Number	Percentage
*Common Carp	*Cyprinus carpio*	257	57.7
White crappie	*Pomoxis annularis*	64	14.3
*Brown bullhead	*Ameiurus nebulosus*	43	9.6
*Yellow bullhead	*Ameiurus natalis*	35	7.8
*Black bullhead	*Ameiurus melas*	9	2
Pumpkinseed	*Lepomis gibbosus*	8	1.7
Largemouth bass	*Micropterus salmoides*	7	1.5
Bluegill	*Lepomis macrochirus*	7	1.5
Black crappie	*Pomoxis nigromaculatus*	5	1.1
Warmouth	*Lepomis gulosus*	3	0.6
*White sucker	*Catostomus commersoni*	3	0.6
Bowfin	*Amia calva*	1	0.2
*Hybrid sunfish	*Lepomis sp.*	1	0.2
Yellow perch	*Perca flavenscens*	1	0.2
*Green sunfish	*Lepomis cyanellus*	1	0.2
Totals		445	100%

Source: IDNR Fishery Report (Robertson, 1971). *Indicates tolerant or moderately tolerant fish species.

Tolerant species (species capable of inhabiting waterbodies with poor water quality) dominated the catch in the 1970 survey. Common carp, brown and yellow bullhead, white sucker, green sunfish, white crappie, and hybrid sunfish comprised 76% of the fish collected in 1970. Carp are among the most tolerant of fish species. Although some anglers fish for carp, it is often considered a nuisance fish known for uprooting aquatic vegetation and decreasing water clarity. The abundance of common carp in Lake George probably added to the turbidity problem noted in the 1971 report. Brown and yellow bullhead, white sucker, and green sunfish are also tolerant of poor water quality and habitat conditions. White crappie have wide ecological tolerances but prefer more turbid waters of well-vegetated lakes and larger rivers. Given the lake's poor water clarity, it is not surprising that Lake George supported more white crappie than black crappie, a species that is less tolerant of turbidity. The presence of a hybrid sunfish is also indicative of poor water quality. Interbreeding occurs due to poor water clarity or competition for spawning habitat. The dominance of tolerant species suggests, at least in 1970, water quality and fish habitat conditions were poor and likely limited the lake's fish community.

In contrast to the abundance of tolerant non-game fish, IDNR biologists collected relatively few game species in 1970. White crappie was the only game fish collected in significant numbers. The collected white crappie exhibited average to above average condition factors (relative plumpness). However, of the 64 collected, most white crappie were 5.5-6.5 inches, a length considered too small to harvest. Bass, bluegill, and pumpkinseed, members of the sunfish family (Centrarchidae), accounted for only 4.7% of the fish collected. According to Robertson (1971), they were "insignificant" in the Lake George fishery.

Lake George Fishery Summary

Lake George offered little for anglers in 1970. Non-game species including common carp, brown and yellow bullhead, white sucker, green sunfish, and hybrid sunfish populations comprised over 60% of the total fish collected in the IDNR survey. The lake supported small populations of bluegill and largemouth bass, two popular game species. White crappie was the only game species with sufficient numbers for anglers to catch. Their small size, however, rendered them unharvestable. Overall, the lake possessed highly turbid waters and lacked sufficient submerged vegetation at the time of survey. Consequently, the lake supported a poor fish community. Robertson (1971) suggested that an entire fish eradication of Lake George and its watershed would be

needed to create a sustainable fishery. Robertson (1971) believed it was physically possible to chemically treat the watershed, but not economically or biologically sensible.

Deep River/ Turkey Creek Fish Community Surveys

In 1990, Simon (1991) conducted nine fish community surveys within and around the Deep River/ Turkey Creek Watershed (**Figure 4-5**). Simon utilized the Index of Biotic Integrity (IBI) to determine the existing health of fish communities in Turkey Creek, Deep River, and several of their tributaries. The IBI is designed to assess biotic integrity directly through twelve attributes of fish communities in streams. Karr, who first developed the IBI, and Dudley (1981) define biological integrity as, "the ability of a aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the best natural habitats within a region". Simon conducted the nine surveys in and around the Deep River/ Turkey Creek Watershed as part of his effort to modify Karr's IBI (Karr, 1981) for use in the watershed's specific ecoregion, the Central Cornbelt Plain (Omernik and Gallant, 1988).

