VERMONT

LAY MONITORING

PROGRAM MANUAL

**Lay Monitoring Program Purpose,
Objectives and
Sampling Instructions**

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INTRODUCTION

Each summer, throughout the State of Vermont, lake users test their favorite lake's water quality by participating in Vermont's Department of Environmental Conservation (DEC) Lay Monitoring Program. The purpose of this manual is to describe the goals of the program, explain the tests involved, and outline the sampling procedure. The manual is intended to be an introduction to the mechanics of the program for those unfamiliar with it, and an instructional booklet for those already sampling with the program.

The principal objectives of the program are to accumulate an accurate data base on lakes and to educate lake residents about lake protection and biology. In detail the goals of the program are:

1. to provide a perspective on the range of water quality conditions on Vermont lakes;
2. to describe water quality conditions on each lake participating in the program;
3. to provide data useful in developing statistical eutrophication models for Vermont lakes;
4. to establish a data base on each lake useful for documenting future changes in water quality;
5. to educate and involve lake residents in lake protection

The long-term data is used to describe and identify changes in lake water quality, make decisions regarding the use and protection of lakes, and develop solutions to problem water quality conditions. Only by collecting weekly data each summer during a period of years can current conditions be assessed and future changes in water quality be documented.

Since it would not be possible for DEC to collect this quantity of information without the help of volunteers (due to personnel and budget constraints), the Lay Monitoring Program is actually a cooperative effort between DEC and lake users. DEC's responsibility in this cooperative venture is to provide the sampling equipment, train volunteers in the sampling procedure, analyze the samples, and interpret the data. In addition, the Department seeks to educate lake users on lake ecology and protection. Lake users for their part, agree to provide the use of their boat and time, sample on a weekly basis during the summer, and use good, accurate sampling techniques.

good, accurate sampling techniques. In addition, lake users help locate replacement monitors if they themselves are unable to, or do not wish to, continue sampling.

The Lay Monitoring Program was initiated on a trial basis during the summer of 1979, and has since become a permanent program in the Department's Lakes and Ponds Section. Interested lake residents, users, and associations can also make the Lay Monitoring Program a yearly commitment and a permanent part of their lake protection activities. The accurate measurement of water quality is an integral part of protecting any lake from degradation.

LAKE PRODUCTIVITY AND EUTROPHICATION

Most lakes naturally contain aquatic plants and algae (microscopic plants). The amount of plant and algae life a lake can support is referred to as that lake's "productivity." Productivity is determined by the amount of nutrients (or food) that is available in the water for plant and algae growth.

In all lakes, productivity will increase gradually during thousands of years through a natural aging process known as **eutrophication.** Although this process is continual, it can be divided into three broad phases or "trophic states" - oligotrophic, mesotrophic, and eutrophic (explained on the following pages).

As a natural process, eutrophication is not considered a problem. Most Vermont lakes would naturally eutrophy at such a slow rate that changes in trophic state would not be noticeable in one person's lifetime. However, when nutrients are introduced into a lake from cultural sources, in addition to those entering from natural sources, the natural eutrophication process is accelerated and productivity can become excessive. Thus, lakes "age" before their time, creating undesirable water quality conditions.

Cultural eutrophication causes a variety of water quality problems. Excessive algal growth decreases water clarity and in some cases causes unsightly surface scums and foul odors. Excessive aquatic plant growth can interfere with boating, swimming, fishing and other recreational activities. As the excessive amounts of plants and algae die back each year they fall to the lake bottom, causing sediments to build up more rapidly. When

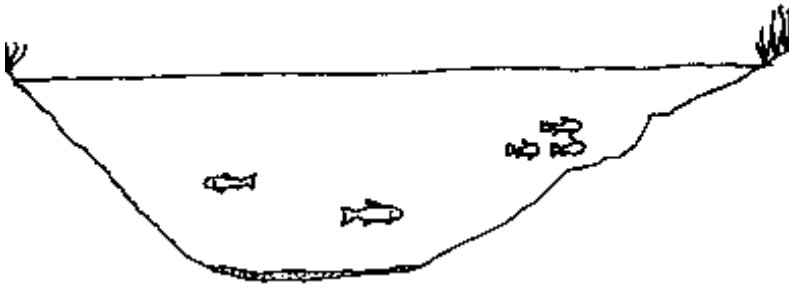
the natural environment of a lake is altered, the species of fish and other wildlife in the lake may also change.

Nutrients are introduced into a lake as a consequence of human activity along the lakeshore and in the drainage basin. Shoreline cultural sources of nutrients include failing septic systems, shoreline erosion, fertilizer runoff, and runoff from roadways. Most of these sources can be controlled by lakeshore residents. Nutrients from within a lake's drainage basin (which travel downstream and flow into the lake) include agricultural and urban runoff, erosion from logging or construction operations, and dirt road and streambank erosion. Further information on the identification and control of such nutrient sources is available from DEC through the Lake and Watershed Protection Program.

All of Vermont's lakes are at different stages in the process of eutrophication. Vermont is fortunate to have a diversity of lake types within its boundaries with lakes that vary widely in terms of their stage in the eutrophication process. It is important to remember that eutrophication as a **natural** process is not undesirable. Lakes in many different trophic states are essential components of Vermont's environment. The Lay Monitoring Program seeks only to identify those lakes in which eutrophication is proceeding at an **accelerated** pace due to the influence of people.

WATERSHED

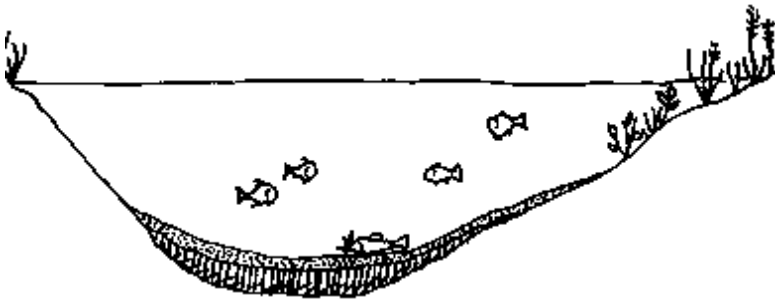
PHASES OF EUTROPHICATION



OLIGOTROPHIC

Lakes in this trophic state are often referred to as “young.” They are usually distinguished by the following characteristics:

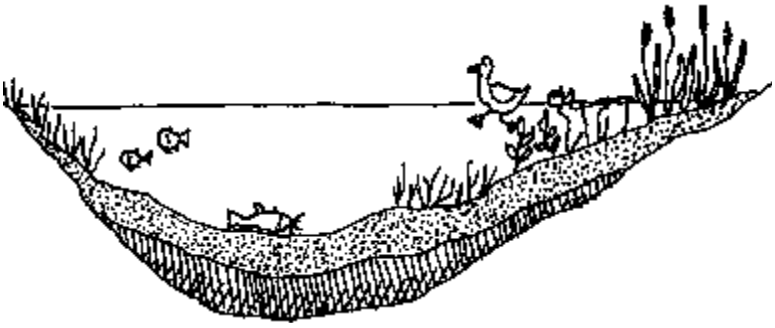
- deep, clear water
- low nutrient enrichment
- little algae growth (low productivity)
- few aquatic plants
- bare sand or rock along most of shoreline (little mud)
- often supporting coldwater fish species



MESOTROPHIC

Lakes in this intermediate trophic state are often characterized by:

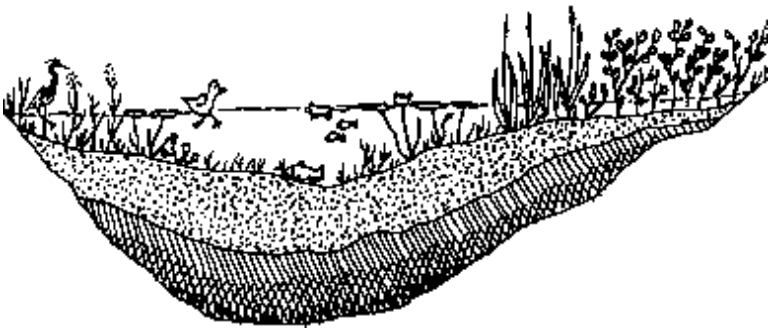
- moderate nutrient enrichment
- moderate algae growth
- moderate aquatic plant growth
- some sediment accumulation over most of lake bottom
- usually supports warmwater fish species



EUTROPHIC

Lakes in this trophic state are often characterized by:

- high nutrient enrichment
- much algae growth (high productivity)
- extensive aquatic plant beds
- much sediment accumulation on lake bottom
- only warmwater fish species



WETLAND

Eventually all lakes transform into marshes, swamps or bogs. Wetlands are highly productive areas and an essential part of Vermont's environment. Wetlands are often important components of lakeshores.

MEASURING LAKE PRODUCTIVITY: AN OVERVIEW

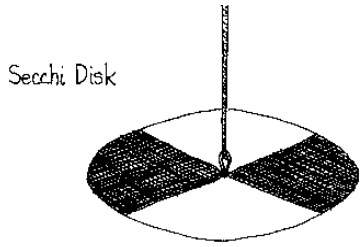
In order to determine what phase a lake is in, referred to as a lake's trophic state, its current "productivity" is measured. A lake's productivity is the amount of plant and algal life that it can support, and is determined by the quantity of nutrients (food) available for their growth. The Lay Monitoring Program therefore measures the lake water clarity, the size of the algal population and the quantity of nutrients present. (Algae are microscopic plants; the program does not measure rooted aquatic plant growth.) The tests performed are:

- Secchi disk transparency (measures water clarity)
- chlorophyll-a concentration (measures the size of the algal population)
- phosphorus concentration (measures the amount of this nutrient)

By analyzing the results of several summers of sampling, the present water quality and trophic state can be documented. By gathering a data base now, a reference point is established and water quality changes for years to come can be documented. In this way, rapid degradations in water quality, which may indicate cultural eutrophication or human impacts, can be recognized and further investigated. Improvements resulting from water quality restoration projects likewise can be observed.

MEASURING WATER CLARITY: SECCHI DISK TRANSPARENCY

Water clarity or transparency is often used as a simple indication of water quality. The transparency of a lake's water is directly related to the amount of materials suspended in the water. Algae, microscopic animals, water color, eroded soil, silt and resuspended bottom sediments are factors which interfere with light penetration and reduce water clarity. The amount of algae in the water is directly related to a lake's productivity or trophic state.



Usually, the greater the nutrient enrichment of a lake, the more algal growth it is able to support.

Silt, too, is often related to the nutrient enrichment of a lake because nutrients such as phosphorus cling to soil particles. A lake is a catch basin for eroded materials from its drainage basin. Fine sediment becomes resuspended in lake water during heavy winds, especially in shallow lakes. In addition, unprotected lakeshores will often erode suspending soil particles in the water.

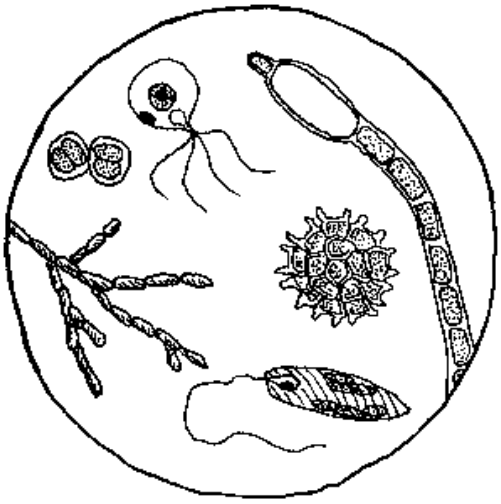
The Secchi disk transparency is a quick and easy measurement which is widely used as a basic measure of water clarity. The Secchi disk is a 20 centimeter (8 inch) diameter metal disk with black and white quadrants. Attached to the center is a line measured and marked in meters. The weighted disk is lowered slowly straight down into the water and the exact depth just before the disk disappears from view is observed and measured on the marked line. This depth is known as the "Secchi disk transparency." Nutrient rich lakes with high algal populations and suspended silt will have shallow Secchi disk readings. Alternatively, lakes without large concentrations of algae and silt will have deep Secchi disk readings. The following chart shows the general range of Secchi disk readings expected in the three different lake trophic states. This chart should only be used in a **general** sense however, as the Secchi disk transparency is a rough measure and varies considerably from year to year as well as from week to week.

Trophic State (Nutrient Enrichment)	**Secchi Disk Transparency** (1 meter = 3.3 feet)
Eutrophic (Very Enriched)	**0 - 3.0 meters**
Mesotrophic (Moderately Enriched)	**3.0 - 5.5 meters**
Oligotrophic (Sparsely Enriched)	**> 5.5 meters**

MEASURING ALGAL POPULATIONS: CHLOROPHYLL-A CONCENTRATION

Algal populations in a lake can be quantified by measuring the amount of chlorophyll-a in a water sample. Chlorophyll-a is the photosynthetic green pigment contained in all algae (in fact, chlorophyll-a is found in all green plants). The concentration of chlorophyll-a present in the water is directly related to the amount of algae living in the water.

