TIER II AQUATIC VEGETATION SURVEY PROTOCOL

Indiana Department of Natural Resources
Division of Fish and Wildlife
402 W. Washington St. Rm W-273
Indianapolis, IN 46204

Revised March 2018

TABLE OF CONTENTS

SECTION **PAGE**

TABLE **PAGE**

FIGURE **PAGE**

APPENDIX **PAGE**

1.0 Monitoring Strategy for Aquatic Vegetation

The following protocol is currently being used by the IDNR Division of Fish and Wildlife to provide a quantitative sampling mechanism for aquatic plant surveying. Pearson (2004) provides additional details regarding the protocol and an example of its use to quantify the occurrence, distribution, and abundance of aquatic plants in 21 northern Indiana lakes. Plant sampling protocols used by the IDNR serve the following objectives:

1. To document the distribution and abundance of submersed vegetation within selected areas and at a lake-wide scale;
2. To compare present distribution and abundance with past distribution and abundance within select areas and at a lake-wide scale.

Aquatic vegetation is monitored in an assortment of lakes and streams across the state as part of a variety of projects. The following procedure is applicable for State-sponsored surveys, integrated fisheries management, pre-treatment and post-treatment herbicide application, and possibly for volunteer monitoring. All of the data collected through the use of this protocol is recorded on standardized data sheets (Appendix A). For State-funded surveys, data sheets along with a digital copy (excel format) must be submitted with the final aquatic vegetation management plan/update to the Department of Natural Resources Division of Fish & Wildlife, LARE Office.

1.1 Habitat Stratification

The waterbodies to be surveyed are divided into strata and subjected to discrete sampling efforts to increase efficiency, effectiveness, and knowledge of habitat influence on plant communities. Each stratum represents a major aquatic geomorphic feature in the State of Indiana (Table 1). A few other strata are not sampled. For example, the main navigation channel on the Ohio River is not sampled because aquatic vegetation is unlikely to grow in this area due to the prevailing depth and flow conditions. In addition, the aquatic areas near dams and spillways may not be sampled because of safety considerations. Refer to Table 1 when categorizing the sampled stratum.

Table 1. Aquatic Area Strata and Codes

Stratum Description	Stratum Code
Inland Lake	IL
Inland Reservoir	IR
Lake Michigan	LM
First Order Stream	FOS
Second Order Stream	SOS
Third Order Stream	TOS
Fourth Order Stream	FROS
Fifth Order Stream	FHOS
Other*	OTR

* When "Other" is selected, describe the habitat type in the comments section of the data sheet.

1.2 Littoral Zone Definition

The littoral zone in lakes is defined as the portion extending from the shoreline to the greatest depth occupied by aquatic plants. Where insufficient information is known about plant growth in a particular water body, the maximum depth of the littoral zone may be estimated based on the trophic status of the lakes as compiled by the Indiana Department of Environmental Management using the Indiana Trophic State Index (2008) (Table 2).

In some cases, the actual distribution of plants will not conform to the prediction made by the ITSI. For this reason, 10 extra sampling sites are always sampled below the lowest contour at evenly distributed locations around the lake bed to determine if plants are growing deeper than anticipated. These results guide the placement of future sampling sites and are not included in the current year calculations. In subsequent years, distribution of sites throughout the littoral zone may be adjusted for actual conditions at that water body. If sampling is being conducted for a state-sponsored project, any adjustment to distribution of sites must be confirmed with the agency project manager. Sampling depths for selected lakes, as determined either by actual plant distribution or estimated based on trophic state, are provided in Appendix D. For state-sponsored surveys on lakes not listed in Appendix D, the maximum depth of sampling should be confirmed with the agency project manager prior to sampling.

Table 2. Maximum depth of plant sampling as determined by trophic state.

Trophic State	Maximum Depth of Sampling (ft)
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

1.3 Sampling Site Selection

After determining the maximum depth of the littoral zone (see Section 1.2), sampling should be conducted using a stratified random methodology. Sampling sites should be apportioned based on the depth classes listed in Table 3, as determined by lake size and trophic state. This will ensure that the sampling sites are well distributed throughout the littoral zone of the lake. It may be useful to predetermine on a bathymetric map the general locations of the number of sites listed in Table 3 so that they are evenly distributed throughout each of the depth contours. When the maximum depth of sampling indicated in Appendix D is different than what is suggested based on the trophic status, sites should be distributed based on the maximum depth class listed in Table 3, not trophic status. To facilitate fieldwork, sites may be programmed into a GPS unit. During the sampling process, these predetermined locations can be adjusted to account for field conditions.

1.4 Sampling Efforts and Schedule

Sampling is conducted twice during the growing season, in order to describe phenological changes (plant community differences that track seasonal climatic differences). For state-sponsored projects, the first (or spring) sampling is typically conducted between May 15 and June 15, and the second (or summer) sampling occurs between July 15 and August 31. Sampling times may be altered, depending on the purpose of the study. For example, if time and resources only allow one sampling event per year and the purpose is to examine peak diversity, sampling would be done between July 15 and August 31. Sampling for early-season invasive plants, such as curly-leaf pondweed, may be conducted earlier in the spring.

Table 3. Sample size requirements as determined by lake size and trophic state, apportioned by depth class.

		Hypereutrophic		Eutrophic			Mesotrophic				Oligotrophic				
Lake Acres	**Total # of Sites**	**0-5 foot contour**	**>5-≤10 foot contour**	**0-5 foot contour**	**>5-≤10 foot contour**	**>10-≤15 foot contour**	**0-5 foot contour**	**>5-≤10 foot contour**	**>10-≤15 foot contour**	**>15-≤20 foot contour**	**0-5 foot contour**	**>5-≤10 foot contour**	**>10-≤15 foot contour**	**>15-≤20 foot contour**	**>20-≤25 foot contour**
<10	20	10	10	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	20	10	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	30	10	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	40	10	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	50	10	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	60	10	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	70	10	43	27	10	25	23	22	10	19	18	17	16	10
500-799	90	80	10	50	30	10	29	27	24	10	22	21	19	18	10
>=800	100	90	10	57	33	10	33	31	26	10	25	23	22	20	10

Calendar date alone may be insufficient to determine appropriate sampling windows for any particular year due to annual variation in seasonal conditions. Water temperature may also be used to determine when the spring sampling occurs. If surface water temperature is >18°C (65°F) on May 15, then sampling can begin. However, if water temperature is <18°C (65°F) on May 15, then it is monitored and sampling delayed until temperatures reach the 18°C threshold. If water temperatures remain low two weeks later (May 29), sampling can be initiated regardless of water temperature in order to complete spring sampling within the sampling window (before June 15).