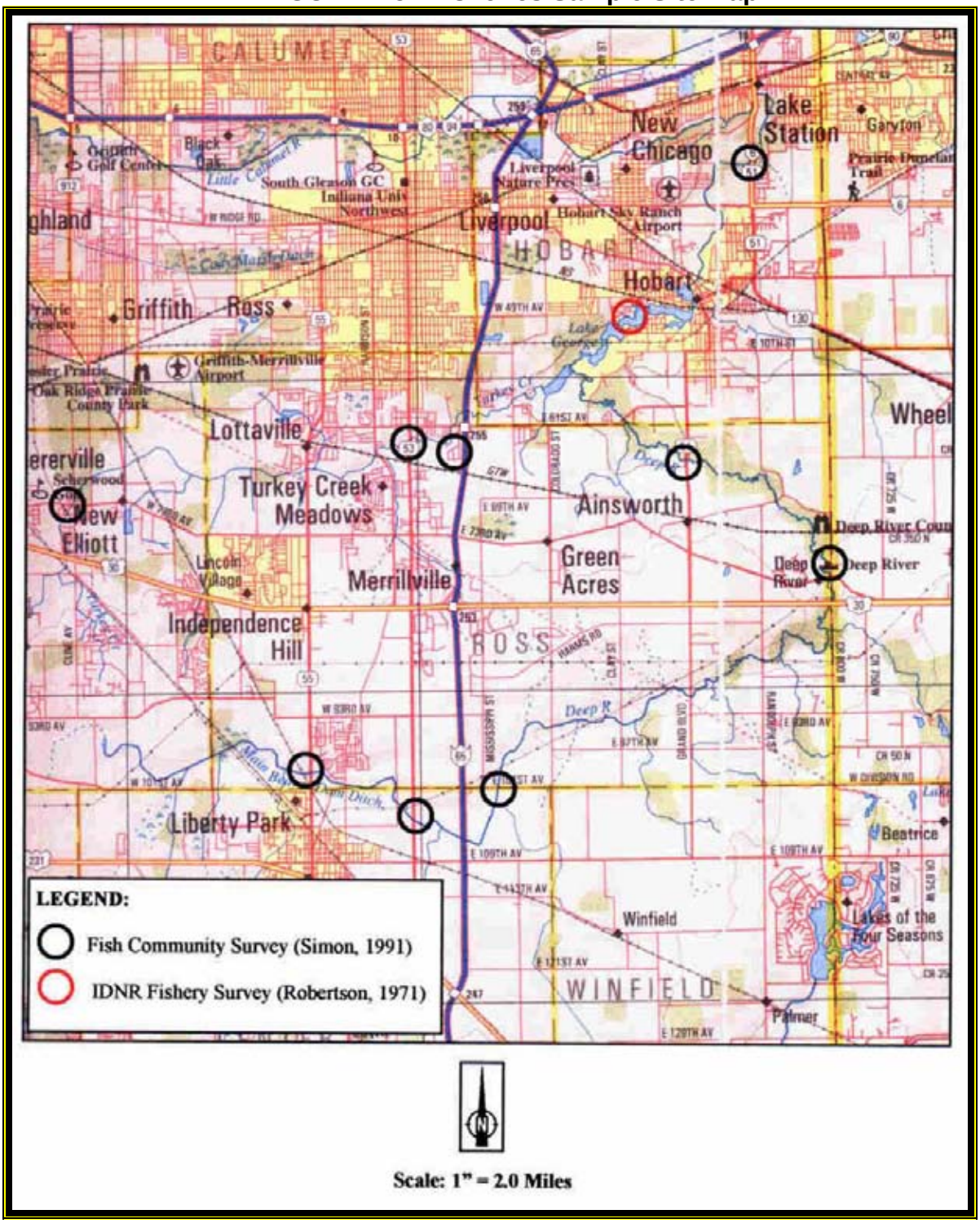
The twelve fish community attributes that form the basis of the IBI fall into such categories as species richness and composition, trophic composition, and fish abundance and condition. Biologists calculate a stream reach's IBI by comparing reach data to expected values for each of the twelve metrics. For each metric, the reach receives a rating of 1, 3, or 5 depending on whether it strongly deviates from, somewhat deviates from, or closely approximates the expected values. The sum of these ratings gives a total IBI score for the site. The best possible IBI score is 60 (**Table 4-9**).

