



Aquatic Enhancement
& Survey, Inc.

**2010 Water Quality Sampling Report
LaGrange County Lakes Council
LaGrange County, Indiana**

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Aquatic Enhancement
& Survey, Inc.
P.O. Box 1036

1-888-867-5253
260-665-8226

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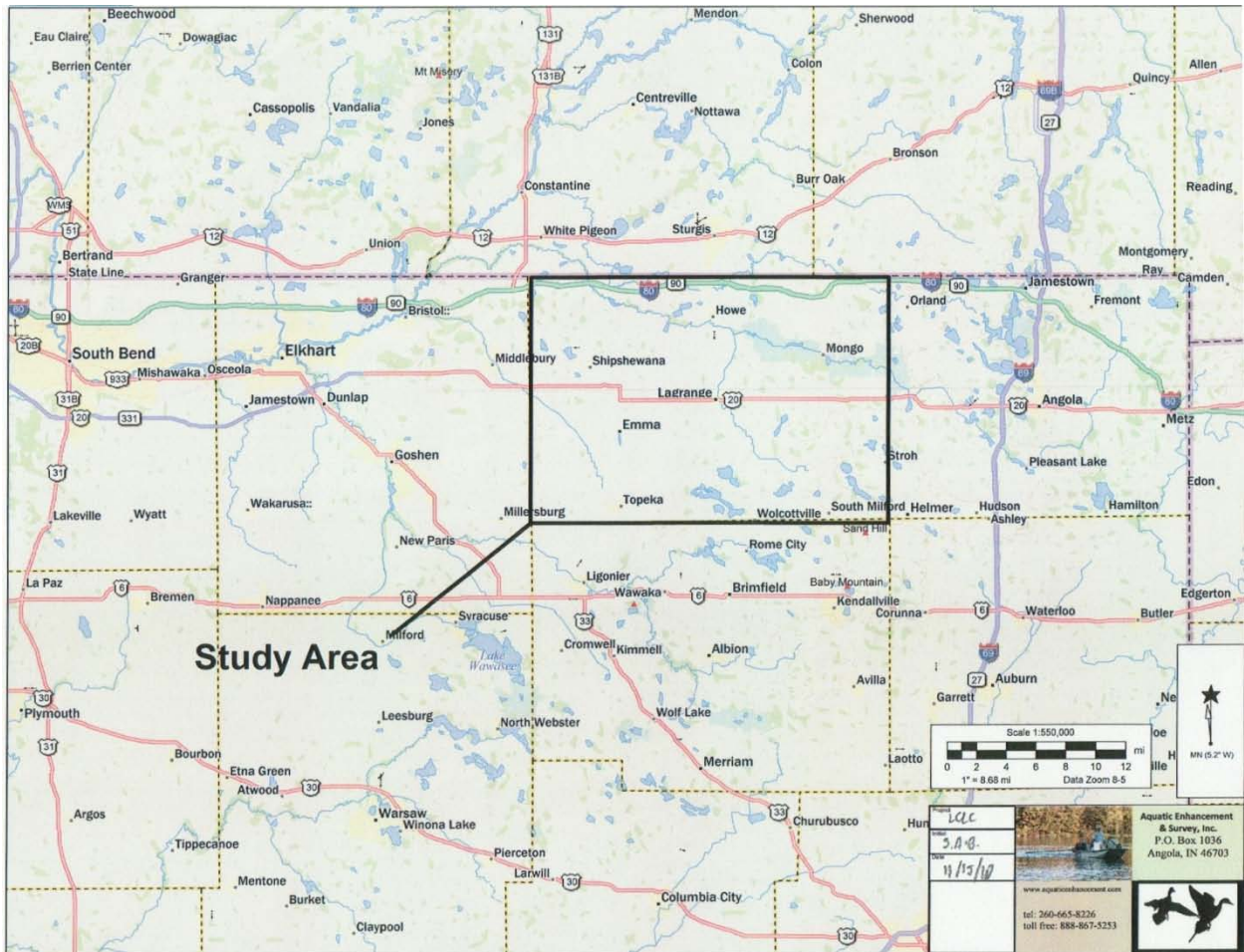