1.5 Equipment and Definitions

A sampling rake (Figure 1) is used for collecting vegetation samples. The sampling rake is essentially a double-headed garden rake attached to a rope (Deppe and Lathrop 1992). It has a 36 cm (13.5 inch) wide head, has 14 teeth 5-cm long (2.25 inch) on each side spaced 1.9 cm (0.75 inch) apart, and is made by welding two square-headed garden rakes together. The rake head is marked into five parts corresponding to 20% increments spaced evenly along the tine length. The rake head is attached to a rope that is scaled at one foot increments (clearly visible marks every five feet) so that it can be used to measure water depth.

Most of the sampling is conducted by boat. The sampling procedures are designed in reference to a typical 16-ft boat, which are approximately 5 m long and 2 m wide.

Throughout the procedure manual, aquatic vegetation or aquatic species refer to the following plant types: submersed, rooted floating-leaved, non-rooted floating-leaved, and emergent. The non-rooted floating-leaved category is composed of *Azolla sp*. and members of the family *Lemnaceae*. Filamentous algae are treated as if they were a single taxon and noted separately.

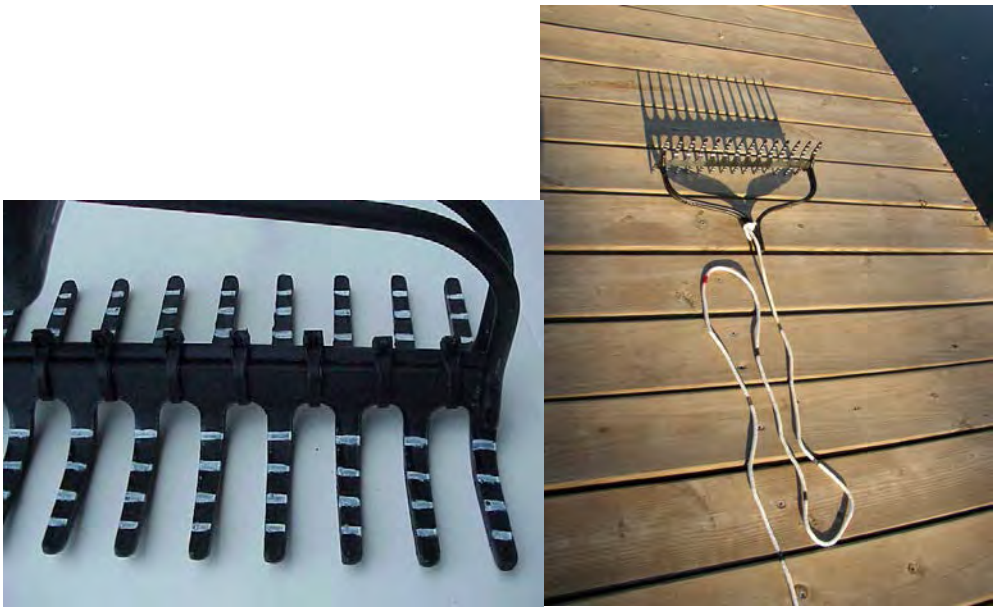

Figure 1: Double-headed rake for aquatic vegetation sampling

2.0 Sampling

A cover sheet is completed for each waterbody (Appendix A). If an erroneous entry is made, mark a line through the field, fields, or entire record, whichever is appropriate, and record initials next to the deletion. To change a field value, line out the incorrect data, enter the corrected value next to it, and initial the correction. All data fields on the data sheets are explained in detail in Appendix B.

Begin the sampling effort by recording general waterbody information on the waterbody cover sheet. Some fields (such as **Total # of Species**) will remain blank until the all sites have been sampled. The sampling operation is composed of multiple steps.

Step 1. Determine sampling times, according to program or research needs (refer to Section 1.4). Record at least one Secchi disk transparency reading offshore. The protocol for accurately measuring **water transparency** is as follows:

A. Anchor the boat to prevent drifting. Be careful not to disturb the sediments on the bottom when anchoring since this could cloud the water and interfere with the Secchi disk reading, especially in shallow lakes.

B. Once you are at the deepest point of the lake, go to the shady side of the boat and if you are wearing sunglasses, remove them.

C. Lower the Secchi disk (8-inch diameter) straight down into the water until the disk just disappears from sight. Mark the rope at the water level with a clothespin.

D. Slowly raise the disk up until it reappears. Mark the rope at the water level with your fingers or with another clothespin.

E. To find the Secchi depth, grasp both clothespins in one hand and find the center of the loop of rope. Move one clothespin to that point and remove the other. This point is one-half the distance between the point of disappearance of the disk and the point where it re-appeared. Measure the distance from this point to the Secchi disk using a measuring tape.

F. Record the Secchi depth on your data sheet to the nearest tenth of a foot.

Step 2. Locate each random sampling site throughout the littoral zone, apportioned by depth contour. The littoral zone was previously identified by trophic status or actual plant growth records (see Section 1.2). The number of sample sites for each depth contour is dependent on lake size and is given in Table 3.

Step 3. Stop the boat at each sampling site. Anchoring the boat is not necessary. Record or log as a waypoint the GPS coordinates of the site. GPS coordinates should be recorded and reported in latitude and longitude.

Step 4. Drop a double-sided weighted rake attached to a rope pre-measured in one-foot intervals (highly visible marks every five feet) off the bow of the boat straight down to the lakebed. Record water depth under "Depth" on the datasheet to the nearest half of a foot. When the depth of the sampling site is not within the desired depth contour, the rake should be retrieved, cleaned and no data collected. The boat should be repositioned to the desired depth in order to maintain the appropriate number of sampling sites within each depth contour as provided in Table 3.

Step 5. After water depth is measured, reverse the boat at minimum operating speed for a distance of ten feet of additional rope length held firmly at the bow of the boat. Then drag the survey rake to the boat with moderate force with the outboard motor still in reverse. The boat is typically backed in the opposite direction as it had approached the site or the boat may be backed with the wind direction.

