INSTRUCTION MANUAL FOR

BASELINE WATER QUALITY SAMPLING

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STATE OF MAINE

DEPARTMENT OF ENVIRONMENTAL PROTECTION

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Table of Contents

Table of Contents (cont.)

LIST OF FIGURES

LIST OF TABLES

List of Appendices

Section 1.0 Introduction:

This manual is intended to provide volunteer monitors with detailed instructions on the sampling procedures used in the collection of baseline water quality data. It is organized so that each parameter or procedure has a separate section. Many of the procedures described were lifted from the instruction manuals that accompanied various kits and pieces of equipment*. Other procedures came from Potvin and Bacon (1993) or EPA (1991) publications. This document is not intended to replace the owners manuals supplied with equipment and it is important that you read all such instructions. If you are using a meter or test kit not discussed in this manual follow the manufacturer's directions for care, calibration, and obtaining data measurements. In addition, if you are using field kits which employ chemicals, read all the instructions that come with the kit, including the Material Safety Data Sheets (MSDS), and follow their safety guidelines. **Safety glasses should be worn when using these kits.**

Before making a commitment to lake sampling contact the DEP Lakes Program's staff to discuss your plans. Read the appropriate sections of this manual carefully before attempting to collect data. You should also read and review the appropriate sections of this manual annually. If you have questions contact the DEP.

You are providing a valuable service by gathering baseline data on your lake but please remember to put safety first. While sampling you will be moving around in your boat and this can be dangerous. Please wear your PFD at all times and observe watercraft safety rules. You should consider taking a safe boating or water safety course. Knowing the "rules of the water" makes a safe enjoyable experience.

*Equipment may be referenced in this document. This does not constitute an endorsement of any particular manufacturer. Such references are based on equipment known to be in use within the state.

Section 2.0 Water Transparency: (Secchi Disk)

The Secchi disk procedure discussed in this manual is the most commonly used method in the State of Maine and the method used by DEP and VLMP.

NOTE 1: As with all samples collected in the field, Secchi readings are taken at the deepest part of the lake, unless DEP has designated another location.

NOTE 2: The boat must be anchored. If it is drifting, even slightly, you will collect a false reading.

NOTE 3: The reading must be taken on the shady side of the vessel between 0900 and 1500 hours. Do not use sunglasses. Always use a view scope.

1. Place the end of the view scope containing the Plexiglas several inches into the water.

1a. Shake the view scope up and down several times. Keeping the scope under the surface of the water to remove air bubbles trapped under the glass.

1a1. If you are using the Aqua Scope II® place your face securely against the foam pad attached to the scope.

1a2. If you are using a DEP-made scope, cup your hands around your face or drape a towel over your head to prevent the sun from causing a reflection on the glass.

2. Lower the disk slowly into the water column. Using a view scope carefully watch the disk until it disappears.

NOTE: It is important to make sure the disk disappears completely, including any reflective glow from the disk. You will lose sight of the shape of the disk, and contrast between the black and white portions of the disk, before the reflective glow disappears.

3. Stop when the reflective glow from the disk disappears.

4. Slowly raise the disk until the reflective glow just re-appears, then stop.

5. Very slowly, lower the disk and stop at the point where the reflective glow just disappears.

6. Pinch the marked line at the water surface and record depth.

NOTE: DEP has provided nylon tapes to all Volunteer Monitoring Program (VLMP) monitors. These tapes are marked in hundredths of meters. Record depth to nearest hundredth of a meter.

Section 2.1 Quality Control For Secchi Disk Reading

Take duplicate reading on every tenth sample. Reading should be within ± 0.1 m. If not, continue taking readings until readings stabilize.

Quality control checks will also be conducted by DEP and VLMP staff or DEP-trained mentors every three years. Reading should be within ± 0.3m of the State standard (DEP). If not, readings will be repeated until they are within this range or stabilized. If stabilization occurs outside this range it will be noted in the quality control data base.

Section 3.0 Temperature & Dissolved Oxygen Profiles

Several manufacturers make dissolved oxygen (DO) meters and chemical field kits. This manual will explain sampling procedures for several popular Yellow Springs Instrument (YSI) meters, models 54A, 50B, 51B, 55 and 95. In addition, the procedures involved with LaMotte's models 5856 and 7414 dissolved oxygen test kits are also discussed.

As stated in the introduction, if you are using a meter or test kit not discussed in this manual follow the manufacturer's directions for care, calibration, and for obtaining data measurements. DEP uses the air calibration method to calibrate its meters.

Dissolved oxygen and temperature profile readings should be conducted at the deep hole of the lake or at a predetermined sampling site set up by DEP to provide specific data. In addition, DO and temperature readings should be collected at every meter. It is vital that the boat be anchored before starting to sample. Even the slightest breeze can blow the boat away from the deep hole. In addition, the dissolved oxygen/temperature probe could descend at an angle, thus affecting the depth of sample collection.

Section 3.1 Probe Preparation (YSI Models 54A, 50B, 51B)

In this section, routine checking and probe preparation before meter calibration for YSI models 54A, 50B, 51B are discussed. The following procedures have been obtained from YSI owner manuals. The probe should be checked, and prepared if necessary, every time the meter is calibrated. **New probes are sent from the manufacturer dry** New probes, and probes properly winterized, will need to have the protective membrane on the probe tip removed, the probe filled with potassium chloride (KCl) solution, and a new membrane installed before using the probe. See Appendix (1) for spring and new probe preparation and proper winterizing techniques.

1. Remove the probe from its calibration chamber.

2. Check the probe for wrinkles in, or air bubbles and coatings of slime or oil on, the membrane. If either are present the membrane must be replaced and KCl replenished. To achieve this, follow Steps 2a through 2l.

NOTE: It is a good idea to replace the membrane every few months regardless of its condition.

2a. Unscrew sensor guard and then carefully remove the "O" ring and membrane.

2b. Check the gold cathode: It must always be bright and untarnished. To clean, wipe with a clean lint-free cloth or hard paper. Never use any form of abrasive or chemical. Rinse the sensor several times with KCl, refill and install new membrane, steps 2c-2l.

NOTE: If the tarnish cannot be removed by vigorous wiping with a soft cloth or hard paper - return the probe to the factory for service. NOTE: DEP trained staff will check probes during the annual QA/QC visit each year and help clean probes before excess tarnish has build up.

2c. Check the silver anode. If contaminated it must be cleaned.

NOTE: To clean the anode, remove the o-ring and membrane and soak the probe overnight in 3% ammonium hydroxide. Rinse the tip and KCl reservoir with deionized water, add new KCl solution and install new membrane and o-ring (Steps 2d to 2l).

2d. Thoroughly flush the reservoir with KCl, then refill until a large meniscus completely covers the gold cathode.

NOTE: On Model 5739 probes, you should also pump the diaphragm (with pencil eraser or similar blunt tool) at this time to ensure no air bubble are present. If air bubbles are present continue pumping the diaphragm and refilling the KCl solution until no bubbles appear.

Continued:

Section 3.1 Probe Preparation (YSI Models 54A, 50B, 51B) (cont.)

2e. Carefully remove one membrane from its packet. Handle membrane by its edges Do Not Touch Any Part Of The Membrane That Will Be In Contact With The KCl

2f. Secure the membrane to the side of the probe with your left thumb, if right handed. Vice versa for left handed people.

2g. With the thumb and forefinger of your other hand grasp the free end of the membrane.

2h. Using a continuous motion stretch the membrane UP, OVER, and DOWN the other side of the sensor. Secure that end of the membrane under the fore finger of the hand holding the probe.

2i. Roll the "O" ring over the end of the probe. There should be no wrinkles or trapped air bubbles in the membrane . Some wrinkles may be removed by lightlypulling on the edges of the membrane beyond the "O" ring.

2j. If bubbles or wrinkles are present repeat steps 2c through 2h.

2k. Trim off excess membrane with scissors or sharp knife. Check to make sure that the stainless steel temperature sensor is not covered by excess membrane.

2l. Shake off excess KCl and reinstall the sensor guard.

3. Check to make sure no drops of water or KCl are clinging to the membrane. If drops are present, shake or blow gently to remove drops. DO NOT Tap The Probe

4. Check the sponge in the calibration chamber to ensure that it is damp.

NOTE: It is important that the sponge be damp, but not excessively wet. You should not be able to squeeze water out of the sponge.

5. Replace the probe to the calibration chamber; wait approximately 15 minutes for the temperature to stabilize.

6. The probe is now prepared.

Section 3.1.2 Probe Preparation (YSI Model 55)

The YSI Model 55 dissolved oxygen probe is a non-detachable, polargraphic sensor designed specially for the YSI handheld dissolved oxygen meter. The probe should be checked, and prepared if necessary, every time the meter is calibrated. **New probes are sent from the manufacture dry** New probes, and probes properly winterized, will need to have the protective membrane on the probe tip removed, the probe filled with potassium chloride (KCl) solution, and a new membrane installed before using the probe. See Appendix (1) for spring and new probe preparation and proper winterizing techniques.

1. Remove the probe from its calibration chamber.

2. Check the probe for wrinkles in, or air bubbles and coatings of slime or oil on, the membrane. If either are present the membrane must be replaced and KCl replenished. To achieve this, follow Steps 2a through 2k.

NOTE: It is a good idea to replace the membrane every few months regardless of its condition.

2a. Unscrew sensor guard and then carefully remove the "O" ring and membrane.

2b. Check the gold cathode: It must always be bright and untarnished.

NOTE: If it is tarnished it must be restored. To restore the gold cathode you may either return the instrument to the factory, or clean it using YSI Model 5680 probe reconditioning kit. Never use chemicals or abrasives not supplied with this kit.

2c. Check the silver anode. If contaminated it must be cleaned.

NOTE: To clean the anode, remove the o-ring and membrane and soak the probe overnight in 3% ammonium hydroxide. Rinse the tip and KCl reservoir with deionized water, add new KCl solution and install new membrane and o-ring (Steps 2d to 2l).

2d. Thoroughly flush the reservoir with KCl, then refill until a large meniscus completely covers the gold cathode.

2e. Carefully remove one membrane from its packet. Handle membrane by its edges Do Not Touch Any Part Of The Membrane That Will Be In Contact With The KCl

2f. Secure the membrane to the side of the probe with your left thumb, if right handed. Vice versa for left handed people..

2g. With the thumb and forefinger of your other hand grasp the free end of the membrane.

Continued:
Section 3.1.2 Probe Preparation (YSI Model 55) (cont.)

2h. Using a continuous motion stretch the membrane UP, OVER, and DOWN the other side of the sensor. Secure that end of the membrane under the fore finger of the hand holding the probe.

2i. Roll the "O" ring over the end of the probe. There should be no wrinkles or trapped air bubbles in the membrane . Some wrinkles may be removed by lightly pulling on the edges of the membrane beyond the "O" ring.

2j. If bubbles or wrinkles are present repeat steps 2c through 2h.

2k. Trim off excess membrane with scissors or sharp knife. Check to make sure that the stainless steel temperature sensor is not covered by excess membrane.

2l. Shake off excess KCl and reinstall the sensor guard.

3. Check to make sure no drops of water or KCl are clinging to the membrane. If drops are present, shake or blow gently to remove drops. DO NOT Tap The Probe

4. Check the sponge in the calibration chamber to ensure that it is damp.

NOTE: It is important that the sponge be damp, but not excessively wet. You should not be able to squeeze water out of the sponge.

5. Replace the probe to the calibration chamber; wait approximately 15 minutes for the temperature to stabilize.

6. The probe is now prepared.

Section 3.1.3 Probe Preparation (YSI Model 95)

The YSI Model 95 dissolved oxygen probes are shipped wet with a shipping membrane installed. This protective membrane cap on the probe tip must be removed and replaced with a new membrane cap filled with MEA probe solution before using the probe.

1. Remove the probe from its calibration chamber.

2. Check the probe for wrinkles, air bubbles or coatings of slime or oil on the membrane. If either are present the cap must be replaced (see Appendix 2).

NOTE: It is a good idea to replace the cap every two to four weeks regardless of its condition.

3. Check the gold cathode: It must always be bright and untarnished.

NOTE: If it is tarnished it must be restored. To restore the gold cathode you may either return the instrument to the factory, or service by buffing (a few light twists against the surface) with the wetcloth mounted on the buffing tool provided in the YSI model 9503 reconditioning kit.

WARNING: Under no circumstances should the gold cathode surface (the MEA surface) be sanded. Sanding will permanently damage the condition of the MEA surface.

4. Check the silver anode. There should not be any significant build-up of silver chloride at the surface of the anode for 3 to 4 years. Therefore, the anode should notrequire chemical cleaning.

NOTE: If the surface of the silver anode has become fouled, gently wet sand it using 400 grit wet/dry sandpaper, rinse thoroughly with deionized or distilled water and wipe with a wet paper towel.

