Lake Notes

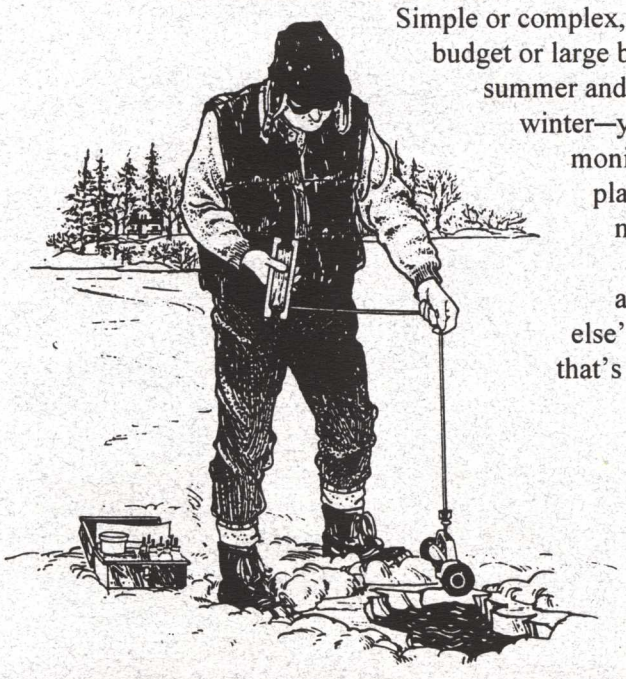
Monitoring Lake Quality

Why Monitor?

There are many reasons to monitor lake quality. Perhaps you wonder how the lake's quality is for swimming or if the fish population is in good shape. Maybe you're interested in keeping tabs on the lake so if its quality appears to worsen, you'll be alerted to it. What are the impacts upon the lake of that new housing development? Maybe the lake has some problems and data is needed to help guide management decisions.

Setting Objectives

The first step in beginning any lake monitoring program is to determine your own objectives or purpose for monitoring. Some typical objectives include learning how the lake functions, assessing general water quality and trends, or diagnosing lake problems. Once you've defined your monitoring purpose, then you can decide where to collect samples, which measurements to include, and how often.



Simple or complex, small budget or large budget, summer and/or winter—your monitoring plan may not be like anyone else's (and that's OK)!