There are many different species (types) of algae found in every lake. The water quality characteristics of a lake largely determine which algae species will be present. Eutrophic lakes (those with high nutrient enrichment) will support larger numbers and different types of algae than oligotrophic lakes (those with low nutrient enrichment). Other factors such as water temperature, depth, acidity and water hardness also influence the species and numbers of algae found in a lake.



To measure chlorophyll-a concentration, a water sample is taken from the lake at a specified location, A certain volume of this water is then filtered. All the algae (and any other suspended particles) in the water collect on the filter paper, which is then analyzed in a laboratory for chlorophyll-a concentration.

The following chart shows the general range of chlorophyll-a concentrations found in lakes of different trophic states. Since chlorophyll-a concentration is influenced by many other factors besides the degree of nutrient enrichment, actual concentrations may vary significantly from those listed here.

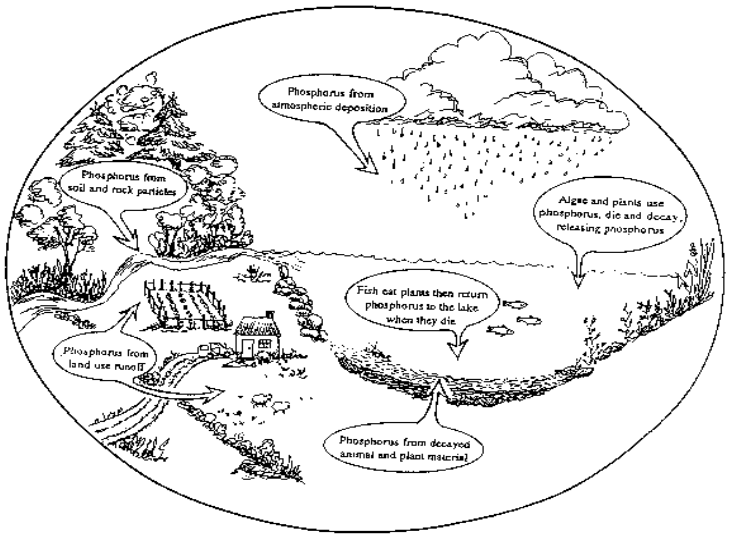
Trophic State (Nutrient Enrichment)	**Chlorophyll-a Concentration** (ug/l = micrograms/liter)
Eutrophic (Very Enriched)	**> 7.0 ug/l**
Mesotrophic (Moderately Enriched)	**3.5 - 7.0 ug/l**
Oligotrophic (Sparsely Enriched)	**0 - 3.5 ug/l**

MEASURING NUTRIENT ENRICHMENT: TOTAL PHOSPHORUS CONCENTRATION

The measurement of the total phosphorus concentration of a lake gives an indication of the extent of nutrient enrichment a lake has already undergone. Of all the nutrients that algae require to grow, phosphorus is in the shortest supply in Vermont lakes. Therefore, the amount of phosphorus in a lake often determines the extent of algal growth. The measure of total phosphorus is also an indication of the amount of nutrients potentially available for algal growth.

Phosphorus enters a lake from a variety of sources, both natural and cultural, via rainfall, incoming streams, overland runoff, groundwater and direct discharges. Naturally, phosphorus is contributed to lakes from decaying material and the erosion of soils. Also, phosphorus which has accumulated in the deep water sediments of a lake may be released into the water under anaerobic (no oxygen) conditions. Culturally, phosphorus is contributed to a lake by human activity in the drainage basin, direct discharge of wastes, runoff from agricultural, urban or cleared land, or failing septic systems.

The majority of phosphorus contributed to a lake enters during the spring when the flow of inlet streams is high due to snowmelt and spring rains. During spring overturn, just after ice-out,



lake waters completely mix and incoming phosphorus is distributed evenly through the water column.
The total phosphorus concentration measured during this time generally represents the total amount of phosphorus which will be available to algae for growth through the summer season. Therefore, the spring total phosphorus concentration in a lake can often be used to predict the amount of algal growth that will occur in the lake during the summer.

Total phosphorus is sampled on many Lay Monitoring lakes, in the spring by the DEC. Lake Champlain monitors sample total phosphorus weekly during the summer months. Weekly phosphorus measurements are necessary on Lake Champlain because it is a large lake and the complex currents and continual phosphorus inputs (from sources such as sewage treatment plants) cause the phosphorus distribution to be in constant flux. In addition, a number of lakes take weekly phosphorus samples when special situations require additional information.

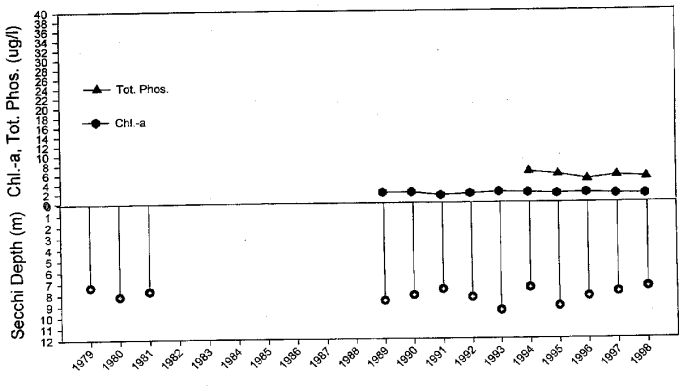
To sample for total phosphorus concentration, in both spring and summer, a water sample is collected in a specially cleaned test tube and transported to the DEC laboratory for analysis.

Total phosphorus concentration influences algae growth and is related to the trophic state of a lake. An oligotrophic lake usually has a low spring total phosphorus concentration, while a eutrophic lake has a high spring total phosphorus concentration. The following chart shows the general range of phosphorus concentrations of lakes of different trophic states. However, due to the complex nature of lake nutrient systems, these are by no means definitive categories.