Step 6. Score the abundance of the individual plant species at each site throughout the littoral zone. Separate the various plant species and place on the rake for an abundance score of 1, 3, or 5 (Table 4). Small tubs are convenient for separating each species prior to scoring their abundance. When re-piling various plant species back on the rake, spread them evenly on one side of the rake across the complete row of tines. Do not overly pack the plants on the rake. When a species is on the borderline between abundance ratings, round to the middle rating. For example, if a species fills the rake right to the first mark, score it as a "3" rather than a "1", so that a score of "1"represents only those instances in which the species is less than 20% abundant. Likewise, if a species fills the rake right to the tip of the rake teeth, score it as a "3" rather than a "5", so that a score of "5" represents only those instances in which the species is over 100% abundant. Record the abundance score for each species on the datasheet under the appropriate acronym heading. Use a single row on the datasheet to record each site.

For those sites where a species is observed but not picked up on the rake, record the species code and use a "9" in the space for that site to denote the presence of that species. Note the presence of filamentous algae, floating or emergent species on the rake using a "9". When the surveyor feels that the collection of algae, floating or emergent species has reduced the ability of the rake to collect submersed species, it may be necessary to relocate the original site so that the collection of submersed plants is not negatively impacted and the true abundance and diversity of the location is recorded. This will insure that the first objective of the survey as specified in Section 1 is accomplished.

Table 4. Vegetation Abundance Ratings[a]

Rake teeth filled (%)	Abundance rating
100+	5
20-100	3
1-19	1
No plants retrieved	0

[a]Ratings are modified from Deppe and Lathrop (1992).

Step 7. When field identification of a plant is uncertain, or a species is suspected not to be in the state herbarium at Purdue University North Central or another official location, representative specimens of each species should be collected and submitted as voucher specimens. For those species for which the genus and/or species are unknown, a species code should be assigned following the instructions in Section 2.2. The abundance score is recorded on the datasheet under the appropriate acronym heading. Record the voucher number ("V1", "V2", etc) and corresponding species code in the "Comments" section on the datasheet. See Section 2.2 for complete instructions on assigning species codes for unknown species and collecting voucher specimens.

Step 8. Record any other species observed in the lake while traveling between sites by listing the species code at the bottom of the datasheet. Use of the rake may facilitate generating a complete species list for the lake, especially where no other extensive sampling protocol is used.

Step 9. Upon completion of all sample sites, record any remaining waterbody summary data (such as **Total # of Species**) on the waterbody cover sheet and attach all datasheets to this cover sheet.

2.1 Unusual Situations

No aquatic vegetation:

If a sample site has no aquatic vegetation, regardless of the reasons, put "0" in the "Notes" column of the datasheet.

Dead or dying plant material:

Include any dead or dying plant material that is intact and identifiable, but discard material that has decayed to the point that identification is not possible. If previous herbicide treatment is known or suspected to be the cause of decaying plants, note this in the "Comments" field and report any possible illicit use of herbicides to the DNR Fisheries Section.

Filamentous algae only:

If only filamentous algae is collected at a site, enter a species code of ALGA, record a "9" in the rake score box, and record the estimated percent bottom coverage (from 1 to 100%) in the "Notes" column.

Unable to rake:

If physical conditions such as depth, wind, obstructions or current velocity preclude raking the bottom for aquatic vegetation, it may be necessary to relocate the sampling site to a more suitable location within the same depth contour. The boat should be repositioned to the desired depth in order to maintain the appropriate number of sampling sites within each depth contour as provided in Table 3.

Threatened and endangered or suspected new invasive species:

Threatened or endangered species (T&E) or suspected new invasive species should be vouchered, recorded on the data sheet, noted on a map, and described on the Indiana Special Plant Survey Form (included in Appendix A). Records on T&E species should be sent to the IDNR Division of Nature Preserves. **Suspected new invasive species must be reported immediately to the Aquatic Invasive Species Coordinator, IDNR Division of Fish & Wildlife. Where possible, use rake tosses to determine whether this represents an isolated plant or if multiple individuals of the species are present. Using a GPS unit, record the location of the collected species and the approximate extent of the species' distribution.**

2.2 Taxonomy, Species Codes, and Voucher Specimens

Plants should be identified to the species level, or lowest taxonomic level possible, using the following taxonomic keys or similar references: Fassett (1957), Voss (1972, 1985), and Gleason and Cronquist (1991). A list of the aquatic species typically found in Indiana is included in Appendix C. Species codes not available in Appendix C are determined by using the first three letters of the genus name followed by the first three letters of the species name. Note: For those genera that represent nearly indistinguishable species, it is sufficient to simply identify plants to the genus level. These taxa are listed in Appendix C by the genus name followed by "sp." (eg. *Chara* sp., *Nitella* sp.).

If the genus of a plant is known and species unknown, make up a new code with the first three letters of the genus name followed by "001" for the first unknown species in the genus. Any subsequent and different unknown species in the same genus should be labeled "002" and so on (for example, "POT001" for *Potamogeton* sp.). If the genus is unknown, make a unique code (e.g., "UNKN01", "UNKN02", etc.) for each unknown taxon. Upon positive identification, uncertain and unknown species codes will be confirmed or replaced with new codes.

Collect voucher specimens for each individual taxon whose identity is in doubt for follow-up verification by external taxonomists, or if a taxon is suspected not to be in the state herbarium at Purdue University-North Central or another official location. Vouchers should include multiple specimens (3 to 5) of the plant, including all available morphological characteristics (leaves, flowers, fruit, roots, tubers, etc.). Specimens should be sealed in an individual ziplock bag and immediately placed on ice in a cooler with a label placed inside the bag that lists the following information: waterbody name, county, date, name of collector, voucher number (eg. V1, V2, and so on) and taxonomic name, if known. Two or more voucher specimens for each

unknown taxon should be collected from different points within the lake, if possible. Voucher specimens are directed to the attention of Dr. Robin Scribailo at Purdue University-North Central or other official state herbarium.

2.3 Data & Equipment Management

All data sheets are identified with the sampling organization's name and waterbody name. For State-funded surveys, copies of all data sheets must be available upon request of the LARE program office **within two weeks of completing the survey**. All originals are retained by the sampling organization.