TABLE 4-9. Attributes of Index of Biotic Integrity classification

IBI	Integrity Class	Attributes
58-60	Excellent	Comparable to the best situation without human disturbance.
48-52	Good	Species richness somewhat below expectations.
40-44	Fair	Signs of additional deterioration include loss of intolerant forms.
28-34	Poor	Dominated by omnivores, tolerant forms, and habitat generalists.
12-22	Very Poor	Few fish present. Mostly introduced or tolerant forms.
0	No Fish	Repeat sampling finds no fish.

Source: Development of Index of Biotic Integrity Expectations for the Ecoregions of Indiana I. Central Corn Belt Plains (Simon, 1991).

FIGURE 4-5. Fisheries Sample Site Map



In 1990, Simon (1991) conducted four fish community surveys in the Deep River/ Turkey Creek Watershed and five surveys just outside the study watershed (See **Figure 4-5**). Simon then determined IBI scores for each sampling location. **Table 4-10** presents the IBI scores for each sampling location in or near the Deep River/ Turkey Creek Watershed. IBI values ranged from a high of 31 (Poor) on Deep River at County Line Road to a low of 12 (Very Poor) on Turkey Creek at S.R. 53. No scores fell between 40 (Fair) and 60 (Excellent). These results indicated that stream fish communities within the Deep River/ Turkey Creek Watershed were of poor quality in 1990. Omnivores, tolerant forms, and habitat generalists typically dominate poor quality fish communities. Poor quality fish communities also support few top predators, and fish in these communities exhibit depressed growth rates and condition factors (Simon, 1997). In the Deep River/ Turkey Creek Watershed, a lack of darter, sucker, and sensitive species and a small proportion of simple lithophilic spawners negatively affected IBI scores.

TABLE 4-10. IBI and Integrity Class by site using the Index of Biotic Integrity

Site (Location)	IBI	Integrity Class
Deep River (101 Ave)	18	Very Poor
Main Beaver Dam Ditch (S.R. 53)	25	Poor-Very Poor
Main Beaver Dam Ditch (S.R. 55)	20	Very Poor
Turkey Creek (S.R. 53)	12	Very Poor
Turkey Creek (S.R. 73)	18	Very Poor
Deep River (County Line Road)	31	Poor
Deep River (S.R. 51)	20	Very Poor
Deep River (S.R. 6)	13	Very Poor
Unnamed Trib. to Turkey Creek	29	Poor

Although Simon (1991) does not specifically identify the factors that may be responsible for the degraded fish communities observed in the Deep River/ Turkey Creek Watershed, Applied Ecological Services (AES, 2001) noted several conditions in the watershed that would inhibit high quality fish communities. At Deep River, just south of Lake George, AES reported significant bank erosion, mass wasting, and tree falls. The streambed and bank in this area consisted of sandy silt. Few intolerant and lithophilic species are capable of successfully reproducing on such unstable substrate. In addition, the AES field biologists observed a contaminating oily substance, mass wasting, eroded slopes and tree falls on Turkey Creek, just west of Lake George. These habitat conditions favor tolerant species over intolerant ones and likely played a role, along with poor water quality, in shaping both of the stream's fish communities.

Deep River/ Turkey Creek Fish Community Summary

To summarize, the fish community surveys conducted in Deep River, Turkey Creek, and its tributaries revealed the presence of poor quality fish communities dominated by tolerant species. Both poor water quality and degraded habitat likely limited the ability of these streams to support high quality fish communities. Simon and Stewart (1999) support this hypothesis. In their work on the southern Lake Michigan basin, which includes Deep River/ Turkey Creek Watershed, they reported that the number of native species has declined 22% since European settlement. They list channelization, water quality degradation, toxins and agrichemicals, sedimentation, wetland drainage and filling, deforestation, and the introduction of exotic species as factors responsible for degrading fish habitat and, consequently, fish communities.