WARNING: Under no circumstances should ammonium hydroxide be used to clean the silver anode. Ammonium hydroxide will permanently damage the condition of the MEA surface.

NOTE: If cleaning of the cathode or anode took place see Appendix (2) for steps of replacing a new membrane cap.

5. Check the sponge in the calibration chamber to ensure that it is damp.

NOTE: It is important that the sponge be damp, but not excessively wet. You should not be able to squeeze water out of the sponge.

continued:
Section 3.1.3 Probe Preparation (YSI Model 95) (cont.)

6. Replace the probe to the calibration chamber; wait approximately 15 minutes for the temperature to stabilize.

7. The probe is now prepared.

Section 3.2 Calibration of YSI Dissolved Oxygen Meters

The following calibration steps have been taken from YSI owners manuals. Calibration involves preparing the dissolved oxygen probe and meter, and calibration of the meter. Calibration must be done prior to taking readings at every sampling location. We strongly suggest checking the meter's response, e.g. red-line properly, before taking it out into the field, to make sure that the batteries are not low.

NOTE: It is important to leave the meter on between calibration and obtaining readings. If the meter is turned off, you must go through the calibration procedures again.

Section 3.2.1 YSI Models 54 ARC & 54 ABP (Meter Preparation)

NOTE: The DEP leaves the cable and probe attached to the meter at all times. This reduces wear on the pin connectors, and does not affect meter preparation or calibration.

1. Prepare the probe as described in Section 3.1.

2. With the meter off, adjust the meter pointer to zero (mg/L line) with the screw in the center of the meter panel. Readjustment may be necessary if the instrument position is changed, i.e. vertically, or horizontally. Meters should be turned on at least 30 minutes prior to use and calibration.

3. Switch to the **Red Line** mode and adjust the Red Line knob until the meter needle aligns with the read mark.

NOTE: Battery replacement or recharging on the YSI Model 54A is indicated if the "red line" adjustment cannot be made or oxygen calibration cannot be achieved. (Warning: A faulty probe will also not permit oxygen calibration.)

4. Switch to **Zero** mode and adjust to zero with Zero control knob.

5. Before calibrating allow 20 minutes for probe and meter stabilization.

NOTE: It is important that the meter and probe be kept at the same climatic conditions during the preparation and calibration steps. It is best to keep both out of direct sunlight.

Section 3.2.2 YSI Models 54ARC and 54ABP: (Air Calibration)

Calibration can be disturbed by physical shock, touching or fouling the membrane, or drying out the electrolyte. Calibration should be performed before any new series of data are collected.

The DEP utilizes the air calibration method. For highest accuracy, calibrate at a temperature as close as possible to the temperature of the sample to be measured.

1. Recheck red line and zero (see Section 3.2.1).

2. Switch to **Temperature** mode and read. Refer to Table (1) to determine calibrationvalue.

3. Determine the local altitude or true atmospheric pressure correction factor (Table 2). Altitude values can be obtained from Delorme or United States Geological Survey (USGS) maps or DEP. True atmospheric pressure can be read directly from a barometer. Do not use Weather Bureau reporting of atmospheric pressure because it is corrected to sea level.

4. Multiply the calibration value from Table (1) by the correction factor from Table (2). This is your corrected calibration value.

Examples: At a temperature of 21°C, the oxygen value at sea level or 760mm Hg atmospheric pressure is 8.92mg/L for saturated air, (Table 1). At an altitude of 1400 feet, the calibration correction value is 0.95 (Table 2). The correct calibration value is (8.92mg/L X 0.95 = 8.47 mg/L).

5. Switch to the appropriate **mg/L** range and adjust the calibration knob until the meter reads the corrected calibration value determined in step (4).

6. Wait two minutes to verify calibration stability.

NOTE: If stability is not achieved or if erratic readings are observed, ensure that temperature is not changing quickly and recalibrate. If stability is still not achieved replace the membrane.

NOTE: It is important to leave the meter on between calibration and obtaining readings. If the meter is turned off, you must go through the calibration procedures again.

Table 1

Solubility of Oxygen in Water Exposed to Water-Saturated Air at Atmospheric Pressure

Temperature ^{o}C	Calibration Value Oxygen Solubility mg/L	Temperature ^{o}C	Calibration Value Oxygen Solubility mg/L
0.0	14.62	26.0	8.11
1.0	14.22	27.0	7.97
2.0	13.83	28.0	7.83
3.0	13.46	29.0	7.69
4.0	13.11	30.0	7.56
5.0	12.77	31.0	7.43
6.0	12.45	32.0	7.31
7.0	12.14	33.0	7.18
8.0	11.84	34.0	7.07
9.0	11.56	35.0	6.95
10.0	11.29	36.0	6.84
11.0	11.03	37.0	6.73
12.0	10.78	38.0	6.62
13.0	10.54	39.0	6.52
14.0	10.31	40.0	6.41
15.0	10.08	41.0	6.31
16.0	9.87	42.0	6.21
17.0	9.67	43.0	6.12
18.0	9.47	44.0	6.02
19.0	9.28	45.0	5.93
20.0	9.09	46.0	5.84
21.0	8.92	47.0	5.74
22.0	8.74	48.0	5.65
23.0	8.58	49.0	5.57
24.0	8.42	50.0	5.48
25.0	8.26		

Source: Standard Methods 18th edition.

Table 2

Calibration Values for Various Atmospheric Pressures and Altitudes

Pressure		Altitude		Calibration
in. Hg	mm Hg	Feet	Meters	Correction Value
	775	540	165	1.02
30.23	768	-276	-84	1.01
29.92	760	0	0	1.00
29.61	752	278	85	0.99
29.33	745	558	170	0.98
29.02	737	841	256	0.97
28.74	730	1126	343	0.96
28.43	722	1413	431	0.95
28.11	714	1703	519	0.94
27.83	707	1995	608	0.93
27.52	699	2290	698	0.92
27.24	692	2587	789	0.91
26.93	684	2887	880	0.90
26.61	676	3190	972	0.89
26.34	669	3496	1066	0.88
26.02	661	3804	1160	0.87
25.75	654	4115	1254	0.86
25.43	646	4430	1350	0.85
25.12	638	4747	1447	0.84
24.84	631	5067	1544	0.83
24.53	623	5391	1643	0.82
24.25	616	5717	1743	0.81
23.94	608	6047	1843	0.80
23.62	600			0.79
23.35	593			0.78
23.03	585			0.77
22.76	578			0.76
22.44	570			0.75
22.13	562			0.74
21.85	555			0.73
21.54	547			0.72
21.26	540			0.71
20.94	532			0.70
20.63	524			0.69
20.35	517			0.68
20.04	509			0.67
19.76	502			0.66

Section 3.2.3 YSI Model 50B: (Meter Preparation) **NOTE:** The DEP leaves the cable and probe attached to the meter at all times. This reduces wear on the pin connectors, and does not affect meter preparation or calibration. 1. Prepare probe according to Section 3.1. ***IMPORTANT NOTE:** When installing a new probe or replacing a problem membrane (see Section 3.1), you must restore the default zero value

N1. Turn the meter off. Press and hold down the two left most display set keys at the same time, and turn the switch to the **C°** position while continuing to hold down both keys. N2. Several displays will appear briefly when the display shows E.00, release the keypads. N3. Recalibrate (steps 1-6). 2. Place the probe in a calibration chamber with a damp, but unsaturated sponge. You should not be able to squeeze water from the sponge. 3. Set the function switch to the **C°** position. An audible tone will sound. Simultaneously, the display shown in Figure (1) will appear. A second tone will sound in approximately seven seconds to signal the end of the Power On Self Testing (POST) diagnosis, and the display will go blank briefly.

4. If the POST diagnosis discovers a fault in instrument operation, the display shown in Figure (1) will no longer appear, or will "freeze." An error display could also be show, see Appendix (3) for explanation. Should this occur, you must return the instrument for repair. **NOTE:** When LOBAT appears on the display replace the batteries as soon as possible with six fresh Alkaline batteries. **NOTE 2:** Clean the battery terminals every 250 hours by rubbing them with a pencil eraser or similar material to remove the oxide layer.

Continued:

Section 3.2.3 YSI Model 50B: (Meter Preparation) (cont.)

5. Temperature will be displayed after the second tone. Observe the reading for stability. Temperature equilibration may take up to 5 minutes.6. Set the function switch to the **mg/L** position and allow 15 minutes for the system to
stabilize. If calibration is attempted prematurely, the calibration value will drift and
may be out of specification. **NOTE:** It is important that the meter and probe be kept at the same climatic conditions
during meter preparation and calibration. It is best to keep both out of direct sunlight.

Section 3.2.4 YSI Model 50B: (Air Calibration) The DEP utilizes the air calibration method. For highest accuracy, calibrate at a temperature as close as possible to the temperature of the sample to be measured. Calibration can be disturbed by physical shock, touching or fouling the membrane, or drying out the electrolyte. Calibration should be performed before any new series of data are collected. 1. Set the function switch to **°C**.

2. Read the temperature. From Table (1), find the mg/L value corresponding to the temperature indicated on the display. 3. Determine the local altitude or the true atmospheric pressure. Altitude values can be obtained from Delorme or United States Geological Survey (USGS) maps or DEP. True atmospheric pressure can be read directly from a barometer. Do not use Weather Bureau reporting of atmospheric pressure because it is corrected to sea level.4. Using Table (2), determine the calibration correction for your local pressure or altitude. 5. Multiply the value found in Step 2 by the correction value determined in Step 4 to obtain the correct calibration value. Example: At a temperature of 21°C, the oxygen value at sea level or 760mm Hg atmospheric pressure is 8.92mg/L for saturated air, (Table 1). At an altitude of 1400 feet, the calibration correction value is 0.95 (Table 2). The correct calibration value is (8.92mg/L X 0.95 = 8.47 mg/L). 6. Turn the function switch to **mg/L CAL**. Using the key beneath the digit positions in the display, set the calibration value determined in Step 5. **NOTE:** Each separate pressure on a key lowers the displayed digit by one. Continuous pressure will cause the display value to cycle. 7. Turn the function switch to **mg/L**. The display will show **CAL**. In a few seconds one or two audible tones will sound. Next, the calibration number you have set will appear. Observe the reading for stability for two or three minutes. Drift in the readingof more than two digits may mean that insufficient warm up time was allowed. **NOTE:** It is important to leave the meter on between calibration and obtaining readings. If the meter is turned off, you must go through the calibration procedures again.

Section 3.2.5 YSI Model 51B: (Meter Preparation) **NOTE:** The DEP leaves the cable and probe attached to the meter at all times. This reduces wear on the pin connectors, and does not affect meter preparation or calibration. 1. Prepare the probe according to directions in Section 3.1. 2. With the meter off, adjust the meter pointer to zero (mg/L line) with the screw in the center of the meter panel. Readjustment may be necessary if the instrument position is changed, i.e. vertically, or horizontally. 3. Switch to **Zero** and adjust to Zero on the mg/L scale with zero control knob.4. Switch to **FULL SCALE** and adjust the FULL SCALE knob until the meter needle aligns with the "15" on the mg/L scale. 5. Before calibrating allow 15 minutes for probe stabilization **NOTE:** It is important that the meter and probe be kept at the same climatic conditions during preparation and calibration. It is best to keep both out of direct sunlight.

Section 3.2.6 YSI Model 51B: (Air Calibration) Calibration can be disturbed by physical shock, touching the membrane, fouling the membrane, or drying out the electrolyte. Calibration should be performed before any new series of data is collected. DEP utilizes the Air calibration method. For highest accuracy, calibrate at a temperature as close as possible to the temperature of the sample. 1. Prepare the probe according to directions in Section 3.1.

2. Recheck zero: full scale reading (see Section 3.2.5; Steps 3 & 4). 3. Switch to **CALIB O_2** position.

4. With the **CALIB** knob set the meter pointer to the mark for the local altitude. Be sure reading is steady. 5. The meter is now calibrated. **NOTE:** It is important to leave the meter on between calibration and obtaining readings. If the meter is turned off, you must go through the calibration procedures again.

Section 3.2.7 YSI Model 55: (Meter Preparation)

1. Install six new AA-sized alkaline batteries in a new meter and replace the batteries every spring. Use a screw driver or a small coin to remove the thumb screw on the bottom of the instrument. There is a small label inside each of the two battery-chamber sleeves which indicate the correct way to install the batteries.

2. Turn the meter on by pressing and releasing the on/off button on the front of the meter. The liquid crystal display (LCD) should come on. If the instrument does not operate, consult your owners manual's troubleshooting section (Appendix 4).

3. Check to make sure that the sponge in the calibration chamber is moist. Remove the probe from the calibration chamber and turn the instrument on its side to allow any excess water to drain out of the chamber. If the sponge appears dry carefully put six to eight drops of distilled water onto the sponge.

