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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM
NEAR COASTAL COMPONENT
1990 DEMONSTRATION PROJECT

FIELD OPERATIONS MANUAL

by

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NOTICE

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ABSTRACT

The Environmental Monitoring and Assessment Program (EMAP) is a Nation-wide program being initiated by the Environmental Protection Agency (EPA) in 1990. The purpose of this program is to annually monitor the condition of all the Nation's major ecosystems. The Near-Coastal component (EMAP-NC) will conduct a Demonstration Project in the Virginian Province (Cape Cod, MA to Cape Henry, VA) in the summer of 1990. The purpose of this project is to produce data to be used in the characterization of the bays and estuaries of the Virginian Province, and to evaluate logistics, indicators, sampling methods, etc. Field operations are scheduled to begin in June, 1990.

Three teams of field personnel will be required to complete data collection activities. Each team will be comprised of two 4-person crews, alternating on a five day cycle. Teams will be supplied with a 24 foot workboat on a trailer, a four wheel drive pick-up truck, a modified van (to serve as a mobile laboratory), and all sampling gear and supplies required to complete all activities. All field activities will be monitored and coordinated by the Field Operations Center at the Environmental Research Laboratory in Narragansett, RI (ERL-N).

Field crews will collect electronic data (temperature, salinity, dissolved oxygen, pH, transmissivity, fluorescence and Photosynthetically Active Radiation) as well as sediment and water samples, fish, and bivalves. Data will be recorded on data sheets as well as in an on-board computer. All data entered into the computer in the field will be uploaded to the ERL-N VAX computer on a daily basis via modem communications.

This manual describes, in detail, all field collection methods, including Quality Assurance (QA) and safety. It will serve a a guide for field personnel and will be carried on the boats at all times. An effort has been made to anticipate problems and questions that may arise, and to include information on resolving them. All methods, as described in this manual, must be adhered to by all field personnel. Any changes in methods will be communicated to the field crews by the Field Coordinator or Demonstration Project Manager. As [if] methods change, an updated version of the pertinent section[s] will be prepared and provided to the field crews.

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Portions of this document were copied from other EMAP-NC documents (U.S. EPA, 1990 and Schimmel, 1990).

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SECTION 1
INTRODUCTION

This document is intended to serve as an operations and training guide for field personnel involved in the Near Coastal (NC) component of the Environmental Monitoring and Assessment Program (EMAP). This document describes all aspects of field operations and prescribed collection methods for the NC Demonstration Project. DEVIATION FROM THESE METHODS BY THE FIELD CREWS REQUIRES APPROVAL THROUGH THE PROJECT MANAGER (PM) OR FIELD COORDINATOR (FC). If methods are revised, the FC will provide field personnel with updates of pertinent sections.

1.1 Environmental Monitoring and Assessment Program

The Environmental Monitoring and Assessment Program (EMAP) was designed to periodically assess the ecological condition and health of the Nation's ecological resources. As a regulatory agency, the U.S. Environmental Protection Agency (EPA) is charged with the mission to set environmental policy, obtain funds for research and development, and evaluate the efficacy of environmental regulations in preserving the Nation's natural resources. EMAP provides a strategy to identify and bound the extent, magnitude, and location of environmental degradation and improvement on a regional scale. When fully implemented, EMAP will answer the following questions:

- What is the current status and extent of our ecological resources (e.g., estuaries, lakes, streams, forests, grasslands, etc.) and how are they distributed geographically?
- What percentages of the various resources currently appear to be adversely affected by pollutants and other man-induced environmental stress?
- What resources are degrading, where, and at what rate?
- What are relative magnitudes of the most likely causes of adverse effects?

- Are adversely affected ecosystems improving as expected in response to control and mitigation programs?

To answer the above questions, EMAP has three major objectives:

1. To estimate the current status, extent, changes, and trends in indicators of the Nation's ecological resources on a regional basis with known confidence;

2. To monitor indicators of pollutant exposure and habitat condition, and to seek correlative relationships between human-induced stresses and ecological condition that identify possible causes of adverse effects; and

3. To provide periodic statistical summaries and interpretive reports on ecological status and trends to the EPA Administrator and to the public.

EMAP is focusing on the Nation's major ecosystems including surface fresh waters, rangelands and deserts, forests, wetlands (including salt marshes), agroecosystems, and near coastal waters. All the above goals and questions are relevant to each ecosystem, including near coastal waters.

1.2 EMAP Near Coastal

The Near Coastal component of EMAP (EMAP-NC) is a joint EPA/National Oceanic and Atmospheric Administration (NOAA) Program that is designed to eventually monitor the waters, sediment, and biota from the head of tide to the Outer Continental Shelf. This program will complement and may eventually merge with NOAA's existing Status and Trends Program for Marine Environmental Quality to produce a single, cooperative, coastal and estuarine monitoring program.

In addition to meeting the overall goals of EMAP, the Near Coastal component is addressing specific environmental problems. The problems specifically applicable to near

coastal waters are: low dissolved oxygen concentrations, eutrophication, chemical and biological contamination, habitat modification, and cumulative impacts.

1.2.1 Low Dissolved Oxygen Concentrations

Well oxygenated water is critical to support a balanced aquatic community. Low dissolved oxygen concentrations in water may reduce or eliminate short- and long-living vertebrate and invertebrate species (e.g., reduced species composition and biomass) and allow for the existence of smaller, opportunistic species that may not be as compatible with ecosystem stability or human needs.

1.2.2 Eutrophication

The process of eutrophication, the over-enrichment of water bodies with nutrients and minerals that results in an excess in primary production, can cause severe reductions in the overall stability and productivity of that water body. Symptoms of stress associated with eutrophication include (but are not limited to: widely fluctuating and often acutely toxic low dissolved oxygen (DO) concentrations; reduced water clarity; presence of nuisance algal blooms; alterations in benthic biomass, abundance and species composition; changes in shellfish growth or survival; and reduced acreage of submerged aquatic vegetation (SAV).

1.2.3 Contamination

The problem of contamination is manifested in several ways, including the chemical contamination (residues) of anthropogenic materials or excessive naturally-occurring materials that result in unacceptable concentrations in marine sediments, water, and biota; pathogen contamination of sediments, water and biota generally through human waste; and toxicity of water, sediment, and biota caused by excessive amounts of either chemicals or pathogens. The overall effect is to render marine resources unsuitable for human (or non-human) consumption.

1.2.4 Habitat Modification

The modification (and general loss) of specific habitats within the near coastal environment is a critical problem. Specifically, habitats such as wetlands and SAV have been significantly reduced, therefore depleting critical spawning and nursery areas for the production of living resources deemed important to man, including fish and shellfish. They

also help improve water clarity by reducing soil erosion and buffering coastlines from the direct effects of coastal storms.