Trophic State (Nutrient Enrichment)	**Total Phosphorus** (ug/l = micrograms/liter)
Eutrophic (Very Enriched)	**> 14 ug/l**
Mesotrophic (Moderately Enriched)	**7.0 - 14 ug/l**
Oligotrophic (Sparsely Enriched)	**0 - 7.0 ug/l**

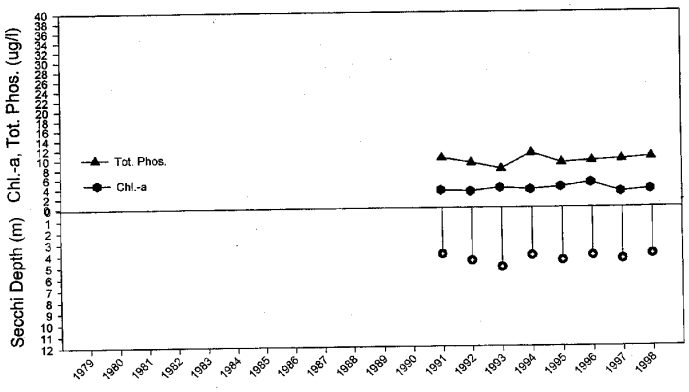
Lay Monitoring Graphs of Lake Trophic Stages

Oligotrophic



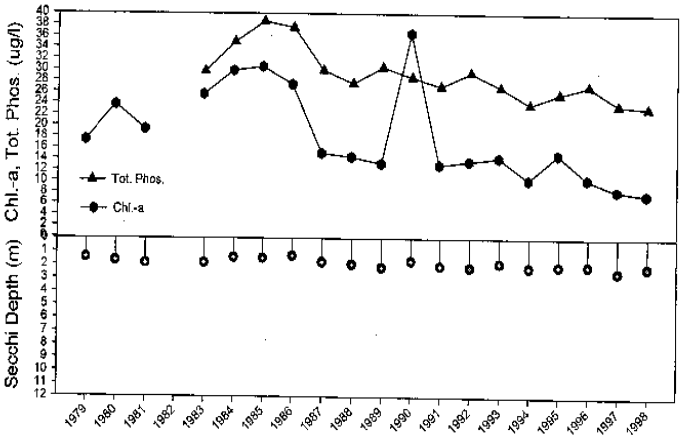
Maidstone Lake, located in the north east kingdom, is an example of an oligotrophic lake. The water clarity in Maidstone Lake is high. There is a low density of algal population and the nutrient enrichment is low.

Mesotrophic



South Pond, in the town of Eden, is an example of a mesotropic lake. The water clarity, algal population, and the nutrient enrichment are all moderate.

Eutrophic



Lake Carmi in Franklin, Vermont is an example of an eutrophic lake. Lake Carmi has low water clarity. The density of algal population is high and the nutrient enrichment is high.

SAMPLING OVERVIEW

The Lay Monitoring Program is divided into several sampling regimes. Lake Champlain sites involve 1 sampling station, while inland lakes involve 2 sampling stations. (Lakes other than Lake Champlain are referred to as “inland lakes.”)

Basic monitors measure Secchi disk transparency on a weekly basis. Supplemental monitors sample Secchi disk, chlorophyll-a, and total phosphorus.

Basic monitoring of water clarity provides a good indication of water quality conditions. Supplemental monitoring is generally performed on inland lakes which have one or more of the following characteristics:

1) the lake is new to the program and chlorophyll-a and total phosphorus baseline information is desired,

2) the lake has a history of water quality problems,

3) a diagnostic study has been performed on the lake and restoration measures have been implemented, or

4) the monitor and lake community are very active and have asked to collect supplemental data.

QUALITY ASSURANCE

Quality assurance is the system of activities which ensures that all samples are collected and tested in a consistently correct manner. It is an important part of all scientific research and allows one to have confidence in the research data and results. The LMP operates under its EPA approved Volunteer Monitoring Quality Assurance/ Quality Control Plan.

Quality assurance procedures for lay monitoring field data collection involve: 1) the DEC providing the same type of equipment for all monitors; 2) the training of all lay monitors by DEC personnel; and 3) on-lake quality control checks of all monitors by program assistants each summer. Assistants perform quality checks by joining monitors for their regular weekly sampling. All monitors participate whether it is their 1st year sampling or their 10th, whether they are basic or supplemental, whether they monitor inland lakes or Lake Champlain. Quality checks focus on: a) proper location of sample sites,

b) proper sampling technique,

c) proper storage of equipment and samples,

d) proper recording of information on data sheets, and
e) duplicate samples taken by program assistants.

In addition, quality control tests are done in the DEC laboratory by laboratory staff. A certain percentage of samples received for processing are "split" and both halves are analyzed separately. The two results should be the same or nearly the same. This provides a check on the precision of the state's laboratory procedures. Also, during the LMP staff visits with the Lay Monitors, extra duplicate samples are collected and given to the laboratory staff for further lab quality control tests.

EQUIPMENT

All sampling equipment except the boat and anchor is supplied by the DEC. Each monitor should have the following equipment (• denotes items supplied by monitor).

Basic Monitoring - Secchi Disk Transparency:
- boat
- anchor with line

Secchi disk with measured line
lake map with station locations
data sheets
pencil (**not** a pen)

Supplemental Monitoring :
All of the above, **plus:**
rubber hose with measured line and weights
plastic bucket with lid
2-500 ml plastic chlorophyll sample bottles
(one labeled "A", and one labeled "B
filtering apparatus
hand vacuum pump with tubing
small chlorophyll filter papers (2 per week)
large filter papers (1 per week)
1-100 ml plastic graduated cylinder
paper clips
tweezers
glass jar or "ziploc" baggie covered with black
tape (for storage of frozen chlorophyll filters)
glass phosphorus test tubes (1 per week)

PROCEDURES

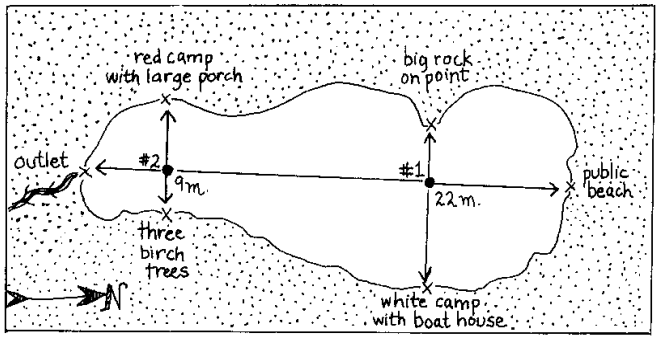
The following are step-by-step instructions for the Lay Monitoring sampling procedure. *It is important that all monitors use exactly the same sampling technique so that the data are truly representative of the lake conditions and all the Lay Monitoring lakes are comparable to each other*. Therefore, be careful and particular while conducting the sampling; all the details **are** important!

GETTING READY

1. Choose a convenient day of the week for sampling. Optimal sampling conditions are calm, sunny days between 10am and 2pm. Please try to sample under these conditions when possible.