To avoid the spread of Aquatic Invasive Species (AIS), survey crews should insure that all traces of aquatic vegetation are removed from boats, motors, and sampling gear before surveying other waterbodies. Even if an invasive species such as Eurasian watermilfoil is known to occur in two bodies of water, care should still be taken not to transfer plant fragments between these waterbodies since herbicide resistant genotypes may be spread to lakes where they did not previously occur. For waterbodies where other aquatic invasive species (e.g., zebra mussels) are known to occur, specific steps should be taken to eliminate the hazard prior to going to another body of water. For zebra mussels, this includes one of the following measures: drying equipment for five days, pressure washing with 104°F water, or chemical disinfection. A list of zebra mussel positive waterbodies can be found at www.invasivespecies.in.gov. For additional information on reducing the spread of AIS contact the DNR AIS Coordinator at (317)234-3883.

3.0 Plant Community Analysis

This section outlines the quantitative and analytical procedures that should be used to describe the submersed plant communities sampled using the Tier II survey for Aquatic Vegetation Management Plans (AVMP) and plan updates. The most recent Aquatic Vegetation Calculator (AquaVeC) spreadsheet, available from LARE staff should be used to ensure accurate, consistent calculations of the metrics described below. Although floating, emergent, and alga species should be recorded when observed during the Tier II survey, the data analysis described in the following section is for submersed species only. An example table for presenting the results of data analysis is included in Appendix A. This output format is required for most state-funded projects and represents what would be considered the minimum amount of analysis. Additional analysis may be required for aquatic vegetation management plan/updates. Additional information on analytical procedures may be found in Pearson (2004).

3.1 Survey and Lake Characteristics

Maximum Plant Depth or Littoral Depth: The maximum plant depth is defined as the greatest depth occupied by aquatic plants as collected by a rake. Maximum depth that should be surveyed for submersed aquatic plants is specified above in Section 1.2.

Total sites (N): Total number of sites as specified above in Section 1.3. This is the number of sites that will be used as the denominator in the plant metrics described below. **Note: This may differ from the method used in older LARE AVMPs and in Pearson (2004) to calculate these values.**

Littoral Sites: Total number of sites sampled as deep as or shallower than the maximum plant depth.

Secchi depth: A measure of the transparency of the water, measured to the nearest one-tenth foot. This parameter must be included in a table summarizing the plant sampling results.

3.2 Community Metrics

Species richness: A count of *all* submersed plant species collected during the survey.

Native species richness: A count of submersed *native* plant species collected during the survey.

Maximum number of species per site: The highest number of *all* species collected at any site.

Mean number of species per site: The average number of *all* species collected per sampling site. This is calculated as the number of all species collected at each site summed for all sites and divided by the total number of sites (i.e., $((\sum s_{i..j})/N)$, where s is the total number of species at each site, summed from sites numbered i to j, and N is the total number of sites surveyed).

Mean number of native species per site: The average number of *native* species collected per site. This is calculated as the number of native species collected at each site summed for all sites and divided by the total number of sites (i.e., $((\sum s_{i..j})/N)$, where s is the number of native species at each site, summed from sites numbered i to j, and N is the total number of sites).

Species diversity index (SDI): This is a modified Simpson's diversity index, which is a measure that provides a means of comparing plant community structure and stability over time. The $SDI = 1 - (\sum((n_{i..j})/ \sum n_{i..j})^2)$, where n is the number of sites where each species occurred, summed for the species numbered from i to j.

Native species diversity index (NDI): This is a modified Simpson's diversity index to measure the diversity of *native* species. The $NDI = 1 - (\sum((n_{i..j})/ \sum n_{i..j})^2)$, where $n_{i..j}$ is the number of sites where each native species occurred, summed for the species numbered from i to j.

3.3 Species Metrics

Frequency of occurrence: This parameter measures the proportion of sites where each species is present and is calculated as (s/N)*100, where s is the number of sites where the species is present and N is the total number of sites surveyed.

Dominance index: This measure combines frequency of occurrence and relative abundance into a dominance value that characterizes how dominant a species is within the submersed macrophyte community. This is calculated as $((\sum r_{i..j})/(N*r_{max}))*100$, where r is the rake score for a species at each site, summed from sites numbered from i to j, r_{max} is the theoretical maximum rake score of 5, and N is the total number of sites surveyed.

4.0 References Cited

Deppe, E.R., and R.C. Lathrop. 1992. A comparison of two rake sampling techniques for sampling aquatic macrophytes. Findings 32, Wisconsin Department of Natural Resources, Madison, Wisconsin.

Fassett, N.C. 1957. A Manual of Aquatic Plants. University of Wisconsin Press, Madison, Wisconsin.

Gleason, H.A., and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Canada. Hafner Press, New York.

Pearson, J. 2004. A sampling method to assess the occurrence, abundance, and distribution of submersed aquatic plants in Indiana lakes. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis, Indiana. 37pp.

Voss, E.G. 1972. Michigan Flora Part I: Gymnosperms and Monocots. Cranbrook Institute of Science, Bloomfield Hills, Michigan.

Voss, E.G. 1985. Michigan Flora Part II: Dicots. Cranbrook Institute of Science, Bloomfield Hills, Michigan.

APPENDIX A

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet

Surveying Organization:

Contact Information:

Waterbody Name:

County(s):

Date:

Habitat Stratum:

Avg. Lake Depth (ft):

Lake Level:

GPS Metadata

Crew Leader:

Datum:

Zone:

Accuracy:

Recorder:

Method:

Secchi Depth (ft):

Total # of Sites Surveyed:

Total # of Species:

Littoral Zone Size (acres):

- ❑ Measured
- ❑ Estimated

Notable Conditions:

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page ____ of _____

WATERBODY NAME:	**DATE:**
COUNTY:	**SECCHI DEPTH (FT):**
SURVEYING ORGANIZATION:	**MAX PLANT DEPTH (FT):**
CREW LEADER:	**WEATHER:**
RECORDER:	**COMMENTS (Include voucher codes - V1, V2...):**
CONTACT INFO:	

Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.