1.2.5 Cumulative Impacts

The cumulative effects of the above stressors on the near coastal system are likely to elicit responses that result in decreases in overall productivity, or losses in diversity and resilience. These general effects may result in reductions in fish and shellfish recruitment, growth, and survival and increases in pathology (fin rot, cancers, and other lesions).

1.3 Virginian Province Demonstration Project (DP)

The Demonstration Project (DP) for near coastal waters will occur during the Summer of 1990. The objectives of the project are to:

1. Provide, on a pilot basis, an estimate of the extent of degraded estuarine resources in the Virginian Province to demonstrate the usefulness and ease of presentation of the data resulting from the EMAP design.

2. Evaluate the specificity, sensitivity, reliability, and repeatability of the responses of the selected indicators over a broad range of environmental conditions.

3. Identify and resolve, before the implementation phase (FY 1991), logistical problems associated with the program design.

4. Develop, evaluate, and refine sampling methods for indicators of near coastal environmental quality.

5. Develop data handling, quality assurance, and statistical procedures for efficient analysis and reporting of the data.

6. Collect the information necessary to evaluate alternative sampling designs and to establish appropriate Data Quality Objectives (DQOs) for the Program.

Information obtained from the DP will also be used to refine the EMAP design, and the study itself will serve as a model for implementing EMAP projects in other regions and for other ecosystem types.

The strategy for accomplishing the above goals will be to field test the EMAP Near Coastal indicators and network design by conducting a demonstration study in the estuaries of the Virginian Province (Mid-Atlantic Region). Estuaries were selected as the target ecosystem type because their natural circulation patterns concentrate and retain pollutants. Estuaries are also spawning and nursery grounds for many valued living resources, and estuarine watersheds receive a large proportion of the pollutants discharged to the Nation's waterways.

EMAP-NC is being implemented in the Virginian Province for the following reasons:

1. There is a high level of public concern that estuarine resources in this region are degrading at a faster rate than those in other regions.

2. Information obtained from the 1990 field program could be used to support many forthcoming management decisions, including development of a restoration plan for the New York Harbor Complex; development of monitoring and management plans for Delaware Bay, Narragansett Bay, Buzzards Bay, and the Long Island Sound National Estuary programs; and evaluation of the effectiveness of the Chesapeake Bay management plan.

3. Many of the proposed indicators and sampling approaches have been tested and validated for broad regions of the Virginian Province.

4. Proximity to the Environmental Research Laboratory at Narragansett, Rhode Island (ERL-N) will facilitate resolution of many logistical problems.

Although the Virginian Province extends beyond Cape Henry to Cape Hatteras, the area from Cape Henry south to Cape Hatteras is excluded from this Province for the purpose of the DP. Splitting Cape Hatteras into two separate monitoring activities would unnecessarily

complicate the Program and therefore will be sampled as part of the Carolinian Province (Cape Hatteras to southern Florida).

The purpose of this document is to describe, in detail, all aspects of proposed field activities for the Virginian Province Demonstration Project. This includes all sampling activities required for meeting the objectives listed above. This manual is carried on board each boat and mobile lab and should be consulted by crew members if there are any questions regarding procedures.

SECTION 2
OVERVIEW OF FIELD SAMPLING ACTIVITIES

2.1 Sampling Period

All sampling for the DP will occur during the period from June 19, 1990 to September 30, 1990. This Index Period is broken down into three sampling intervals, with different sampling activities being performed in each interval. The first interval begins on June 19, 1990 and continues until July 18, 1990. The second interval extends from July 19, 1990 to August 30, 1990 and the third from September 1, 1990 to September 30, 1990. Section 12 describes the station types sampled in each of these intervals, and the sampling activities performed at those stations. Prior to the start of any sampling activities, all personnel will undergo thorough training.

During the summer Index Period, 217 stations will be sampled. Some station types are visited on more than one occasion, with the total number of station visits being 585.

2.2 Classification Scheme

Virginian Province estuarine waters were classified into three size categories: large estuaries, large tidal rivers, and small estuarine systems. (See Near Coastal Program Plan for 1990 (U.S. EPA, 1990) for further details.) These three classes represent estuarine systems with different behavior in relation to potential stressors. In addition, it makes sense to monitor the status of estuaries of a particular size range in terms of potential management consequences. The large size category was expected to be rather small in number and thus adequate samples would be expected to fall within each large estuarine system to permit rough status estimates of these individual, large estuaries (e.g., Chesapeake Bay, Long Island Sound).

The size classification uses the following associative criteria:

Large: Surface area > 100 mi^2 and aspect (Length/Average Width) < 20; 12 systems (Surface Area = 6186 mi^2). Examples: Chesapeake Bay, Long Island Sound, Buzzards Bay.

Large Tidal Rivers: Surface area > 100 mi^2 and aspect > 20; 5 systems (Surface Area = 1104 mi^2). This class includes the Hudson River, Potomac River, James River, Delaware River, and the Rappahannock River.

Small Estuarine Systems: All remaining estuarine systems within the Virginian Province with surface areas > 1.0 mi^2; 132 systems (Surface area = 1490 mi^2). Examples: Barnegat Bay, Mystic River, Maurice River, Baltimore Harbor.

2.3 Sampling Design

The Near Coastal sampling design combines the strengths of systematic and random sampling with our understanding of estuarine systems. It provides a design that will allow unbiased estimates of the status of the Nation's near coastal systems, the variability associated with that status, its spatial and temporal components, and the temporal trends associated with changes in the near coastal systems.

The objective of the sampling design is to provide a statistically defensible strategy to collect information concerning the Near Coastal indicators and their variability. The design will remain flexible to alternative future uses and yet is logistically reasonable and implementable.

In developing the sampling design, a list frame was used to represent the population of estuaries in the United States. This list frame was subdivided to represent all estuarine systems within the Virginian Province with a surface area greater than 1.0 square mile. The Virginian Province list frame was subdivided into three sampling sub-populations representing small estuaries and tidal rivers, large tidal rivers, and large estuaries (as described in Section 3.3 (Classification) of the Program Plan (U.S. EPA, 1990)). The 1990 Near Coastal sampling design is based on a single annual sampling season (i.e., index period) of each of these near coastal classes taken to:

- Provide the basic information necessary to plan the implementation of the monitoring program in the Virginian Province in 1991;
- Test the reliability of the selected core indicators (and some research indicators) to discriminate between sites that are clearly affected and those that appear unaffected.

