

Project Work/QA Plan

FISH TISSUE CONTAMINATION IN THE STATE OF MAINE

A Regional Environmental Monitoring and Assessment Program Project

Submitted by

Maine Department of Environmental Protection
Maine Department of Inland Fisheries & Wildlife
Environmental Services Division, USEPA - Region I

to

U.S. Environmental Protection Agency
Region I
60 Westview Street
Lexington, Mass 02173

June 1, 1993

Project Work/QA Plan Acceptance

Prepared By:

Signature: _____
Barry Mower, Biologist, ME DEP Date

EPA Project Officer Acceptance:

Signature: _____
Donald P. Porteous, Dpty Dir., ESD Date

Maine Project Officer Acceptance

Signature: _____
David Courtemanch, Dir., DEP Date

Maine Project QA Officer Acceptance:

Signature: _____
Barry Mower, Biologist, DEP Date

Maine Field Coordinator Acceptance:

Signature: _____
Kendall Warner, Super., DIFW Mgmt & Res. Date

Maine Info. Systems Coordinator Acceptance:

Signature: _____
Linda Bacon, Biologist, DEP Date

Maine Health & Env. Testing Laboratory Acceptance:

Signature: _____
Jack Krueger, Assist. Dir, HETL Date

USFWS, U. Maine at Orono Laboratory Acceptance:

Signature: _____
Terry Haines, Director Date

U. Maine, Sawyer Environmental Research Laboratory Acceptance:

Signature: _____
Jeffrey S. Kahl, Director Date

EPA Reg. I NERL Acceptance:

Signature: _____
Gerry Sotolongo, Tech. Serv. Br. Chief Date

EPA QA Office Acceptance:

Signature: _____
Arthur Clark, Reg. I QA Office Date

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APPENDICES

1. FIELD SAMPLING PROTOCOLS

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2. ANALYTICAL PROCEDURES AND METHODS
3. QUALITY ASSURANCE AND PREVENTATIVE MAINTENANCE
4. UNIVERSITY OF MAINE R-EMAP QUALITY ASSURANCE PROJECT PLAN

1. Project Name: Fish Tissue Contamination in the State of Maine
2. Project Proposed By: David Courtemanch, Director, DEP
3. Date of Proposal: September 30, 1992
4. Date of Project Initiation: May 3, 1993
5. EPA Project Officer: Donald Porteous, Region I ESD
6. State Project Officer: David Courtemanch, ME DEP
7. State QA Officer: Barry Mower, ME DEP
8. Project Description

A. Objective and Scope Statement

The purpose of this study is to determine the concentration of mercury and other metals, PCBs and selected pesticides in fish collected from Maine lakes. This information will be used to estimate the levels of contamination in fish populations and the risk that these levels pose to human and wildlife consumers. Data will be used to identify the variability of contamination and risk, which may be associated with, for example, species, lake type, geographic region and the ability to project this analysis across the entire population of lakes. Appropriate environmental management efforts can then be focused to evaluate and manage these risks.

Since the status of fish tissue contamination in Maine concerns both ecological and human health implications, two fish tissue matrices will be performed. One set of ten piscivorous fish collected from each of the lakes will be subdivided into two groups of five. One group will be used for whole body analysis of metals and organics, the other group for the analysis of mercury in the fillets. Mercury, as reported in the literature, has a tendency to concentrate in fish muscle (fillets). The separate analysis for mercury in fillets will allow comparison with the whole fish mercury analysis being conducted as part of this study. In addition, the information will be useful to evaluate human health risk and will be appropriate for comparison with other literature values. The set of five omnivorous fish will be used for whole body analysis of metals, PCBs and selected pesticides.

Lake sediments will be analyzed for metals and water column measurements will be made for trophic state indicators. Linkages with air flow patterns, geology, lake limnology, land use and other factors which may influence geographical distribution of fish tissue contamination will be evaluated.

The scope of this study will supplement the national EMAP Northeast Lakes Monitoring Program by applying site selection procedures in a more geographically intensive pattern and by using as many EMAP

protocols as is feasible to meet study objectives. Information will also be available for use by other federal programs, such as NAWQUA, BEST and State of Maine environmental assessment reports, including the CWA 305(b) reports.

B. Data Usage

Study results will be compared to existing data and serve as baseline information for follow up actions. Data will supplement a USFWS study of the status of contaminants in Maine eagles, thereby helping to determine ecological risks (food chain biomagnification). Data will also be compared to safe fish consumption levels for the determination of human health risks.

Maine and EPA Region I have GIS files for human population density, roads, air transport regions, surface water hydrography, surficial and bedrock geology, ground water chemistry and certain water quality parameters. This information can be used with the study data to construct associations, inferences and estimates of geographic areas at risk.

C. Experimental Design

One hundred and fifty lakes were selected using EMAP's stratified statistical design from a group of approximately 1800 lakes which have been surveyed and have significant fisheries as defined by the Maine Department of Inland Fish and Wildlife. The selection of lakes includes a spectrum of size classes, flowages and includes lakes formed from impoundments. A minimum of 120 lakes is targeted to be sampled for fish, sediment and water column parameters.

Fish

Target Species

The fish species targeted for collections will be driven by trophic level considerations, i.e., for any given water body, the primary objective will be to collect the top predator species in the system and a widely distributed omnivore. A hierarchal order of preference by species importance has been developed based on knowledge of distribution and desirability as game fish. In an effort to obtain specimens from different lakes that are of comparable age, target fish sizes (length) are made based on available length/age relationships, "legality" and "desirability" as game species, and likelihood of capture. Where possible select larger fish near the top of the target size range. Stocked hatchery fish should have been at large at least one year.

Order of priority whether species coexist or not:

Predators

Cold water species

1. Lake Trout (Salvelinus namaycush). Size 16-22 inches. Lake trout of this size would probably be 4 years old and older. Sampling population will likely include both native and stocked fish.
2. Burbot (Lota lota). Size 14-20 inches. Burbot of this size will probably be 3-8 years old. Sampling population will include only native fish.
3. Landlocked Salmon (Salmo salar). Size 14-18 inches. Salmon of this size would probably range from 2-5 years old. Landlocked salmon are native to Maine. Sampling population will likely include both native and stocked fish.
4. Brown Trout (Salmo trutta). Size 12-18 inches. Brown trout of this size would probably be 3 years old and older. Sampling population will include predominantly stocked fish.
5. Brook Trout (Salvelinus fontinalis). Size 8-14 inches. Brook trout of this size would probably be 1-4 years old. Sampling population will include both native and stocked fish.

Warm water species

1. Smallmouth Bass (Micropterus dolomieu). Size 10-16 inches. Smallmouths of this size would probably be 4-8 years old. Sampled population will include only native fish.
2. Largemouth Bass (Micropterus salmoides). Size 12-16 inches. Largemouths of this size would probably be 5-8 years old. Sampling population will include only native fish.
3. Chain Pickerel (Esox niger). Size 14-22 inches, pickerel of this size would probably be 3-7 years old. Sampling population will include only native fish.
4. Yellow perch (Perca flavescens). Size 8-12 inches. Yellow perch of this size would probably be 4-5 years old. Sampling population would be only native fish.
5. White perch (Morone americana). Size 8-12 inches. White perch of this size would probably be 4-5 years old. Sampling population would be only native fish.

Omnivores

1. White Sucker (Catostomus commersoni). Size 14-18 inches. Age estimates for white suckers in this size range are 3-8 years old. This is the most common sucker found in Maine lakes, and is considered ubiquitous throughout the state. Since the white sucker is likely to be collected in most lakes, it will be used as an index species and internal standard for inter-lake comparison of contaminants and for comparison with the predator species.
2. Brown Bullhead (Ictalurus nebulosus). 8-12 inches. Age estimates for bullhead in this size range are 3-5 years old. The brown bullhead feeds on anything from plant material to fish and is fairly common in Maine lakes.

Aging of Fish

Fish scales or other structures will be normally collected in the field from fresh specimens and retained and processed by DIFW.

Salmonids will be aged by reading scales collected above the lateral line.

Smallmouth bass and largemouth bass will be aged by reading scales collected posterior to the left pectoral fin.

Chain pickerel will be aged by scale reading.

Yellow perch will be aged by reading scales collected posterior to the left pectoral fin.

White sucker will be aged by measurement of the first or second pectoral fin ray.

Brown bullhead will be aged from cross sections of the left pectoral spine.

Sediments

Surficial bottom sediments will be collected from the deep hole of each study lake to assist in interpretation of differences among lakes. Samples will be collected at the time of water quality sampling from mid-July through mid-September. Only the surficial layer (0-2 cm) will be analyzed on most samples. In addition, to determine the history of accumulation of mercury in sediments, core samples will be collected from 3 lakes. Cores will be sectioned at 1-2 cm intervals and selected intervals chosen for analysis. All sampling methods, station identification, location, sample numbering and labeling, analysis designation, and chain of custody will follow the directions as indicated in Appendix 1.