Site #	R/T	Latitude	Longitude	Depth	Species Codes:								Notes

Other plant species observed at lake:

Standard Format for Single-year Data Presentation

Occurrence and abundance of submersed aquatic plants in Lake _____.							
County:		Sites with plants:			Mean species/site:		
Date:		Sites with native plants:			SE Mean species/site:		
Secchi (ft):		Number of species:			Mean native species/site:		
Maximum plant depth (ft):		Number of native species:			SE Mean natives/site:		
Littoral sites:		Maximum species/site:			Species diversity:		
Total sites:					Native species diversity:		
All depths: 0 to 15 ft	Frequency of	Rake score frequency per species					
Species	Occurrence	0	1	3	5	Plant Dominance	
Depth: 0 to 5 ft	Frequency of	Rake score frequency per species					
Species	Occurrence	0	1	3	5	Plant Dominance	
Depth: 5 to 10 ft	Frequency of	Rake score frequency per species					
Species	Occurrence	0	1	3	5	Plant Dominance	
Depth: 10 to 15 ft	Frequency of	Rake score frequency per species					
Species	Occurrence	0	1	3	5	Plant Dominance	

Standard Format for LARE AVMP Multi-year Data Presentation

Lake X									
Surveyor									
Date									
Total Sites									
Sites with Plants									
Sites with Native Plants									
Maximum Plant Depth									
Secchi (ft)									
Number of Species									
Number of Native Species									
Species Diversity									
Native Species Diversity									
Mean Native Species/Site									
Species Frequency of Occurrence - All Depths: 0 to 15 ft									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species Frequency of Occurrence - Depth: 0 to 5 ft									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species Frequency of Occurrence - Depth: 5 to 10 ft									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species x									
Species Frequency of Occurrence - Depth: 10 to 15 ft									
Species x									
Species x									

Quad Code:_____

Indiana Special Plant Survey Form

Element Name: _____

Surveyor (s): _____Date: _____ Time: ____ to _____

Contact information (telephone or email): _____

Location: ____ ¼ ____ ¼ ____ ¼ ____ Sec. ____T ____R ____ Quad name: _____

Repeat visit: Yes No Repeat visit needed: Yes No When: _____

EO boundaries mapped: Yes No County: _____

Area name (if applicable): _____

Biology

Phenology	Approx # Indiv	Population Area	Age Class
__In leaf	__ 1-10	__ 1 yd^2	__ % Seedlings
__In bud	__ 11-50	__1-5 yd^2	__% Immature
__In flower	__ 51-100	__5-10 yd^2	__% 1st year
__In fruit	__101-1000	__10-100 yd^2	__% Mature
__Seed Dispersing	__ 1001-10,000	__100 yd^2-2 ac	__%Senescent
__Dormant	__10,001+	__2 ac +	

Comments on above: _____

Compared to your last visit to this site:	Approx # Indiv	Population Area	Age Class
	__more	__more	__same
	__same	__same	__diff
	__less	__less	

Reproduction Is reproduction occurring?__ Type: __sexual, __asexual, __both

Show exact location and boundaries of taxon on map. (attach)

Population Distribution __ solitary, __clumps or dense groups, __small patches or cushions

__small colonies or large carpets, __large, almost pure population stands.

Vigor: 1) very feeble, 2) feeble, 3) normal, 4) exceptionally vigorous

Evidence of symbiotic or parasitic relationships: _____

Habitat

Aspect	Slope	Light	Topographic Position	Moisture
__N	__Flat	__Open	__Crest	__Inundated (Hydric)
__E	__0-10’	__Filtered	__Upper slope	__Saturated (Wet-mesic)
__S	__10-35’	__Shade	__Mid-Slope	__Moist (Mesic)
__W	__35’ +		__Lower slope	__Dry (Xeric)
	__Vertical		__Bottom	

Elevation: _____ft to _____ft. Surface Relief: ___/: ___∪:___∩:___—:___~~

Substrate/Soils: _____

Associated Natural Community/Plant Community: _____

List other members of this genus co-occurring at this site: _____

Characteristic associated species: _____

_____

Estimated size of potential Habitat: (as in population area) Boundaries mapped: yes no

---

Ownership info: (if known) _____

NOTE: Collect specimen if a healthy, viable population exists. Collection # _____

APPENDIX B

Explanation of Fields on the Aquatic Vegetation Waterbody Cover Sheet

Surveying Organization: Name of agency, corporation, group, individual, etc. that is collecting the data.

Contact Information:	Means of reaching the surveyor (telephone or email address).
Waterbody name:	Common name of the lake or stream. Name should be consistent with the name found on the USGS Topographic Map (e.g. Lake Lemon, not Lemon Lake). If not identified by USGS, list all commonly used local names for the waterbody (e.g., Little Maxinkuckee, Lost Lake and Hawk's Lake). See Appendix D for names of selected lakes.
County(s):	Name of the county(s) where sampling was conducted. When the waterbody or stream section traverses more than one county, list the primary county (county with the greatest acreage of water) first.
Date:	The month (MM), day (DD), and year (YYYY) on which a waterbody was sampled. Zeros (0) must be written in so that the date has eight digits (MMDDYYYY).
Habitat stratum:	Each stratum code defines a unique, major aquatic geomorphic feature in the state of Indiana. The habitat stratum of the waterbody according to the above protocol is an important ecological consideration and is valuable for the purposes of stratifying future sampling. The letter codes are listed in Table 1.
Average Lake Depth:	Average depth of the lake. Reference bathymetric maps, state personnel, historic studies etc.
Lake Level:	Actual lake level at the time of sampling as a measurement against a gauge at the dam or other known elevation, if available.
Crew leader:	The full name to identify the individual responsible for certifying that the samples and the data on the data sheets were collected in compliance with current protocol and are, to the best of their knowledge, complete and free of errors. This identifying field is an important chain-of-custody procedure.
Recorder:	Name to identify the individual recording the data on the data sheets.
Datum:	A mathematical model describing the shape of the earth. **NAD 83** is the preferred datum.
Zone:	The number that identifies the correct grid from which the coordinates were taken. All of the State of Indiana falls into Zone 16.
Accuracy:	The GPS measure of possible error related to the geometry of satellites. This number value is recorded when the Lat/Long coordinates are recorded. The method field indicates whether the scale is PDOP (Percent Dilution of Precision) or FOM (Figure of Merit). For WAAS-enabled GPS receivers, indicate whether a differentially corrected signal was being received.

Method:	A code that identifies the method used to locate the site and the type of accuracy measurement used by the equipment. B = Base Map D = GPS with differential corrections and PDOP G = GPS without differential corrections and PDOP F = GPS with differential corrections and FOM X = GPS without differential corrections and FOM W = GPS with WAAS-enabled O = other (explain)
Secchi Depth:	A measure of water transparency. Secchi depth is measured to the nearest one-tenth foot over the deepest point in the lake.
Total # of Sites:	Number of sites surveyed on the particular waterbody as part of this sampling effort.
Total # of Species:	The total number of species observed at the particular waterbody as collected on the rake as well as any additional species observed in the lake while traveling between sampling sites. This number represents the species richness for the entire waterbody.
Littoral Zone Size:	The littoral zone in lakes is defined as the portion extending from the shoreline to the greatest depth occupied by aquatic plants. Size in acres of the entire littoral zone may be measured through a variety of mapping techniques or estimated by the surveyor. The method is then noted.
Notable Conditions:	Comments that describe any unusual weather or water conditions that may interfere with accurate sampling such as rain, strong winds, algal blooms, equipment failure, etc.