- Generate descriptive statistics concerning the indicator attributes and evaluate their distributions.

2.4 Indicators of Ecosystem Health

The primary goal of EMAP is to provide an assessment of overall ecosystem health. To accomplish this goal for the near coastal ecosystem, a number of "indicators" of ecosystem health have been proposed. These indicators have been classified as core, developmental, or research indicators.

Core indicators are those for which there presently exists sufficient data to define the sensitivity and reliability of responses to stress with a high degree of confidence. The variability of core indicators over the Index Period is expected to be small. Core indicators for the EMAP-NC Demonstration Project are:

- sediment contaminant concentrations,
- sediment toxicity,
- benthic species composition and biomass,
- salinity,
- sediment characteristics (grain size, organic carbon content, percent water), and
- water depth.

Developmental indicators are those indicators for which the sampling methods are not well refined, or for which only limited data are available on their reliability or sensitivity. In addition, the variability of these indicators over the Index Period is unknown. One important goal of the DP is to provide the information needed to assess the reliability, sensitivity, and variability of these indicators, and to develop appropriate sampling methods. Developmental indicators for the DP are:

- dissolved oxygen concentration,
- contaminants in fish flesh,
- gross pathology of fish, and
- fish community composition.

Research indicators have the potential to eventually become incorporated into the program as core indicators after much additional investigation. Sampling methods are only partially developed and the reliability, sensitivity, and variability of these indicators are unknown. Research indicators will be tested at only a small number of stations for which the physical and chemical conditions are known (Indicator Testing and Evaluation Stations - see Section 12). Research indicators for the EMAP-NC Demonstration Project are:

- continuous measurements of dissolved oxygen concentration,
- relative abundance of large burrowing shellfish,
- tissue contaminants of large bivalves,
- histopathology of fish populations,
- apparent redox potential discontinuity (RPD), and
- water column toxicity.

2.5 Site Reconnaissance

Prior to the start of field activities, a thorough reconnaissance of the Virginian Province will be performed. This includes determining the locations of boat ramps, hotels, and dry ice suppliers; visiting any stations that may fall in water too shallow for boats; and attempting to identify any potential problems that the field crews may face during the Index Period. The results of this reconnaissance can be found in Appendix A.

SECTION 3
DESCRIPTION OF FIELD TEAMS

3.1 Personnel

For the DP, three teams of field personnel are required to accomplish all activities. Each of these teams is comprised of two 4-person crews. Each crew is made up of a Crew Chief and three crew members. One of the Crew Chiefs also serves as the Team Leader, who is ultimately responsible for all equipment and activities assigned to his/her team. This design is outlined in Figure 3.1.

All field personnel are contract workers, employed by Science Applications International Corporation (SAIC) or Versar, Inc. SAIC personnel are based in Rhode Island, and Versar personnel in Maryland. Crews 1A, 1B, and 2A are comprised of SAIC employees, and crews 2B, 3A, and 3B of Versar personnel.

The two crews comprising a team work alternating schedules, each working five consecutive days then having five days off. Operating on a longer schedule could result in fatigue and a subsequent reduction in data quality. A shorter schedule results in more days in transit (crews being paid to travel between their base location and the field) and is therefore more expensive. Five days was chosen as an efficient compromise.

Team Leaders are responsible for the overall operation of their teams. This includes tracking equipment and supplies, and progress made in sampling activities. Crew Chiefs are responsible for direct supervision of their crews, sample tracking, quality assurance (QA), and communications with the EMAP-NC Command Center (including the transfer of electronic data - see Section 11). All decisions pertaining to field operations and safety are the responsibility of the Crew Chiefs.

During the transfer of crews, it is the responsibility of the Team Leader to assure that all pertinent information be transferred from the crew leaving for home to the crew coming on duty. This includes the stations sampled by the crew going off duty, any problems or suggestions, the status of any samples in the mobile lab that may need to be shipped by the crew starting their shift, a list of supplies that are running low, and any other information that might be needed or helpful to the crew coming on duty.