Water

For basic characterization of lake water chemistry and trophic state, to assist in evaluation of the fish data, a water quality assessment will be made in each lake. Water temperature, dissolved oxygen, specific conductance, and pH profiles will consist of measurements at 1-m, 2-m or 5-m intervals over the deep hole in the lake. Secchi disk readings will be taken to evaluate water clarity. Samples will be collected for measurement of anions, cations, total alkalinity, and dissolved organic carbon at one meter below the surface and one meter above bottom. If thermal stratification occurs additional samples will be collected at the top of the hypolimnion for measurement of total alkalinity and dissolved organic carbon. Samples for total phosphorus will be collected from a water core of the epilimnion in stratified lakes (a 10 meter core or core to the bottom in unstratified lakes), the top of the hypolimnion (if stratified), and one meter from the bottom. All sampling methods, station identification, location, sample numbering and labeling, analysis designation, and chain of custody will follow the directions as indicated in Appendix 1.

D. Laboratory Analyses

A summary of analyses is presented below. Please refer to Appendix 2. for processing and analytical protocols.

Fish

Whole body fish analyses - Predators and Omnivores

Chemical analyses will be conducted on composites. Five fish of the same species will be ground up, combined and homogenized. A sub-sample of this tissue will be used for extraction and subsequent analysis. The analyses will include the following metals and organic compounds/pesticides.

- Metals - Mercury (Hg), Cadmium (Cd), Lead (Pb)

- Chlorinated Organic Compounds/Pesticides - Total PCBs, Aldrin, Alpha-BHC, Delta-BHC, Gamma BHC, Chlordane, DDD 4,4', Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor epoxide, and Toxaphene.

- Additional Analyses - lipids and percent moisture.

Samples will be analyzed by the Maine Department of Human Services/Health and Environmental Testing Laboratory (HETL).

Fish fillet analyses - Predators

Chemical analysis will be conducted on composites. Five fish of the same species will be filleted, skinned, ground, combined and homogenized. A sub-sample of this tissue will be digested and used for subsequent analysis. Fish fillets will be analyzed for Mercury(Hg) only. Additional analysis will include percent moisture.

These samples will be analyzed by the University of Maine at Orono Zoology Department laboratory.

Sediments

Chemical analysis will be conducted on a homogenous mix of the field composite collected from each lake. Each sediment sample will be homogenized and split into two samples, one for ME DEP and one for EPA's New England Regional Laboratory (NERL). The EPA lab will perform TOC analysis and percent moisture. ME HETL will also perform percent moisture and all other analyses.

The sediments will be digested and sub-samples will be used for subsequent analysis as listed below.

- Metals - Mercury (Hg), Cadmium (Cd), and Lead (Pb).
- Additional Analyses - Total organic carbon(TOC), Sediment Grain size, and percent moisture.

Water

Water samples collected at three depths from each of the lakes will be analyzed for total phosphorus, dissolved organic carbon, anions, and cations. See Appendix 2 for a complete list of analytical procedures and methods.

In the following table, the number of samples for the water samples are based upon all lakes being stratified in order to estimate the maximum number of samples possible.

E. Parameter Table

<u>Parameter</u>	<u># Samples</u>	<u>Sample Matrix</u>	<u>Analytical Method Ref.</u>	<u>Sample Preserv.</u>	<u>Holding Time</u>
% moisture	120	Sediment	Attached	Freeze	6 months
TOC	120 7 dups.	Sediment	Attached	Freeze	6 months
Mercury	120 7dups.	Sediment	Attached	Freeze	6 months
T-Phos.	120 7dups.	Water	Attached	none	28 days
DOC	120 7 dups.	Water	Attached	Freeze	28 days
pH	240 14 dups.	Water	Meter	N/A	N/A
Alkalinity	240	Water	Color comp	cool, 4C	14 days
Anions	240 14 dups.	Water	Attached	cool, 4C	14 days
Cations	240 14 dups.	Water	Attached	cool, 4C	14 days
Mercury	120 7 dups.	Fish fillet	Attached	Freeze	N/A
% Moisture	120 7 dups.	Fish fillet	Attached	Freeze	N/A
Mercury	240 14 dups.	Whole Body Fish**	Attached	Freeze	N/A
Cadmium	240 14 dups.	Whole Body Fish	Attached	Freeze	N/A
Lead	240 14 dups.	Whole Body Fish	Attached	Freeze	N/A
Chl-Org &Pesticides***	240 14 dups.	Whole Body Fish	Attached	Freeze	N/A
Lipids	240 14 dups.	Whole Body Fish	Attached	Freeze	N/A
% Moisture	240 14 dups.	Whole Body Fish	Attached	Freeze	N/A

*Alkalinity analysis will be done in the field using a Hach colorimeter. If Alkalinity exceeds 5 mg/l, then a water sample will be sent to the Maine HETL for analysis.

**Each sample is a composite of 5 individuals. For each lake there is a predator sample and an omnivore sample. Therefore, for each lake there would be two whole-body samples.

***Compounds are Total PCBs, Aldrin, Alpha-BHC, Delta-BHC, Gamma BHC, Chlordane, DDD4,4', DDE, DDT, Dieldrin, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor epoxide, and Toxaphene.

9. Schedule of Tasks and Products

The start date is contingent upon EPA Quality Assurance Officer's approval of this Work/QA Plan and laboratory availability to handle the samples. It is anticipated the start date will be in May 1993.

TARGET DATES	ACTIVITY
2/10/93 - 6/1/93	Initiate project; develop QA/Work Plan and receive Quality Assurance Officer approval.
2/10/93 - 3/1/93	Schedule laboratory support (B.S. Pros).
3/22/93 - 5/1/93	Lab analytical "dry runs"
4/1/93 - 5/1/93	ME IFW Sampling crew organization & equipment checks
5/3/93 - 5/7/93	Sampling crew training
5/10/93 - 10/30/93	Conduct sampling and deliver to Lab.
5/10/93 - 12/31/93	Laboratory analysis.
5/10/93 - 12/31/93	Field data evaluated
1/1/94 - 2/1/94	Laboratory data evaluation.
5/10/93 - 3/1/94	Field & laboratory Data Entry
2/1/94	Field report to Maine QA Officer
3/1/94	Lab report to Maine QA Officer
4/1/94	Data Evaluation Review and Reporting
5/1/94	Sampling & Analytical Report to EPA and Maine DEP Project Officers and IFW Coordinator

5/94	Begin sampling of any lakes left to sample from 1993
9/30/94	Draft project report
3/1/95	Submit final project report to EMAP

10. Project Organization and Responsibility

The following is a list of key project personnel and their corresponding responsibilities:

Sampling Operations - Kendall Warner, IFW

Sampling QC - Kendall Warner, Field QA Officer

Laboratory Analysis - Charles Elvin, ME HETL
 Larry Boston, ME HETL
 Irma Simon, ME HETL
 Craig Stafford, UMO
 Gerry Sontolongo, EPA NERL, Sawyer Res. Center

Laboratory QC - John Nims, ME HETL
 Dr. Terry Haines, UMO, EPA NERL
 Jeffrey S. Kahl, Sawyer Res. Center

Data Processing Activities - Bio I, ME DEP

Data Processing QC - Linda Bacon, ME DEP

Data Quality Review - Barry Mower, ME DEP

State Project/QA Officer -David Courtemanch, ME DEP

EPA Performance Auditing - Arthur Clark

EPA QA Officer - Arthur Clark

EPA Project Coordination - Don Porteous, Region I, ESD

Organization Chart:

Sampling & Analysis Organization Structure

D. Courtemanch

B. Mower

P. Bourque

HETL

UME-O

K. Warner

11. Data Quality Requirements and Assessments

<u>Parameter</u>	<u>Sample Matrix</u>	<u>Detect. Limit</u>	<u>Quant. Limit</u>	<u>Estim. Accuracy</u>	<u>Accuracy Protocol</u>	<u>Estim. Precis.</u>	<u>Precis. Protoc.</u>
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Please refer to individual protocols

Data Representativeness:

Data must be representative of conditions existing at the time of sample collection. Samples must be preserved immediately according to procedures stated in the Parameter Table above. Field and laboratory conditions which may affect sample integrity are to be documented in field or laboratory logs. 5 % Sample Duplicates are to be collected.

At least 80% of the data must be determined to be representative for the project to be considered complete.

Data Comparability and Completeness:

Data must be comparable for all samples within each media, i.e. all analyzed with the same detection limits and method for each parameter. Data will be compared with existing databases and risk limits.

Concentrations for sediments must be reported in dry weight and fish must be reported as wet weight and accompanied by percent lipids and percent moisture.

Analytical methods will be those cited in the Parameter Tables, 7(E) above.

At least 80% of the data must be complete and valid (not rejected) for the project to be considered complete.