Explanations of Fields on the Aquatic Vegetation Survey (Tier II) Datasheet

WATERBODY INFORMATION

Waterbody name: Common name of the lake or stream. Name should be consistent with the name found on the USGS Topographic Map (e.g. Lake Lemon, not Lemon Lake). If not identified by USGS, list all commonly used local names for the waterbody (e.g., Little Maxinkuckee, Lost Lake and Hawk's Lake). See Appendix D for names of selected lakes.

County(s): Name of the county(s) where sampling was conducted. When the waterbody or stream section traverses more than one county, list the primary county (county with the greatest acreage of water) first.

Surveying Organization: Name of agency, corporation, group, individual, etc. that is collecting the data.

Crew leader: The full name to identify the individual responsible for certifying that the samples and the data on the data sheets were collected in compliance with current protocol and are, to the best of their knowledge, complete and free of errors. This identifying field is an important chain-of-custody procedure.

Recorder: Name to uniquely identify the individual recording the data on the data sheets.

Contact Information: Means of reaching the surveyor (telephone or email address).

Date: The month (MM), day (DD), and year (YYYY) on which a waterbody was sampled. Zeros (0) must be written in so that the date has eight digits (MMDDYYYY).

Secchi Depth: A measure of water transparency. Secchi depth is measured to the nearest one-tenth foot over the deepest point in the lake.

Max. Plant Depth: The maximum depth at which plants are found, measured in feet.

Weather: Record weather conditions that exist at the time of sampling.

Comments: A field for recording any additional observations. Voucher codes, with their corresponding species codes, should be recorded here.

SITE COORDINATES

Site #: Record the number of the site

R/T: Record whether the sample site is a random site ("R"), or a targeted site ("T") selected in order to survey a particular area that was missed through the random sampling (e.g., "extra" sites below the prescribed deepest sampling site). Data collected at targeted sites are not included in the analysis of plant community or species metrics.

Latitude: The latitude coordinate for the site recorded in decimal degrees (e.g., 40.12345). The coordinate is recorded from a GPS unit when first arriving at the site.

Longitude: The longitude coordinate for the site recorded in decimal degrees (e.g., -85.12345). The coordinate is recorded from a GPS unit when first arriving at the site.

Depth: The measured depth (in feet) to the lake bottom at the sampling site.

SPECIES INFORMATION

Species code: Record the alphanumeric six character code for each species collected on the rake. Many of the common species codes are listed in Appendix C. If the genus of a plant is known and species unknown, make up a new code with the first three letters of the genus name followed by "001" for the first unknown species in the genus, for example, "POT001" for *Potamogeton* sp. If the genus is unknown, use a unique code (e.g., "UNKN01") for each unknown taxon. Collect voucher specimens of unknown species following the protocol described above in section 2.2 and record the voucher code (V1, V2…) in the Comments section on the datasheet. Upon positive identification, uncertain and unknown species codes will be confirmed or replaced with new codes.

Rake score: Record under the species code a number (1, 3, or 5) for plant abundance rated according to Table 4 for each submersed species found in the rake sample of vegetation. A floating-leaved or emergent species receives a "9" regardless of its plant abundance as long as the species was collected in the rake sample of vegetation. Species observed at the sampling site but not sampled by the rake receive a "9". Record the presence of filamentous algae with a "9".

Notes: When there is no aquatic vegetation at a site, record a "0" in this column.

Other plant species observed at lake:
Additional species observed in the lake while traveling between sampling sites are listed at the bottom of the datasheet, using species codes.

APPENDIX C

Aquatic Vegetation Species Codes

Species Code	Scientific Name	Common Name	Vegetation Type
ALGA	Any species of filamentous alga (incl. *Spyrogyra*, *Cladophora*, *Hydrodictyon*)	algae	N
ARMLAC	*Armoracia lacustris*	lake cress	S
BIDBEC	*Bidens beckii*	water marigold	S
CABCAR	*Cabomba caroliniana*	cabomba	S
CERDEM	*Ceratophyllum demersum*	coontail	S
CERECH	*Ceratophyllum echinatum*	spiny coontail	S
CHARA	*Chara* sp.	A chara species	S
EGEDEN	*EGERIA DENSA*	BRAZILIAN ELODEA or BRAZILIAN WATERWEED	S
ELOCAN	*Elodea canadensis*	Canada waterweed or common waterweed	S
ELONUT	*Elodea nuttallii*	slender waterweed	S
HETDUB	*Heteranthera dubia*	water stargrass	S
HYIVER	*HYDRILLA VERTICILLATA*	HYDRILLA	S
MYRAQU	*MYRIOPHYLLUM AQUATICUM*	PARROT FEATHER	S
MYRHET	*Myriophyllum heterophyllum*	various-leaved watermilfoil or variable watermilfoil	S
MYRSIB	*Myriophyllum sibiricum*	northern watermilfoil	S
MYRSPI	*MYRIOPHYLLUM SPICATUM*	EURASIAN WATERMILFOIL	S
MYRVER	*Myriophyllum verticillatum*	whorled watermilfoil	S
MYR001	*Myriophyllum* sp.	a watermilfoil species	S
NAJFLE	*Najas flexilis*	slender naiad or common naiad	S
NAJGRA	*Najas gracillima*	northern naiad	S
NAJGUA	*Najas guadalupensis*	southern naiad	S
NAJMAR	*NAJAS MARINA*	SPINY NAIAD	S
NAJMIN	*NAJAS MINOR*	BRITTLE NAIAD	S
NITELL	*Nitella* sp.	a nitella species	S
NITOBT	*NITELLOPSIS OBTUSA*	STARRY STONEWORT	S