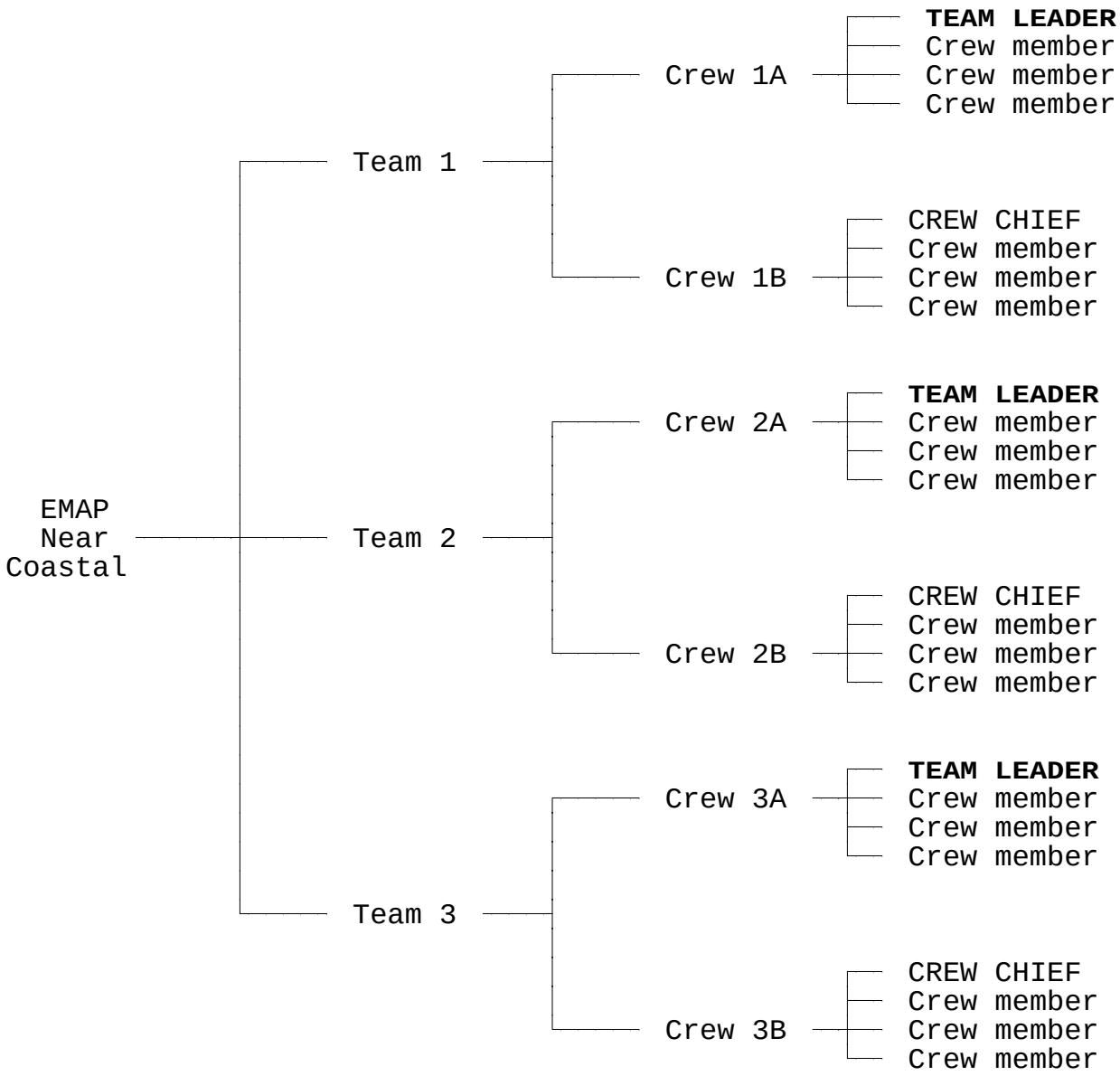


Figure 3.1. Manpower distribution for the Virginian Province Demonstration Project.

3.2 Station Assignments

As stated above, three teams are needed to sample all stations during the Demonstration Project. Team 1 is responsible for all stations from Cape Cod west to the Hudson River, excluding those stations in New York Harbor. Team 2 has been assigned those stations in New York Harbor, all stations in New Jersey and Pennsylvania, all stations in Delaware except for those along the Delmarva Peninsula, and stations in the Maryland portion of the Chesapeake Bay north of Station 65. Stations in the remainder of the Chesapeake Bay and all tributaries south of the Potomac River (inclusive), and along the Delmarva Peninsula have been assigned to Team 3. Maps of these regions are included as figures 3.2 to 3.4. A listing of stations, by team, can be found in Appendix B.

3.3 Equipment

Each team is provided with all the equipment and supplies required to perform all sampling activities. This includes a 24-foot boat on a trailer, a four-wheel drive (4WD) pick-up truck to tow the boat, a 15-foot parcel van to serve as a mobile laboratory, a station wagon, two field computers, marine-band VHF radios, a cellular telephone, one Sea-Bird CTD profiling instrument, one benthic grab sampler, one Rocking Chair dredge, two *Go-Flo* water sampling bottles, two trawl nets, 13 deployable DO monitoring instruments (Hydrolab DataSonde 3 dataloggers), and all additional supplies necessary to successfully complete sampling for all indicators. A complete list of equipment is provided in Appendix C.

Whereas all equipment required for obtaining samples is carried by the teams at all times, supplies (e.g., sampling bottles, floppy disks, etc.) are stored at one of two Base Facilities (see Section 6) and brought to the team by returning off-duty crews as required. Supplies can also be restocked on days when it is convenient for the on-duty crew to stop at their Base.

3.3.1 Boats

Each team is supplied with a 24-foot Romarine "Chesapeake"-style work boat equipped with twin 155 Hp commercial Johnson outboard engines, a mast and boom assembly, a hydraulic winch, and a self-contained hydraulic power supply. The purpose of the twin engines is to allow the crew to complete sampling activities should one of the engines fail. A single engine should be sufficient to bring the boat to a plane. The on-board navigation system consists of a Loran C unit

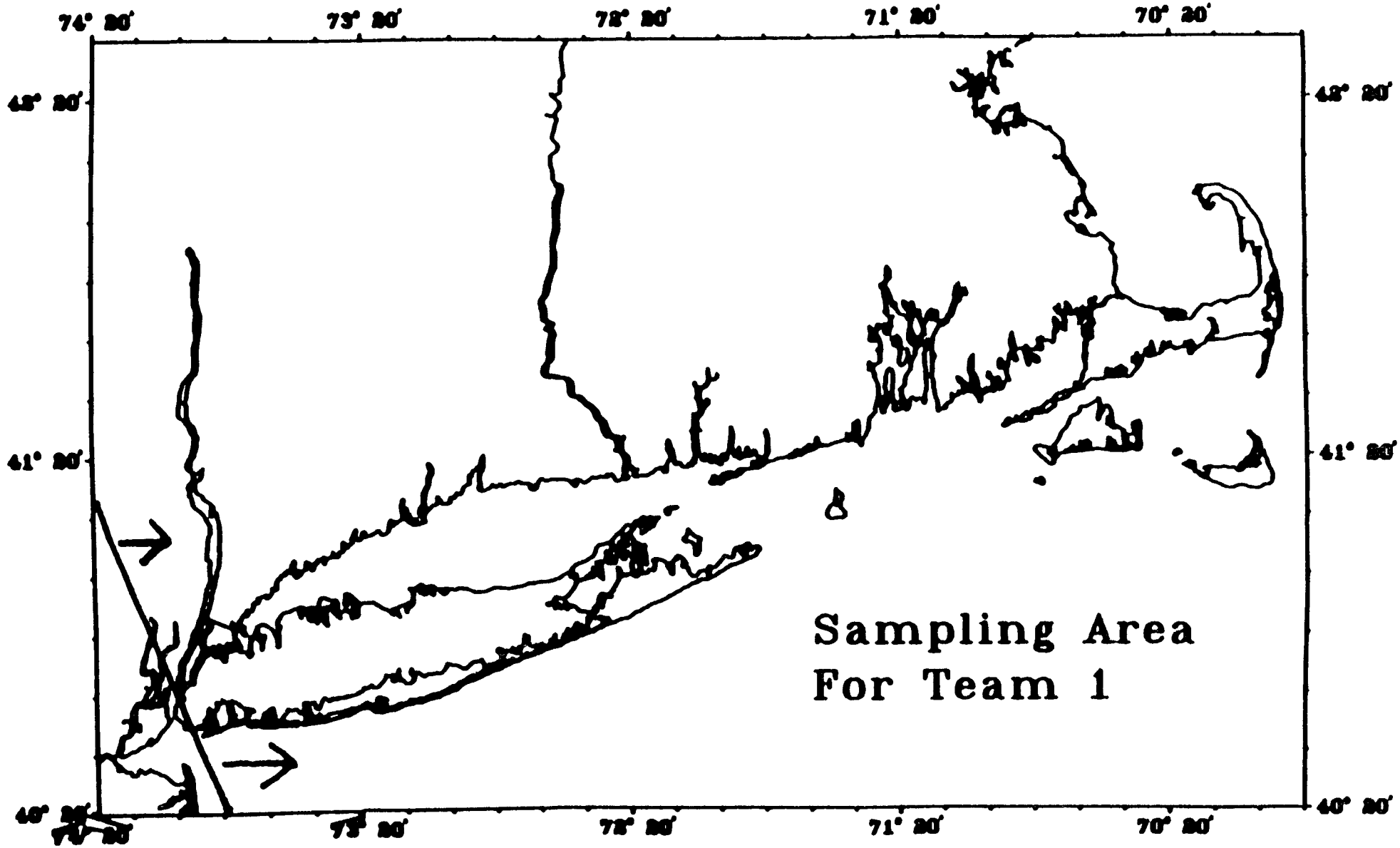


Figure 3.2. Map of sampling area for Team 1.