12. Sampling Procedures

Samples for each matrix and parameter will be in accordance with the Maine R-EMAP Standard Operating Procedures, attached. Where conditions warrant, the procedure may be altered with the approval of the EPA Quality Assurance Officer prior to sampling initiation. Alterations shall also be approved by the Project Officer. Any special circumstances or alterations will be recorded in the field logbook. Field data sheets, copies of which are attached, will be filled out completely as appropriate for each sample type.

13. Sample Custody Procedures

Maine DEP's written procedures will be followed whenever the samples are collected, transferred, stored, analyzed or destroyed. The primary objectives of the procedures will be to create an accurate written record which can be used to trace the possession and handling of the sample from the moment of its collection to disposal.

Sample tags, chain-of-custody forms and field data records will be completed at the time of sampling. State DEP Chain-of-Custody SOP will be followed throughout the project by all participants. Please refer to attached SOP for details.

14. Field Instrument Calibration and Preventive Maintenance

Field meters to be used during sampling, including pH, dissolved oxygen and conductivity meters, will be maintained and calibrated as per manufacturers and S.O.P. requirements. In addition, buffer solutions will be used to calibrate pH and conductivity meter as described in the S.O.P.s.

The preparation date of standard solutions will be clearly marked on each of the containers. It will be the responsibility of the user to check its calibration status prior to using the instrument and to check its calibration periodically during use. A log which documents problems experienced with the instrument and corrective measures taken will be maintained by the Field Team Leader.

Global Positioning System units for location data will also be maintained according to manufacturers' instructions and S.O.P. requirements.

All equipment to be utilized during the field sampling will be examined to certify that it is in operating condition prior to its use. This includes checking the manufacturer's operating manuals and the instructions with each instrument to ensure that all maintenance items are being observed.

The Field Team Leader will assume responsibility for control and calibration of field measurement equipment.

The Field Team Leader will assume responsibility for control and calibration of field measurement equipment.

15. Documentation, Data Reduction, and Reporting

A. Documentation: All activities will be documented either in S.O.P. or modifications which must be first approved by both the Maine Project Officer and Field QA Officer before use. Adequate documentation will be provided to insure that the data derived in sampling and analysis are justifiable, with respect to the sample and the requirements of the project. Each sample will be documented as to its place of origin, how the sample was taken, person performing collection and conditions relating to sample collection. In addition, members of the project staff working in the field operations will keep a field notebook of their project activities.

B. Data Reduction and Reporting: Raw data will be summarized and incorporated in report form. At the completion of the study, a final report will be submitted to the Project Officer. That report will detail in text supported by illustrations and tables the method of data collection, results of the field and analytical work and purpose. Appended to the report will be all appropriate field documentation, analytical data and QA/QC documentation.

16. Data Validation/Evaluation

Data validation/evaluation is a process of review of the analytical results and documentation against established criteria. ?? will perform data validation.

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17. Performance and Systems Audit

USEPA Office of Quality Assurance may conduct field and lab audits to assess the level of adherence to this Work/QA Plan. Audits of field notebooks and other project documents may also be conducted by the Office of Quality Assurance.

In addition, the State DEP Office of Quality Assurance may conduct an audit of contracted work on this project.

18. Corrective Action

When it is found that data are incomplete or that results are unacceptable, the Project Officer may determine that one or more of the following procedures for corrective action shall be undertaken:

A. Incomplete Data: Omissions from logs, notebooks and worksheets place the entire analysis in question. Incomplete field sampling data may require resampling of the questionable location. Incomplete laboratory data usually calls for re-introduction or re-analysis of the questionable sample if possible.

B. Conflicting Data: As in the case of omitted data, conflicting data may require that the entire analytical performance be questioned. In some cases, however, other supportive documentation may aid in resolving problems. When this is not available, the Project Officer may require re-sampling or re-analysis of samples if possible.

C. Poor Performance: When results from duplicates, spikes, blanks, etc., fall outside acceptable ranges, the available data will be reviewed by the Project Officer. Upon examination, all or some of the following actions may be applied:

1. System audit for analyte in question.
2. Determination of matrix interference.
3. Re-sampling of the questionable sample.
4. Reconsideration of acceptance limits with statements included with results explaining the action/rationale taken.
5. Rejection of data and exclusion from the report with written explanation.
6. Rejection of the entire sample/site location with recommendation of relocation of sample site or reconsideration of results sought.

19. Reports

The Laboratory Manager shall submit to the Project QA Officer a copy of raw data and validated data with all required documentation.

The Field Team Leader shall submit to the Maine Project QA Officer all sample collection and field activity documentation.

The Maine Project QA Officer shall prepare a QA Review Report detailing results of documentation and data review. The report shall be submitted to the Maine Project Officer for incorporation into the Project Summary Report.

The Maine Project Officer shall submit to the EPA Project Officer a report that details the method of investigation, results of the field and analytical work and purposes. The Field Team Leader shall append to the report all appropriate field documentation, analytical data and QA/QC documentation.

To be submitted to:

Don Porteous, Dpty Dir
EPA Reg. I ESD
60 Westview Street
Lexington, MA 02173

APPENDIX 1
FIELD SAMPLING PROTOCOLS

SAMPLING CREW AGENDA FOR EACH LAKE

READ ALL INSTRUCTIONS BEFORE GOING INTO THE FIELD

PRACTICE WITH ALL EQUIPMENT BEFORE GOING INTO THE FIELD

INSTALL SOFTWARE ON OFFICE COMPUTER PER INSTRUCTIONS IN SECTION H

HOOK UP OMNIDATA/YSI6000 TO OFFICE COMPUTER TO BECOME FAMILIAR WITH OPERATION OF SOFTWARE ON A SCREEN WHERE YOU CAN SEE IT ALL AT ONCE. YOU CAN ONLY SEE ABOUT 1/4 OF IT ON THE OMNIDATA AT ONE TIME. THEN TRY IT ON THE OMNIDATA.

NIGHT BEFORE

Assemble all equipment and check to see that it is in working order

CHARGE OMNIDATA PC

CHARGE THE GPS RECEIVER BATTERY

MORNING OF (before leaving lab)

1. GPS

- a. Retrieve GPS battery from charger and install in GPS unit
- b. Check to see GPS unit is operating

2. Omnidata/YSI6000

- a. Retrieve Omnidata PC from charger
- b. Check batteries in sonde (install batteries and connect sonde to PC, start PC, select SONDE/STATUS: if voltage is below 10V replace batteries)
- c. Calibrate pH (still in PC6000/SONDE select CALIBRATE/pH and follow instructions in section I
- d. Calibrate specific conductance (still in PC6000/SONDE/CALIBRATE select SPECIFIC CONDUCTANCE and follow instructions in section I
- e. Rewet sponge in calibration cup

3. Other equipment

Check equipment lists for type of sampling (fish, water quality and sediment) to make sure you have it all

Look up MIDAS numbers for lakes to be sampled

SAMPLING

1. Fish sampling - Follow procedures in section A
2. Water quality sampling (Between 0900-1500 hrs) **BEFORE SEDIMENT SAMPLES ARE COLLECTED TO AVOID CONTAMINATION OF WATER SAMPLES.**

Follow specific procedures in section B

- a. Station location using GPS.
 - b. Temperature, dissolved oxygen, pH, specific conductance profiles using Omnidata/YSI6000 multiprobe to identify epilimnion, hypolimnion, bottom.
 - c. Water samples for anions, cations, dissolved organic carbon, and total alkalinity.
 - d. Water core for total phosphorus.
 - e. Secchi disk measurement.
3. Sediment sampling **AFTER WATER SAMPLES ARE COLLECTED TO AVOID CONTAMINATION OF WATER SAMPLES.** Follow procedures in section C.

UPON RETURN TO THE LAB

1. GPS

- a. Check the Batteries DIR 6, SUB 2

If System battery is ≤ 10.7 -charge overnight with the square charger (the one with lights!)

If CDU/DR reads CHRG or the Polycorder does not turn on - charge for exactly 8 hours. This charger has 25 pin adapter.

- b. Check the Memory DIR 5, SUB 3

If available memory is $< 10,000$ bytes, arrange for polycorder exchange with EPA.

2. Omnidata/YSI6000

- a. Remove batteries from sonde
- b. Do file transfers as described in section H
- c. Place sonde in pH 4 buffer and store upright
- d. Do backup as described in section H
- e. Recharge Omnidata if needed

3. Other equipment
 - a. Open all cases to all equipment to dry
 - b. Make preparations for next day, repairs, supplies, bottles etc.

A. FISH SAMPLING PROTOCOL

1.0 Equipment and Supplies

Supplied by DIFW

nets or other sampling gear
 cooler and ice
 plastic buckets
 measuring board
 scales
 knife
 scale envelopes
 aluminum foil
 plastic garbage bags

Supplied by DEP

string tags
 labels
 field sheets
 field log

2.0 Pre-cleaning and Decontamination

The plastic buckets, measuring board, scales, and knife will be washed in soap and water using a soft brush and rinsed in tap water and then lake water before use in each lake.

3.0 Collection of fish

Fish will be collected during the open water season according to the following schedule.