NOTE: It is important that the meter and probe be kept at the same climatic conditions during preparation and calibration. It is best to keep both out of direct sunlight.

NOTE: All calibrations should be completed at a temperature which is as close as possible to the sample temperature.

Section 3.2.8 YSI Model 55: (Air Calibration)

Calibration can be disturbed by physical shock, touching the membrane, fouling the membrane, or drying out the electrolyte. Calibration should be performed before any new series of data is collected.

1. Prepare the probe according to directions in Section 3.1.2
2. Ensure that the sponge inside the calibration chamber is wet. Insert the probe into the calibration chamber.

3. Turn the instrument on by pressing the **on/off** button on the front of the meter. Wait for the dissolved oxygen and temperature readings to stabilize (usually a fewminutes is required. We recommend letting the meter warm up for a minimum of 15 minutes.

4. Use two fingers to press and release the two ▲ ▼ keys at the same time.

5. The LCD will prompt you to enter the local altitude in hundreds of feet (i.e. 12 represents 1200 feet). Use the arrow keys to increase or decrease the altitude. When the proper altitude appears on the LCD, press the **ENTER** key once to view the calibration value in the lower right of the LCD: and a second time to move to the salinity compensation procedure.

NOTE: Altitude values can be obtained from Delorme or United States Geological Survey (USGS) maps or DEP.

6. The LCD will prompt you to enter the approximate salinity of the water you are testing. You may enter any number from 0 to 40 parts per thousand (ppt). Use the arrow keys to increase or decrease the salinity compensation. When the correct salinity appears or the LCD, press the **ENTER** key.

NOTE: The salinity of fresh water is 0ppt.

7. The meter is now calibrated.

Section 3.2.9 YSI Model 95: (Meter Preparation)

1. Install six new AA-sized alkaline batteries in a new meter and replace the batteries every spring. Use a screw driver or a small coin to remove the thumb screw on the bottom of the instrument. There is a small label inside each of the two battery-chamber sleeves which indicate the correct way to install the batteries.

2. Turn the meter on by pressing and releasing the on/off button on the front of the meter. The liquid crystal display (LCD) should come on. If the instrument does not operate, consult your owners manual's troubleshooting section (Appendix 5).

3. Check to make sure that the sponge in the calibration chamber is moist. Remove the probe from the calibration chamber and turn the instrument on its side to allow any excess water to drain out of the chamber. If the sponge appears dry carefully put ten drops of clean water onto the sponge.

NOTE: It is important that the meter and probe be kept at the same climatic conditions during preparation and calibration. It is best to keep both out of direct sunlight.

Section 3.2.10 YSI Model 95: (Air Calibration)

Calibration can be disturbed by physical shock, touching the membrane, fouling the membrane, or drying out the electrolyte. Calibration should be performed before any new series of data is collected.
When turned on the meter will activate all segments of the display for a few seconds. This will be followed by a self test procedure which will last for several more seconds. During this self test sequence, the meter's microprocessor is verifying that the systems is working properly. If the meter were to detect a problem a continuous error message would be displayed (Appendix 5).

1. Prepare the probe according to directions in Section 3.1.3
2. Ensure that the sponge inside the calibration chamber is moist. Insert the probe intothe calibration chamber.

3. Turn the instrument on by pressing the **on/off** button on the front of the meter. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required).

4. Use two fingers to press and release the two ▲ ▼ keys at the same time. (Down arrow slightly ahead).

5. The LCD will prompt you to enter the local altitude in hundreds of feet (i.e. 12 represents 1200 feet). Use the arrow keys to increase or decrease the altitude. When the proper altitude appears on the LCD, press the **ENTER** key once.

NOTE: Altitude values can be obtained from Delorme or United States Geological Survey (USGS) maps or DEP.

6. The LCD will prompt you to enter the approximate salinity of the water you are testing. You may enter any number from 0 to 80 parts per thousand (ppt). Use the arrow keys to increase or decrease the salinity compensation. When the correct salinity appears or the LCD, press the **ENTER** key.

NOTE: The salinity of fresh water is 0ppt.

7. The meter will now display **CAL** in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current dissolved oxygen reading (before calibration) should be on the main display. Make sure that the dissolved oxygen reading (large display) is stable, then press the **ENTER** button. The display should read SAVE then should return to the normal operation mode.

Section 3.3 Collecting Temperature and Dissolved Oxygen Data As stated earlier, temperature and DO readings should be performed every meter at the DEP-appointed sampling station. Sampling should be performed monthly, at a minimum, with bi-weekly sampling preferred.

Section 3.3.1 YSI Model 54A: (Data Collection) 1. Start at the surface, "zero meter". Place the probe approximately 9-15 cm (4-6 inches) below the surface of the lake and gently jig the probe up and down at a rate of approximately 3-4 centimeters (cm) or approximately 1 inch per second. 2. Switch to **temperature** and allow the needle to stabilize. Record the temperature from the temperature scale onto field sheet DEP-142 (see Section 12.2). **NOTE:** This scale is designated in whole degrees. You should estimate the temperature to tenths. 3. Switch to the **appropriate oxygen scale** and allow needle to stabilize before recording the value onto the field sheet. **NOTE:** It is important to remember which scale range you are reading. For example with the 0-10 mg/L range each delineation equals 0.1 mg/L, while with the 0-20 mg/L each delineation equals 0.2 mg/L. 4. After both temperature and DO readings have been recorded, lower the probe to the next lower meter and repeat steps 1-4. **NOTE:** When you are nearing the bottom of the lake (last 3-4 meters) proceed with care, because the probes are very sensitive and fragile. You do not want to bounce the probe off, or drive it into the lake bottom. Watch for DO readings suddenly going to 0

when close to bottom, this may happen if the probe is in the sediments. Lift the probe up 1 - 2 meters and watch for the DO to rise and stabilize. Slowly lower probe until you feel a release of weight on the cable indicating probe is in the sediment.

Section 3.3.2 YSI Model 50B: (Data Collection) 1. Start at the surface, "zero meter". Place the probe approximately 9-15 cm (4-6 inches) below the surface of the lake and gently jig the probe up and down at a rate of approximately 3-4 cm (1 inch) per second. 2. Turn function switch to **C°** position. Wait until temperature readings stabilize. Record temperature reading onto field sheet DEP-142 (see Section 12.2).

3. Set function switch to the **mg/L** mode. Wait until readings stabilize. Record the displayed value onto the field sheet. **NOTE:** The right-most DISPLAY SET Key is a toggle switch for showing or suppressing the last digit of the reading in both mg/L and percent modes. When the last digit is suppressed, the measurement will still be as accurate as it is when the last digit is displayed. **DEP only records mg/L values to the nearest tenth** **NOTE :** Another option available with the Model 50B is auto read. Auto read will notify you when stability is reached. Auto read function: After the CAL key is pressed, a tone will sound when the reading is stable. This does not affect the instrument's measurement in any way. Auto read is off in the default mode and works only for DO measurement.4. When both temperature and DO readings have been recorded, lower the probe to the next lower meter and repeat Step 1-4.

NOTE: When you are nearing the bottom of the lake (last 3-4 meters) proceed with care, because the probes are very sensitive and fragile. You do not want to bounce the probe off, or drive it into the lake bottom. Watch for DO readings suddenly going to 0 when close to bottom, this may happen if the probe is in the sediments. Lift the probe up 1 - 2 meters and watch for the DO to rise and stabilize. Slowly lower probe until you feel a release of weight on the cable indicating probe is in the sediment.

Section 3.3.3 YSI Model 51B: (Data Collection) 1. Start at the surface, "zero meter". Place the probe approximately 9-15 cm (4-6 inches) below the surface of the lake and gently jig the probe up and down at a rate of approximately 3-4 centimeters (cm) or approximately 1 inch per second.

2. Switch to **temperature** and allow the reading to stabilize. Record temperature from the temperature scale onto field sheet DEP-142 (see Section 12.2). **NOTE:** This scale is designated in whole degrees. You should estimate the temperature to tenths. 3. Set the **O_2 SOLUBILITY** factor dial to the observed temperature, taking care to

use the appropriate salinity index. **NOTE:** For Maine lakes use the freshwater mark on the O_2 solubility factor dial. 4. Turn the switch to **READ O_2** and allow needle to stabilize. Record the dissolved oxygen value in mg/L directly from the meter onto the field sheet. 5. When both temperature and DO readings have been recorded, lower the probe to the next lower meter and repeat steps 1-4. **NOTE:** When you are nearing the bottom of the lake (last 3-4 meters) proceed with care, because the probes are very sensitive and fragile. You do not want to bounce the probe off, or drive it into the lake bottom. Watch for DO readings suddenly going to 0

when close to bottom, this may happen if the probe is in the sediments. Lift the probe

up 1 - 2 meters and watch for the DO to rise and stabilize. Slowly lower probe until you feel a release of weight on the cable indicating probe is in the sediment.

Section 3.3.4 YSI Model 55: (Data Collection)

Once the calibration process is complete, the only keys which will remain operational are the **Mode** key, the **Light** key, and the **On/Off** key. You can move back and forth from reading dissolved oxygen in the mg/L or % saturation modes by pressing the **Mode** key.

1. Start at the surface, "zero meter". Place the probe approximately 9-15 cm (4-6 inches) below the surface of the lake and gently jig the probe up and down at a rate of approximately 3-4 centimeters (cm) or approximately 1 inch per second. 2. Wait for the temperature reading to stabilize. Record temperature onto field sheet DEP-142 (see Section 12.2).

NOTE: Temperature readings are displayed continuously.

3. Press the Mode button until the meter is in the mg/L mode. Wait for the dissolved oxygen reading stabilize. Record dissolved oxygen reading onto the field sheet.

4. After both temperature and dissolved oxygen readings have been recorded, lower the probe to the next lower meter and repeat Steps 1 to 4.

NOTE: When you are nearing the bottom of the lake (last 3-4 meters) proceed with care, because the probes are very sensitive and fragile. You do not want to bounce the probe off, or drive it into the lake bottom. Watch for DO readings suddenly going to 0
when close to bottom, this may happen if the probe is in the sediments. Lift the probe up 1 - 2 meters and watch for the DO to rise and stabilize. Slowly lower probe until you feel a release of weight on the cable indicating probe is in the sediment.

Section 3.3.5 YSI Model 95: (Data Collection)

The YSI Model 95 has four modes: dissolved oxygen in **mg/L** or **%** saturation, **Recall**, and **Erase all**. This manual will discuss only the first two modes.

1. Start at the surface, "zero meter". Place the probe approximately 9-15 cm (4-6 inches) below the surface of the lake and gently jig the probe up and down at a rate of approximately 3-4 centimeters (cm) or approximately 1 inch per second. 2. Wait for the temperature reading to stabilize. Record temperature onto field sheet DEP-142 (see Section 12.2).

NOTE: Temperature readings are displayed continuously.

3. Press the Mode button until the meter is in the mg/L mode. Wait for the dissolved oxygen reading stabilize. Record dissolved oxygen reading onto the field sheet.

NOTE: Pressing the up arrow button allows quick switching between the two DO parameters (**mg/L** and **%** saturation modes) without going through all four modes.

4. After both temperature and dissolved oxygen readings have been recorded, lower the probe to the next lower meter and repeat Steps 1 to 4.

NOTE: When you are nearing the bottom of the lake (last 3-4 meters) proceed with care, because the probes are very sensitive and fragile. You do not want to bounce the probe off, or drive it into the lake bottom. Watch for DO readings suddenly going to 0
when close to bottom, this may happen if the probe is in the sediments. Lift the probe up 1 - 2 meters and watch for the DO to rise and stabilize. Slowly lower probe until you feel a release of weight on the cable indicating probe is in the sediment.

Section 3.4 Quality Control for Dissolved Oxygen (Meters) DO accuracy is taken into consideration during the calibration process. However, for every tenth profile taken, three duplicate readings should be made randomly throughout that profile. We recommend you include near surface and 2 meters off the bottom to test the largest available range of DO and temperature variation. Initial readings are recorded from the surface to the bottom in one meter intervals. Duplicate readings are taken as the probe is raised to the surface. Allow enough time for the temperature to equilibrate as the probe is retrieved. Duplicate oxygen readings should not vary more than plus or minus one percent (±1%). If dissolved oxygen readings at the same depth vary more than 0.5ppm, repair of the membrane or meter is advised. Since temperature is critical to accurate DO readings, at least once a year the temperature of the DO meter should be compared to a thermometer with known calibration. Check the DO results against a Winkler titration at the start of sampling season. **NOTE:** DEP meters are checked against Winkler titration and calibrated thermometer. Calibrating your meter to DEP's will preclude the need for you to directly perform Winkler calibration or check against calibrated thermometer.