Draft 2002 305(b) Report – Deep River/ Turkey Creek Watershed Assessments

Section 305(b) of the Clean Water Act (CWA) requires each State to monitor the quality of its waters and prepare a report describing their quality. This process of monitoring and assessment produces an evaluation of the degree to which each waterbody supports a State's designated uses and resulting water quality standards.

Appendix 4-1 provides an excerpt from the draft 2002 305(b) report that includes the waterbody assessments that have been compiled to date by IDEM for the Deep River Turkey Creek Watershed. The draft report indicates that multiple stream segments within the Deep River/ Turkey Creek Watershed are not supporting designated uses for aquatic life support and primary contact recreation. In addition, the draft report identifies multiple sources causing waterbodies to be impaired. Waterbodies assessed during the 2002 305(b) process are listed in **Table 4-11**.

Draft 2002 303(d) List – Impaired Streams in the Deep River/ Turkey Creek Watershed

Section 303(d) of the CWA requires that waters not meeting or not expected to meet water quality standards after the implementation of regulatory controls (NPDES permits) be compiled and listed as “impaired waters” by IDEM. Impaired waters are considered to be those waterbodies that do not meet the State’s water quality standards for one or more designated uses. The statewide list of impaired streams was recently updated in March of 2002. **Figure 4-6** illustrates the locations of 303(d) listed streams within the Deep River/ Turkey Creek watershed that will be required to undergo TMDL development. A list of impaired streams in the Deep River/ Turkey Creek watershed is also listed in **Table 4-12**.

Table 4-11: Draft 2002 305(b) Waterbody Assessments

Waterbody Name	Designated Use/ Support*	Pollutant/ Stressor	Source(s)
Turkey Creek – Mainstem	ALUS – Not Supporting; Recreation – Not Supporting	Impaired Biotic Communities; Pathogens	Municipal Point Sources; Landfills; Urban Runoff
Turkey Creek – Merrillville	ALUS – Not Supporting; Recreation – Not Supporting	Impaired Biotic Communities; Pathogens	CSO
Main Beaver Dam Ditch	ALUS – Not Supporting	Impaired Biotic Communities	Nonpoint Sources
Main Beaver Dam Ditch above Niles Ditch	ALUS – Not Supporting	Impaired Biotic Communities; Habitat alterations	Nonpoint Sources; Channelization
Niles Ditch	ALUS – Not Supporting	Impaired Biotic Communities;	Nonpoint Sources
Deep River U/S of US 30	Recreation – Not Supporting	Pathogens	Nonpoint Sources
Deep River Tributary - Merrillville	ALUS – Not Supporting	Impaired Biotic Communities; Siltation	Habitat Modification
Lake George	Recreation – Fully Supporting		
Deep River above Lake George Dam	Recreation – Not Supporting	Pathogens	Nonpoint Sources