<u>Time Window</u>	<u>Species</u>
15 May-30 June	bass brook trout pickerel white perch

	yellow perch omnivores
1 July-31 August	lake trout brown trout burbot omnivores
1 September-15 October	salmon omnivores

Normally Swedish experimental gill nets with variable mesh will be set and "fished" until the desired number of 10 (5 for whole body, 5 for fillet) predators and 5 omnivores are collected. Other sampling gear as appropriate may be used on a case by case basis, and may include rod and reel, seines and trap nets. Maximum time spent should not ordinarily exceed 2 days, including one overnight set if necessary. Regional personnel, however, will have the option of spending more time on some lakes if necessary to complete collections for this or other Regional management purposes.

It is critical to remember to keep the fish clean and uncontaminated. Keep them away from gasoline and oil, cigar/cigarette smoke and ash, or other sources of contamination.

- 3.1 Lake name, MIDAS number, collector, time and date, collection method external anomaly codes, and other pertinent information will be recorded on the field sheet.
- 3.2 Upon capture the fish will be placed in a cooler with ice in a cooler or clean plastic bucket until dead.
- 3.3 Lengths and weights will be taken and scales or other structures will be collected for aging.
- 3.4 Measuring equipment should be scrubbed with lake water between species.
- 3.5 Lengths and weights will be recorded on the field sheet using a unique number assigned to each fish as follows. Each fish will be identified by a number comprised of the letters LK followed by the MIDAS number, a dash, a three letter code for species, another dash, and finally a number from 1 to 10. For example fish LK2345-WSU-01 is white sucker number 1 from lake 2345.

3.6 Species codes to be used are as follows:

brown bullhead	BUL
brook trout	BKT
brown trout	BNT

burbot (cusk)	CSK
chain pickerel	PKL
lake trout	LKT
landlocked salmon	LLS
largemouth bass	LMB
longnose sucker	LNS
smallmouth bass	SMB
white perch	WHP
white sucker	WHS
yellow perch	YLP

3.7 Each fish will also be examined externally for anomalies with the anomaly code entered in the space provided. Additional notes may be entered under remarks.

3.8 The fish will be rinsed in lake water and then individually wrapped in heavy duty aluminum foil.

3.9 Using an indelible marker the fish ID number and date will be entered on the pre-printed label which will then be attached to the fish.

3.10 The fish will be placed on ice in a cooler and taken back to each regional office and frozen at the end of each day. Fish of the same species from the same lake should be placed in a plastic garbage bag and labeled with lake name, MIDAS number, species, and number of fish using string tags supplied. Dissimilar species will not be mixed or packaged together. Predators should be divided as equally as possible by size and number into two plastic bags, one each for analysis of whole body and of fillets. Fish will be filleted in the lab at the University of Maine.

3.11 Periodically DEP will visit each regional headquarters and pick up the fish. Original field sheets will accompany the fish at all times and serve as documentation of chain of custody. Copies may also be kept by DIFW. Fish will be sorted and taken to the appropriate laboratory and submitted for analysis.

ANOMALY CODES

B	blind in any eye
D	deformities
E	eroded fins
F	fungus
H	hooking injury
L	lesions or ulcers
M	mucous (excessive)
N	normal
O	other (explain under remarks)
P	parasites
R	predator marks

METHOD CODES

AN	angling
BS	beach seine
DN	dip net
GN	gill net
O	other
TN	trap net

S emaciated
T tumors

B. WATER SAMPLING PROTOCOL

EQUIPMENT CHECK LIST

B1. GPS

GPS unit and charged batteries

B2. DISSOLVED OXYGEN, TEMPERATURE, CONDUCTIVITY, AND pH PROFILES

YSI 6000 Multiprobe with Omnidata field PC data logger
calibration standards
50, 100, or 150 ft cable
plastic wrap or bags and masking tape to weather proof connections

B3. WATER SAMPLES FOR ANIONS, CATIONS, DISSOLVED ORGANIC CARBON AND DETERMINATION OF TOTAL ALKALINITY

Kemmerer or Van Dorn water bottle
Messenger
Calibrated chain or line
alkalinity kit
250 ml Nalgene polypropylene sample containers
per lake: 3 for DOC (pre-labeled red tape)
2 for anions, 2 for cations, (label as R-EMAP and
either anion or cation, LK????-##G where ??? is the MIDAS no. and ## is
depth in meters)

B4. WATER "CORE" SAMPLING FOR PHOSPHORUS

Tygon tubing, 10 meters long, 1/2 -5/8 inch inner diam.
1 ga plastic mixing jug
3 250 ml Ehrlenmeyer flasks per lake

B5. SECCHI DISK TRANSPARENCY PROCEDURE

Secchi disk
Calibrated line - Calibrated line refers to depth markings made against a standard tape measure.
Metal chain is preferred, or other line that doesn't stretch
Water scope

B1. STATION LOCATION

Water samples will be collected at the deepest part of the lake, deep hole, as determined from the Department of Inland Fisheries and Wildlife's bathymetric map. Latitude and longitude of the sampling location will be determined using the Global Positioning System (GPS) as shown below and detailed in Appendix G.

CHARGE THE GPS RECEIVER BATTERY OVERNIGHT PRIOR TO USE.

GPS OPERATION PROCEDURES (For Trimble Pathfinder Professional)

WEEKLY RECEIVER SET UP:

(Also check these parameters if the receiver is not logging satellites)

- 1) Check Recording Interval: DIR 5, SUB 1
Set Position = 1
- 2) Check Position Fix Mode: DIR 8, SUB 2
Set Manual 3D
- 3) Check Masks: DIR 8, SUB 8
Input Land (1)
 - Check Elevation Mask = 15
 - Signal Level Mask = 6
 - PDOP Mask = 8
 - PDOP Switch = 8Enter through screen.

AT INDEX/SAMPLING SITE:

- 1) GOTO DIR 6, SUB 0
Wait until screen reads DOING POSITION FIXES
 - If no SV's check: DIR 6, SUB 2
 - Sys Bat: >9.5v
 - Ant Volts: >3, <5.1
 - Check connections or charge battery
- 2) GOTO DIR 0 Position
Write the coordinates (lat./long.) on the lake sampling form or input them to data logger.
- 3) GOTO DIR 5, SUB 0
 - Enter 1 Log Rover
 - Enter the filename (ME Midas no.) for example (ME01234)
- 4) Wait 5 or more minutes while the recorder continuously beeps.

- 5) GOTO DIR 5, SUB 0
Enter LOGGING OFF
- 6) TURN THE RECEIVER OFF

AT THE BASE SITE:

- 1) Check the Batteries DIR 6, SUB 2
If System battery is ≤ 10.7 -charge overnight with the square charger (the one with lights!)
If CDU/DR reads CHRG or the Polycorder does not turn on - charge for exactly 8 hours.
This charger has 25 pin adapter.
- 2) Check the Memory DIR 5, SUB 3
If available memory is $< 10,000$ bytes, arrange for polycorder exchange with EPA.

B2. DISSOLVED OXYGEN, TEMPERATURE, CONDUCTIVITY, AND pH PROFILES

1.0 Equipment and supplies

YSI 6000 Multiprobe with Omnidata field PC data logger
calibration standards
50, 100, or 150 ft cable
plastic wrap or bags and masking tape to weather proof connections

2.0 Night before **CHARGE OMNIDATA**

3.0 Morning of (before leaving lab)

- 3.1 Retrieve Omnidata PC from charger
- 3.2 Check batteries in sonde (install batteries and connect sonde to PC, start PC, select SONDE/STATUS: if voltage is below 10V replace batteries)
- 3.3 Calibrate pH (still in PC6000/SONDE select CALIBRATE/pH and follow instructions in section I)
- 3.4 Calibrate specific conductance (still in PC6000/SONDE/CALIBRATE select SPECIFIC CONDUCTANCE and follow instructions in section I)
- 3.5 Rewet sponge in calibration cup
- 3.6 Change or repair any parts necessary for a properly operating meter.

NOTE: It takes about 24 hours for a new D.O. membrane to stabilize. If it is necessary to change in the field perform calibration checks frequently and note such on the field sheet.

4.0 Sample & Analysis Procedures

- 4.1 See section H for more details

Connect the sonde to the computer's serial port using the sonde cable and if needed, the serial adapter. Make sure the 8 C cell batteries have been installed in the sonde.