Section 4.0 Dissolved Oxygen Test Kits (LaMotte)Warning: Several reagents used in LaMotte's dissolved oxygen test kit are considered hazardous substances. These reagents, Manganous Sulfate, Alkaline Potassium Iodine Azide, and Sulfuric Acid all come with a Material Safety Data Sheet (MSDS). Please review the MSDS and the directions found in each kit carefully before using the kit. Safety glasses must be used.

NOTE: New chemicals must be purchased each year.

NOTE: Do not dispose of the fixed sample or reagents into the lake. The fixed samples and tritrant should be scattered over the ground away from any wells. Use up all reagents before disposal, even if this means testing tap water. **DO NOT dispose of any samples or reagents down your sink; explosive gases could form**

Sampling should occur at a minimum once per month, with bi-weekly sampling being preferred, especially during the first few years of a study. Readings should be recorded every meter (m) on shallow lakes, (less then 10 m). On deeper lakes a lake specific strategy can be developed by DEP. See Appendix (6) for examples.

Section 4.1 Sample Collection and Temperature Determination **NOTE:** The sampling apparatus must be rinsed three times at the start of the sampling procedure. This is accomplished by collecting three separate sub-surface samples and allowing approximately 100 ml to pass through the port valve. **NOTE:** Sampling bottles should be rinsed with sample water before collection is made. 1. To collect a surface DO sample, tightly cap the bottle and submerge to the desired depth, 4-6 centimeters. Remove cap and allow the bottle to fill. 2. Tap the sides of the submerged bottle to dislodge any air bubbles clinging to the inside. Replace cap while bottle is still submerged. 3. Once the bottle is back in the watercraft, examine the bottle carefully to make sure no air bubbles are trapped inside. Once satisfied, proceed immediately to (Section 4.2, Step 11, for kit model 7414), (Section 4.3, Step 11A for kit model 5856). 4. For lower depth samples, follow the procedure described in Section (10.0) to obtain the sample, then proceed to Step 5 (below). 5. After retrieving the water sampling apparatus, immediately record temperature from thermometer, seen through the wall of the sampler. If the sampler does not have a mounted thermometer, tilt the sampler so one end may be opened without releasing water and place a thermometer in the sampler. Let acclimate for 20 to 60 seconds, retrieve, and quickly record temperature onto field sheet DEP-142 (Section 12.2). 6. Carefully release the collected water sample through the release valve into the water sample bottle. 7. Rinse the water sample bottle with sample water. 8. Stick the discharge tube to the bottom of the sample bottle and slowly fill the bottle. **NOTE:** Take great care not to incorporate air bubbles into the sample. 9. Continue to fill the bottle and let it overflow while slowly removing the discharge tube from the bottle.

NOTE: While filling, tap the side of the sample bottle to release any air bubbles trapped on the side.

10. Carefully examine bottle for air bubbles.

Once satisfied proceed immediately to (Section 4.2, Step 11 for Model 7414), Section 4.3, Step 11A for model 5856).

Section 4.2 Dissolved Oxygen Fixation: (LaMotte Model 7414) NOTE: Be careful not to introduce air into the sample while adding the reagents in Step 11 and 12. Simply drop the reagents into the sample. Cap carefully, and mix gently. ***Safety glasses must be worn for Steps 11 - 14** 11. Add 8 drops of Manganous Sulfate solution. 12. Add 8 drops of Alkaline Potassium Iodide Azide. Cap and mix by inverting several times. A precipitate will form. Allow precipitate to settle below the shoulder of the bottle before proceeding. 13. Use the supplied scoop to add 1 gram of Sulfamic Acid powder. 14. Cap and gently mix until reagent and precipitate dissolve. A clear-yellow to brown-orange color will develop, depending on the oxygen content of the sample. **The sample is now fixed. NOTE:** It is extremely important to continue to mix the sample until all the reagent and all precipitate are dissolved.

NOTE: After completing Step 14, contact between the water sample and the atmosphere will not affect the test result. Once the sample has been "fixed" in this manner, it is not necessary to perform the actual titration test for up to 8 hours. Thus, several samples can be collected and "fixed" in the field, then carried back to a testing station or laboratory where the test procedure can be continued.

Section 4.3 <u>Dissolved Oxygen Fixation</u>: (<u>LaMotte Model 5856</u>) **NOTE:** Be careful not to introduce air into the sample while adding the reagents in Step 11A and 12A. Simply drop the reagents into the sample. Cap carefully, and mix gently. **<u>*Safety glasses must be worn for Steps 11A - 14A</u>** 11A. Add 8 drops of Manganous Sulfate Solution, and 8 drops of Alkaline Potassium Iodide Azide. Cap and mix by inverting several times. A precipitate will form. Allow precipitate to settle below the shoulder of the bottle before proceeding. 12A. Add 8 drops of Sulfuric Acid. 13A. Cap and gently shake until the reagent and the precipitate have dissolved. A clear-yellow to brown-orange color will develop, depending on the oxygen content of the sample. **<u>The sample is now fixed</u>**. **NOTE:** It is extremely important to continue to mix the sample until all the reagent and all precipitate are dissolved. **NOTE:** After completing Step 13A, contact between the water sample and the atmosphere will not affect the test result. Once the sample has been "fixed" in this manner, it is not necessary to perform the actual titration test for up to 8 hours. Thus, several samples can be collected and "fixed" in the field, then carried back to a testing station or laboratory where the test procedure can be continued.

Section 4.4 Titration Procedure for Dissolved Oxygen Determination (LaMotte) 1. Using a graduated cylinder, add 20 ml of the fixed sample to the titration tube and cap the tube. 2. Insert the titrator into the plastic fitting of the sodium thiosulfate bottle. Fill the direct reading titrator with sodium thiosulfate, 0.025 N. **NOTE:** To fill the titrator invert the bottle and slowly withdraw the plunger until its tip is opposite the zero mark on the scale. 3. Depress plunger of the titrator to expel air and refill with sodium thiosulfate. **NOTE:** If a small air bubble appears in the titrator barrel, expel the bubble by partially filling the barrel and pumping the sodium thiosulfate back into the inverted Sodium Thiosulfate bottle. Repeat this pumping action until the bubble disappears. 2D. Turn the bottle right side up and remove the titrator. **NOTE:** For a more precise measurement, a special plastic DRT Tip should be used. First fill the titrator past the zero mark. Attach the special plastic tip to the titrator. Slowly press the plunger until the plastic tip is full and the plunger tip is opposite the zero mark on the titrator. 3. Insert the titrator into the center hole of the titration tube cap. While gently swirling the tube, slowly press the plunger to titrate, drop by drop, until the yellow-brown color is reduced to a very faint yellow. **NOTE:** If the color of the "fixed" sample is already very faint yellow, skip to Step 4. 4. Remove the titrator and cap. Be careful not to disturb the titrator plunger, as the titration begun in Step 3 will be continued in Step 5. Use the eye dropper to add 8 drops of Starch Indicator solution. The sample should turn blue. 5. Replace the cap and titrator. Continue titrating until the blue color just disappears. Read the test results, the volume of sodium thiosulfate used, where the plunger tip meets the scale. Record as ppm or mg/L dissolved oxygen onto field sheet DEP-142 (see Section 12.2). **NOTE:** Each minor division on the titrator scale equals 0.2 ppm.

6. If the plunger tip reaches the bottom line of the titrator scale (10 ppm) before the end point color change occurs, refill the titrator and continue the titration. When recording the test results, be sure to include the value of the original amount of reagent dispensed (10 ppm) to the value obtained from the second titration.

Section 4.5 Quality Control For Dissolved Oxygen Test Kits (LaMotte) Take duplicate samples twice during each profile. We recommend you include near surface and two meters off the bottom to test the largest available range of DO and temperature variation. Results should not vary more then plus or minus five percent (±5%). If results exceed this limit, titrate a third sample. If the third sample exceeds the limit, check technique or chemicals used for titration.

Section 5.0 Total Phosphorus: Total phosphorus (TP) can be obtained from either core or grab samples. TP sample must be placed only in Laboratory provided containers. Read Sections 9.0 and 10.0 for proper sample collection techniques. There is a slight difference in obtaining a TP sample between a grab or a core sample. TP containers are provided by the laboratory doing the analysis. **NOTE: No matter what method is used to collect the sample, extreme care must be taken in handling the container and its cap, and sampler so contamination does not occur. NOTE:** Make sure that whatever laboratory you use, it is capable of doing low level TP analysis, less than or equal to 2 ppb detention limit, with a sample to sample variability averaging less than 1 ppb. The lab should also be conducting internal quality control checks to insure the quality of their analyses. **NOTE:** The following procedures are for the State of Maine Health and Environmental Testing Lab. Consult with the lab you are using to obtain the proper sample containers and procedures.

Section 5.1 Total Phosphorus Collection from a Grab Sample **NOTE:** Refer to Section 10.0 for the proper procedures to obtain a grab sample **NOTE:** If temperature or DO readings are required it is extremely important to record that data first. In addition, pH samples should be collected before TP. **NOTE:** The following procedures are for the State of Maine Health and Environmental Testing Lab. Consult the lab you are using to obtain the proper sample containers and procedures. 1. Label all containers before collecting the samples (Section 11.1).

2. Once the sampling apparatus is secured in the boat, carefully remove caps from the transfer vial and sample container. **Be careful not to touch the lip or inside of the caps, vial or container.** 3. The Kemmerer has a lip on its release valve that can be operated without having to touch it directly with your hand. To obtain a sample put the lip of the transfer vial against the valve lip and push. Rinse both the transfer vial and container with sample water before collecting the sample for analysis. 3A. Modified Van Dorn samplers use a tube and clamp system to allow sample collection. Place the end of the tube, without using your fingers, into the transfer vial and release the clamp. Rinse both the transfer vial and container with sample water before collecting the sample for analysis. 4. Fill the transfer vial until it is full. It is important to have the sample level with the top of the vial. 5. Carefully transfer the sample from the transfer vial to the Erlenmeyer flask. 6. Replace the cap and store the flask in a cool (4°C) place where it will not break or tip over. 7. Repeat Steps 2 - 6 at each depth sampled or for duplicate samples. 8. Samples must be taken to the lab within a week. The sample will then be acidified. **NOTE:** Refrigerate until delivered to the lab. Samples should be analyzed within 28 days of collection date.

Section 5.1.1 Quality Control For Total Phosphorus Grab Samples For every tenth TP sample taken, a triplicate sample should be taken and labeled as such. If less than ten TP samples are collected in one year, i.e., monthly, then a triplicate sample should be taken once during the field season. A triplicate TP sample is taken three separate times from the same depth. If results are radically different, i.e., one result is more than 10% greater than the other, the results should be questioned. Check the sampling, handling and laboratory methods for sources of contamination. Repeat triplicate process next time samples are taken. If results are still in question, do not record TP results on field sheet or into the database and contact the DEP.

The lab should also be conducting internal quality control checks to insure the quality of their analyses.

Section 5.2 Total Phosphorus From a Core Sample: **NOTE:** Refer to Section 9.0 for the proper procedure to obtain a core sample. **NOTE:** If pH is to be recorded, remove this sample first, before swirling. 1. Label all containers before collecting the samples (Section 11.1). 2. Place the lid on mixing jug after the required number of core samples have been obtained and swirl well. Be careful not to touch the inside of the jug or cap. 3. Remove the lids from both mixing jug, transfer vial, and sample container. Be careful not to touch the lip or inside of the vessels or lids. Rinse both the transfer vial and container with sample water before collecting the sample for analysis. 4. Fill the transfer until it is full. It is important to have the sample level with the top of the vial. 5. Carefully transfer the sample from the transfer vial to the Erlenmeyer flask. 6. Replace the cap and store the flask in a cool (4°C) place where it will not break or tip over. 7. Repeat Steps 2 - 6 at each depth sampled or for duplicate samples. 8. Samples must be taken to the lab within a week. The sample will then be acidified. **NOTE:** Refrigerate until delivered to the lab. Samples should be analyzed within 28 days of collection date. **Section 5.2.1 Quality Control for Total Phosphorus Core Samples:** A triplicate sample should be taken and labeled as such from every tenth core. A triplicate TP sample is taken from the same water composite sample as the first. If less than ten TP samples are collected in one year, i.e. monthly, then a triplicate sample should be taken once during the field season. If results are radically different (i.e. one result more than 10% greater than the other), the results should be questioned. Check the sampling, handling and laboratory methods sources of contamination. Repeat triplicate process next time samples are taken. If results are still in question, do not record TP results on field sheet or into the database and contact the DEP.