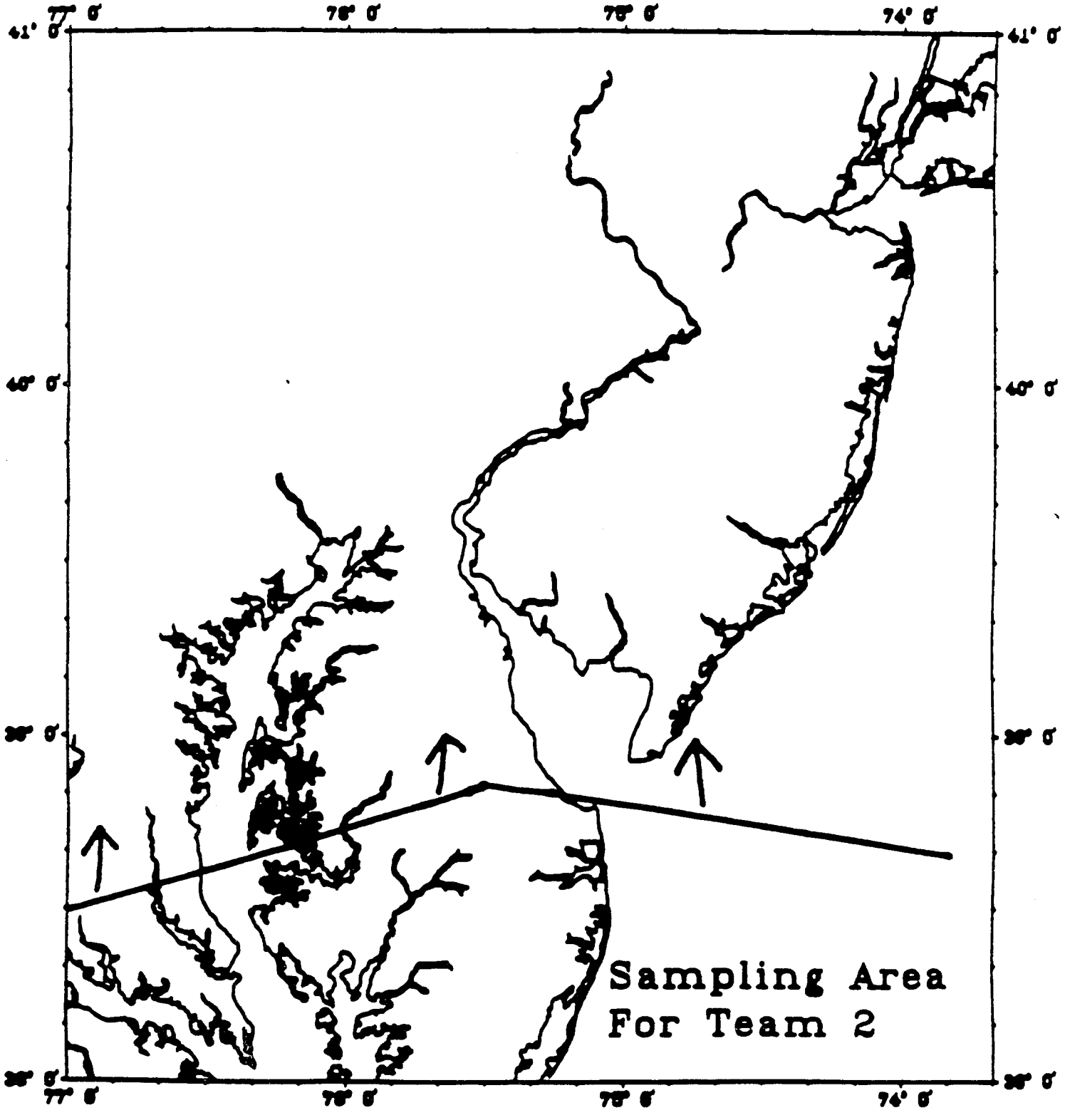


Figure 3.3. Map of sampling area for Team 2.