*ALUS – Aquatic Life Use Support

Figure 4-6

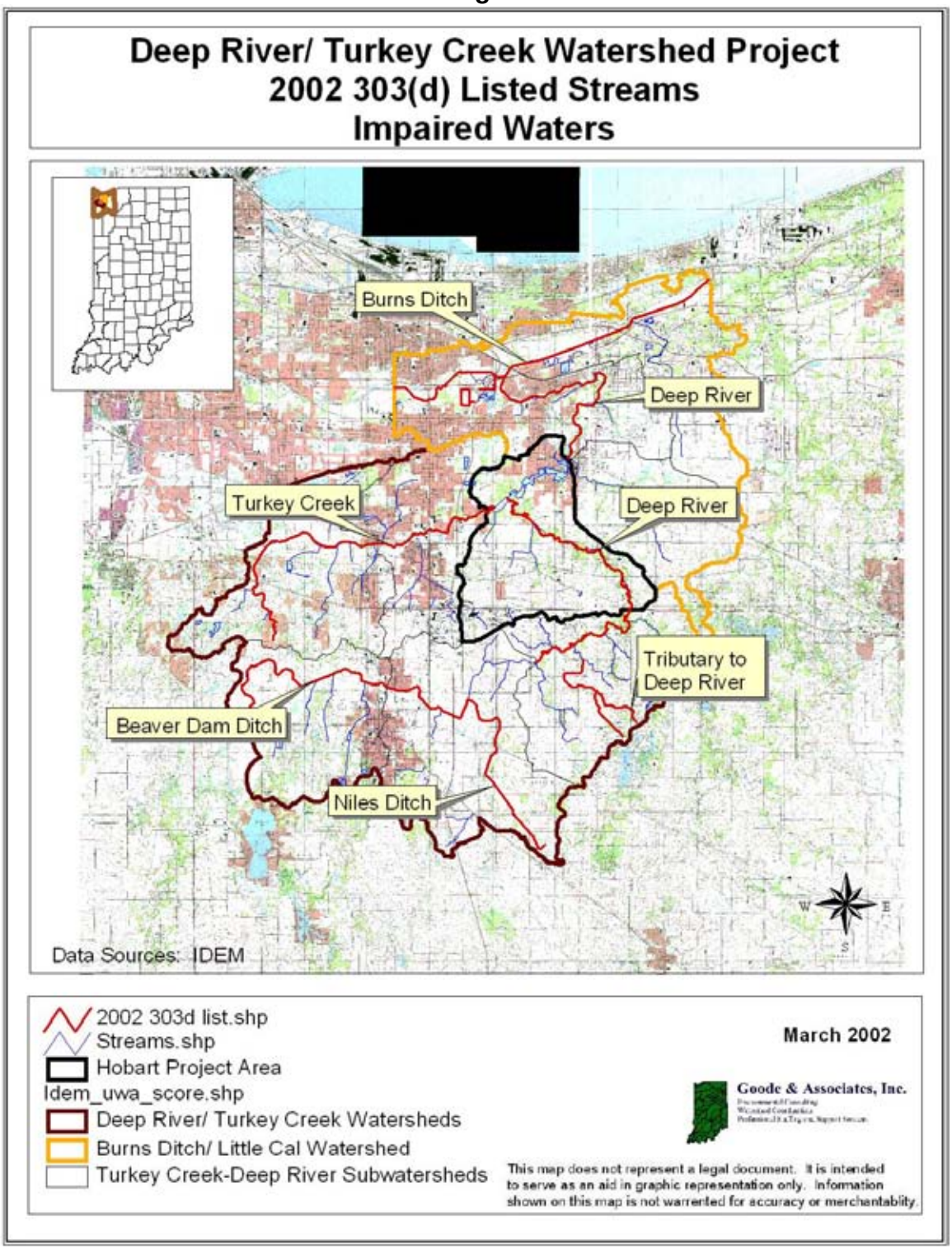

Deep River/ Turkey Creek Watershed Project
2002 303(d) Listed Streams
Impaired Waters
Burns Ditch
Deep River
Turkey Creek
Deep River
Tributary to
Deep River
Beaver Dam Ditch
Niles Ditch
Data Sources: IDEM
2002 303d list.shp
Streams.shp
Hobart Project Area
Idem_uwa_score.shp
Deep River/ Turkey Creek Watersheds
Burns Ditch/ Little Cal Watershed
Turkey Creek-Deep River Subwatersheds
March 2002
Goode & Associates, Inc.
This map does not represent a legal document. It is intended to serve as an aid in graphic representation only. Information shown on this map is not warrented for accuracy or merchantability.