The lab should also be conducting internal quality control checks to insure the quality of their analyses. **Section 6.0 Chlorophyll a:** Chlorophyll a (Chl a) samples are usually obtained by using a core sampler (see Section 9.0). There are three separate procedures in Chl a analysis: collection, filtration and analysis. This manual will discuss the first two, as the third procedure is conducted in a lab. Sample containers for Chl a can be either glass or plastic. Containers should be large enough to hold 1 liter of sample (approximately 1 quart). DO NOT COMPLETELY FILL THE CONTAINER because it is important to shake the sample prior to filtering. Initially, containers should be soap and water washed and rinsed well to remove all soap residue. After use, the containers need only be rinsed three times with tap water to remove sample, then allowed to air dry before re-use. Opaque containers are preferred, however if using glass or clear plastic containers, cover the outside of the container with aluminum foil or keep in a dark place such as a cooler to reduce light penetration during sample handling.

Section 6.1 Chlorophyll a Sample Collection: 1. Follow the procedures described in Section (9.0) to obtain a core sample. 2. Follow the procedure described in Section (11.1) to label the sample container before collecting the sample. 3. After the required number of core samples have been collected in the mixing jug, cap. **NOTE:** If the pH is to be recorded, remove that sample from the mixing jug before mixing. 4. Shake well to resuspend any algae that might have settled. 5. Rinse the sample container with a small amount of sample before making your collection. **NOTE:** It is important to leave a little space in the container to allow for shaking before filtering. 6. Immediately after the sample collection has been obtained, cap the sample container, and place in a cool dark place until filtering. A cooler is perfect for storage.

NOTE: Filtration should be performed within 24 hours of sample collection. If this is not possible the sample can be stored at 4°C in the dark for up to 14 days. Do not freeze the water sample.

Section 6.2 Chlorophyll a Filtration: As stated in Section 6.1, filtration of Chl a samples must be completed within 24 hours of collection. If this can not be accomplished the sample must be stored at 4°C, in the dark, for up to 14 days. Do not freeze the water sample. Filtration can be done by using electric or hand held vacuum pumps. Procedures are essentially the same. This manual will discuss the hand held vacuum method. **NOTE:** Filtration should be done in low light if possible. 1. Using tweezers place a Gelman or equivalent, 47 mm type HA, 0.45 u pore size filter on the funnel pedestal. **NOTE:** Be careful not to touch the filter with your fingers. **NOTE 2:** Filters are white, discard the paper used to separate filter in package. 2. Securely fasten the upper portion of the filter apparatus to the base. Make sure the filter paper is not wrinkled or torn, and covers the entire filtration base. 3. Remove the sample container from the cooler and shake vigorously for two minutes

to ensure a well mixed sample. 4. Rinse the graduated cylinder with sample. 5. Carefully measure a known volume of sample and place it in the filtering apparatus. It is strongly advised to filter 250 ml of sample at first. Replace sample in cooler. **NOTE:** It is important to filter at least 250 ml if possible. Be careful not to attempt to filter too much. As the volume of filtered water increases, so does the sediment and algae trapped on the filter paper, making filtering more difficult. 6. Add 1 ml of magnesium carbonate ($MgCO_3$) solution to the sample while the sample is still in the funnel.

NOTE: Shake the magnesium carbonate ($MgCO_3$) solution prior to adding to the sample (Nolan 1997).

NOTE: Add 1 ml of $MgCO_3$ per 200 ml of sample (Nolan 1997).

7. Secure the cap, if provided, on the apparatus.

Continued:

Section 6.2 Chlorophyll a Filtration: (cont.)

8. Depress and release the handle of the hand pump to create suction.

9. Watch for ease and speed of filtration. **NOTE:** If this amount of sample filters well, does not clog filter paper or take too long to complete, then add more sample and repeat the procedure (Step 3 -8 &11).

Keep track of the total volume of sample filtered. **NOTE:** You will be filtering two samples from each sample container. It is important that the volumes of these two samples be equal. It is recommended that you filter slightly less than half of the sample on your first filtration even if the filtering is

extremely easy. **NOTE:** Be careful not to allow filtrate to enter into the pump. A water trap, which is

an empty container such as a Erlenmeyer flask, should be placed in the vacuum line between the pump and filtering apparatus. In addition, after each filtering event the filtrate reservoir should be emptied and water discarded. 10. After filtration is completed, wash sides of the holding reservoir with distilled

water. Allow this water to be filtered as it could contain algae that adhered to the inner

sides of the apparatus. 11. Break the vacuum by removing one of the plastic stoppers on the cap of the holding reservoir or by depressing the release value located on the hand pump. Carefully remove the top portion of the apparatus. 12. Using tweezers fold the filter paper in quarters and place in pre-labeled glassine envelopes (see Section 11.2). **DO NOT TOUCH THE FILTER PAPER WITH YOUR FINGERS**.

13. Place the glassine envelop containing the filter in a light-excluding container containing desiccant.

NOTE: Store filters in the dark, frozen for up to three weeks prior to extraction and analysis if non-acidic. Otherwise, analyze right away (Nolan 1997). 14. Repeat steps 1-13 for the second Chl a sample. **Section 6.3 Quality Control for Chlorophyll a:** Duplicate filters run by the lab are currently the only quality control measures. It is up to you and the laboratory to determine how often duplicate filters are run.

Section 7.0 Chemical and Physical Parameters: Glass or plastic containers may be used for collecting the chemical and physical parameters used by the VLMP. The sample containers should be filled to the brim with sample. In this manual it is assumed that you received your collection bottle from the DEP or certified lab. If not, refer to Potvin and Bacon (1993) for the correct bottle cleaning procedures. The following section describes the proper procedures for the collection and handling of various chemical parameters. To open plastic cube containers

remove the cap and place it where it will not become contaminated. Next, reach under the container (cube is folded into itself, concave) and pinch the first layer of plastic between your fingers. Slowly pull out to open the container. Never blow into a plastic cube container to open it

Section 7.1 Alkalinity: The DEP uses two procedures to determine alkalinity, both of which produce similar results. This manual will discuss both procedures **Section 7.1.1 Lab Titration Method:** 1. Rinse two 250 ml Erlenmeyer flasks and one 100 ml graduated cylinder twice with tap water, followed by two rinses with a small amount of sample.

2. Using the graduated cylinder, place 100 ml of sample into each of the Erlenmeyer flasks.

3. Add 2 drops of bromcresol green indicator into each of the Erlenmeyer flasks, then swirl to distribute the indicator uniformly.

NOTE: Be sure that the indicator in the eyedropper is reasonably fresh, i.e., less than two months old. If the indicator is suspect, discard and refill with stock solution. It will be extremely difficult to detect the color change if the solution has faded.

4. Fill the titration burette to the zero line with 0.02 normal acid, either H_2SO_4 or HCL, and note the exact location of the meniscus as the burette often drains to below 0.0 ml level.

NOTE: Read volumes from the bottom of the meniscus.

5. Titrations should be done with flasks positioned on a white background, in good light.

6. Titrate the first sample slowly, by allowing only a drop at a time into the flask while gently swirling, until the color change is apparent. Note the volume of titrant used to the nearest 0.05 ml.

7. Refill the burette and titrate the second sample. Record the volume of titrant used to the nearest 0.05 ml.

NOTE: Often, the first titration is used to get a "ball park volume," while the second used to get the exact volume by adding titrant drop by drop when nearing previously obtained end point.

continued:

Section 7.1.1 Lab Titration Method: (cont.)

8. Multiply the volume of the second titration by ten and record the result, in mg/L, on the field form (Section 12.2).

NOTE: It is highly recommended that the two results be within +/- 0.1 ml of each other even if three to four titrations are required.

NOTE: If the alkalinity result is less than 5 mg/L, the alkalinity should be done by the Gran Plot method. See Standard Methods for procedure. We recommend submitting the sample to a laboratory for analysis.

Section 7.1.2 Alkalinity Test Kit: (Hach Model AL-AP MG)

In most Maine lakes the low range test procedures should be followed. Contact DEP before testing to get assistance on determining which test to use.

WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use proper safety equipment.

Safety goggles must be worn.

Section 7.1.2.1 Low Range Test: (Hach Model AL-APMG)

NOTE: We recommend that the Sulfuric Acid Standard Solution be diluted 1:4 with distilled water. Each drop will then equal 1 mg/L instead of 5 mg/L. However, the DEP does not recommend that volunteers dilute the acid. Extreme caution must be used. Protective clothing and eye wear are also required. **Bring your test kit to the DEP and we will dilute it for you.**

1. Rinse mixing bottle twice with small amount of sample.

2. Fill the mixing bottle to the 23 ml mark with the sample.

3. Add one Phenolphthalein Indicator Powder Pillow and swirl to mix. An effective way to swirl the sample is to place your index finger under the mixing bottle, and use your other hand to rotate the bottle in a clockwise, counter-clockwise fashion.

4. If the water remains colorless, the phenolphthalein alkalinity is zero, skip to Step 7.

4a. If the water becomes pink, proceed to Step 5.

5. Add Sulfuric Acid Standard Solution drop-wise while swirling to mix after each drop. Continue adding and counting drops until the water becomes colorless.

6. The phenolphthalein alkalinity, in mg/L as calcium carbonate ($CaCO_3$), is found by multiplying the number of drops of Sulfuric acid Standard Solution used in Step 5 by five, if undiluted, or one if diluted (see Note above).

7. Add the contents of one Bromcresol Green-Methyl Red Indicator Powder Pillow to the mixing bottle and swirl to mix. The color will change to blue-green.

8. Continue the drop-count procedure, adding Sulfuric Acid Standard Solution while counting the drops and swirling to mix until the color changes to pink.

9. The total (methyl-orange) alkalinity in mg/L as $CaCO_3$ is found by multiplying the total number of drops of Sulfuric Acid Standard Solution used in both Step 5 and Step 8 by five if undiluted, or one if diluted (see Note above). Record the results on field form DEP-142 (Section 12.2).

10. Repeat steps 1-9 for each sample to be analyzed.

11. When all samples have been analyzed, rinse the mixing bottle twice with tap water and allow to air dry.

Section 7.1.2.2 <u>High Range Test</u>: (<u>Hach Model AL-APMG</u>)

1. Rinse plastic measuring tube and mixing bottle twice with a small amount of sample.

2. Fill the plastic measuring tube with the sample until it is full. Pour the contents of the tube into the mixing bottle.

3. Add one Phenolphthalein Indicator Powder Pillow and swirl to mix. An effective way to swirl the sample is to place your index finger under the mixing bottle, and use your other hand to rotate the bottle in a clockwise, counter-clockwise fashion.

4. If the water remains colorless after the addition of the phenolphthalein, the phenolphthalein alkalinity is zero. Skip to Step 7.

4a. If the water becomes pink, proceed to Step 5.

5. Add Sulfuric Acid Standard Solution drop-wise while swirling to mix after each drop. Continue adding and counting the drops until the water becomes colorless.

6. The phenolphthalein alkalinity, in mg/L as calcium carbonate ($CaCO_3$), is equal to the number of drops of sulfuric acid used times twenty if undiluted, four if diluted (See Note, Section 7.1.2.1).

7. Add the contents of one Bromcresol Green-Methyl Red Indicator powder Pillow to the mixing bottle and swirl to mix. The color will change to blue-green.

8. Continue the drop-count procedure, adding Sulfuric Acid Standard Solution while counting the drops and swirling to mix until the color changes to pink.

9. The total (methyl orange) alkalinity, in mg/L as $CaCO_3$, is equal to the total number of drops of Sulfuric Acid Standard Solution used in both Steps 6 and 8 times twenty if undiluted, or four if diluted (See Note, Section 7.1.2.1). Record results on field form DEP-142 (see Section 12.2).

10. Repeat steps 1-9 for each sample to be analyzed.

11. When all tests have been analyzed rinse all bottles and tubes with tap water and air dry.

Section 7.1.3 Quality Control For Alkalinity: (Hach Model AL-APMG)

Duplicate samples should be run every fifth test using the Hach Kit. Samples should be within ± 1 ml of each other if using diluted Sulfuric Acid Standard Solution (± 5 ml if undiluted solution is used). Repeat titration until values fall within this range. Quality Control steps for lab procedures are listed in Section 7.1.1, Step 8.

Section 7.2 Apparent Color:

There are currently four methods for determining apparent color commonly being used in Maine. These included Nessler Tubes, portable color kits, Hach color wheel, and LaMotte color kits. The first two methods are used at DEP and the correct procedures for their use can be found in Potvin and Bacon (1993). This manual will detail the Hach and LaMotte kit because these two are most often used by volunteers.

Section 7.2.1 Apparent Color Test Kit (Hach Model CO-1)

This test kit allows the user to use a low or high color range. You should use the low range first, unless you know your lake is highly colored.

Section 7.2.1.1 Low Range: (Hach Model CO-1)

1. Rinse both sample tubes with distilled water.

2. Place the lengthwise viewing adapter in the comparator as shown in Figure (2).

3. Fill one sample tube to the line underling "Cat. 1730-00" with the sample. This will be approximately 15 ml. If not using 1730-00 tubes, fill to the line found at approximately 7.6 mm (3 inches) up from the bottom of the tube.