- 4.2 To start PC6000, from the C: prompt type:

cd\REMAP1 <ENTER> followed by: PC6000 <ENTER>

The PC6000 program should start. Across the top you will see a menu with 5 selections:

SONDE	-accesses sonde software
FILE	-allows you to open a file
SETUP	-allows configuration of display and communications
REALTIME	-displays a graph of parameters
EXIT	-exits the program

- 4.3 Select SONDE which will connect you with the sonde and allow access to the sonde software.
Hopefully, you've connected to the sonde and you will receive a message to type the word MENU to start the sonde software.
The main sonde menu has eight options and looks like this:

```
-----  
Menu  
-----  
1. Run          5. System Setup  
2. Calibrate    6. Report Setup  
3. File         7. Sensor Setup  
4. Status       8. Diagnostics
```

Select option (0 for previous menu):

- 4.4 Calibrate depth(select SONDE / CALIBRATE / DEPTH) and follow menu
- 4.5 Calibrate D.O. (select SONDE / RUN / DISCRETE / START DISCRETE, allow readings to stabilize, select /SONDE / CALIBRATE / D.O. %, enter barometric pressure of 760mm Hg (remember to check membrane).
- 4.6 Name the data file (still in PC6000, select SONDE / RUN / DISCRETE / SITE DESCRIPTION, name must have the following format, ME???? where ??? is the Midas #)
- 4.7 Lower Multiprobe to the desired depth. Make measurements every meter down through the top 15 meters, every 2 meters from 15-25 meters, and every 5 meters from 25 meters to the bottom.
- 4.8 Collect data (still in PC6000, select SONDE / RUN / DISCRETE / START DISCRETE, at each depth, allow readings to stabilize then press 1 to log a line of data; when profile is obtained, press ESC to exit)

- 4.9 Raise electrode up through water column until at 1-meter depth. Compare readings at 1-meter depth to previous readings as QC check.
- 4.10 Close file (still in SONDE/RUN/DISCRETE select CLOSE FILE)
- 4.11 Upload files to Omnidata (still in PC6000 SONDE select FILE / QUICK UPLOAD, upload in all 3 formats renaming extension each time: .DAT for PC6000, .DEL for COMMA & "" DELIMITED, .ASC for ASCII)

NOTE: IF EITHER THE YSI6000 OR OMNIDATA ARE ACCIDENTLY LOST OVERBOARD, MARK THE SPOT WITH THE ANCHOR AND PFD AND ARRANGE FOR A SCUBA DIVER TO RETRIEVE THE EQUIPMENT.

5.0 Storing Meter & Electrode

- 5.1 Follow manufacturers instructions for storage in field
- 5.2 At lab
 - a. Remove batteries from sonde
 - b. Do file transfers
 - c. Place sonde in tap or lake water and store upright
 - d. Do backup
 - e. Recharge Omnidata if needed

B3. COLLECTION OF WATER SAMPLES FOR ANIONS, CATIONS, DISSOLVED ORGANIC CARBON AND DETERMINATION OF TOTAL ALKALINITY

1.0 Equipment

Kemmerer or Van Dorn water bottle

Messenger

Calibrated chain or line

alkalinity kit

250 ml Nalgene polypropylene sample containers

per lake: 3 for DOC (pre-labeled red tape)

2 for anions, 2 for cations, (label as R-EMAP and

either anion or cation, LK####-##G where #### is the MIDAS no. and ## is depth in meters)

2.0 Pre-Cleaning & Decontamination Procedures

2.1 Keep water bottle in carrying case except when being used.

2.2 Rinse water bottle with lake water three times at a new lake before collecting samples.

3.0 Filling Pre-Labeled Sample Containers

3.1 If necessary, lower the water bottle more than once to have enough volume to fill all containers, fill each container partially with the first aliquot.

3.2 Continue to fill containers with succeeding aliquots until all containers are full.

4.0 Operation of Water Bottle

4.1 Open water bottle without touching inside of container or inner areas of stoppers and cock the release mechanism.

4.2 Holding onto messenger, lower water bottle through water column until reaching designated depth.

4.3 Move water bottle vertically and horizontally to flush the bottle and then release messenger.

4.4 Raise water bottle.

4.5 Drain water into sample container.

5.0 Collection of Samples

5.1 Anions and cations

- A. Samples will be collected at one meter below the surface and one meter above bottom.
- B. Fill one 250 ml Nalgene bottle for anions and one for cations at each depth sampled.
- C. Drain water into the pre-labeled containers filling to the top, leave no air space.
- D. Mark lake MIDAS number and depth in the space on the label.
- E. Record bottle number (Midas no. and depth) on PC.
- F. Place in a cooler with ice and keep refrigerated until picked-up by DEP.

5.2 Dissolved organic carbon

- A. Samples will be collected at one meter below the surface, the top of the hypolimnion (if stratification occurs), and one meter above bottom.
- B. Fill one pre-labeled bottle (red tape) to the shoulder for each depth sampled. DO NOT OVERFILL.
- C. Mark lake MIDAS number in the space on the label.
- E. Record bottle number on PC.
- F. Place in a cooler with ice immediately and freeze as soon as possible.

5.3 Total alkalinity

- A. Samples will be collected at one meter below the surface, the top of the hypolimnion (if stratification occurs), and one meter above bottom.
- B. Collect the required amount of sample as specified by each kit.
- C. Follow directions in each kit for measuring total alkalinity to low levels using Bromcresol green-methyl red endpoint.
- D. Record results to the nearest mg/l on PC for the appropriate depth.

B4. SAMPLING FOR PHOSPHORUS

1.0 Equipment

Kemmerer or Van Dorn water bottle
Tygon tubing, 10 meters long, ½ -5/8 inch inner diam.
1 ga plastic mixing jug
3 250 ml Ehrlenmeyer flasks per lake

2.0 Pre-Cleaning Tubing and Mixing Jug

2.1 Wash with non-phosphate detergent & tap water rinse.

3.0 Sample Collection

3.1 Samples will be collected from an epilimnetic core, the top of the hypolimnion (if stratification occurs), and one meter above bottom.

3.2 For the epilimnetic core

- a. rinse tubing three times by lowering vertically over the side of the boat until it fills and then retrieving it allowing it to drain.
- b. Rinse mixing jug three times in surface water.
- c. Slowly lower tube vertically to the depth of the epilimnion as determined by the temperature profile so that it fills as it is lowered (epilimnion is the zone where the temperature changes less than 1 degree centigrade for each meter of depth).
- d. Place thumb over free end to create an air tight seal and double tube below the water line.
- e. Retrieve tube and drain into the mixing jug. Mix and pour 50 mls (at the bottom of the meniscus) into the Ehrlenmeyer flask, **DO NOT OVERFILL!**

3.3 For collection of discrete samples from the hypolimnion use the water bottle as described in section B3 and pour 50 mls into Ehrlenmeyer flasks.

3.4 Label flasks as follows ® followed by lake MIDAS number hyphen followed by a two digit depth of the core or discrete sample in meters followed by C for the core or G for grab. (Ex. R4567-06C).

3.5 Record number on PC for appropriate depth.

3.6 Store in cooler.

B5. SECCHI DISK TRANSPARENCY PROCEDURE

1.0 Equipment

Secchi disk

Calibrated line - Calibrated line refers to depth markings made against a standard tape measure. Metal chain is preferred, or other line that doesn't stretch.

Water scope

2.0 Procedure

2.1 Transparency determination is made on the shady side of the boat.

2.2 Sunglasses must not be worn. If photogray prescription are worn, note this on field sheet.

2.3 Place glassed end of water scope into the water, tilt to release air trapped between the glass and the water surface. Put face in contact with the other end to block as much light as possible from entering the scope.

2.4 Looking through the scope lower the Secchi disk on a calibrated line until it disappears from view and then raise the disk until it reappears.

2.5 The average of these depths is the Secchi disk transparency.

2.6 Record the reading on the PC.

C. SEDIMENT SAMPLING PROTOCOL

Sediment sampling is performed at the same location as water quality sampling, the deep hole.

SEDIMENT SAMPLING SHOULD NOT OCCUR UNTIL AFTER ALL OTHER SAMPLES AND MEASUREMENTS HAVE BEEN TAKEN, SO AS NOT TO INFLUENCE OTHER RESULTS BY WATER COLUMN DISTURBANCE.

1.0 Equipment & Supplies

Brass Ekman Dredge, messenger, line
Plastic spoons
Bucket
Brush
3 250 ml Nalgene polypropylene bottles/lake

2.0 Pre-Cleaning & Decontamination of Ekman Dredge and plastic spoons.

2.1 Pre-Cleaning at DEP

- A. Scrub Ekman in tap water with detergent using a soft brush
Rinse with tap water and air dry.
- B. Acid wash plastic spoon in 10 % fuming HCL and rinse with distilled water 3 times.

2.2 Decontamination Between Grab Samples At Same Location

- A. Rinse with lake water.
- B. Collect next aliquot.

2.3 Decontamination Between Lakes

- A. Scrub Ekman with brush in lake water at the old site, rinse in lake.
- B. Rinse Ekman in lake water at new site before taking sample.

3.0 Sample Collection

- 3.1 Tie off end of line to boat before lowering dredge overboard.
- 3.2 At index site (deepest site in lake), lower Ekman Dredge slowly until it contacts the bottom.
- 3.3 Keeping line taut and vertical release messenger to trigger closure of dredge.
- 3.4 Carefully raise the dredge to the lake surface and carefully open trap doors at the top of the dredge.