Table 4-12: Impaired Streams in the Deep River/ Turkey Creek Watershed

Waterbody Name	County	Major Basin	Parameter(s) of Concern	TMDL Development Schedule**
Deep River – Burns Ditch	Lake	GREAT LAKES	E. coli	2000 - 2004
Deep River – Burns Ditch	Lake	GREAT LAKES	Impaired Biotic Communities	2005 - 2007
Main Beaver Dam Ditch - above Crown point WWTP	Lake	GREAT LAKES	Impaired Biotic Communities	2015 - 2017
Lake George	Lake	GREAT LAKES	FCA for PCB	2015 - 2017
Niles Ditch	Lake	GREAT LAKES	Impaired Biotic Communities	2015 - 2017
Turkey Creek mainstem; Turkey Creek - Merrillville	Lake	GREAT LAKES	E. coli	2015 - 2017
Turkey Creek mainstem; Turkey Creek - Merrillville	Lake	GREAT LAKES	Impaired Biotic Communities	2015 - 2017
Deep river tributary Merrillville	Lake	GREAT LAKES	Impaired Biotic Communities; Siltation	2015 - 2017
Deep River U/S U.S. 30; Deep River above Lake George Dam	Lake	GREAT LAKES	E. coli	2015 - 2017

Fish Consumption Advisory (FCA)

Each year since 1972, three agencies have collaborated to create the Indiana Fish Advisory. These agencies include the Indiana Department of Environmental Management (IDEM), the Indiana Department of Natural Resources (IDNR), and the Indiana State Board of Health (ISBH). Each year, members from these agencies meet to discuss the findings of recent fish monitoring data and to develop the new statewide fish consumption advisory.

The 2001 advisory is based on levels of polychlorinated biphenyls (PCBs) and mercury found in fish tissue. In each area, samples were taken of bottom-feeding fish, top-feeding fish, and fish feeding in between. More than 1,600 fish tissue samples were analyzed for polychlorinated biphenyls (PCBs), pesticides, and heavy metals. Of those samples, the majority contained at least some mercury. However, not all fish tissue samples had mercury at levels considered harmful to human health. If they did, they are listed in the fish consumption advisory.

Because of past, widespread agricultural and industrial use of these materials, their great stability and persistence in the environment, and the potential for bioaccumulation, it is not surprising that concentrations exceeding safe levels have been found in some species. Criteria for the statewide 2000 Indiana Fish Consumption Advisory are developed from the Great Lakes Task Force risk-based approach.

Fish Consumption Advisories that are currently in effect for the Deep River/ Turkey Creek Watershed are listed in **Table 4-13**. ISBH criteria for fish consumption advisory groups are outlined in **Table 4-14**.

Table 4-13: FCA for the Deep River/ Turkey Creek Watershed

Location	Species	Fish Size(inches)	Contaminant	Group (See Table 4-14)
Lake George				
Lake County	Northern Pike	18+	■	2
All Rivers and Streams				
	Carp	15-20 inches	■❍	3
	Carp	20-25 inches	■❍	4
	Carp	25 +	■❍	5

❍ = Mercury; ■= PCB

TABLE 4-14: ISDH DEFINITIONS FOR FISH CONSUMPTION ADVISORY GROUPS

Group 1	Unrestricted consumption
Group 2	One meal per week (52 meals per year) for adult males and females. One meal per month for women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15.
Group 3	One meal per month (12 meals per year) for adult males and females. Women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15 do not eat.
Group 4	One meal every two months (six meals per year) for adult males and females. Women who are pregnant or breastfeeding, women who plan to have children, and children under the age of 15 do not eat.
Group 5	No consumption (DO NOT EAT)

Unified Watershed Assessment (UWA) – Natural Resources Conservation Service

The Clean Water Action Plan, released in February 1998, presented a plan and certain incentives directed toward accelerating the control of nonpoint source pollution in America. States were requested, as one of the 111 Action Items presented in the Plan, to prepare a Unified Watershed Assessment (UWA). This Assessment was developed through the cooperation of state, federal, and local agencies and the public. The guidance for completing the UWA, published by the USEPA in June 1998, charged the USDA Natural Resources Conservation Service (NRCS) and the state water quality agency (IDEM) with convening the assessment process. What sets this assessment apart from other lists and reports regarding watersheds is the involvement of numerous organizations, the participation of all states, and the recognition of both impaired and healthy watersheds. UWA scores for the Deep River/ Turkey Creek Watershed are located in **Table 4-15**.