4. Place the tube containing the water sample in the top right opening of the comparator.

5. Fill the other sample tube with distilled water to the line underlining "Cat. 1730-00", or same level as described in Step 3.

6. Place this tube in the left top opening of the comparator.

7. Hold the comparator with the tube tops pointing to a window or light source at an approximate angle of 45-50° (Figure 3). View through the opening in the front of the comparator. When viewing, be careful not to spill samples from the tubes.

8. Rotate the disc until a color match is obtained. The reading obtained through the scale window is the apparent color in AF Platinum Cobalt Units. Record the results on field form DEP-142 (see Section 12.2).

9. Empty the lake sample, rinse tube with distilled water and repeat procedure for each new sample.

NOTE: If color is greater than that of the low range; follow the high range procedure.

Section 7.2.1.2 High Range: (Hach Model CO-1)

1. If the lengthwise view adapter is in place remove it. (See Section 7.2.1.1, Step 2.)

2. Rinse both tubes with distilled water.

3. Fill one of the tubes to 5 ml mark with the water sample.

4. Insert the tube in the right top opening of the comparator.

5. Fill the other tube to the 5 ml mark with distilled water and insert this tube into the left opening of the comparator.

6. Hold the comparator up to a light source such as a window, the sky or a lamp and view through the openings of the comparator (Figure 3). Rotate the disc until a color match is obtained. The reading obtained through the scale window is multiplied by five to obtain the apparent color in AF Platinum Cobalt Units. Record the results on field form DEP-142 (Section 12.2).

Section 7.2.1.3 Quality Control for Hach Apparent Color Kits (Low & High Range)

Duplicate samples should be run every fifth sample. After obtaining the first reading, rotate the color wheel before the second reading. Do not look at the numbers on the color wheel until you feel a match is made. Readings should be within ± 5 units (low range), ± 25 (high range). Repeat analysis until sample reading falls within range.

Section 7.2.2 Apparent Color Test Kit (LaMotte Model CT-PC)

This kit is similar to the Hach kit in that it has a low and high range available. There will not be a separate section for each range because the procedures change only in the amount of sample and distilled water used and the multiplication factor, see "NOTE(s)" in procedures.

WARNING: The Standard Color Reagent of this kit is considered a hazardous substance. Please read the Material Safety Data sheets (MSDS) supplied with the kit before performing the tests and use proper safety equipment.

Safety goggles must be worn

1. Rinse both color columns with distilled water.

2. Fill one color column to the 50 ml mark with sample.

NOTE: It is recommended that the first test be run using the low range (50 ml mark).

NOTE: If sample contains a high level of color, pour off water to the 25 ml mark. Run the test on 25 ml sample (high range).

3. Fill the second color column to the 50 ml mark with distilled water.

NOTE: If using a 25 ml sample, fill color column to 25 ml mark with distilled water.

4. Place the two columns side by side. Note the difference in color.

5. Use the pipette to add 0.5 ml of Standard Color Reagent to the tube containing the distilled water. Use the supplied stirring rod to mix contents. Continue adding Standard Color Reagent in 0.5 ml increments, mixing after each addition, until the colors in both columns match. Count number of increments of Standard Color Reagent added.

6. If using 50 ml mark (low range), multiply the volume of standard color reagent used by ten, and record on field sheet (see Section 12.2).

7. If using 25 ml mark (high range), multiply the volume of standard color reagent used by twenty, and record on field sheet (see Section 12.2).

8. Rinse columns with distilled water and repeat steps 2-7 for each sample. Rinse sample columns when tests are completed.

Section 7.2.3 Quality Control For LaMotte Apparent Color Test Kit

Duplicate samples should be read every fifth sample. Readings should be within ±5 units of each other (±10 units is using LaMotte High Range Procedure). Repeat analysis until sample reading fall within range.

Section 8.0 Determining Epilimnetic Depth:

A temperature and dissolved oxygen profile (readings every meter) will have to be obtained before the depth of the epilimnion and associated core sampling depth can be determined. A thermocline, a change of one degree Celsius per one meter depth change, is used to determine the lower boundary of the epilimnion.

The DEP uses an additional qualifier in determining a true (permanent) epilimnion. At times, an ephemeral epilimnion can develop, usually during the summer or in late spring as a result of a few calm warm days. This weather condition causes the top most water layers to warm dramatically. This condition could produce a temporary thermocline that will be destroyed when the wind blows. It is important not to consider this condition a true thermocline.

A good rule of thumb to use in the summer is to include all depths with temperatures warmer than 18°C as part of the true epilimnion. Appendix (7) shows examples of various DO and temperature profiles with associated epilimnetic depths.

Section 9.0 Obtaining a Core Sample:

Core samples are composite samples of epilimnetic water, obtained by using a weighted piece of tygon tubing, 1.27 cm (0.5 inch) inner diameter, marked in 1 meter intervals. Core samples are an average of the lake water from the surface to the depth the core is taken. Epilimnetic core samples are typically taken to collect water for chlorophyll a, total phosphorus, pH, specific conductance, color and alkalinity.

NOTE: Store core and collection jug in clean container, away from possible contaminants in bottom of boat, etc. A five gallon bucket works well. The core, collection jug, and container they are stored in, should be used for sample collection only , to avoid contamination.

1. Determine depth to which the core samples will be taken (see Section 8.0). Maximum length of the core is 10 meters (m). If the epilimnetic depth is greater than 10 m, take a 10 m core.

2. Rinse the mixing jug three times with surface water; be sure that all interior surfaces including the cap have been in contact with surface water during each rinse. **Be extremely careful not to touch any interior surface.**

3. Rinse the core tube three times by lowering the core into the water at least 1 m greater than the depth of the core to be taken. If a 10 m core is required rinse the entire core, being careful not to drop the core. Lift the core so all the water drains back into the lake.

NOTE: When rinsing or collecting water, allow the core to remain outside the boat to keep it clean and reduce the risk of contamination. It is good practice to rinse the core on the opposite side of the boat from which the samples are collected.

4. To obtain a core sample, lower the core slowly to the desired depth. The water level inside the core should be level with the lake surface during the lowering procedure, otherwise, the sample will be made up of a disproportionate amount of water from lower levels.

NOTE: The core sample should be 1 meter below the depth of the true epilimnion (Section 8.0), with the exemptions listed in the Notes below.

NOTE: NEVER TAKE A CORE FROM WATER HAVING 2 ppm OF OXYGEN OR LESS.

NOTE: If the lake is shallow, or epilimnion extends to the bottom of the lake, the core should be taken to a depth of 1.0 m from the bottom.

Continued:

Section 9.0 Obtaining a Core Sample: (cont.)

5. Bend the core over at the water surface and pinch it tightly to ensure that the sample stays within the core. Another option is to place a stopper in the end of the tube to form a seal. If the core is not tightly sealed, a portion of the sample will be lost and the sample will need to be retaken.

6. Rapidly retrieve the core with a hand over hand motion. Keep the core out of the boat; only the weighted end should enter the boat.

7. Place weighted end of core sampler into mixing jug. Release the pinched end of the tube so water can drain into mixing jug. (Avoid contamination of the sample. Do not allow water to run off hands or down the exterior of the tube.)

NOTE: It is important to secure the mixing jug so it will not tip over during the filling procedure. This can be done by putting the jug between your feet or in a bucket.

8. Obtain a minimum of three combined samples. A general rule of thumb: if various water chemistry tests will be run from one sample, collect enough core sample to equal 20 linear meters. For example, if core depth is 5m collect 4 samples (5 x 4 = 20); if 7 m, collect 3 (7 x 3 = 21); if 8 m, collect 3 (8 x 3 = 24). Place the lid on the mixing jug to avoid contamination and follow the procedures for securing various water chemistry results, see Sections 5.0 - 7.2.3.

NOTE: It is extremely important to place the mixing jug in a cool, 4°C, dark place until the various individual water chemistry samples can be taken.

Section 10.0 Obtaining a Grab Sample:

There are two common types of grab samplers used in the state of Maine, the Kemmerer and the Modified Van Dorn. The Kemmerer is oriented vertically in the water while the modified Van Dorn is oriented horizontally. Grab samplers are used to obtain a discrete sample from deep water. The procedures to collect a water sample are very similar between the two samplers; both require the release of a weighted messenger and tripping of the apparatus.

1. Open and set the tripping mechanism. With the Kemmerer this is done by pulling both stoppers, one on each end of the Kemmerer, away from each other at the same time. You will feel and hear a click when the sampler is set.

1A. To set the tripping mechanism of the modified Van Dorn simply pull the two stoppers from each end of the main sampling tube and place the looped end of each cable over one of the pins on the tripping mechanism, 1 loop per pin. There are other types of tripping mechanisms, however, all are similar in design.

NOTE: Rinse all samplers three times before collecting samples. This is done by obtaining a sub-surface water sample and expelling at least 100 ml through the apparatus pour spout.

2. Lower the sampler to the desired depth. Markings on the support rope or chain should be in meters, (a single mark at every meter, double marks every five meters). Maintenance of clean marks is essential to accurate data.

3. Release the messenger and wait for the apparatus to trip.

NOTE: You should be able to feel the apparatus trip.

4. Retrieve the sampling apparatus carefully, avoid touching the drain valve or the end of the sampler that contains the drain valve.

5. Rinse the sample container with a little of the sample before collecting the final sample.

6. Follow handling procedure for the types of samples collected, to obtain a collection sample (Sections 5.0 to 7.2.3).

Section 11.0 Labeling Samples and Containers:

DEP has developed a label system which provides the following information: Person collecting the sample, sampling station, lake, depth of sample, and type of sample. This code can use up to ten letters or numbers, but usually only seven are used. See Appendix (8) for examples.

NOTE: It is important to record the sample date on all labels, as this assists in differing between same-lake samples.

Section 11.1 Total Phosphorus and Chlorophyll a Containers:

1. Record date that the sample was collected.

2. Record your two or three letter and number identifier code. This is provided by DEP.

3. Record sampling station number, use two numbers. If number is less than 10 use zero and number, i.e., 01, 02, 03, etc.

4. Record the two letter code for the lake being sampled. This is provided by DEP.

5. Record two digit depth (in meters) of sample collection point. If depth is less than 10 meters, use zero followed by depth, i.e., 01, 02, 03, etc.

6. Record Type of sample: G = grab; C = core.

Section 11.2 Chlorophyll a Glassine Envelopes:

The following information must be placed on all glassine envelopes before. If you are using another lab follow their labeling procedure. Please use ink.

1. Record Chl a coding number; this will be the same number found on the top left corner of the Chl a lab analysis sheet (Section 12.3).

2. Record lake name and Midas number (available from DEP).

3. Record date of sample collection, not filtration.

4. Record volume of sample filtered.

5. Record either 1 of 2, or 2 of 2. Chla requires duplicate filters in separate envelopes.

Section 12.0 Forms:

In any monitoring program there are forms to be filled out. This is not just more paperwork. Attention to detail at this step can save lost samples, wasted time and wasted money! The DEP utilizes four forms, DEP-142B, DEP-142, Chl a lab analysis sheets, and Department of Human Services Health and Environmental Testing Laboratory (HETL) request form. If you use another lab follow their protocol for sign in and chain of custody.

Section 12.1 Field Form DEP-142B:

The DEP 142B (Figure 4) is the standard form issued to all VLMP monitors. This form is used when only transparency data are collected. A separate form is needed for each lake or lake station. Each line of the form is equivalent to one sampling event. The following procedure should be used when filling out the form.

NOTE: The top portion of the form needs to be filled in only once. Fill in the lake name, town in which the lake is located, MIDAS, station number, and your name as surveyor.

NOTE: The most important information in the top portion of the field sheet are the MIDAS and station numbers. These numbers are obtained from DEP.

1. Fill in the date the transparency reading is taken in the format month, day, year.

NOTE: Fill in all boxes, e.g., June 7, 1995 = 06 07 95

2. Fill in the time the transparency reading is taken, in military time.

NOTE: Military time is based on a 24 hour clock starting at midnight. Every hour is equivalent to 100 hours, i.e., 3:00 a.m. = 0300, 11:00 a.m. = 1100 hours. After 12:00 noon the time is determined by adding the p.m. hour to 1200 hours, i.e., 3:00 p.m. = 1500 hours, 7:00 p.m. = 1900 hours.

3. Fill in the wind velocity at the time of transparency readings. Wind velocity ranges are located near the bottom of the form, or from Table (3).

NOTE: The ranges provided are for guidance only. It is important to record a single wind velocity not a range.

4. Fill in the wind direction at the time of transparency reading. A direction code is provided next to the wind velocity on the lower portion of the form. Wind direction is the direction from which the wind is blowing.