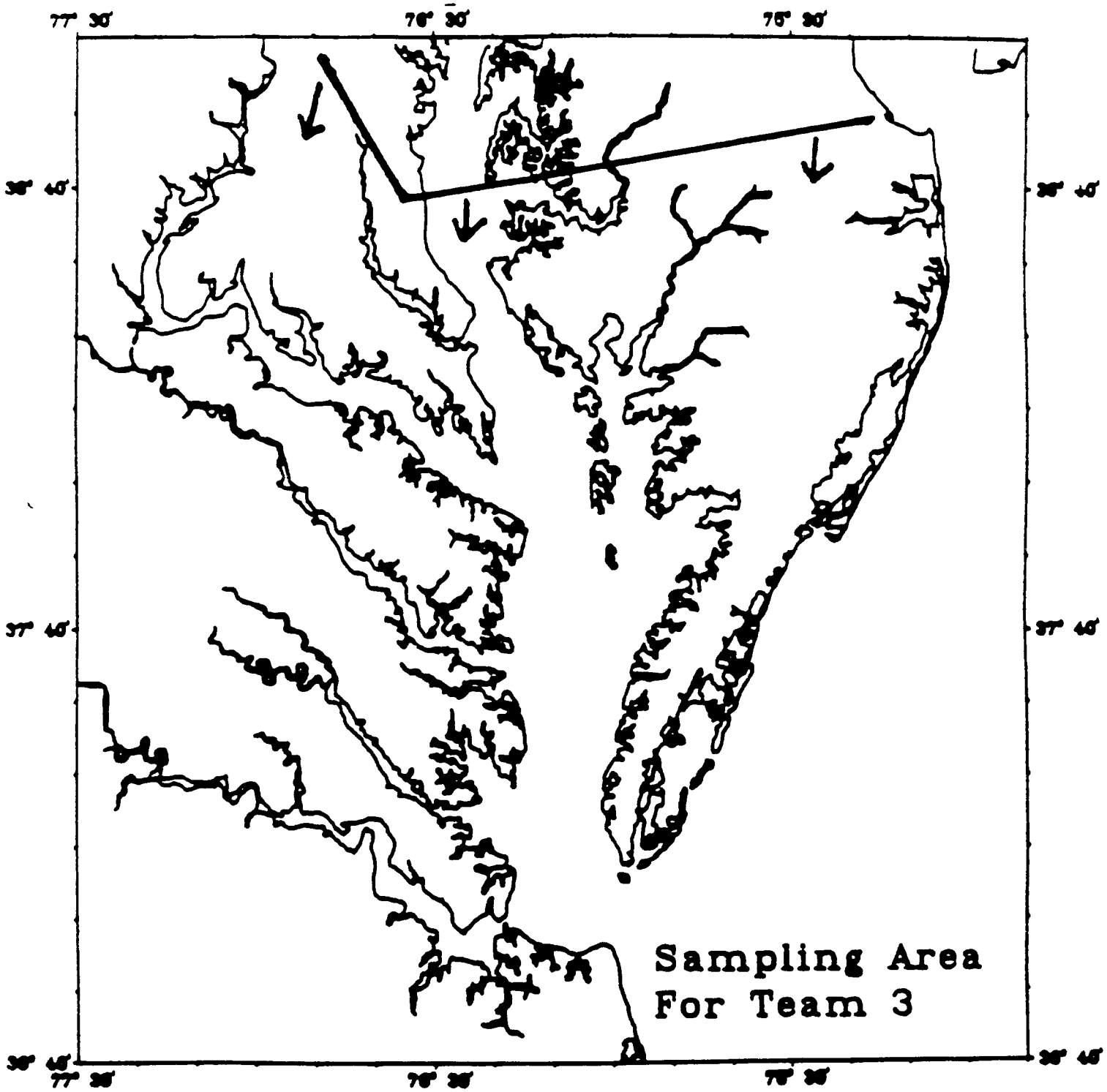


Figure 3.4. Map of sampling area for Team 3.

and a Global Positioning System (GPS) unit interfaced with computerized navigation software contained on a GRiD laptop computer. In addition, each boat is equipped with radar, two marine VHF radios, a compass, a depth finder, a tool kit, and all required and suggested safety equipment. One completely outfitted spare boat is stored at ERL-N, and will be transported overnight to any team who needs a replacement.

3.3.2 Boat Trailers

Each boat is transported on a heavy-duty, dual-axle trailer (each axle equipped with inertial brakes), and equipped with a power winch, a spare tire, and spare rollers.

3.3.3 Four-Wheel Drive (4WD) Pickup Trucks

A one-ton 4WD pickup truck is used to tow the boat. One spare is located at ERL-N as a backup, and to tow the spare boat. Trucks are equipped with a camper shell (to allow for stowage of field gear), bed liner, front bumper winch, and a heavy-duty towing package. Four-wheel drive vehicles were chosen to assure that the boat can be pulled up steep, wet ramps.

3.3.4 Mobile Laboratory

Each team is equipped with a "mobile laboratory" (a 15-foot "parcel van") equipped with a marine band VHF radio (to communicate with the boat), a portable telephone, a GRiD laptop computer, shelves, and a work bench. This vehicle serves as a communications center as well as a staging area for calibrating instruments and processing and packaging samples for shipment.

3.3.5 Station Wagon

A station wagon is provided for transporting crew members to and from the Satellite Laboratory when they go off and on duty.

3.3.6 CTD

Each team is equipped with one Sea-Bird, model SBE 25 "Sealogger" CTD unit. This unit is equipped to measure temperature, salinity, depth, dissolved oxygen, pH, transmissivity, fluorescence (chlorophyll *a*) and photosynthetically active radiation (PAR). Spare probes and an entire spare unit are stored at ERL-N. Data from this unit are uploaded directly to the on-board GRiD computer.

3.3.7 Deployable Data Logger

Each team is supplied with 10-13 (depending on the number of sites that team is responsible for) Hydrolab DataSonde 3 deployable data loggers equipped to measure salinity, temperature, DO, pH, and depth. These units are deployed for approximately 60 days at Long-Term Dissolved Oxygen (LTDO) monitoring sites (sites described in Section 12). Each team is also supplied with spare parts for these units. Upon recovery, data from the DataSonde units are uploaded directly to the on-board computer.

3.3.8 Trawl Nets

Each team is provided with three 16-meter, high-rise trawl nets, equipped with several cod-end liners.

3.3.9 Water Sampling Bottles

Each team is supplied with two General Oceanics 5 liter, Teflon-lined "*Go-Flo*" water sampling bottles. An additional two bottles are stored at ERL-N. Each team also has a supply of spare parts for these units.

3.3.10 Grab Sampler

Each team is equipped with two stainless steel, Young-modified Van Veen grab sampler. This gear has a hinged top to allow for the removal of surficial sediments from the sample.

3.3.11 Laptop Computers

Each team is supplied with two GRiD model 1530 laptop computers. These computers contain an 80386 processor and are equipped with 2 MB RAM, a 40 MB hard drive, a 1.4 MB disk drive, a rechargeable battery, an external power cable for running off of the boat's battery, three serial ports, a gas-plasma screen, a 2400 baud internal modem, an 80387 math coprocessor, a battery-operated printer, a bar code reader and a carrying case. Each computer contains navigation, communications, data management and word processing software. Three backup computers are stored at ERL-N.

3.3.12 Rocking Chair Dredge

Each team is equipped with one 12-inch wide Rocking Chair dredge to be used in the collection of surface dwelling bivalves. Dredges are equipped with a 1-inch mesh polypropylene cod-end and weigh approximately 150 pounds empty. Two spare dredges are stored at ERL-N.

3.3.13 Sediment Profile Camera

The sediment profile camera will be used on a trial basis in the Virginian Province Demonstration Project. One camera, along with a technician to operate it, will visit with one team during Interval 2.

3.4 Chain-of-Command

To avoid confusion and to establish a proper flow of instructions, it is important that a proper chain-of-command be in place. This order is outlined in Figure 3.5 and below. The names and phone numbers of appropriate personnel are listed in Section 21.

1. The Crew Chief is directly responsible for all field activities conducted by his/her crew.

2. ALL CHANGES IN THE SAMPLING PLAN THAT ARE OUTSIDE THE JURISDICTION OF THE CREW CHIEF ARE COMMUNICATED TO THE TEAM BY THE FIELD COORDINATOR (FC) OR THE DP PROJECT MANAGER. (See Section 15 for a description of allowable changes.) The teams accept technical direction from no other persons.