Figure 1 Project location map

1. Project Overview and Purpose:

This project was performed by Aquatic Enhancement & Survey, Inc. for the LaGrange County Lakes Council. Basic water quality data and stream flow (discharge) measurements were collected from several streams and lakes in LaGrange County, Indiana. (See figure 1 above for general project area location). Sampling was completed in September and October of 2010. Figure 2 (page 6) displays sampling locations and associated surface water features. Measured parameters included total phosphorus, total suspended solids, pH, dissolved oxygen, temperature, specific conductance, E-coli, and a basic measurement of stream flow-rate (discharge) at each sampling site having measurable flow. Total phosphorus and total suspended solids loading figures were calculated for each site at which these measurements were detectable and at which a flow measurement was taken. The purpose of the sampling was to gain a basic understanding of the fate and source of contaminants in these systems with a goal of directing future sampling or directing remediation of watershed point and non-point pollution sources. Table 1 on page 7 provides a site key showing brief written descriptions of each numbered sampling site. Collected data and calculated loading rates are provided in table 2 on page 7.

2. Methods:

All samples collected were grab samples. Samples were placed on ice immediately after collection. All samples held overnight were refrigerated. Measurements for temperature and dissolved oxygen were taken in the field using a YSI 85 dissolved oxygen, temperature,

conductivity, and salinity meter. Measurements of pH were taken in the field using an Oakton pH 6 Acorn series meter. Both meters were calibrated at the beginning of each sampling day. Where possible, stream flows were calculated using measurements of the stream cross-sectional area and stream velocity. Stream flow cross sectional area was calculated by measuring stream width using a marked section of rope, tape measure, or laser rangefinder and calculating average stream depth by measuring depth at multiple equidistant points using a tape measure, measuring staff, or sonar unit. Laboratory analysis for all samples was completed by A & L Great Lakes Laboratories, Inc., 3505 Conestoga Dr., Fort Wayne, Indiana 46808. Quality Assurance Procedures and EPA method codes are available upon request.

3. Parameters Defined.

Total Phosphorus. The concentration of total phosphorus present in a sample measured in parts per million. Includes dissolved phosphorus and that contained in plants, animals, and other solids suspended in the water column. As a nutrient necessary for the growth of planktonic algae, phosphorus levels profoundly influence lake productivity and water clarity/quality.

Total Suspended Solids. The dry weight concentration of non-dissolved, filterable particulate material present in the sample, measured in parts per million. This material is generally composed of suspended soil particles or organic materials.

pH. The negative log of the hydrogen ion concentration present in the sample, measured in pH units. This is the measure of how "acidic" or "basic" the sample is. Acids tend to have low pH measurements while basic solutions yield high pH measurements.

Dissolved Oxygen (D.O). The concentration of dissolved oxygen present in sampled waters, measured in parts-per-million. Dissolved oxygen levels of 3 to 5 parts per million are generally required to sustain most fish and other gill-breathing aquatic animals and insect larvae.

Specific Conductance. A measurement of how well sampled waters conduct electricity. This measurement is generally reflective of the amount or mobility of dissolved ions present in the sample. Common dissolved ions which generally result in producing conductance include chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron.

E-coli. A count of a particular genera of bacteria that can provide an indication of the presence of human or animal waste. E-coli is generally measured in CFU (colony forming units) per 100 milliliters of water. Because the presence of large numbers of E-coli in waters indicates a potential presence of associated disease causing organisms, it is measured to gauge the safety of swimming or drinking waters. Counts of 235 CFU or higher in lake waters could indicate unsuitability for swimming or bathing.