5. Check one box that most closely relates to the cloud cover at the time of transparency reading.
Bright -- indicates bright sunshine with distinct shadows.
Cloudy Bright -- indicates hazy type days with no distinct shadows, but you have to squint without sunglasses.
Overcast -- indicates days with no sunshine. You can see without squinting or sunglasses.

Continued:

Section 12.1 Field Form DEP-142B: (cont.)

6. Record Secchi disk depth (see Section 2.0) to the nearest hundredth of a meter. A decimal point has been provided on the form for you.

NOTE: Fill in all boxes; for example, a 5.6 meter transparency would be recorded as 05.60.

7. Place a **B** in the next open column **only if** the Secchi disk rested on the bottom of the lake before it disappeared from your view.

8. If transparency is below 2.0 meters and your lake's water color is less than 25 standard platinum units (SPU), record a Y in the last open box. If the transparency is above 2.0 m place a N in the box. If the water color is greater than 25 SPU, or if you don't know, leave this column blank.

9. Place any comments or explanation in the comment section on the bottom of the page.

10. Tear off the top sheet and mail to your Regional Coordinator if you belong to the VLMP, following the VLMP schedule (first half of the data by July 15, second half data by November 10). Keep the second sheet for your records.

NOTE: Be sure to fill in all boxes; if box has two spaces and a single digit is used, place a zero in front.

Table 3

Wind Speed Chart

Velocity (mph)	Weather Bureau Term	Water Surface	Land Area
0-7	Light	Smooth or rippled, to small wavelets (not breaking).	Wind felt on face, leaves rustle.
8-11	Gentle	Large wavelets, crests begin to break, only scattered whitecaps.	Leaves and small twigs in constant motion, flag waving.
12-16	Moderate	Small waves, frequent whitecaps.	Raises dust and loose paper, small branches are moved.
17-24	Fresh	Moderate crested waves, many whitecaps.	Small trees begin to sway.
25-35	Strong	Large waves, white foam crests everywhere, wind blown spray	Large branches or whole trees in motion.

Section 12.2 Field Form DEP-142:

The DEP-142 forms are used by DEP staff and monitors who collect dissolved oxygen and temperature profiles, and baseline data (Figure 5 and 5A). A new sheet is needed for each profile. The following procedure should be followed when filing out field forms DEP-142.

1. Fill in the lake information on top of the sheet. Lake name, station number, town and county where the lake is found.

2. Fill in the MIDAS and station numbers. These numbers are obtained from DEP.

3. Fill in your name(s) as surveyor(s). If two people are sampling together, the person who is collecting the transparency data is listed first.

4. Fill in agency and project codes. All volunteers monitors are: Agency = EI and Project = 03. See Appendix (8) for examples.

5. Fill in the date of the sampling event in the form of month day year.

NOTE: Fill in all boxes, i.e., June 7, 1995 = 06 07 95.

6. Fill in the time the transparency reading is taken, in military time.

NOTE: Military time is based on a 24 hour clock starting at midnight. Every hour is equivalent to 100 hours, i.e., 3:00 am = 0300 hours, 1:00 a.m. = 1100 hours. After 12:00 noon the time is determined by adding the p.m. hour to 1200 hours, i.e., 3:00 p.m. = 1500 hours, 7:00 p.m. = 1900 hours.

7. Fill in the wind velocity. Wind velocity ranges can be found in Table (3).

NOTE: The ranges provided are for guidance only. It is important to record a single wind velocity, not a range.

8. Fill in the wind direction at the time of transparency reading. A direction code is provided in the top left corner of the form. Wind direction is the direction from which the wind is blowing.

continued:

Table 3

Wind Speed Chart

Velocity (mph)	Weather Bureau Term	Water Surface	Land Area
0-7	Light	Smooth or rippled, to small wavelets (not breaking).	Wind felt on face, leaves rustle.
8-11	Gentle	Large wavelets, crests begin to break, only scattered whitecaps.	Leaves and small twigs in constant motion, flag waving.
12-16	Moderate	Small waves, frequent whitecaps.	Raises dust and loose paper, small branches are moved.
17-24	Fresh	Moderate crested waves, many whitecaps.	Small trees begin to sway.
25-35	Strong	Large waves, white foam crests everywhere, wind blown spray	Large branches or whole trees in motion.

Section 12.2 Field Form DEP-142: (cont.)

9. Check one box that most closely relates to the cloud cover at the time of transparency reading.
Bright -- indicates bright sunshine with distinct shadows.
Cloudy Bright -- indicates hazy type days with no distinct shadows, but you have to squint without sunglasses.
Overcast -- indicates days with no sunshine. You can see without squinting or sunglasses.

10. Record Secchi disk depth (see Section 2.0) to the nearest hundredth of a meter. A decimal point has been provided on the form for you.

NOTE: All measurements should be in meters.

NOTE: Fill in all boxes; for example, a 5.6 meter transparency would be recorded as 05.60m.

11. Place a **B** in the appropriate box **only if** the Secchi disk rested on the bottom of the lake before it disappeared from your view.

12. Leave all boxes in the "For DEP use only" blank.

13. Check appropriate box after DO calibration has been completed.

14. Circle the appropriate depth and temperature units.

15. Circle the method used to obtain the DO reading. If the method used is not listed write it in.

16. Record temperature and DO concentration in the appropriate boxes. (Section 3.3 - 3.3.5 for proper procedures.)

NOTE: Depths from 0 to 15 meters are preprinted on the sheet. At greater depths, write in the depth along with temperature and DO readings.

NOTE: The last five rows of the profile portion of form DEP-142 have been set aside for temperature and DO Quality Control measurements. Record depth and readings of QC samples in these boxes.

17. Record bottom depth on appropriate line labeled "Bottom", in lower portion of the front page.

Continued:

Section 12.2 Field Form DEP-142: (cont.)

18. If chemical/physical parameters are collected, a two sided version of the DEP-142 must be used. Record core depth, chlorophyll*a* and TP container number on the appropriate line and fill out the reverse side of the form.

19. Record lake name and date on top of page 2.

20. Record depth, unit of measure, and type of sample collected, and all pertinent information, including results. Use one line for each sample.

NOTE: Codes are listed on top of page 2 for your assistance. See Figure (5A).

21. Add total phosphorus and Chl a results to the sheet when you receive the lab results. Do not send the field sheet in until you have received all the results from the lab.

NOTE: Be sure to fill in all boxes; if box has two spaces and a single digit is used, place a zero in front.

Section 12.3 DEP Chlorophyll a Lab Analysis Sheets:

A Chlorophyll a lab analysis sheet (Figure 6) must be filled out for each set of samples filtered. A four digit number should appear in the top left hand corner of the sheet. If it is not there, contact the DEP's VLMP coordinator. This number is the same number that should be recorded on the glassine envelope.

1. Record lake name, station number, town and county where the lake is located on top of form.

2. Fill in the MIDAS and station numbers. These numbers are obtained from DEP.

3. Fill in the date of the sampling event in the form of month day year.

NOTE: Fill in all the boxes, i.e., June 7, 1995, equals 06 07 95

4. Record depth of sample, unit of measure and type of sample. Type code is located to the right of the box.

5. Record the volume of sample filtered.

6. Record the four digit number found on the top left corner of the sheet in the box labeled "sample number" located in the bottom left corner of the sheet.

NOTE: This four digit code is the number recorded on the HETL Laboratory Request Form (Section 12.4).

7. Record any comments on the bottom of the sheet.

8. This sheet is handed in with the Chl a sample, along with the HETL Laboratory Request Form.

Section 12.4 Department of Human Services Health & Environmental Testing Lab (HETL) Request Form:

A Laboratory Request Form (Figure 7) must accompany any sample handed in to HETL. If you use another lab be sure to fill out their request form properly because it will save time and effort later. The following protocol should be followed when filing out the HETL's Laboratory Request Form.

1. Fill in the APPR/Activity line. This is for billing. The name appearing here will receive the bill.

2. Fill in the project name. This is the name of the lake sampled.

3. Record the town and county in which the lake is located; record the name(s) of the sampler(s); record who should receive the results.

4. In the "station code" box write "LK", followed by its MIDAS number, followed by a dash and station number. MIDAS and station numbers are obtained from DEP.

5. Record the date the sample was collected.

6. Fill out the information pertaining to the sample. Information for each sample is written on a separate line.

   a. Location - the lake name.
   b. Time - the time sample was collected (military form).
   c. Client number - the code you assign to the sample container. (See Section 11.1).

NOTE: The client number for a Chl a sample number is the four digit number on the top left hand corner of the Chl a coding form. You should also record this number on the field sheet (DEP-142). You should record the code you assigned to the sample container (see Section 11.1) in the location column.

7. Leave the HETL number column blank. The lab uses this column to assign their own internal tracking number.

8. Mark the type of sample(g=grab, c=core), and if it is a duplicate.

9. Fill out the matrix column, for our purposes it is water.

Continued:

Section 12.4 Department of Human Services Health & Environmental Testing Lab (DHSHETL) Request Form (cont.)

10. Check the appropriate test to be run.

NOTE: TP is listed under the second to last column, Chl*a* must be written in under the "other" column (last column).

NOTE: You will have to sign and date the "chain of custody" box when you hand the sample and form in to the lab.

NOTE: During the summer, HETL lab is busy. Do not expects results in a hurry, it will be several weeks for TP results, and up to several months for Chl*a* results to be reported from the lab. If results are very late, more than two months, contact HETL directly (not DEP) and use your request sheet copy to help them track the sample(s).

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Appendix 1

Spring or New Probe Preparation and Winterizing Techniques. For YSI Models 54A, 50B, 51B, and 55 Dissolved Oxygen Meters

New or Spring Probe Preparation

1. Follow Section 3.1 for proper procedure to prepare the probe.

2. Load new batteries into the meter. Follow manufacture's instructions as to what type batteries are needed. Before using rechargeable batteries contact manufacture as to applicability.

Winterizing Techniques

1. Remove batteries from meter.

2. Remove safety guard from probe.

3. Remove "o" ring and membrane.

4. Empty KCl from probe and flush with distilled water.

Note: On model 5739 probes you should also pump the diaphragm with a pencil eraser, or similar blunt tool, to ensure all the KCl and distilled water is removed.

5. After the probe has dried, place a new membrane on the probe. Follow the procedure discussed in Section 3.1 for proper placement of the membrane.

Appendix 2

Spring or New Membrane Cap Replacement and Winterizing Techniques for YSI Model 95 Dissolved Oxygen Meter

Follow the step listed below to install a new, or replace a membrane cap on the YSI Model 95 dissolved oxygen probe (Figure A1).

1. Unscrew and remove the probe guard.

2. Unscrew and remove the old membrane cap.

3. Thoroughly rinse the sensor tip with distilled water.

4. Hold the new membrane cap and add 8 to 9 drops of MEA probe solution (about half full).

Warning: Use only YSI MEA probe solution in the membrane cap. Any other solution will damage the MEA sensor.

5. Tap the bottom of the cap with your finger a few times to remove any trapped air bubbles. **Don't touch the membrane surface.**

6. Screw the membrane cap onto the probe tightly by hand (to prevent leakage of electrolyte). A small amount of probe solution should overflow.

7. Shake off any excess probe solution and rinse the stainless steel thoroughly with distilled water to prevent corrosion.

Winterizing the Model 95

For long term storage (4 weeks or longer), remove the membrane cap, thoroughly rinse the MEA sensor with deionized or distilled water and install a new membrane cap filled with MEA probe solution. Store the sensor in a humid environment such as the calibration chamber with the moist sponge. **Do not store the probe dry.**

Appendix 3

Error Display Messages for YSI Model 50B Dissolved Oxygen Meter

The instrument will perform a Power On Self Test (POST) each time it is turned on. In addition, the following error displays are provided to facilitate troubleshooting. The **E0** through **E1** error modes are operational throughout the operation of the model 50B; **E2** through **E4** are active only during calibration.

Error Indication	Cause	Correction
E.0 System Error	Defective ROM	Return for Service
E.00 Lost Calibration value	Defective RAM backup battery	Return for Service
E.01 Defective RAM	Defective RAM	Return for Service
E.1 Open circuit in Temperature Probe	Connector improperly installed. Intermittent connection in cable or plug. Faulty temperature sensor.	Check connection Repair or Replace Repair or Replace
E.2 High Background	Insufficient warm-up time. Improper probe zeroing procedure. Probe needs servicing.	See start up procedure (Section 2.3.1) See highest accuracy measurements. See probe instructions.
E.3 Low sensitivity	Insufficient electrolyte. Contaminated electrodes or fouled membrane. Membrane too thick. High resistance in probe connection.	See probe instructions. See probe instructions. Try another membrane. Return for evaluation.
E.4 Output too high	Membrane too thin. Short circuit. Electrodes need resurfacing. Internal leakage in probe or in cable connector.	Try another membrane. Repair or Replace. Repair or Replace. Repair or Replace.
F.XX Incorrect Mode (X any be any digit or letter between A and F)	Switch of circuit defect	Return for Service.