Ideally, samples should be taken at regular weekly intervals, since evenly spaced samples give a more accurate picture of lake conditions throughout the summer. If poor weather or other factors prevent sampling on the same day each week, try to space samples 5-10 days apart.

2. Locate your sampling stations. The program staff will help you locate your station(s) during the initial on-lake training session. Many stations have been sampled by DEC in the past so, precise station location is important to ensure that the same site is sampled year after year. On inland lakes Station #1 is usually located over the deepest spot in the lake, while #2 is positioned at the opposite end. A series of coordinate landmarks on the shoreline are used to locate stations. The following picture presents examples of the way landmarks are used to locate stations:



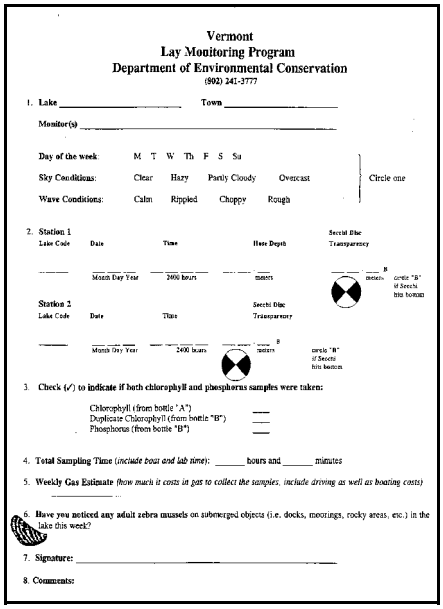
3. Anchor the boat firmly. If the boat drifts off the proper location during sampling, return to the correct spot and anchor again.

To double check station location, mark the anchor line at the proper station depth with a waterproof pen or knots. In the lake shown on the preceding page the anchor line would be marked at 22 meters and 9 meters. Stations can then be located by both landmarks and water depth.

4. Fill out the data sheet. Fill out the preliminary sections of the data sheet:

- i lake name,
- i town,
- i date,
- i name of monitor(s) please include everyone who accompanies you,
- i day of week,
- i sky and wave conditions, and
- i time.

Please record the time in 2400 hours, for example, 10:30 am = 1030, and 2:05 pm = 1405.



Vermont
Lay Monitoring Program
Department of Environmental Conservation
(802) 241-3777

1. **Lake** _____ **Town** _____

Monitor(s) _____

Day of the week: M T W Th F S Su

Sky Conditions: Clear Hazy Partly Cloudy Overcast } Circle one

Wave Conditions: Calm Rippled Choppy Rough

2. **Station 1**

Lake Code	Date	Time	Hose Depth	Secchi Disc Transparency
_____	___ ___ ___ Month Day Year	___ ___ 2400 hours	___ ___ meters	___ ___ meters (circle "B" if Secchi hits bottom)

Station 2

Lake Code	Date	Time	Secchi Disc Transparency
_____	___ ___ ___ Month Day Year	___ ___ 2400 hours	___ ___ meters (circle "B" if Secchi hits bottom)

3. **Check (✓) to indicate if both chlorophyll and phosphorus samples were taken:**

Chlorophyll (from bottle "A") ___
Duplicate Chlorophyll (from bottle "B") ___
Phosphorus (from bottle "B") ___

4. **Total Sampling Time** *(include boat and lab time)*: _____ hours and _____ minutes

5. **Weekly Gas Estimate** *(how much it costs in gas to collect the samples, include driving as well as boating costs)*
_____

6. **Have you noticed any adult zebra mussels** on submerged objects (i.e. docks, moorings, rocky areas, etc.) in the lake this week?

7. **Signature:** _____

8. **Comments:**

SECCHI DISK TRANSPARENCY

• All Monitors •

1. Lower the Secchi disk slowly into the water on the **shaded** side of the boat (sun glare off the surface of the water interferes with accurate measurement).

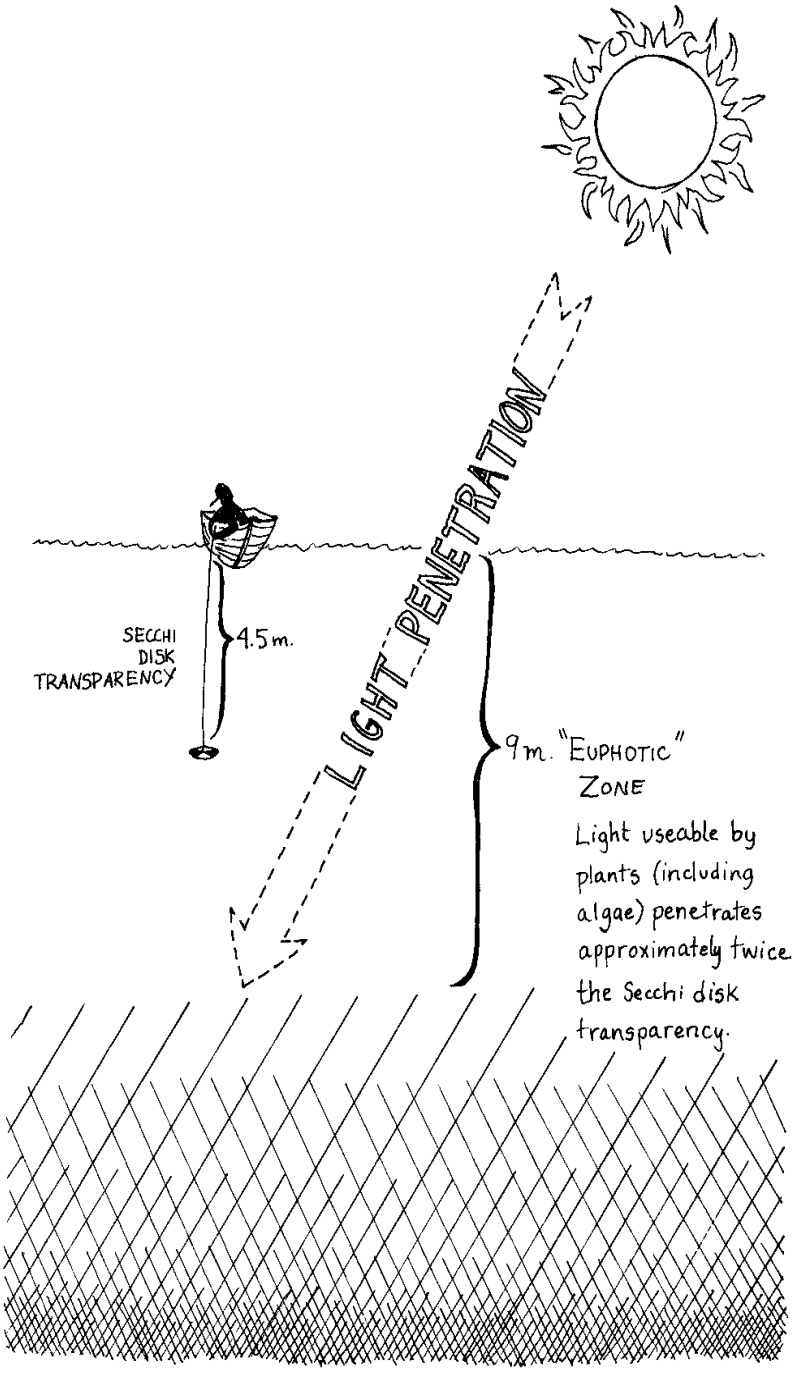
2. When the disk disappears from sight raise it back up slightly until you can just see it. The disk will be *very* indistinct at this point, so take your time and watch for it carefully.