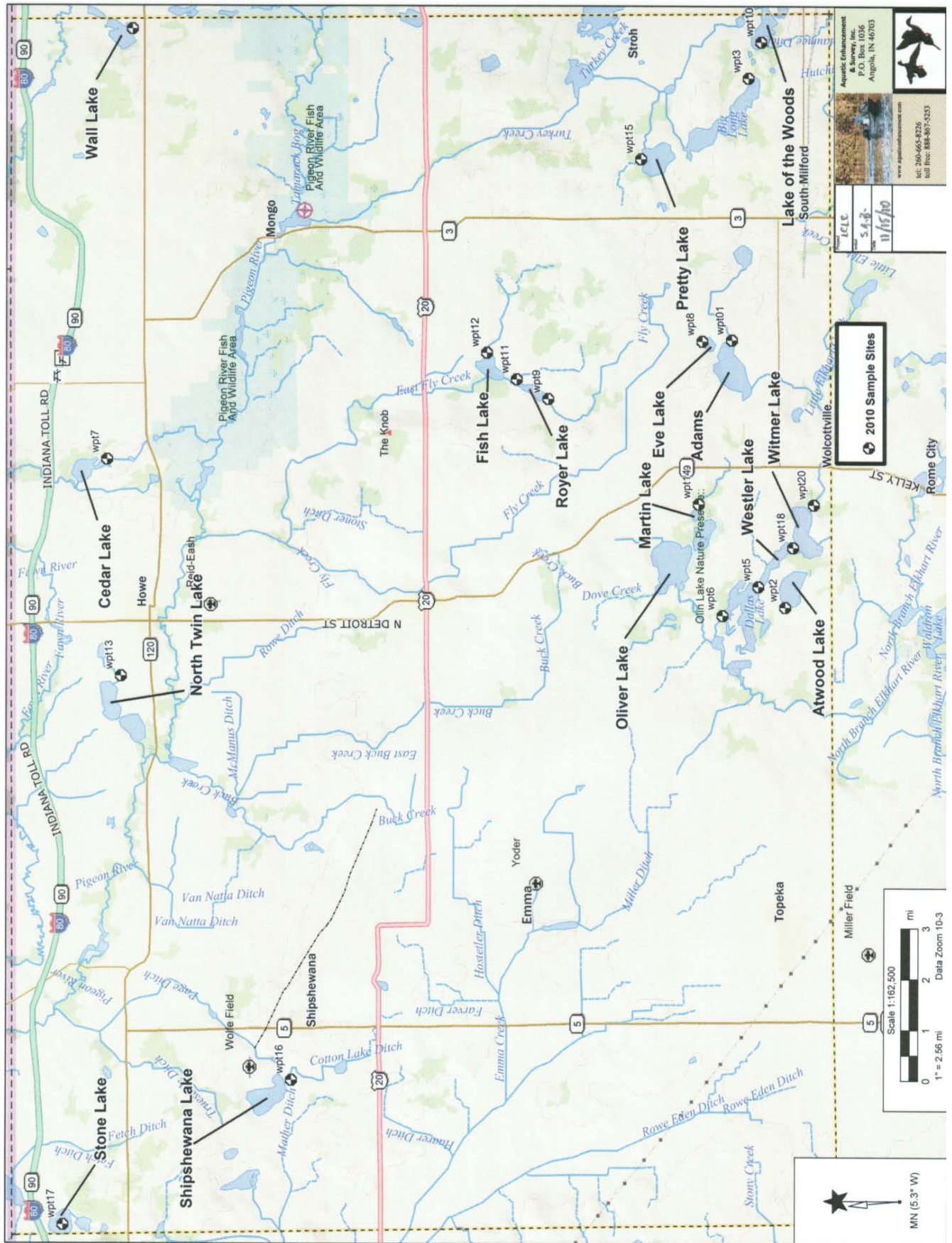


Figure 2 Sampling site map.