- 3.5 Allow the water to drain off slowly. If dredge is full of sediment or the surface is so roiled that much will be lost with the water, discard the sample and get a new one.
 - 3.6 Place dredge in or over bucket.
 - 3.7 Using a new plastic spoon for each lake, collect sediment from the 0-2 cm depth being careful not to collect sediment that is in contact with the sides of the dredge.
 - 3.8 Fill the three bottles about 3/4 full. Place one spoonful in bottle #1, the second spoonful in bottle #2, etc. until all bottles are full.
 - 3.9 Place remaining sediment in a bucket until sample collection is complete.
 - 3.10 Rinse Ekman and utensil in lake water.
 - 3.11 Repeat, starting from 3.2 until 16 oz. container is filled, leaving a one-inch headspace.
- NOTE: Use both sides of the boat to avoid sampling in a previously disturbed area.**
- 3.12 Once containers are full, tighten lids and place in cooler on ice.
 - 3.13 Record depth, number of dredge samples collected, and sediment surface appearance on PC.
 - 3.14 Rinse equipment in lake water. Dump unused sediment overboard. rinse bucket in lake.
 - 3.15 Pre-clean all equipment as instructed above before using at another lake.
 - 3.16 At lab store sediment in freezer until picked up by DEP.

D. PACKAGING, TRANSPORT, AND TRACKING OF SAMPLES TO PARTICIPATING LABORATORIES

1.0 Field Team

- 1.1 The field team will package, label, preserve, record and transport all samples back to the office according to the procedures described above for each sample type.
- 1.2 At the office each sample will be stored according to the requirements specified in Table E of the Project Work/QA Plan.
- 1.3 At the end of the day field data will be downloaded from field PCs to a data disk in the office.

2.0 Maine DEP

- 2.1 DEP will collect the samples and transport them to the appropriate lab periodically.
- 2.2 DEP will collect the data disk at the same time as the samples are collected and enter the data into the main database at DEP.

3.0 ME HETL

- 3.1 HETL will check in samples by the unique user number on the label assigned in the field and track the sample through analysis.
- 3.2 HETL will report results by user number in electronic format specified by DEP.

4.0 U. ME ORONO

- 4.1 U. Me Orono will check in samples by the unique user number on the label assigned in the field and track the sample through analysis.
- 4.2 U. Me Orono will report results by user number in electronic format specified by DEP.

5.0 EPA REG I NERL

- 5.1 For split samples EPA Reg I NERL will check in samples by the unique user number on the label assigned in the field and track the sample through analysis.
- 5.2 HETL will report results by user number in electronic format specified by DEP.

E. FIELD QUALITY CONTROL PROCEDURES

1.0 Sample Duplicates

A **Sample Duplicate** is a second sample obtained following the same procedures as for the first sample. It provides information on the homogeneity of the matrix and the consistency with which samples are collected, preserved and analyzed. The sample duplicate result is not averaged with the sample, but is maintained in the data base as a quality control indicator.

Field duplicates are assigned sample numbers of their own, not the same numbers as original samples. Pre-labeled containers are identified as additional samples, not as duplicates, to reduce analytical bias.

Each sampling crew will collect one set of sample duplicates during the sampling season. The sample duplicates for the sediment and water matrices may be taken from different lakes, but within a matrix, all parameters must have sample duplicates from the same lake.

Sample duplicates will be collected for the following parameters:

Sediment - Mercury, Cadmium, Lead

Total Organic Carbon

Grain size

Percent moisture

Water - Anions/cations

Total Phosphorous

Dissolved Organic Carbon

Conductivity

pH

Temperature profile

Dissolved Oxygen profile

2.0 Equipment Blanks

An **Equipment Blank** is collected after routine decontamination of field sampling equipment is done. Blank water - DI-distilled water, or other water which does not contain target compounds, is poured into, or over, equipment and collected in the same containers used for project samples. The equipment blank provide information as to whether the source of contamination is the matrix or the equipment used to collect the sample. It also indicates if there is any cross-contamination between sample sites due to insufficient decontamination.

Equipment blank samples are noted as such on field sheets for the lake after which the samples were collected. They are generally not designated as such on container labels. However, to

avoid confusion in the lab, the equipment blank for sediment collection equipment should be labeled as such.

After routine decontamination of equipment upon completion of sampling a lake, each team will submit one equipment blank for each of the following parameters and pieces of equipment:

Metals (Hg, Cd, Pb), Organics & TOC

Ekman Dredge
Sediment sampling utensil

Mg, Ca, DOC

Water bottle

Total Phosphorous

Water "core" tubing

NOTE: Blank water free from target compounds will be supplied by the Maine HETL. The field crews should give the laboratory notice one week before the equipment blanks will be collected.

3.0 Split Samples

A **split sample** is a sample for which a sufficient quantity of sample is collected and split into two separate samples for analysis by two different laboratories. The two samples are treated identically regarding homogenization or mixing, preservation and other samples treatments in the field. Split sample analyses provides information regarding consistencies in analytical procedures and laboratory biases. This information indicates a level of confidence in that the data generated is comparable to other data generated by the same methods.

Fish fillets- split between U. ME and EPA NERL

Hg
Percent Moisture

Whole-fish - split between ME HETL and EPA NERL

Hg, Cd, Pb,
Chl-org., Pesticides
Lipids
Percent Moisture

Sediment - split between ME HETL and EPA NERL

Hg, Cd, Pb,
Percent Moisture

F. R-EMAP FIELD DATA FORMS AND PC SCREENS

DIRECTIONS

REMAP PAGE 1

TRANSACTION: _____

(ignore this field, it is for internal use only)

LAKE: _____

(enter the first 4 characters of the lake name)

MIDAS: _____

(enter the lake identification number)

DATE: _____

(enter the date mmddyy)

TIME: _____

(enter time in military format)

CREW: _____

(enter last names of crew members)

WIND DIR: _____

(enter one: N/NE/E/SE/S/SW/W/NW)

WIND VEL: _____

(enter estimation in mph)

CLOUD CVR: _____

(enter 0 = sunny bright, 1 = cloudy bright, 2 = heavy overcast)

LONG: ___° ___' ___" ___

(enter longitude from GPS)

LAT: ___° ___' ___" ___

(enter latitude from GPS)

SECCHI: _____

(enter secchi reading and M for meters or F for feet)

REMAP PAGE 2

DEPTH BOTTLE NUMBER

NOTE: in this and the following screen MC = meter core
and MG = meter grab.

TOTAL PHOSPHORUS:

____MC| R____-____

} (Enter the depth of sample in the leftmost fields and the

____MG| R____-____

} phos. bottle numbers consisting of the MIDAS # and depth

____MG| R____-____

} in the rightmost fields.)

CALCIUM/MAGNESIUM:

____MG| ____MG

} (Enter the depth of sample before MG and the

93E-DIN-____&____

} bottle numbers after DIN)

93E-DIN-____&____

}

DOC/VOC:

____MG| 93E-DIN-____

} (Same as above)

____MG| 93E-DIN-____

}

____MG| 93E-DIN-____

}

REMAP PAGE 3

DEPTH RESULT

ALKALINITY:

____MG _____

} (Enter the depth of samples in the leftmost fields and

____MG _____

} the results in the rightmost fields)

____MG _____

}

SEDIMENT DEPTH: _____ (enter lake depth where sample collected)

SED. SAMPLES: _____ (enter the number of dredge samples taken)

SEDIMENT BOTTLE #'S:

93E-DIN-_____ } (Enter the sediment sample bottle #'s)
93E-DIN-_____ }
93E-DIN-_____ }

REMAP PAGE 4

SED.NOTES:

_____ } (enter any notes pertaining to sediment sampling
_____ } ie., visual characteristics, smell, etc.)
_____ }
_____ }
_____ }

GENERAL NOTES:

_____ } (enter notes pertaining to all other aspects
_____ }
_____ }
_____ }
_____ }

NOTE: To save a record in add mode, you must go through all 4 screens and be sure to press ENTER at the last line of the last page. If you hit ESC, the record will not be saved. When you see the menu at the bottom, the ESC key will exit the program safely.

G. OPERATION OF TRIMBLE PATHFINDER GPS UNIT

H. OMNIDATA/YSI6000 SOFTWARE INSTALLATION AND OPERATING PROCEDURES

Enclosed is a disk with the software you'll need on your desktop computers for REMAP water quality monitoring. The disk includes batch files called INSTALLA and INSTALLB. Use INSTALLA to install the software from your A: drive **or** INSTALLB to install the software from your B: drive (depending on which drive matches the size of disk enclosed). The installation procedure will make a directory named REMAP1 on your C: drive then install the following: PC6000 (the YSI 6000 software), FILELINK (the program to download data from the OMNIDATA hand held computer), CONDCALI (a small database to enter the conductivity calibrations) and batch files for backing up data and a few other tasks.