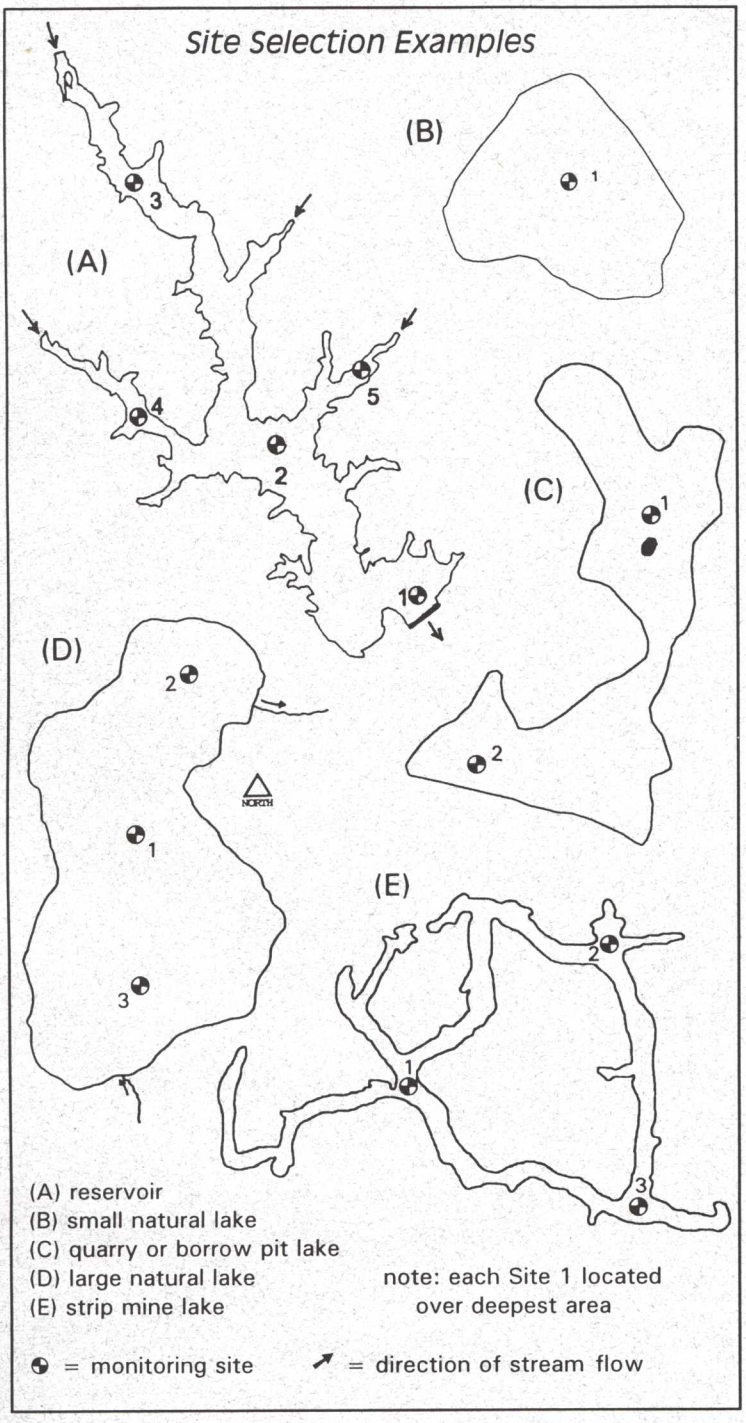
Selecting Sampling Locations

The selection of sampling sites depends on your monitoring objectives. If your objective is to assess general water quality, one site may be enough to represent your lake. If your objective is to learn how the lake functions or to diagnose the entire lake, sites in different locations (e.g., open water and bays) might be selected. If your monitoring objective focuses on a particular problem, it may be appropriate to add monitoring sites in the problem areas.

The size and shape of the lake basin usually is the most influential factor in determining the number and location of monitoring sites. In most cases, a site over the lake's deepest area best represents "average" conditions in the lake. In natural lakes that are round in shape, the deepest area usually is located near the center. In lakes created by the damming of a stream (e.g., reservoirs), the deepest section often is near the dam.

Some lakes also have bays or "arms." To gain more information, additional sites can be established in the deepest part of these areas. In long lakes, additional sites can be located in a transect (line) along its midsection. In many cases, differences in water quality will be noticeable between transect sites (sediments often settle out of the water as it flows toward the dam) or between arms (especially if the surrounding land uses differ).

Avoid sampling near shore, near inflows, or in downwind areas (unless specifically targeting these areas to document worst case conditions). Prevailing winds blow algae, zooplankton (microscopic aquatic animals), debris, and trash down the lake and toward the shoreline. Samples collected in these areas are not representative of the lake's overall water quality.



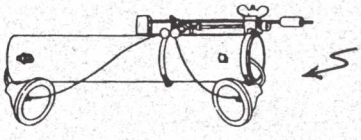
To select the location of a monitoring site(s), you must have some preliminary information about the lake, such as that noted below. This information not only influences site selection, but it also is important for interpreting the data.

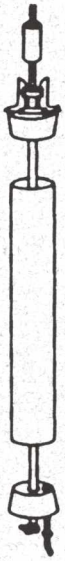
- a lake map (a "bathymetric" [depth contour] map is best, but if such a map is not available, you'll at least need a lake outline and general knowledge of the where the deepest areas are);
- the location of the lake's major inflows and outflows (e.g., streams, storm sewers—indicate these on your lake map);
- the location of previous sampling sites and a historical summary of water quality including documentation of lake problems (e.g., algae blooms, nuisance aquatic plant growth, fish kills);
- updates of current activities in the watershed that may affect sampling results (point sources of pollution such as a wastewater treatment plant or storm drain outfalls; and nonpoint sources such as agricultural operations and urban construction areas); and
- updates of current lake activities that may affect sampling results (such as dredging, aquatic plant harvesting, water level drawdowns, and aquatic herbicide applications).