Sampling Site	Location Description
1	East Tributary to Adams Lake
2	Atwood Lake (Lake sample, no flow at tributary)
3	Big Long Lake (Lake sample, no flowing tributary located)
5	Westler Lake Outlet, Dallas Inlet
6	Dallas Lake Outlet, upstream of Hackenburg Lake
7	SE Tributary to Cedar Lake
8	Eve Lake (Lake sample, no flow at inlet)
9	South Tributary to Royer Lake
10	SW Tributary to Lake of the Woods
11	NE Tributary to Royer Lake
12	East Tributary to Fish Lake
13	SE Tributary to North Twin Lake
14	East Tributary to Martin Lake
15	Pretty Lake, North Tributary
16	SE Tributary to Shiphewana Lake
17	Stone Lake
18	Witmer Lake Outlet, Westler Inlet
19	Wall Lake (Lake sample, no flow at inlet)
20	Witmer Lake, East Tributary

Table 1 Description of numbered sampling sites.

Site	Sampling Date	E-coli (CFU or colonies/100 ml)	Total Phos. (ppm)	Total Suspended Solids (ppm)	D.O. (ppm)	pH	Temp (C)	Specific Conductance	Post rain event *	CFM discharge estimate	T.S.S. Loading estimate Kg/day	Phos. Loading estimate Kg/day
1	9/30/10	1500	.10	<1	8.76	8.13	15	698	NO	9.60	Below detect limit	0.031
2	9/27/10	4	.03	4	7.93	8.55	19.6	309.9	NO	Lake Site		
3	9/29/10	0	.01	<1	7.71	8.18	19	313.8	NO	Lake Site, no trib. located		
5	9/20/10	20	.02	3	8.98	8.43	21.3	432.5	NO	397.80	48.63	0.32
6	9/20/10	12	<.01	2	8.53	8.41	21.4	427.8	NO	Flow not measureable		
7	9/30/10	124	<.01	<1	9.74	7.78	14.8	650	NO	418.08	Below detect limit	Below detect limit
8	10/4/10	6	<.01	6	7.70	8.29	16.7	354.7	NO	Lake Site		
9	9/30/10	4520	.10	17	8.84	8.24	14.2	729	NO	Flow not measureable		
10	9/29/10	6	.02	<1	8.06	8.53	19.7	399	NO	Lake Site, no flow at trib.		
11	9/30/10	980	.04	2	8.52	8.06	13	645	NO	36.53	2.98	0.06
12	9/29/10	1400	.03	7	8.90	8.21	14.2	689	NO	51.23	14.61	0.06
13	9/28/10	1140	.02	10	8.84	7.66	15.5	611	Minor	2.40	0.98	0
14	9/30/10	700	.02	5	8.60	8.11	14.3	681	NO	28.03	5.71	0.02
15	9/29/10	600	.03	4	9.93	8.23	10.3	774	NO	8.40	1.37	0.01
16	9/30/10	212	.11	3	7.01	7.90	14.5	753	NO	19.80	2.42	0.09
17	9/28/10	0	.02	4	8.65	8.26	19.3	218.3	Minor	Lake Site		
18	9/20/10	6	.02	1	9.68	8.40	21.4	435.3	NO	Flow not measureable		
19	9/28/10	0	.01	3	8.36	8.30	18.6	304.3	Minor	Lake Site, no flow at trib.		
20	9/27/10	128	.17	1	8.64	8.10	14.5	570	NO	35.40	1.44	0.25

Table 2. 2010 Sampling Results. Parameters that exceed selected state provided maximums (shaded in table 3 below) are shaded.