To install, place the diskette in the appropriate disk drive, go to that drive, then type:

INSTALLA <ENTER> (if using the A: drive)

or

INSTALLB <ENTER> (if using the B: drive)

YSI SOFTWARE

The YSI 6000 requires the software PC6000 to configure and operate the sonde. There are a multitude of settings available, however very few of them will need modification for sampling under the REMAP project. **Before** you embark on your first sampling venture with the new equipment, you will need to become familiar with the PC6000 software as the OMNIDATA hand held computer can only display 1/4 of the screen at a time. You will also need to calibrate the pH and Specific Conductance probes prior to field use. These calibrations need to be done periodically to assure that the data is accurate. Please record the Date, Time and Type of calibration as well as the Sonde ID# (found on white label on sonde) in your field logbooks. Both pH and Specific Conductance should be calibrated daily. If after a couple of weeks the specific conductance of the standard has proven to be constant, you may calibrate every other day or every three days.

NOTE: When entering the number corresponding to a menu selection when using PC6000 on the Omnidata, often you will have to press the number followed by RETURN twice. Also, remember that F10 returns you to the first menu (may have to be pressed twice as well).

Connect the sonde to the computer's serial port using the sonde cable and if needed, the serial adapter. Make sure the 8 C cell batteries have been installed in the sonde. To start PC6000, from the C: prompt type:

cd\REMAP1 <ENTER>

followed by:

PC6000 <ENTER>

The PC6000 program should start. Across the top you will see a menu with 5 selections:

SONDE	-accesses sonde software
FILE	-allows you to open a file
SETUP	-allows configuration of display and communications
REALTIME	-displays a graph of parameters
EXIT	-exits the program

Selecting SONDE will connect you with the sonde and allow access to the sonde software.

[NOTE: If you get an error message indicating that the software can't connect to the sonde (or it hasn't connected after 5-10 seconds), check your cable connections and make sure that the batteries are installed in the sonde. Press F10 to return to the main PC6000 menu then try again. If the software still won't connect after checking these items, the serial port on your desktop computer may not be configured as Port 1. Press F10 to return to the main PC6000 menu, select SETUP, then change COMM PORT from 1 to 2. Press ESC to return to the main PC6000 menu and select SONDE again.]

Hopefully, you've connected to the sonde and you will receive a message to type the word MENU to start the sonde software.

The main sonde menu has eight options and looks like this:

```
-----  
-----  
Menu  
-----  
1. Run      5. System Setup  
2. Calibrate 6. Report Setup  
3. File     7. Sensor Setup  
4. Status   8. Diagnostics
```

Select option (0 for previous menu):

There is very little of this menu that you will actually utilize in the field. We have preset all of the YSI 6000 units prior to delivery. What follows is a brief explanation of what each menu (and subsequent submenus) does and a summary of what settings we've made. At the end of this document is a step-by-step summary of what needs to be done in the field which can be inserted in your field logbooks for quick reference.

You should note that the "Select option (0 for previous menu):" appears at the bottom of most screens; by pressing 0 you back-up through the menus. When you reach the main sonde menu (shown above) you must press F10 to get back to the Main PC6000 menu. Also, pressing the escape key will often return you to the previous menu.

5. System Set-up

The following submenu options appear:

1. Date -allows you to change date and time
2. Radix -allows change of decimal notation (. in the U.S.; , in Europe)
3. Communication -allows configuration of communication parameters; defaults are:
 1. 9600 baud
 2. 8 bits
 3. address 0
 4. kermit padding 0
4. Instrument ID -allows input of instrument ID# (already entered)

All of these items have been preset. You shouldn't have to make any changes during the course of the study.

6. Report Set-up

The following Submenu options appear:

1. Units - allows selection of units to report parameters with; the units used in this study follow:
 1. Temp: (1) Celsius
 2. Conductivity: (2) uS/cm
 3. Resistivity: (not applicable)
 4. TDS (not applicable)
 5. pH (1) pH
 6. Depth (2) Meters
2. Output - allows selection and order of parameters reported; it is imperative that all regions save files which have the same parameters reported in the same order. The order is:
D3A4BE12
(depth,temp,D.O.,Sp.Cond,ISE1-pH,voltage,date,time)
3. Page length - allows selection of page length for data file. **THIS MUST BE SET AS 0 SO THAT THE DATA CAN BE READ INTO OUR DATABASE!!!**
4. Reset to default -allows all unit settings to be reset to manufacturers defaults---**DO NOT SELECT THIS OPTION. THE REMAP DEFAULTS WE HAVE PRESET FOR YOU ARE NOT THE DEFAULTS REFERRED TO IN THIS OPTION!!!**

All of these items have been preset. You shouldn't have to make any changes during the course of the study.

7. Sensor Set-up

The following Submenu options appear along with the settings used for each sonde in this study:

1. Conductivity (2) Enable; cell constant (A=4.614, B=4.726, C=4.786, 1=4.679, 2=4.619, 3=4.632)
2. D.O. (2) Enable; 52 sec. warmup
3. ISE1 (2) pH
4. ISE2 -not used; do not select---program will exit
5. Depth (2) Enable; full scale (A=106.150, B=106.830, C=98.620, 1=102.650, 2=105.300, 3=103.400)
6. Battery (2) Enable
7. TDS -not used
8. Reset to default -do not select---Will reset to manufacturers defaults

Once again, all of these items have been preset. You shouldn't have to make any changes during the course of the study, however, you should be aware of what these menus control just in case the need to re-enter the REMAP defaults arises.

8. Diagnostics

This option allows diagnostics to be run on each of the sensors. You should not have to use this option.

2. Calibrate

This is a menu you will be using regularly.

1. Conductivity -asks for the conductivity of the standard in mS/cm: 0.971 (we are using a standard of 0.971mS/cm which equals 971 uS/cm).
- the software will return the value it obtains for the standard; record this value in your field logbook and enter it into the database (also installed at the same time the PC6000 software was) called CONDCALI. These are used to calculate correction factors for the data and are extremely important to record. You will be calibrating the conductivity probe daily prior to leaving the office.
2. D.O. % -this is used to calibrate D.O. Further details can be found at the end of this document. You will be calibrating the D.O. just prior to obtaining D.O. profiles at each lake.
3. D.O. mg/L -not used

4. pH 2 point -you will be using this pH calibration daily prior to leaving the office; it is the two buffer method using a pH 7.0 buffer first, followed by the pH4.0 buffer. Further details can be found at the end of this document.
5. pH 3 point -not used
6. Depth -you will be calibrating depth just prior to taking profile data; you simply select 6 then press any key to zero the sensor to local barometric pressure. After depth is zeroed, press any key as indicated, to return to the calibrate menu.

1. Run

The following submenu(s) appear(s):

1. Discrete sample
 1. Start discrete -selected when you are ready to get readings
 2. Site description -name of data file; for REMAP use ME???? where ???? is the Midas # for the lake.
 3. Sample interval -sample interval should be set to 4 seconds (can be longer if needed)
 4. Close file -select when done obtaining readings at a given lake
 5. Set auto -stop timer-automatically shuts off sampler according to number of minutes entered; enter 15-30 minutes depending on how much experience you have with the unit and how deep the lake is.
2. Conditional sample -not used
3. Unattended sample -not used

4. Status

This will give you a quick summary of the following:

- EMS Version 1.02
- Current date & time
- Sensors
- Battery voltage
- Free FlashDisk space (KBytes)

You will use this primarily for checking battery voltage. You should replace the batteries when the voltage falls below 10V. The unit will cease to function when the batteries fall below 8V. The 'Free Flash Disk Space' refers to the amount of memory left in the sonde for file storage.

3. File

The following submenu appears:

1. Directory -returns a list of files in the sonde directory
2. Upload -used to copy a file from the sonde to the Omnidata; when selected will display the following file format choices:
 1. PC6000 -readable by the PC6000 software on the Omnidata
 2. Comma & "" Delimited -used for importing data into a Database

3. ASCII Text -used for importing data into a text editor

Once a format has been chosen, the program displays a list of files in the directory. Enter the file number to upload as requested, then the program will display the following:

Enter Starting date (/ /):
Enter Starting time (: :):
Enter STOPPING date (/ /):
Enter STOPPING time (: :):

There will be default dates and times in the parentheses based on the contents of the file; just select the defaults by pressing ENTER after each message.

If there is already a file by the same name on the Omnidata you will get an error message:

File already exists!
Overwrite file?
Press Y or N

If you press N, another message will appear allowing you to change the name:

Filename: FILENAME.EXT

When you upload more than one file format this message will appear after the first upload because the default name the sonde gives is the site description and the extension .DAT. For the REMAP project please use the following extensions for the respective file type:

PC6000	MEXXXX.DAT
Comma & "" Delimited	MEXXXX.DEL
ASCII Text	MEXXXX.ASC

- 3. Quick upload -works like the previous upload except that it skips the sonde directory display and automatically uses the last file created.
- 4. View file -allows you to pick a file from the sonde directory then view the contents.
- 5. Quick view -allows you to view the contents of the last file created.
- 6. Delete file -allows you to delete a file from the sonde directory
- 7. Format FlashDisk -will erase EVERYTHING on the sonde directory
- 8. Test FlashDisk - will also erase EVERYTHING on the sonde directory

Once you have become familiar with the sonde software, press F10 to return to the main PC6000 software with the following 5 menu selections:

SONDE
FILE
SETUP
REALTIME
EXIT

At this point, you can select EXIT if you wish. There are no more features you need to be familiar with for REMAP.