3. Record the depth to the nearest 1/10 meter - the rope is marked off in meters with a double mark at 5 meters and a triple mark at 10 meters. The reading should be the deepest point at which you can still see the Secchi disk and it should be taken from water level.

Monitors on inland lakes take Secchi disk transparency readings at both stations #1 and #2.

Monitors at shallow lake stations please note:

If the Secchi disk is visible resting on the bottom, the actual Secchi disk transparency cannot be measured. Even though it is impossible to determine how much deeper the disk would have gone before disappearing, it is still important to note that the Secchi disk transparency was *at least* the depth to the bottom of the lake. Indicate this on the data sheet by recording the lake depth and circling "B" after the space for the Secchi disk reading.


LIGHT PENETRATION
SECCHI DISK TRANSPARENCY
4.5m.
9m. "EUPHOTIC" ZONE
Light useable by plants (including algae) penetrates approximately twice the Secchi disk transparency.

CHLOROPHYLL-A HOSE SAMPLING

NOTE: If you have not been equipped with a hose, please use the chlorophyll-a surface sampling technique on page 24.

1. Rinse equipment **twice**.

a. **Thoroughly** rinse the bucket and sample bottles twice with surface water. NEVER wash equipment with detergent.

b. Rinse the hose twice by unscrewing the ends and slowly lowering the weighted end straight into the water to a depth which is **twice** the Secchi disk transparency. (Example on pg. 19: Secchi reading **= 4.5** meters, hose is lowered to **9** meters.) NOTE: in lakes or ponds where twice the Secchi disk reading results in hitting bottom, only lower the hose to 1 meter from the bottom. Hold the rope loosely to prevent tangling and straighten all kinks to allow water to freely fill the hose. While lowering the hose keep the un-weighted end clear of water and dirt in the boat. Pull the hose back up with the weighted end coming out of the water last. Move slowly to prevent water from backwashing into the hose and boat.

c. **NOTE**: KNOW YOUR STATION DEPTH *BEFORE* LOWERING THE HOSE. Do not lower the hose closer than 1 meter to the bottom to avoid contaminating the hose with sediment. Example: If the Secchi reading is 4.5 meters, you would normally lower the hose to 9 meters - but, if the station depth is only 8 meters this is not possible. Instead, lower the hose to 7 meters so that it is 1 meter off the bottom.

2. Take the water sample.

a. **Slowly** and **evenly** lower the hose, weighted end first, into the water to a depth which is twice the Secchi disk transparency. Hold the rope loosely to prevent tangling and straighten all kinks to allow water to freely fill the hose. The measurement should be taken at water level. If you are taking a 9 meter hose sample, the 9 meter mark should be right at the water surface.

b. Crimp the hose just above water level by folding the hose **twice** and holding the crimp firmly in your hand. **Always** hold the crimp higher than the rest of the hose, to prevent backwash into the back end of the hose (and the boat!).

c. Use the attached rope to pull up the weighted end of the hose. (If two people are sampling, one can hold the crimp while the other

pulls up the weighted hose end.) Let the hose hang in the water while the rope is being pulled in.

d. Lift the weighted end out of the water with the open end facing up. Place the weighted hose end over the bucket, holding it high enough so that it will not touch the bottom of the bucket or the sample water once it is emptied into the bucket. The tightly held crimp should hold all the water in the hose. If the hose was lowered slowly and evenly, it will now contain a little water from each depth, and thus be a "composite" sample of the water column.

3. Empty the hose.

a. Begin emptying the water out of the hose by releasing the crimp, holding it high over your head. The crimp should be released by lifting the **empty** side of the hose higher than the water-filled side. (This will prevent any backwash of water that is near the crimp.

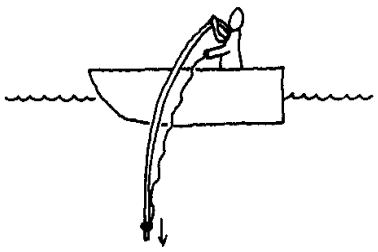
b. Slowly bring the hose through your hands (held high), starting from the section of the hose were the crimp was, and passing the hose slowly thru your hands toward the weighted end. The water should run out of the weighted end of the hose into the bucket. *In order to prevent backwash, always hold the section of hose in your hands higher than the rest of the hose.*

4. Fill the bottle.

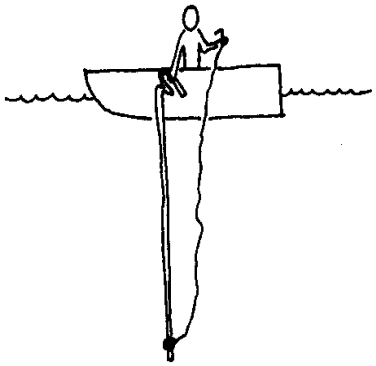
Swirl the bucket to thoroughly mix the water. If there is enough water, rinse bottle "A" twice before filling. Pour the bucket water into bottle "A," do not dip the bottle into the bucket. Cap the bottle tightly.

5. Repeat procedure to fill bottle "B."

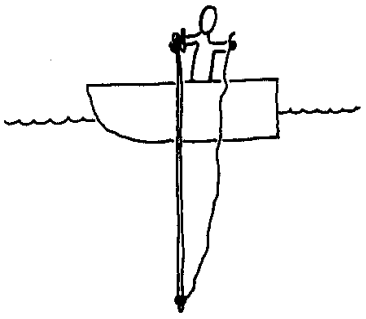
Never take samples "A" and "B" from the same hoseful even if there is plenty of water. They are intended to be completely separate, duplicate samples to measure the "average" conditions.