POTAMP	*Potamogeton amplifolius*	large-leaved pondweed	S
POTCRI	*POTAMOGETON CRISPUS*	CURLY-LEAF PONDWEED	S
POTDIV	*Potamogeton diversifolius*	water-thread pondweed	S
POTEPI	*Potamogeton epihydrus*	ribbon-leaved pondweed	S
POTFOF	*Potamogeton foliosus*	leafy pondweed	S
POTFRI	*Potamogeton friesii*	Fries' pondweed	S
POTGRA	*Potamogeton gramineus*	variable pondweed	S
POTILL	*Potamogeton illinoensis*	Illinois pondweed or grass-leaved pondweed	S
POTNAT	*Potamogeton natans*	floating-leaf pondweed or common pondweed	S
POTNOD	*Potamogeton nodosus* (formerly *P. americanus*)	American pondweed or long-leaf pondweed	S
POTPRA	*Potamogeton praelongus*	white-stemmed pondweed	S
POTPUP	*Potamogeton pusillus*	small pondweed	S
POTROB	*Potamogeton robinsii*	fern pondweed	S
POTRIC	*Potamogeton richardsonii*	Richardson's pondweed or clasping-leaf pondweed	S
POTSTR	*Potamogeton strictifolius*	stiff pondweed	S
POTZOS	*Potamogeton zosteriformis*	flat-stemmed pondweed	S
POTNLV	*Potamogeton foliosus*, *P. pusillus*, or other unidentified narrow-leaved pondweeds	narrow-leaved pondweeds	S
RANFLA	*Ranunculus flabellaris*	yellow water crowfoot or yellow water buttercup	S
RANLON	*Ranunculus aquatilis v. diffusus* (incl. *R. longirostris* and *R. trichophyllus*)	white water crowfoot	S
STUPEC	*Stuckenia pectinata*	sago pondweed	S
UNKN01		Unknown specimen No. 1	
UNKN02		Unknown specimen No. 2	
UTRGIB	*Utricularia gibba*	creeping bladderwort or humped bladderwort	S
UTRINT	*Utricularia intermedia*	flat-leaved bladderwort	S
UTRMAC	*Utricularia macrorhiza*	common bladderwort	S

UTRPUR	*Utricularia purpurea*	purple bladderwort	S
VALAME	*Vallisneria americana*	wild celery or eel grass	S
ZANPAL	*Zannichellia palustris*	horned pondweed	S
HETDUB	*Heteranthera dubia*	water stargrass	S

Note: The scientific and common names of NON-NATIVE species are shown in ALL CAPITAL LETTERS.
Key to Vegetation Types:
S = submersed vegetation

APPENDIX D

Surface Area, Trophic State, and Sampling Depth for Selected Lakes

Lake	Sponsor	County	Surface Area (acres)	Trophic Status	Tier II Max Sampling Depth (ft)[a]
Adams Lake	Adams Lake Conservation Club	Lagrange	308	M	20
Atwood Lake	Atwood Lake Association	Lagrange	170	M	20
Ball Lake	Ball Lake Association	Steuben	87	M	20
Backwater Lake	Webster Lake Conservation Association	Kosciusko	140	M	10*
Banning Lake	Barbee Lakes Association	Kosciusko	16	M	20
Bass Lake	Bass Lake Conservancy District	Starke	1440	M	15*
Bear Lake	East Shore Property Owners Association	Noble	136	E	15
Beaver Dam Lake	Beaver Dam and Loon Lake Conservation Club, Inc.	Kosciusko	146	H	10
Big Barbee	Barbee Lakes Association	Kosciusko	304	E	15
Big Chapman Lake	Chapman Lakes Foundation, Inc.	Kosciusko	512	O	20*
Big Lake	Big Lake Association	Noble	228	E	15
Big Long Lake	Big Long Lake Association	Lagrange	365	M	20
Big Turkey Lake	Big Turkey Lake Association	LaGrange	450	E	15
Brokesha Lake	Stone Lake Conservation Club	Lagrange	36	O	20*
Cedar Lake	Tri-lakes Property Owners Association	Whitley	99	O	25
Center Lake	Center Lake Conservation Association, Inc.	Kosciusko	120	O	15*
Clear Lake	Clear Lake Township Land Conservancy	Steuben	800	O	25
Clear Lake	City of LaPorte	LaPorte	106	O	15*
Cook Lake	Four Lakes Lake Association	Marshall	93	M	20
Cree Lake	Cree Lake Association	Noble	58	O	20*
Crooked Lake	Crooked Lake Association	Steuben	828	M	20
Dallas Lake	Five Lakes Conservation Association, Inc.	LaGrange	283	M	15*
Dewart Lake	Dewart Lake Protective Association	Kosciusko	551	M	20
Diamond Lake	Diamond Lake Conservation Club	Kosciusko	79	E	15
Fish Lake	Michiana Fish Lake Association, Inc.	Lagrange Michigan	139	E	15
Fish Lake (Lower)	Fish Lake Conservancy District	LaPorte	134	O	15*
Fish Lake (Upper)	Fish Lake Conservancy District	LaPorte	139	O	15*
Flint Lake	Valparaiso Lakes Area Conservancy District	Porter	89	M	25*

Fox Lake	Fox Lake Property Owners Association	Steuben	142	M	20
Galbraith (Gilbert) Lake	Ancilla Domini Sisters	Marshall	37	E	15
Geist Reservoir	Geist Lake Coalition	Marion/ Hamilton	1478	M	20
Griffy Lake	Bloomington Parks & Recreation	Monroe	130	M	20
Hackenberg Lake	Five Lakes Conservation Association, Inc.	LaGrange	42	E	15
Hamilton Lake	Hamilton Lake Association	Steuben	802	E	15
Harris Lake	City of LaPorte	LaPorte	35	N/A	15*
Heaton Lake	Heaton Lake Conservation Club	Elkhart	87	M	20
Henry Lake	Big Turkey Lake Association	Steuben	20	H	15*
Hill Lake	Diamond Lake Conservation Club	Kosciusko	67	E	15
Holem Lake	Four Lakes Lake Association	Marshall	40	M	20
Hudson Lake	Hudson Lake Conservation Association	LaPorte	432	O	25
Irish Lake	Barbee Lakes Association	Kosciusko	182	H	15*
James Lake	Lake Tippecanoe P.O.A.	Kosciusko	282	M	20
Jimmerson Lake	Jimmerson Lake Association	Steuben	434	O	25
Jones Lake	West Lakes Conservation	Noble	115	H	10
Koontz Lake	Koontz Lake Association	Starke	346	M	20
Kreighbaum Lake	Four Lakes Lake Association	Marshall	20	M	20
Kuhn Lake	Barbee Lakes Association	Kosciusko	137	M	20
Lake Bruce	Lake Bruce Conservancy District	Fulton/ Pulaski	245	H	10
Lake Gage	Lake Gage and Lime Lake Association	Steuben	332	O	25
Lake George	Lake George Cottager's Association	Steuben	488	O	25
Lake James	Lake James Association	Steuben	1140	O	25
Lake Lemon	Lake Lemon Conservancy District	Monroe/ Brown	1650	E	15
Lake Manitou	Lake Manitou Association	Fulton/ Miami	1156	E	20*
Lake Maxinkuckee	Lake Maxinkuckee Environmental Council	Marshall	1854	M	25*
Lake of the Woods	Lake of the Woods-McClish P.O.A.	LaGrange/ Steuben	136	E	20*
Lake of the Woods	Lake of the Woods P.O.A	Marshall	416	E	15
Lake Pleasant	Lake Pleasant Cottage Owner's Association	Steuben	424	M	25*
Lake Tippecanoe	Lake Tippecanoe P.O.A.	Kosciusko	768	M	20