CONDCALI

This is a program in which to put the results of the conductivity calibrations. It has been installed on your desktop PC in C:\REMAP1. To access it, type:

```
CD\REMAP1 <ENTER>
CONDCALI <ENTER>
```

A data entry screen will appear. Enter the date, the number or letter associated with the Sonde (A,B,C,1,2, or 3) and the reading obtained from the standard solution. Press RETURN at the end of the line, then ESC to quit.

FILELINK

FILELINK is the utility you will be using to transfer files from the Omnidata to your desktop PC. There are three batch files which will utilize Filelink. One was put on your desktop PC during the software installation, the other has been installed on the Omnidata. To transfer the data files created by the YSI 6000 and the database program:

- (1) connect the Omnidata to your PC with the serial cable,
- (2) change to the appropriate directory on your PC by typing CD\REMAP1 then pressing RETURN.
- (3) put your desktop PC into 'slave' mode by typing SLAVE then pressing RETURN (this invokes a single line batch file with the exact syntax: FILELINK SLA COM1:115).
- (4) send copies of all the files created by the YSI 6000 from the Omnidata to your PC. From the Omnidata's C: drive, type SEND1 then press RETURN (this invokes a single line batch file with the exact syntax: FILELINK TRA ME??????.* COM1:115) NOTE: IT IS VERY IMPORTANT TO ENTER THE SITE DESCRIPTION (which names the data file) as ME???? WHERE ???? IS THE MIDAS NUMBER FOR THIS COMMAND TO WORK!!!).
- (5) send a copy of the database which stores the other data/info (secchi, weather, etc.) from the Omnidata to your PC. From the Omnidata's C: drive, type SEND2 then press RETURN (this invokes a single line batch file with the exact syntax: FILELINK TRA OMNI1.DBF COM1:115).
- (6) Press CTRL and C on your PC to exit slave mode.

MISC.

There are also two batch files named BACKUPA and BACKUPB installed on C:\REMAP1\ which will copy all of the following files to either your A: or B: drive respectively:

CONDCALI.DBF	-the conductivity calibration database
OMNI1.DBF	-the secchi,weather,bottle #, etc. database
ME????.*	-all of the files created by the YSI 6000

To do the backup type:

CD\REMAP1 <ENTER>

followed by:

BACKUPA <ENTER> (to copy to the A: drive)

OR

BACKUPB <ENTER> (to copy to the B: drive)

Please do a backup after doing file transfers.

OMNI1 DATABASE ON OMNIDATA COMPUTERS

Water quality and sediment field data collected under the REMAP project will be inputted directly into the Omnidata hand held computer. Omni1 is the name of the database program that will hold all of the information other than the profile data collected during the REMAP water quality sampling.

To access the program turn on the Omnidata. If the Omni is owned by DEP (id's A, B and C), go to the C: drive, type:

OMNI1 <ENTER>

If the Omni is owned by EPA (id's 1, 2, and 3), go to the D: drive, type:

OMNI1 <ENTER>

REMAP PAGE 1 will be displayed with test data. At the bottom of the screen there are three menu options: F3|ADD F5|EDIT ESC|QUIT . Press F3 to add data. There will be four pages or screens for data entry which look like these:

DIRECTIONS

REMAP PAGE 1	
TRANSACTION: _____	(ignore this field, it is for internal use only)
LAKE: _____	(enter the first 4 characters of the lake name)
MIDAS: _____	(enter the lake identification number)
DATE: _____	(enter the date mmddyy)
TIME: _____	(enter time in military format)
CREW: _____	(enter last names of crew members)

WIND DIR: ____ (enter one: N/NE/E/SE/S/SW/W/NW)
WIND VEL: ____ (enter estimation in mph)
CLOUD CVR: _ (enter 0 = sunny bright, 1 = cloudy bright, 2 = heavy
overcast)
LONG: __o__'__"__ (enter longitude from GPS)
LAT: __o__'__"__ (enter latitude from GPS)
SECCHI: ____ (enter secchi reading and M for meters or F for feet)

REMAP PAGE 2
DEPTH BOTTLE NUMBER
TOTAL PHOSPHORUS:
____MC| R____-____
____MG| R____-____
____MG| R____-____
CALCIUM/MAGNESIUM:
____MG| ____MG
93E-DIN-____&____
93E-DIN-____&____
DOC/VOC:
____MG| 93E-DIN-____
____MG| 93E-DIN-____
____MG| 93E-DIN-____

NOTE: in this and the following screen MC = meter core
and MG = meter grab.
} (Enter the depth of sample in the leftmost fields and the
} phos. bottle numbers consisting of the MIDAS # and depth
} in the rightmost fields.)
} (anions/cations: Enter the depth of sample before MG
} Enter bottle numbers (MIDAS no.) after DIN)
}
} (Same as above)
}
}

REMAP PAGE 3
DEPTH RESULT
ALKALINITY:
____MG _____
____MG _____
____MG _____

} (Enter the depth of samples in the leftmost fields and
} the results in the rightmost fields)
}

SEDIMENT DEPTH: _____ (enter lake depth where sample collected)
SED. SAMPLES: _____ (enter the number of dredge samples taken)

SEDIMENT BOTTLE #'S:
93E-DIN-____ } (Enter the sediment sample bottle #'s)
93E-DIN-____ }
93E-DIN-____ }

REMAP PAGE 4

SED.NOTES: } (enter any notes pertaining to sediment sampling
_____ } ie., visual characteristics, smell, etc.)
_____ }
_____ }
_____ }
_____ }

GENERAL NOTES: } (enter notes pertaining to all other aspects
_____ }
_____ }
_____ }
_____ }
_____ }

NOTE: To save a record in add mode, you must go through all 4 screens and be sure to press ENTER at the last line of the last page. If you hit ESC, the record will not be saved. When you see the menu at the bottom, the ESC key will exit the program safely.

I. OMNIDATA/YSI6000 CALIBRATION PROCEDURES

Conductivity

You will be calibrating the conductivity probe daily prior to leaving the office. Remove calibration cup and gently remove as much water as possible from the probe guard and probe shafts with a soft paper towel. Position end of sonde in conductivity calibration jar and wait at least 1 minute for temperature equilibration. Using PC6000/SONDE/CALIBRATE select CONDUCTIVITY. The software asks for the conductivity of the standard in mS/cm: 0.971 (we are using a standard of 0.971 mS/cm which equals 971 uS/cm). The software will return the value it obtains for the standard; record this value in your field logbook and enter it into the database CONDCALI. Rinse the probe in tap water, gently dry once again and proceed to pH calibration.

pH

You will be using this pH calibration daily prior to leaving the office; it is the two buffer method using a pH 7.0 buffer first, followed by the pH 4.0 buffer. The probe should be dried gently. Position end of sonde in pH 7 buffer calibration jar and wait at least 1 minute for temperature equilibration. Using

PC6000/SONDE/CALIBRATE select pH 2 POINT. Press any key to calibrate to pH 7. When pH 7 calibration is complete, press any key as instructed. Rinse the probe in tap water, gently dry once again and proceed to pH 4 calibration. Position end of sonde in pH 4 buffer calibration jar and wait at least 1 minute for temperature equilibration. Press any key to continue. When prompted, enter the value of the second buffer (pH 7). When calibration is complete, press any key as instructed to return to the previous menu. Rinse the probe in tap water, rewet sponge and replace calibration chamber.

Depth and Dissolved Oxygen (mg/L)

Calibrate depth and dissolved oxygen at each lake. Using PC6000/SONDE/CALIBRATE select DEPTH then press any key to zero the sensor to local barometric pressure. After depth is zeroed, press any key as indicated, to return to the calibrate menu.

Check the membrane on the D.O. probe for bubbles or tears and replace if needed. The calibration procedure for D.O. requires that the calibration chamber has been installed on the probe for 10-15 minutes prior to performing the calibration to assure it is filled with water saturated air. Return to the main Sonde menu and select RUN / DISCRETE SAMPLE / SAMPLE INTERVAL Enter 4 seconds. Next, select START DISCRETE SAMPLE and in 4 seconds data will begin to display. Wait for the D.O. & temperature readings to stabilize (note: if the sonde has been taken from shade and placed in the sun this will take a long time; try to keep the unit at the same temperature during this procedure). Press **ESC** to return to the main menu. Next select CALIBRATE/D.O. %. Enter a barometric pressure of 760 mm Hg, press **ENTER** and wait approx. 1 minute for the calibration to be completed. When complete press any key as indicated.