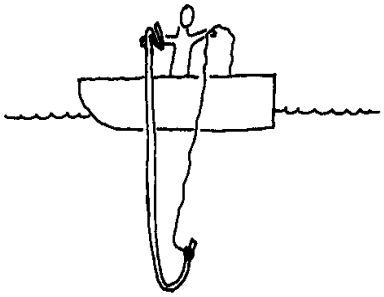
1. Lower the weighted end of the hose into the water. Make sure the attached line is loose.



2. When hose is at proper depth, crimp the hose closed at water level.

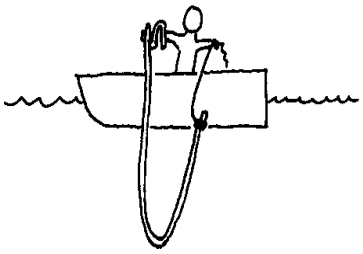


3. Maintain a firm grip to keep hose crimped shut.

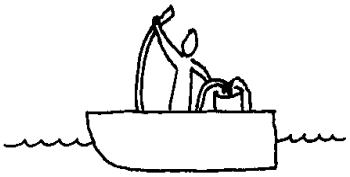


4. Pull up weighted end of hose by reeling in the line.

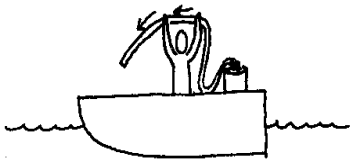
COMPOSITE SAMPLING PROCEDURE



5. The open end of the hose will be facing upward just as the hose surfaces.



6. Place the weighted end in the bucket, hold crimped end high, and release crimp.



7. Pass the hose through your raised hands until all the water from the hose empties into the bucket.

8. Swirl the bucket to mix the sample water thoroughly.

COMPOSITE SAMPLING PROCEDURE cont.

CHLOROPHYLL-A SURFACE SAMPLING

NOTE: Monitors who sample at shallow stations (generally less than 4 meters deep) take "surface" samples instead of using the hose to obtain the samples. If you have been equipped with a hose, please use the chlorophyll-a hose sampling technique on page 20.

1. Rinse bottles **twice**.

Thoroughly rinse sample bottles "A" and "B" twice with surface water. *NEVER* wash with detergent.

2. Take water sample.

Reach down into the water as deep as possible with sample bottle "A" upside down. Turn the bottle upright slowly and evenly *while* raising the bottle up toward the surface. Try to fill the bottle evenly with a little water from each depth, from arm's depth to the surface. Cap tightly. On the data sheet record 0.5 meters in the hose depth space.

3. Repeat procedure to fill bottle "B."

Never take samples "A" and "B" from the same sample bottle even if there is plenty of water. They are intended to be completely separate, duplicate samples to measure the "average" conditions.

TOTAL PHOSPHORUS SAMPLING

1. Fill the phosphorus test tube.

   Note: The test tubes are clean when they are distributed and ***do not*** need to be rinsed prior to being filled.

   Fill the phosphorus test tube from sample bottle "B."
   (Pour the sample water into the test tube up to the line.)

2. Label.

   Use pencil to fill in lake name and date.

3. Sample Storage.

   Cap tightly and store in a cool, dark place until pickup time. A kitchen cupboard is fine; it is not necessary to keep them in a refrigerator.

LABORATORY PROCEDURES AND SAMPLE STORAGE

Instructions for filtering chlorophyll "A" and "B" samples:

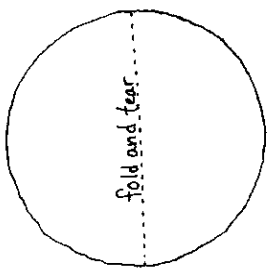
1. Getting ready.

Check laboratory equipment and wash hands to prevent contamination of the filter papers.

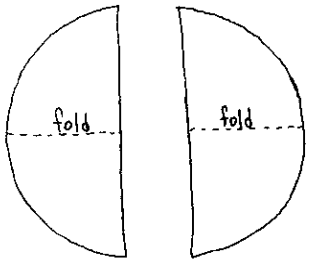
2. Prepare filter jackets.

Cut or tear a large filter paper in half. Fold each half in half.
Label **clearly, in pencil, on the outside**:

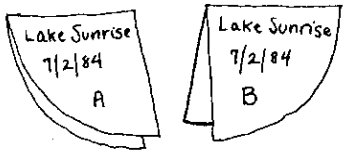
LAKE NAME (if Champlain use STATION #)
DATE
"A" on one half, "B" on the other half
Write only in pencil, as pen ink runs and interferes with test results.



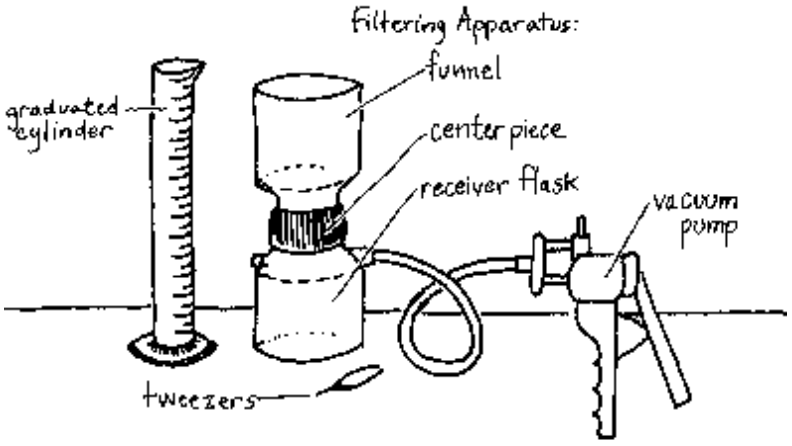
1. Fold a large filter paper down the middle and tear in half.



2. Fold each half in half.



3. With pencil label each half with the lake name, the date, and sample "A" or "B".



LABORATORY EQUIPMENT

3. Rinse and assemble apparatus.

a. Unscrew the funnel from the center piece. **Shake** bottle "A" vigorously and use a small amount to **rinse** the funnel and center piece **twice**. Using tweezers to avoid contamination, carefully center a small filter paper on the top of the center piece.

b. Check the placement of the red rubber ring (proper positioning ensures a tight seal). Screw the funnel back onto the center piece as tightly as possible *without ripping the filter paper or cracking the plastic*.

c. Attach the vacuum pump to one of the nozzles on the side of the receiving flask (shown in the diagram). A tan rubber cap must be attached to the other nozzle.