3. All technical matters, i.e., equipment problems, questions regarding station locations, sampling schedules, etc. should be addressed to the FC by the Crew Chief AS SOON AS POSSIBLE.

4. Non-technical personnel issues should be addressed to the appropriate contract personnel coordinator.

5. If the FC cannot resolve the problem (e.g., determine how a station may be relocated), he then takes the matter to the DP Project Manager, the Technical Director, or other appropriate personnel.

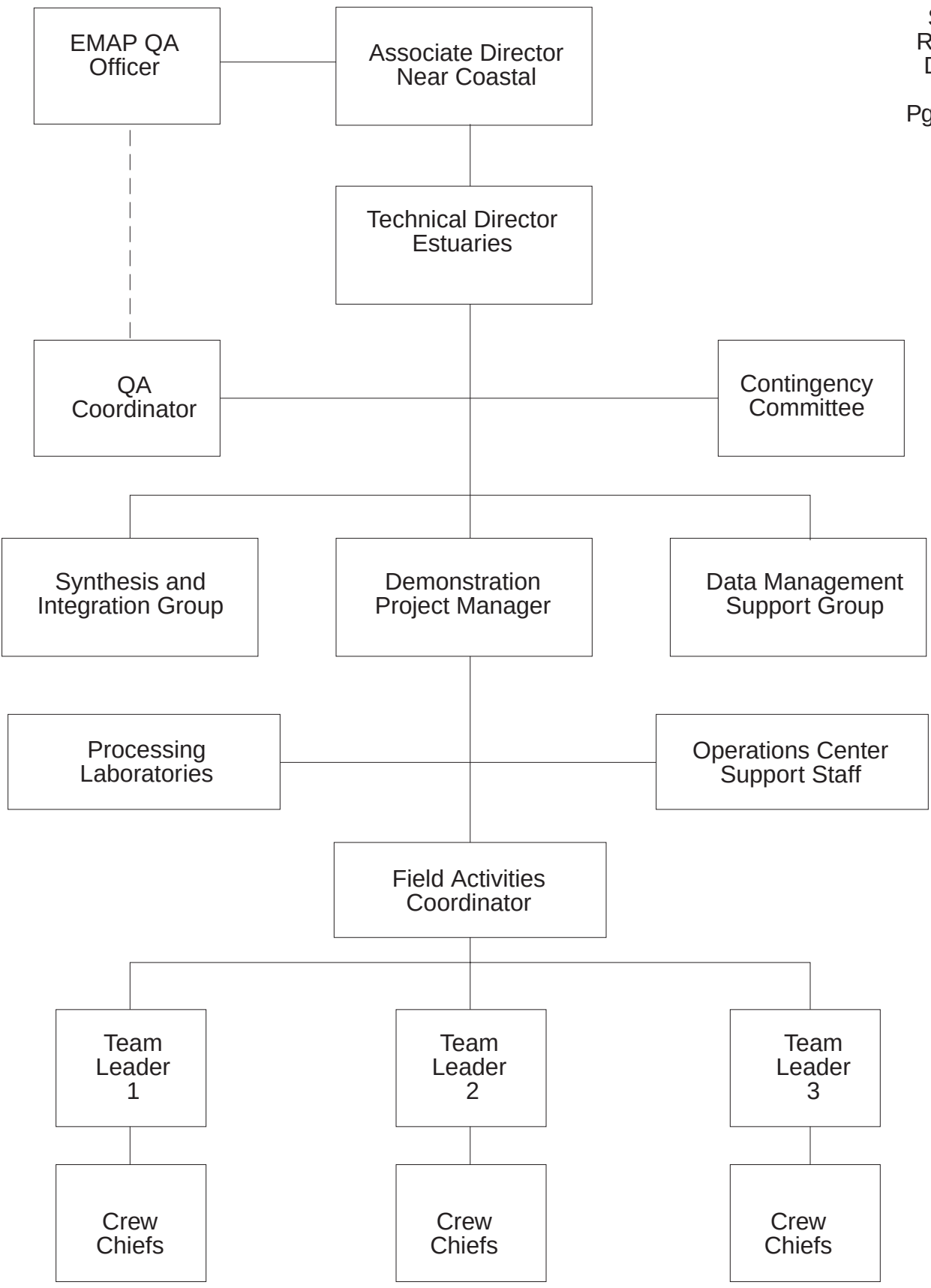


Figure 3.5. Management structure for the 1990 Virginian Province Demonstration Project (taken from Holland, et al., in preparation).

SECTION 4
SAFETY

Field sampling endeavors are inherently dangerous. Operation of boats and sampling equipment even under ideal conditions carry a high degree of risk. This danger is greatly compounded in bad weather. Safety of the crews and equipment is of paramount importance throughout the Demonstration Project.

4.1 Training

All field personnel are required to participate in an extensive training program (see Section 5). An important component of this training is related to safety procedures and precautions. All field personnel must demonstrate to the instructors that they are aware of all safety protocols and are capable of operating all gear in a safe manner. Training includes first aid, cardiopulmonary resuscitation (CPR), basic lifesaving techniques (water rescue), and basic marine fire fighting.

4.2 Swimming Proficiency Requirement

Since a large portion of each crew member's time is spent in a small boat, all field personnel are required to demonstrate swimming proficiency. Although flotation gear is worn whenever sampling gear is being operated, there is always the potential for someone to fall overboard without a flotation vest.

4.3 Priorities

The safety of personnel is, at all times, the Crew Chief's number one priority. At no time should the crew take unreasonable risks to obtain a sample.

The safety of the general public is included in this top priority. At no time should the crew operate any vehicle or equipment in any way that might endanger the public. In addition, sampling activities must cease immediately if the crew is in a position to render assistance in life or limb threatening situations.

The second priority is the safety of major equipment. Loss of a boat, pickup truck, or CTD could jeopardize the program. Activities that represent an unreasonable risk to this equipment must not be attempted. It is up to the discretion of the Crew Chief to determine what risks are unreasonable.

4.4 Accidents

Exact procedures to follow in the event of an accident are described along with the operation of the vehicles and boats (sections 8 and 9). As described in Section 4.3, the number one priority in the event of an accident is to assure the safety and well-being of crew members and the general public. This is followed by the safety of major pieces of equipment, the samples, and then minor, replaceable equipment.