Other useful information to have includes:

- a watershed map showing watercourses and types of land use (e.g., residential, commercial, agricultural, recreational);
- locations and types of shoreline vegetation (e.g., turfgrass lawn, wetland, wooded, agricultural crops, pasture).

In addition to deciding where to monitor on the lake, you also have to decide at what water depths to collect water samples. A point or "grab" sample is taken at a specific depth, while an "integrated" sample is collected from a range of depths. Near-surface grab samples typically are collected at 1 to 3 feet below the water surface. If the site is greater than 10 feet deep, the collection of a near-bottom sample (2 feet above the lake bottom) can provide additional information. Water for chlorophyll analysis is commonly collected as an integrated sample to twice the Secchi disk depth. While near-surface grab samples can be collected by leaning over the side of the boat and submerging the collection bottle in the water, specialized equipment is needed to collect deeper samples and integrated samples.

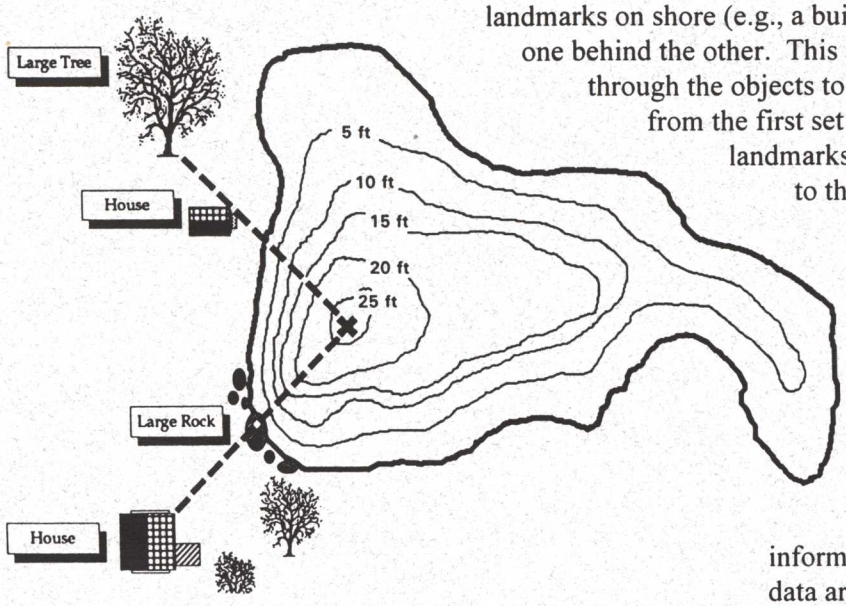




Kemmerer sampler and Van Dorn sampler for collecting deep water samples

Once the site(s) is identified in the field, it should be clearly marked on a lake map. You will always want to return as close as possible to the same location in the lake. Two simple ways to find the site are by using landmarks visible on shore or setting a permanent buoy at the sampling site. Even if a buoy is used, landmarks should be documented to check the site's location or in case the buoy is moved or disappears.

Shoreline Landmark Method



Once you are securely anchored at the sampling site, pick out two permanent landmarks on shore (e.g., a building, tall tree, large rock, flagpole) that align one behind the other. This alignment forms an imaginary bearing line through the objects to the sampling site. Then, at about a 90° angle from the first set of landmarks, choose two more aligning landmarks. These next landmarks form a second bearing to the site. The two bearing lines will position you at the same location each time. If you have one, an electronic depth finder can help verify you're in the right spot.

When to Sample

The monitoring objectives will be the primary factor influencing when to collect water samples. The following assumes your objectives are fairly general.

The most important time to monitor a lake usually is during the growing season. For most water quality assessment purposes, it is sufficient to monitor from May through October, either monthly or preferably twice a month. Samples also should be collected at about the same time of day each time you monitor so as to compensate for the indirect effects daylight has on some lake processes.