1998 UWA

As a requirement of the Clean Water Action Plan, the Unified Watershed Assessment was organized as a multi-agency effort to prioritize watershed restoration needs in each state. In Indiana, a workgroup appointed by the Watershed Agency Team for Enhancing Resources (WATER Committee) developed the first Assessment in September 1998 for FFY 1999-2000 in accordance with EPA guidelines.

In the first version of the UWA, the workgroup ranked the 8-digit hydrologic unit watersheds according to the present condition of the water in lakes, rivers, and streams. The data provided information about the water column, organisms living in the water, or the suitability of the water for supporting aquatic ecosystems. Each layer of data was partitioned by percentiles into 5 scores, with "1" being indicative of good water quality or minimum impairment, and "5" indicating heavily impacted or degraded water quality. Scores for each 8-digit watershed were compiled, and the watersheds were sorted into four categories as required by the USEPA guidance.

The four categories are as follows:

I. Watersheds in need of restoration: waters do not meet designated uses or other natural resource goals. 25% or more of the waters that have been assessed do not meet state water quality standards. (Note that in some watersheds, only a very small percentage of waters have been recently assessed.)

II. Watersheds that on average meet state water quality goals and require attention to sustain water quality. In most of these watersheds, there is habitat that is recognized as critical for threatened or endangered species.

III. Watersheds with pristine or sensitive aquatic systems on federal or state managed lands.

IV. Watersheds with insufficient data to make an assessment.

1999 UWA

During the summer of 1999, the UWA workgroup used additional layers of information to identify resource concerns and stressors for each of the 361 11-digit watersheds in Indiana (See **Table 4-15**). This time, the UWA examination included more information about human activities that have the potential to impact ecosystems and information to help planners to focus on those areas where restoration may be most critical.

The UWA process was conducted to illuminate areas where the interests of two or more partner agencies may converge. It was intended that this would lead to more effective allocation of resources for restoration and protection activities. At the local level, it was hoped that the UWA could assist groups in prioritizing watershed activities and providing discussion points for planning.

The amended UWA assessment provided the following benefits:

- Provided a logical process for targeting funds, which may be expanded or updated without changing the basic framework.
- Provided information at a finer resolution (11-digit hydrologic units) to agencies and local groups interested in watershed assessment.
- Identified data gaps.

- Could be used as a complement to other assessments, such as the 305(b) Report and 303(d) List.

2000-2001 UWA

In order to target the allocation of FFY 2001-2002 Section 319 funds that were made available through the Clean Water Action Plan, 11-digit hydrologic units with the greatest indication of existing or potential problems were given a higher priority. Based on the additional information gathered in this iteration of the UWA, all watersheds in the state are now considered to be in Category I.

Watersheds (11-huc) with two or more scores of 5, one score of 5 and two or more scores of 4, or three or more scores of 4 (in any category) were given a higher priority. Note that there are significant gaps in data, especially for water quality, and this assessment should be evaluated in the context of available local information. This funding targeting process is known to be imperfect, but used the best information available at the time.

TABLE 4-15: Unified Watershed Assessment, 2000-2001.

Deep River/ Turkey Creek Watershed Scores for Each Parameter Used in the Unified Watershed Assessment [2000-20001]															
	Measured Parameters														
11 Digit Hydrologic Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
04040001030 (DEEP RIVER/ TURKEY CREEK)	nd	nd	nd	nd	nd	nd	3	4	3	1	5	3	1	2	1

ND = No Data

Parameters:
1 - Mussel Diversity and Occurrence
2 - Aquatic Life Use Support
3 - Recreational Use Attainment
4 - Stream Fishery
5 - Lake Fishery
6 - Eurasian Milfoil Infestation Status
7 - Lake Trophic Status
8 - Critical Biodiversity Resource
9 - Aquifer Vulnerability
10 - Population Using Surface Water for Drinking Water
11 - Residential Septic System Density
12 - Degree of Urbanization
13 - Density of Livestock
14 - % Cropland
15 - Mineral Extraction Activities