Parameter	Target	Reference/other information
Temperature	Dependent on time of year and whether stream is designated as a cold water fishery	Indiana Administrative Code (IAC)
Dissolved Oxygen (DO)	Min: 4.0 mg/L Max: 12.0 mg/L	Indiana Administrative Code (IAC)
	Min: 6.0 mg/L in coldwater fishery streams	Indiana Administrative Code (IAC)
	Min: 7.0 mg/L in spawning areas of coldwater fishery streams	Indiana Administrative Code (IAC)
E. coli	Max: 235 CFU/ 100mL in a single sample,	Indiana Administrative Code (IAC)
	Max: Geometric Mean of 125 CFU/ 100mL from 5 equally spaced samples over a 30-day period	
Total Phosphorus	Max: 0.076 mg/L	U.S. EPA recommendation
	0.07 mg/L	Dividing line between mesotrophic and eutrophic streams (Dodd et al. 1998)
	Max: 0.08 mg/L	Ohio EPA recommendation to protect aquatic biotic integrity in WWH
	Max: 0.3 mg/L	IDEM draft TMDL target
Total Suspended Solids (TSS)	Max: 80.0 mg/L	Wawasee Area Conservancy Foundation recommendation to protect aquatic life in lake systems
	Max: 30.0 mg/L	IDEM draft TMDL target
	Range: 25.0-80.0 mg/L	Concentrations within this range reduce fish concentrations (Waters, 1995)
	Max: 40.0 mg/L	New Jersey criteria for warm water streams
	Max: 46.0 mg/L	Minnesota TMDL criteria for protection of fish/macroinvertebrate health

Table 3 Indiana Department of Environmental Quality Table of Water Quality Targets. Standards shaded on results tables correspond to standards shaded in this table.

4. Sampling Results.

Stream and lake sampling was performed at 19 sites between September 20 and October 4. Sampling results are listed in table 2, page 7. Samples collected represented mostly low flow conditions following a dry late-summer season. At Wall Lake, Eve Lake, Lake of the Woods, Atwood Lake, and Big Long Lake no flow was present in tributaries targeted for sampling, so lake waters were sampled over the deepest portion of each lake. Table 3, page 8 contains a variety of stream water quality targets provided by the Indiana Department of Environmental Management (IDEM) for comparison with the 2010 season data. Also provided for comparison is table 4 page 10 containing averages of stream data from the IDEM probabilistic data set. The data used to calculate these averages was collected from Indiana Streams within the St. Joseph River watershed from year 2000 to 2005. Most of the collection sites included in the 2010 LCLC data are also within the St. Joseph River watershed and therefore represent somewhat similar soil types, topography, and land uses. This allows a judgment to be made as to whether the 2010 LaGrange County Lakes Council (LCLC) samples were “below average”, “average” or “above average” in terms of Indiana stream water quality.

Measurements of pH ranged from 7.66 at the northeast tributary to North Twin Lake to 8.55 in Atwood Lake surface waters. All were considered to be normal. No pH data is available from the IDEM probabilistic dataset for comparison. Dissolved oxygen levels ranged from 7.01 parts per million (ppm) at the southeast tributary to Shipshewana Lake to 8.55 ppm at Atwood Lake. Levels at all sites were adequate to sustain fish and other gill-breathing aquatic organisms and were above relevant target minimums listed with IDEM. Measured temperatures ranged from 10.3 C at the tributary entering Pretty Lake along its' north shore to 21.4 at the Dallas Lake and Witmer Lake outlets. All measured temperatures were considered to be normal for the prevailing climatic conditions. Specific conductance ranged from 218.3 umho/cm at Stone Lake to 753 at the southeast tributary to Shipshewana Lake. All were below the mean of the IDEM probabilistic data set. No targets for specific conductance were listed in the IDEM table of maximums.

Four sites returned a total suspended solids (TSS) measurement below a lab detection limit of one ppm. The highest TSS recorded was 17 ppm in the sample from the south tributary to Royer Lake. Interference by frogs moving across this small flow at the time of sampling probably elevated this measurement over that that was actually prevalent in this inflow. No sites showed TSS measurements which exceeded the IDEM draft total maximum daily load (TMDL) of 30 ppm or the IDEM probabilistic stream average of 36 ppm.