Source: YSI Instruction Manual for Model 50B

Appendix 4

YSI Model 55 Dissolved Oxygen Meter Troubleshooting Guide

SYMPTOM	PROBLEM CAUSE	ACTION
1. Instrument will not turn on	A. Low battery voltage B. Batteries installed wrong C. Meter requires service	A. Replace batteries (P4) B. Check battery polarity (P4) C. Return system for service (P17)
2. Instrument will not calibrate	A. Membrane is fouled or damaged B. Probe anode is fouled or dark C. probe cathode is tarnished D. System requires service	A. Replace membrane & KC1 (P9) B. Clean anode (P10) C. Clean cathode (P10) D. Return system for service (P17)
3. Instrument "locks up"	A. Instrument has rec'd a shock B. Batteries are low or damaged C. System requires service	A & B. Remove battery lid, wait 15 seconds for reset, replace lid (P4) C. Return system for service (P17)
4. Instrument readings are inaccurate	A. Cal altitude is incorrect B. Cal salinity is incorrect C. Probe not in 100% O_2 saturated air during Cal procedure D. Membrane fouled or damaged E. Probe anode is fouled or dark F. Probe cathode is tarnished G. System requires service	A. Recalibrate with correct value (P11) B. Recalibrate with correct value (P11) C. Moisten sponge & place in Cal chamber w/ probe & Recal (P5, 11) D. Replace membrane (P9) E. Clean anode (P10) F. Clean cathode (P10) G. Return system for service (P17)
5. LCD displays "LO BAT"	A. Batteries are low or damaged	A. Replace batteries (P4)
6. LCD displays message "ER 0"	A. Instrument's self-test detects improper probe voltage during calibration	A. Return system for service (P17)
7. LCD displays message "ER 1"	A. Instrument's self-test detects a variance in RAM B. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid (P4) B. Return system for service (P17)
8. LCD displays message "ER 2"	A. Instrument's self-test detects a system malfunction or component failure B. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid (P4) B. Return system for service)P17)
9. LCD displays message "ER 3"	A. Instrument's self-test detects a system malfunction or component failure B. System requires service	A. Remove battery lid, wait 15 seconds for reset, replace lid (P4) B. Return system for service (P17)

Appendix 4 (cont.)

YSI Model 55 Dissolved Oxygen Meter Troubleshooting Guide

10. LCD displays message "ER 4"	A. Sample O_2 concentration is more than 20 mg/l B. System requires service	A. Recalibrate using correct altitude and salinity compensation (P11) B. Return system for service (P17)
11. LCD displays message "ER 5"	A. Sample O_2 concentration is below -0.5 mg/l B. System requires service	A. Recalibrate using correct altitude and salinity compensation (P11) B. Return system for service (P17)
12. LCD displays message "ER 6"	A. Sample saturation is more than 200% B. System requires service	A. Recalibrate using correct altitude and salinity compensation (P11) B. Return system for service (P17)
13. LCD displays message "ER 7"	A. Sample saturation is less than -3.0% B. System requires service	A. Recalibrate using correct altitude and salinity compensation (P11) B. Return system for service (P17)
14. LCD displays message "ER 8"	A. Sample temperature is more than +46 degrees C B. System requires service	A. Reduce the sample temperature B. Return system for service (P17)

15. LCD displays message "ER 9"	A. Sample temperature is less than -5 degrees C B. System Requires service	A. Increase sample temperature B. Return system for service (P17)

Appendix 5

YSI Model 95 Dissolved Oxygen Meter Troubleshooting Guide

SYMPTOM	POSSIBLE CAUSE	ACTION
1. Instrument will not turn on	A. Low battery voltage B. batteries installed wrong C. Meter requires service	A. Replace batteries (pg. 6) B. Check battery polarity (pg. 6) C. Return system for service (pg. 23)
2. Instrument will not calibrate	A. Membrane is fouled or damaged B. Probe anode is fouled or dark C. Probe cathode is fouled D. System requires service	A. Replace membrane cap (pg. 8) B. Clean anode (pg. 16) C. buff cathode (pg. 16) D. Return system for service (pg. 23)
3. Instrument "locks up"	A. Instrument has rec'd a shock B. Batteries are low or damaged C. System requires service	A & B. Remove battery lid, wait 15 seconds for reset, replace lid (pg. 6) C. Return system for service (pg. 23)
4. Dissolved Oxygen readings are inaccurate	A. Cal altitude is incorrect B. Probe not in 100% water saturated air during Cal procedure C. Membrane fouled or damaged D. Probe anode is fouled or dark E. Probe cathode is fouled F. System requires service	A. Recalibrate with correct value (pg 11) B. Moisten sponge & place in Cal chamber with probe & Recal (pg. 11) C. Replace membrane cap (pg. 8) D. Clean anode (pg. 16) E. Buff cathode (pg. 16) F. Return system for service (pg. 23)
5. LCD display "LO BAT"	A. Batteries are low or damaged	A. Replace batteries (pg. 6)
6. Main Display reads "OVER" (Secondary display reads "ovr") (Secondary display reads "udr")	A. Temperature reading is >45 degrees C B. Temperature reading is <-5 degrees C C. DO temperature is >45 degrees C D. DO % saturation is > 500% E. DO concentration is > 50 mg/l F. Probe current too high to calibrate	In all cases, check calibration values and procedures. (pg. 11) If each of these were done correctly, return instrument for service. (pg. 23)

Appendix 5 (cont.)

YSI Model 95 Dissolved Oxygen Meter Troubleshooting Guide

7. Main display reads "PErr"	A. Incorrect sequence of keystrokes	A. Refer to manual section for step by step instructions for the function you are attempting
8. Main display reads "Err" (Secondary display reads "ra")	A. System has failed its RAM test check procedure	A. Turn instrument OFF and back ON again. B. Return the system for service (pg. 23)
9. Main display reads "Err" (Secondary display reads "ro")	A. System has failed its ROM test check procedure	A. Turn instrument OFF and back ON again B. Return the system for service (pg. 23)
10. Main display reads "FAIL" (Secondary display reads "eep")	A. EEPROM has failed to respond in time	A. Return the system for service (pg. 23)
11. Readings on main display don't change	A. Meter is in recall mode	A. Press MODE button to return to Normal Operation (pg. 12, 14)

Appendix 6

Temperature and Dissolved Oxygen Sampling Strategies

Shallow Lakes (<10 meters)	Stratified	(Temp) 0-10m, every meter (DO) one in epilimnion, every meter through thermocline to bottom
	Un-Stratified	(Temp) 0-10m, every meter (DO) at one meter and 1m off bottom, more if low DO, e.g. <5ppm, is found

To save time and chemicals, you should generally sample temperature every other meter, i.e., 1,3,5,7,9 to determine if the lake is stratified. Sample oxygen accordingly.

Mid-Depth Lake (10 to 15m)	Stratified	(Temp) Every odd meter until thermocline is found, then every meter through the metalimnion, and one mid hypolimnion and 1m off the bottom. (DO) Every odd meter until thermocline is found, then every meter through the metalimnion, and one mid hypolimnion, and 1m off the bottom. Fill in if low DO (<3ppm) is found.
	Un-stratified	(Temp) Every odd meter. (DO) Every odd meter. Fill in if low DO (<3ppm) is found.

Generally, temperature differences greater than 2 degrees Celsius between odd sampling depths should be supplemented with additional temperature readings between the depths.

Deep Lake (>15)	Stratified	(Temp) Every odd meter until thermocline is found, then every meter through the metalimnion, and one mid hypolimnion and 1m off the bottom. (DO) Every three meters until thermocline is found, then every meter through the metalimnion, and one mid hypolimnion, and 1m off the bottom. Fill in if low DO (<3ppm) is found.
	Un-stratified	(Temp) Every odd meter. (DO) Every odd meter. Fill in if low DO (<3ppm) is found.

Generally, temperature differences greater than 2 degrees Celsius between odd sampling depths should be supplemented with additional temperature readings between the depths.

The above listed scenarios are only guidelines, each lake will require its own sampling scheme.

Appendix 7

Epilimnetic Depth versus Epilimnetic Sampling Depth

Upper Range Lake
8/21/79

Depth	Temp.	DO
0	23.0	8.1
1	22.0	8.4
2	20.5	8.4
3	20.0	8.4
4	20.0	8.3
5	19.5	8.2
6	18.0	8.7
7	14.5	8.0
8	11.0	4.2
9	10.0	2.3
10	9.0	1.5
11	8.0	0.4

Epilimnetic depth = 5m
Sampling depth = 6m
Lower Metalimnetic depth = NA

Three-corner Pond
9/11/79

Depth	Temp.	DO
0	19.8	7.9
1	19.8	7.9
2	19.8	7.9
3	19.8	7.9
4	19.8	7.9
5	19.6	7.8
6	15.0	0.4
7	11.5	0.2
8	9.8	0.1
9	8.5	0.1
10	8.0	0.1

Epilimnetic depth = 5m
Sampling depth = 5m
Lower Metalimnetic depth = 9m

Three Cornered Pond
8/5/80

Depth	Temp.	DO
0	28.0	8.3
1	27.3	8.1
2	26.0	8.1
3	25.0	7.9
4	21.0	2.1
5	16.2	0.2
6	13.0	0.0
7	10.0	0.0
8	8.0	0.0
9	7.5	0.0
10	7.0	0.0

Epilimnetic depth = 1m
Sampling depth = 3m
Lower Metalimnetic depth = 8m

China Lake
7/30/86

Depth	Temp.	DO
0	22.5	8.6
1	22.5	8.6
2	22.5	8.6
3	22.5	8.6
4	22.5	8.6
5	22.5	8.6
6	21.5	8.2
7	20.2	8.0
8	19.5	7.8
9	17.8	4.8
10	16.2	3.9
11	15.5	3.3
12	14.5	2.9
13	13.0	2.4
14	12.5	2.4
15	12.5	2.3

Epilimnetic depth = 5m
Sampling depth = 9m
Lower Metalimnetic depth = 13m

China Lake
8/5/869

Depth	Temp.	DO
0	23.8	8.9
1	23.0	9.1
2	22.2	9.1
3	22.0	9.2
4	22.0	9.2
5	21.8	9.2
6	20.8	8.9
7	20.0	8.4
8	19.5	4.6
9	17.2	4.4
10	16.5	3.4
11	15.2	2.7
12	14.2	2.3
13	13.0	1.8
14	12.8	1.8
15	11.2	1.7

Epilimnetic depth = 5m
Sampling depth = 9m
Lower Metalimnetic depth = 13m

China Lake
6/9/89

Depth	Temp.	DO
0	17.9	9.5
1	17.9	9.5
2	17.9	9.5
3	17.9	9.6
4	17.8	9.6
5	17.6	9.6
6	13.0	9.1
7	11.4	8.3
8	10.8	8.4
9	10.1	8.3
10	10.0	8.2
11	9.7	8.2
12	9.3	8.0
13	9.1	7.9
14	9.0	7.9
15	9.0	8.0

Epilimnetic depth = 5m
Sampling depth = 6m
Lower Metalimnetic depth = 7m

Epilimnetic depth equals depths from surface to where $1^{o}C$ change occurs for every meter drop.
Sampling depth equals depths containing epilimnetic waters plus waters with temperatures $18^{o}C$ or warmer.
Lower Metalimnetic depth equals depths where temperatures stop dropping $1^{o}C$ for every meter drop.

Appendix 8

DEP Field Coding System

Agency:		Project:	
DEP =	EI	DEP =	02
VLMP =	EI	VLMP =	03
CWD =	CW	CWD =	03
LEA =	LE	LEA =	03

Sample Flasks or Containers

Surveyor:	Web Pearsall (DEP) = E	Sample Type:	Core = C
	Linda Bacon (DEP) = L		Grab = G
	Roy Bouchard (DEP) = B		
	VLMP Monitor = V1 through V99		

Lakes:
Threemile = TM
Three Corner = TC
Sebago = SE
Little Sebago = LS
Crystal = CR
China (Basin 1) = 01CH
China (Basin 2) = 02CH
China (Basin 3) = O3CH
Flying = FL
Great = GR
Pleasant = PL
Pocassett = PO
Androscoggin = AN

EXAMPLES:

E03CH15G = Web sampled China Lake (Basin 3), 15 meter grab
8/19/95 = Sampled on August 19, 1995

V4PL10C = Volunteer Monitor Number 4 sampled Pleasant Lake, 10 meter core
6/7/92 = Sampled on June 7,1992

Codes are available from DEP's Water Resources Survey Unit.