If you decide to monitor the lake throughout the year, collecting samples just once per month from November through April typically is enough. If your lake freezes in the winter, consider at least monitoring dissolved oxygen under the ice every few weeks to assess if oxygen levels are adequate for fish survival.

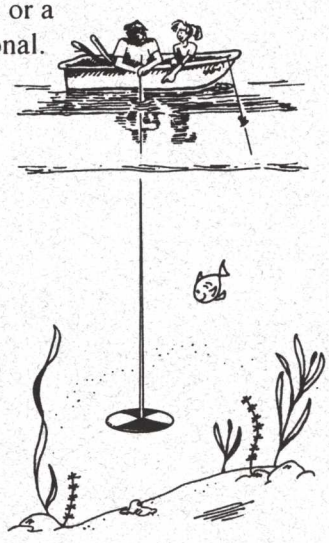
Selecting Parameters

Water quality parameters also should be selected to meet project objectives, as well as your budget limitations. Field measurements such as Secchi disk transparency, pH, alkalinity, temperature, and dissolved oxygen are inexpensive to measure once the initial equipment or chemical reagents have been purchased.

Secchi transparency is a fundamental component of all lake monitoring programs. Secchi information alone is enough to conduct a basic water quality assessment, characterize the lake's trophic state, provide educational information, and even describe water quality trends if data are collected for enough years. Dissolved oxygen and temperature measurements provide insight into the lake's water quality patterns and its ability to support aquatic life. Parameters such as nutrients (phosphorus and nitrogen), chlorophyll *a*, and suspended solids provides more specific information that will help you understand algae and sediment conditions in the lake. Other useful data includes aquatic plant maps, fish population surveys, and inflowing stream water quality.

Note to the Reader:
Are you uncertain about the meaning or importance of the water quality "parameters" mentioned here? To find out more about them, you are encouraged to read another fact sheet in the *Lake Notes* series, "Common Lake Water Quality Parameters."

Four lake monitoring scenarios ranging from basic to very extensive are shown on the next page. For additional guidance, contact Illinois EPA's Lake and Watershed Unit at 217/782-3362 or a local lake management professional.



A good way to get started in lake monitoring is through Illinois' Volunteer Lake Monitoring Program (VLMP). Volunteers are provided with a Secchi disk and monitoring forms and instructed in proper data ollection technique. Also, some VLMP volunteers are given the opportunity to collect water samples that are analyzed at Illinois EPA's lab. Call Illinois EPA's Lake and Watershed Unit (217/782-3362) for more details.

Example Lake Monitoring Scenarios

LEVEL 1: MINIMUM

Purpose: gain awareness and fundamental knowledge of lake quality processes
Sites: one or more in-lake
Parameters: Secchi disk transparency
Frequency: twice per month, May through October; every year

LEVEL 2: BASIC

Purpose: generally characterize lake quality and identify potential problems
Sites: one or more in-lake
Parameters:

- ✓ Secchi disk transparency [A]
- ✓ dissolved oxygen/temperature [A,G]
- ✓ total phosphorus [B,H]
- ✓ nitrate+nitrite nitrogen [B,H]
- ✓ ammonia nitrogen [B,H]
- ✓ total suspended solids [B,H]
- ✓ volatile suspended solids [B,H]
- ✓ chlorophyll *a* [B,I]
- ✓ aquatic plants (types, locations) [C]
- ✓ bacteria (if beach) [D]
- ✓ lake level [E]

Frequency:

- [A] twice/month, May – Oct.; every year
- [B] once/month, May – Oct.; every 2 or 3 years
- [C] at peak growth (July/Aug.); every yr.
- [D] weekly during swim season; every yr.
- [E] weekly when lake ice-free

Depth:

- [G] profiles (readings at 1 foot below the water surface and at 1- or 2-foot intervals thereafter to 2 feet above the lake bottom)
- [H] 1 foot below water surface
- [I] integrated to twice the Secchi depth

LEVEL 3: INTERMEDIATE

Purpose: diagnose lake problems, determine possible causes, and identify alternative management solutions
Sites: one or more in-lake
Parameters:

- ✓ Secchi disk transparency [A]
- ✓ dissolved oxygen/temperature [A,G]
- ✓ total phosphorus [B,H,J]
- ✓ dissolved phosphorus [B,H,J]
- ✓ nitrate+nitrite nitrogen [B,H,J]
- ✓ ammonia nitrogen [B,H,J]
- ✓ total Kjeldahl nitrogen [B,H,J]
- ✓ total suspended solids [B,H,J]
- ✓ volatile suspended solids [B,H,J]
- ✓ conductivity [B,H,J]
- ✓ pH [B,H,J]
- ✓ alkalinity [B,H,J]
- ✓ chlorophyll *a* [B,I]
- ✓ phytoplankton [B,I]
- ✓ aquatic plants (types, locations) [F]
- ✓ bacteria (if beach) [D]
- ✓ fish population [C]
- ✓ surficial sediment (metals, organics) [C]
- ✓ lake level [E]

Frequency:

- [A] twice/month, May – October
- [B] once/month, May – October
- [C] once during summer
- [D] weekly during swim season
- [E] weekly when lake ice-free
- [F] twice (late spring, peak growth)

Depth:

- [G] profiles
- [H] 1 foot below water surface
- [I] integrated to twice the Secchi depth
- [J] 2 feet above lake bottom (if site > 10' deep)

LEVEL 4: INTENSIVE

Purpose: thoroughly study the lake to develop comprehensive management alternatives or evaluate their effectiveness (e.g., Clean Lakes Program studies)
Sites: one or more in-lake
Parameters:

- ✓ as in Level 3 [A] *plus...*
- ✓ turbidity [A]
- ✓ fish flesh analysis [C]
- ✓ sediment cores (metals, organics) [C]
- ✓ benthic macroinvertebrates [F]
- ✓ water metals [C,H,J]
- ✓ water organics [C,H,J]
- ✓ waterfowl counts [D]
- ✓ lake level [E]

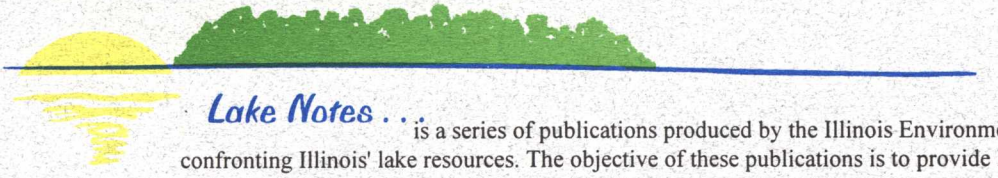
Frequency: minimum one year duration; repeat for another one year period after implementation of management and/or restoration practices

- [A] twice/month, May – October; once/month, November – April
- [C] once during a summer
- [D] weekly year 'round
- [E] daily year 'round
- [F] twice during a summer

Depth:

- [H] 1 foot below water surface
- [J] 2 feet above lake bottom (if site > 10' deep)

Other Monitoring: physical and chemical parameters also analyzed for major inflowing streams, and groundwater wells (if appropriate)



Lake Notes . . . is a series of publications produced by the Illinois Environmental Protection Agency about issues confronting Illinois' lake resources. The objective of these publications is to provide lake and watershed residents with a greater understanding of environmental cause-and-effect relationships, and actions we all can take to protect our lakes.

Appreciation is extended to the U.S. EPA, University of Wisconsin–Extension, Wisconsin Department of Natural Resources, and Illinois EPA for permission to excerpt illustrations from their publications. Other illustrations by Linda Wallis and Holly Hudson.

This *Lake Notes* publication was prepared by Holly Hudson of the Northeastern Illinois Planning Commission, Chicago, Illinois. Thanks are extended to Bob Kirschner of the Commission and Illinois EPA Headquarters and Regional staff for their review and comments.

For more information about other publications in this series and to request copies, please contact the Illinois Environmental Protection Agency, DWPC–Lake and Watershed Unit, P.O. Box 19276, Springfield, Illinois, 62794-9276; 217/782-3362.