Lake Wawasee	Wawasee Area Conservancy Foundation	Kosciusko	3410	M	25*
Lily Lake	City of LaPorte	LaPorte	16	O	25
Lime Lake	Lake Gage and Lime Lake Association	Steuben	30	M	20
Little Barbee Lake	Barbee Lakes Association	Kosciusko	74	E	15
Little Cedar Lake	Tri-lakes Property Owners Association	Whitley	45	E	15
Little Chapman Lake	Chapman Lakes Foundation, Inc.	Kosciusko	177	E	15
Little Turkey	Little Turkey Lake Association	LaGrange	135	E	15
Long Lake	Valparaiso Lakes Area Conservancy District	Porter	65	O	25
Loon Lake	Beaver Dam and Loon Lake Conservation Club, Inc.	Kosciusko	40	E	15
Martin Lake	Oliver and Martin Lakes Conservation and Improvement Association	LaGrange	26	M	20
McClish Lake	Lake of the Woods-McClish P.O.A.	LaGrange/ Steuben	35	M	20
Meserve Lake	Life of Riley Estates	Steuben	18	N/A	25
Messick Lake	Five Lakes Conservation Association, Inc.	LaGrange	68	E	15
Millpond Lake	Four Lakes Lake Association	Marshall	136	M	20
Mud Lake	Fish Lake Conservancy District	LaPorte	18	N/A	10*
New Lake	Oakland City	Gibson	77	N/A	15
North Twin	North Twin Lake Cottage Association	LaGrange	135	O	25
Nyona Lake	Nyona & South Mud Lakes Booster Association	Fulton	104	E	15
Olin Lake	Oliver and Martin Lakes Conservation and Improvement Association	LaGrange	103	M	20
Oliver Lake	Oliver and Martin Lakes Conservation and Improvement Association	LaGrange	394	O	25
Oswego Lake	Lake Tippecanoe P.O.A.	Kosciusko	83	M	20
Palestine Lake	Palestine Lake Association	Kosciusko	290	E	15
Pike Lake	Pike Lake Association	Kosciusko	228	M	15*
Pine Lake	LaPorte Area Lake Association / City of LaPorte	LaPorte	564	O	25
Pleasant Lake	Lakeville Business Owner's Association	St. Joseph	29	M	10*
Pretty Lake	Pretty Lake Conservation Club, Inc.	LaGrange	184	M	20
Pretty Lake	Pretty Lake P.O.A.	Marshall	97	O	25

Riddles Lake	Lakeville Business Owner's Association	St. Joseph	77	M	15*
Ridinger Lake	Tippecanoe Environmental Lake & Watershed Foundation/ Ridinger Lake Association	Kosciusko	136	H	10
Rock Lake	Rock Lake Conservation & Improvement Club	Fulton	56	E	10*
Round Lake	Tri-lakes Property Owners Association	Whitley	131	E	20*
Sawmill Lake	Barbee Lakes Association	Kosciusko	74	M	20
Sechrist Lake	Barbee Lakes Association	Kosciusko	105	M	20
Shipshewana Lake	Shipshewana Community Lake Improvement Association	Lagrange	202	H	10
Shriner Lake	Tri-lakes Property Owners Association	Whitley	93	M	20
Silver Lake	Silver Lake Association	Kosciusko	102	E	15
Skinner Lake	Skinner Lake Association	Kosciusko	125	E	15
Snow Lake	Snow Lake Cottager's Association	Steuben	421	M	20
South Mud Lake	Nyona & South Mud Lakes Booster Association	Fulton	94	E	15
South Twin Lake	North Twin Lake Cottage Association	LaGrange	116	M	20
Steinbarger Lake	West Lakes Conservation	Noble	73	H	10
Stone Lake	LaPorte Area Lake Association / City of LaPorte	LaPorte	125	M	25*
Stone Lake	Stone Lake Conservation Club	Lagrange	116	M	20
Sylvan Lake	Sylvan Lake Improvement Association, Inc.	Noble	630	M	20
Syracuse Lake	Syracuse Lake Association	Kosciusko	414	M	20
Tamarack	West Lakes Conservation	Noble	50	E	15
Waldron	West Lakes Conservation	Noble	216	H	10
Wall Lake	Wall Lake Fisherman's Association	Lagrange	141	M	20
Waubee Lake	Waubee Lake Association	Kosciusko	127	M	20
Waveland Lake	Waveland Park Board	Montgomery/ Parke	358	M	15*
Webster Lake	Webster Lake Conservation Association	Kosciusko	774	M	20
West Otter Lake	West Otter Lake Property Owners Association	Steuben	118	M	20

Westler Lake	Five Lakes Conservation Association, Inc.	LaGrange	88	E	15
Winona Lake	Winona Lake Preservation Association	Kosciusko	562	E	20*
Witmer Lake	Five Lakes Conservation Association, Inc.	LaGrange	204	H	15*

Key to Trophic Status Codes (from IDEM 305b list 2008):
H = Hypereutrophic
E = Eutrophic
M = Mesotrophic
O = Oligotrophic

[a] Unless otherwise noted, sampling depths are estimated based on trophic state.
* Sampling depth adjusted for actual plant distribution based on past survey data.
N/A = trophic state not available