4. Filter 100 mls of sample water.

a. **Shake** bottle "A" vigorously again and use a small amount to **rinse** the graduated cylinder **twice**.

b. Using the graduated cylinder, measure 100 mls of sample "A" water and pour it into the funnel of the filtering apparatus.

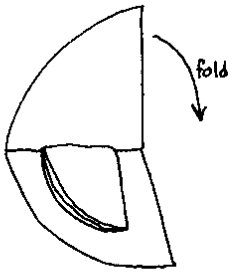
c. Squeeze the vacuum pump until all the water in the funnel has been drawn through the filter paper into the receiving flask. Squeeze the pump several extra times to remove as much water as possible from the filter paper.

d. Release the pressure by squeezing the small trigger on the pump or by disconnecting the pump. This helps prevent the filter form being torn when the funnel is removed. All of the algae (and other particles) in the 100 mls of sample water will now be trapped **on top** of the filter paper.

5. <u>Fold and remove the filter paper</u>.

a. Carefully unscrew the funnel from the center piece. Using the tweezers, gently lift one edge of the filter paper and fold it in half right on top of the center piece. Be sure to fold it so the **top side** of the filter is on the **inside**. Fold the filter paper again (into quarters).

b. Place the small, folded, chlorophyll filter inside the pre-prepared, properly labeled, filter paper jacket ("A" filter should be placed in the "A" jacket). Paper clip the filter jacket to hold the small filter paper tightly inside.



1. Place the folded chlorophyll filter inside the folded filter jacket.

2. Paper clip the filter jacket shut.

6. Repeat the filtering procedure with sample "B."

NOTE: It is not necessary to rinse the filtering apparatus a second time.

7. Rinse and store equipment.

Discard extra sample water. Rinse the graduated cylinder and funnel with tap water. Store all equipment in a box (or inside the sample bucket) where it will not get dirty between sampling days.

Sample storage

Filters should be frozen **immediately** after the filtering procedure in an airtight, dark jar or dark "ziploc" baggie. Freezing filters and removing them from light sources prevents degradation of the chlorophyll and yields more accurate test results. Black electrical tape works well for covering jars and baggies. If it is necessary to transport samples, please do so in a cooler containing ice.

Sample pick-up

A Lay Monitoring Program staff member will stop by every other week to pick up the frozen chlorophyll samples, Phosphorus test tubes, and data sheets from the previous two weeks.

FINISHING UP

1. Complete the data sheet.

a. In the "Comment" section include observations about the lake, recent notable weather and any problems you had with the sampling procedure.

b. Fill in the "Total Sampling Time *(including boat and lab time)*" in hours and minutes and sign where indicated. Please note that total time includes on-lake time, laboratory time, and time spent discussing the program with other people. We are interested in knowing how much time monitors are actually spending on the program.

2. Make a copy of the data sheet.

Turn in the original and keep the copy for yourself. This will allow you to keep track of the Secchi disk readings during the summer, and provide an extra copy should one get lost.

3. Store equipment.

None of the Lay Monitoring equipment should be used for anything but the Lay Monitoring sampling procedure.

Store the Secchi disk in a safe, **dry** place to prevent rusting.

Store the hose, bucket and sample bottles where they won't get dirty. Screw hose ends together after sampling is completed to prevent dirt from getting inside. Straighten hose kinks before storing or the kinks will become permanent. The bucket should also be kept clean and tightly covered. ***PLEASE*** do not store Secchi disks inside buckets, they leave rust stains!

4. Contact the program coordinator if:
   a) you need supplies,
   b) equipment needs repair or replacement, or
   c) you have any questions concerning the program.

CONDENSED SAMPLING PROCEDURES

BASIC

1. Load equipment: anchor, secchi disk, data log sheet, pencil.
2. Locate your first station.
3. Anchor firmly.
4. Fill out the first sections of the data log sheet.
5. Measure Secchi disk transparency on shaded side of boat.
6. Record reading to nearest 1/10 meter on data log sheet.
7. Proceed to station #2 and anchor firmly.
8. Measure Secchi disk transparency and record.
9. Return to shore.
10. Complete data log sheet.
11. Store Secchi disk in a safe, dry place.

SUPPLEMENTAL and LAKE CHAMPLAIN

1. Load equipment: anchor, secchi disk, hose, bucket, sample bottles, phosphorus test tube, data sheet, pencil.
2. Locate your first station.
3. Anchor firmly.
4. Fill out the first sections of the data sheet.
5. Measure Secchi disk transparency on shaded side of boat.
6. Record reading to nearest 1/10 meter on data sheet.
7. Take water samples:

SURFACE SAMPLING (shallow station monitors):

- Rinse sample bottles "A" & "B" twice with surface water.
- Fill bottles with lake water from arm's depth to the surface.

HOSE SAMPLING:

- Rinse sample bottles "A" & "B" twice with surface water.
- Rinse bucket and hose twice.
- Slowly lower hose to twice the Secchi disk transparency.
- Tightly crimp hose near water line.
- Bring up the weighted end first using attached rope.
- Hold weighted end **over** bucket (don't let it touch bottom).
- Release crimp over head and bring hose through hands.
- Swirl bucket.

- **Pour** water from bucket into bottle "A."
- Repeat procedure for bottle "B."

8. Inland lake monitors proceed to station #2, anchor firmly, measure Secchi disk transparency and record.
9. Return to shore and store sampling equipment.
10. Begin laboratory procedure.

LABORATORY PROCEDURES:

PHOSPHORUS SAMPLING:

- Shake bottle “B,” open and fill up to the line on the phosphorus test tube (save rest of sample “B” for later).
- Cap tightly and label with lake name and date.
- Store sample in a cool, dry place.

CHLOROPHYLL-A SAMPLING:

1. Cut in half the large filter jacket.
3. Label filter halves in **pencil** with: Lake name, date, A or B.
4. Shake bottle "A" and rinse filtering apparatus and graduated cylinder twice.
5. Using tweezers, place small filter paper on center piece.
6. Assemble filtering apparatus.
7. Pour 100 ml of sample water from graduated cylinder to filter.
8. Give extra squeezes on the pump to remove excess water.
9. Fold and remove filter paper and place inside jacket "A."
10. Paper clip small filter into jacket securely.
11. Repeat for sample "B."
12. Freeze chlorophyll filters in an airtight, dark jar.
13. Rinse laboratory equipment and store in a clean box.
14. Complete data sheet and make a copy.