Three sites returned total phosphorus measurements below a lab detection limit of .01 ppm. The highest total phosphorus measurement was .17 ppm. It occurred in the sample collected from Witmer Lake's east tributary. The samples collected from the east tributary to Adams Lake, the south tributary to Royer Lake, the southeast tributary to Shipshewana Lake, and the Witmer Lake's east tributary all exceeded the IDEM listed U.S. EPA recommended maximum of .076 ppm. All samples were well below the IDEM probabilistic dataset mean of .382 ppm. The Royer Lake sample probably contained interference from the previously mentioned frog activity. For the other samples it should be noted that phosphorus levels may run higher in the fall than during the growing season when most sampling is completed. This is usually due to the decomposition of organic matter in the watershed as a result of the seasonal senescence of watershed flora. Sampling during the 2011 growing season will provide additional insights.

E-coli bacteria measurements in the sampling ranged from zero colonies per 100 milliliters (col/100 ml) in the Big Long Lake, Stone Lake, and Wall Lake samples, to 4520 col/100 ml in the south tributary to Royer Lake. All measurements but the Royer south tributary sample were below the IDEM probabilistic mean of 1895.58 cfu/100 ml. A total of 7 samples exceeded a target maximum of 235 CFU/100 ml listed in the IDEM standards. E-coli, total phosphorus, and total suspended solids data exceeding IDEM standard maximums are shaded in table 2 on page 7.

Where possible, a rough estimate of stream flow (discharge) was calculated and total suspended solids and total phosphorus loading figures were calculated using the data. Of the sites where flow rates could be taken, the highest estimated discharge occurred on the southeast tributary to Cedar Lake. The discharge was estimated to be 418.08 cubic feet per minute (CFM). The highest estimated total suspended solids loading was 48.63 kilograms per day (kg/day) and occurred at the Westler Lake outlet/Dallas Lake Inlet. The highest estimated total phosphorus loading was .32 kg/day and also occurred at the Westler Lake outlet/Dallas Lake Inlet.

Parameter	IDEM Mean Stream Data
	St. Joseph Wtrshd 2000-2005
pH	n/d
D.O. (ppm)	7.14
Temp. (deg C)	19.91
Specific conductance umho/cm	764.19
Total Suspended Solids (ppm)	36
Total Phosphorus (ppm)	0.382
E-coli (CFU/100ml)/(MPN)	1895.58
Tss Loading Kg/day	n/d
Total Phos. Loading Kg/day	n/d

Table 4 Average of IDEM-collected probabilistic Indiana stream data for the St Joseph River Watershed 2000-2005

5. Conclusions

Overall water quality was considered to be average or well above average at nearly every sampling site when compared with the IDEM probabilistic dataset. The most notable water quality concern in the data is the presence of E-coli levels above IDEM standards at 9 of the sampling sites. Because these counts could be solely the result of normal wildlife sources such as geese or raccoons they may not indicate a water quality problem that can be remediated, but it may be advisable to investigate these watersheds further to determine if a preventable problem exists. E-coli levels in tributary waters often dissipate quickly after entering a lake as oxygenation and mixing with lake waters occurs, so the main potential concern will be for swimming area safety in the immediate proximity of the confluence. Phosphorus levels above published maximums at the east tributary to Adams Lake, the southeast tributary to Shipshewana Lake, and the east tributary to Witmer Lake point to these as watersheds where improvements in

land use practices may be possible. While the south tributary to Royer Lake was also above published maximums for phosphorus, it should be noted that flows were extremely small at the time of sampling and that agitation by amphibians had disturbed stream sediments just before sampling. This likely inflated parameter measurements for total suspended solids and total phosphorus somewhat. Relatively low phosphorus levels were noted in all the lake samples collected. If sampling is continued in 2011 an attempt should be made to collect at least one rain event sample at each tributary location. Often sediment and nutrient loads are much greater in streams during times of increased runoff, making rain even sampling much more revealing than baseline flow data. As the LCLC produces additional water quality data, and evidence of any specific problem areas emerges it will be important to take steps to work with local Soil and Water Conservation District Personnel and watershed landowners to help implement improvements in land use practices that reduce contaminants in lake-bound runoff.