4.5 Personnel Emergency Information

All field personnel are issued identification cards that carry their name and emergency information. This information includes medical problems, allergies, and the names and phone numbers of persons to be contacted in the event of an emergency. The EMAP telephone number is included on this card.

In addition, emergency information for all crew members is stored in each field computer, and at the Field Operations Center. Emergency information on the field computers can be accessed from the main menu.

Each Crew Chief must be aware of any medical problems his/her crew members may have. He/she must also be aware of any medication (including seasickness medication) taken be any crew member, as this could impair the reactions of that person.

4.6 Operation of Equipment

All EMAP equipment must be operated in a safe manner. Safety procedures for each piece of equipment are described in the sections describing the operation of that gear.

At no time should anyone operate heavy gear (such as the hydraulic winch or boat) while under the influence of any prescription drugs that could impair reactions. Likewise, CONSUMPTION OF ALCOHOLIC BEVERAGES DURING FIELD ACTIVITIES IS ABSOLUTELY PROHIBITED.

A special note will be made here regarding operation of the boat's radar. Radar is used to assist in navigation when visibility is reduced. It works by emitting microwaves which bounce off of dense objects (buoys, boats etc.) and are then received by the radar receiver. Microwaves have been shown to damage living tissue, with the retina of the eye being particularly sensitive to damage from microwaves. Due to the location of the radar's antenna (which emits the microwaves), personnel standing on the deck behind the cabin would be in the direct line of microwave emission. Therefore, radar should be used **only when the boat is underway and the visibility is reduced. No one is permitted to stand on the rear deck while radar is in operation.**

4.7 Safety Equipment

Each boat is equipped with required and recommended safety equipment. Each boat contains hard hats for all personnel, appropriate personal flotation devices (PFDs) and survival suits, a Type IV life ring, a "life sling" man overboard rescue device, fire extinguishers, flares, a portable spotlight (works off of cigarette lighter), a heavy-duty flashlight, a Class A Emergency Position Indicator Radio Beacon (EPIRB) and an extensive first aid kit. In addition, each boat is equipped with a main and backup radio, and radar.

Each mobile lab is equipped with a fire extinguisher, heavy-duty flashlight, and first aid kit, in addition to a mobile telephone that can be used to call for assistance.

4.9 Weather Conditions

Since all sampling operations are conducted from small boats, weather conditions and sea state are important safety considerations. In no case should sampling be attempted in large, open systems when the Coast Guard has issued small craft warnings. Likewise, seas in excess of two feet may also require a delay of field activities. The crews should monitor one of the marine-band weather channels prior to departing from the dock each morning. It is the responsibility of the

Crew Chief to assess weather conditions and the locations of the stations to be sampled, and make a decision as to whether or not sampling activities can be safely accomplished.

Even if weather conditions are not severe enough to force the cancellation of sampling activities, the Crew Chief may elect to return to shore if crew members become severely seasick and are unable to function in a safe manner, or if the quality of data collection becomes questionable.

4.10 Responsibility for Safety

Although each crew member is responsible for his/her safety and for operating all gear in a safe and responsible manner, it is the responsibility of the Crew Chief to assure the safety of his/her crew.

4.11 Boat Itinerary

Each time the boat crew departs from the dock, the boat Crew Chief provides the crew member remaining on shore with an itinerary. This includes the areas in which the boat will be operating and the time they expect to return to the dock. Any changes in this schedule must be transmitted by radio to the lab. If the boat is overdue by more than 30 minutes, the land-based crew member should attempt to contact the boat by radio. Attempts should continue until the boat is contacted.

If the crew has not returned within three hours of the expected arrival time, and no contact has been made, the lab crew member should notify the Coast Guard by phone that a boat is overdue. He/she should inform them of the area in which the boat was working, a description and name of the boat, the number of people on board, and that the boat is a U.S. government vessel on official business. The Coast Guard should also be informed that the caller (the lab) will be monitoring Channel 16, and can be contacted by a Coast Guard vessel on that channel.

It is the responsibility of the Crew Chief to inform the lab crew member of any changes in the boat's itinerary. If the boat crew cannot reach the lab by radio directly, and the boat will be more than two hours late returning to dock, they should attempt to contact the lab via the marine operator, trying to reach it both on the lab's radio and cellular telephone.

If the boat crew has been unable to contact the lab and their estimated time of arrival at the dock is greater than three hours past their original projection, the boat crew should notify the Coast Guard, who, in turn, can pass this information to the lab crew member when he/she attempts to notify the Coast Guard of the overdue boat.

4.12 Handling of Hazardous Materials

Some hazardous materials are carried on board each boat. In addition to gasoline, boats are carrying small quantities of formalin, Dietrich's fixative (formalin, acetic acid, and alcohol), and acetone. All of these compounds present some form of health hazard. In no case should containers be opened in the cabin; use of any of these materials requires adequate ventilation. Gasoline and acetone are very volatile, therefore, **SMOKING ON BOARD THE BOATS IS ABSOLUTELY PROHIBITED.** Solvents should always be stored on deck in the shade away from any equipment that could generate a spark.

Care should be taken when using any hazardous material. Protective clothing (gloves, safety glasses) must be worn when using these materials.

Material Safety Data Sheets (MSDSs) for the hazardous materials to be carried on board are included in Appendix D. First aid information is listed on these sheets. The appropriate MSDS should be read before handling any hazardous material.

Both the boats and the pickup trucks carry dry ice. Care must be exercised when handling dry ice or samples frozen on dry ice. Under no circumstances should dry ice, or samples frozen on dry ice, be handled without insulated gloves. Doing so could result in severe damage to the skin and tissue that comes in contact with it. In addition, as dry ice warms and sublimes it releases carbon dioxide. Although the danger of suffocation is small, it still exists. Therefore, large quantities of dry ice should not be stored in the mobile lab. Dry ice should only be stored outside, or in the back of the pickup truck. A greater danger from suffocation exists during the process of loading or unloading samples from the dry ice chest. As a result of sublimation, most of the oxygen in the chest is displaced by heavier carbon dioxide. Crew members must avoid breathing in this gas.

4.13 Proper Handling of Potentially Hazardous Samples

Several of the stations to be sampled during the DP are located in contaminated systems. Sediments, organisms, and water collected at these stations may present a health hazard to field personnel if proper precautions are not followed. Many compounds can be absorbed through the skin; therefore, protective clothing is required when sampling at these sites. Stations representing a known or suspected health hazard are listed in Table 4.1. In addition, any station in or around an urban environment should be treated as a potentially contaminated site.

The following precautions should be taken when sampling at potentially contaminated stations:

1. Always wear protective rubber or Viton gloves.

2. Avoid touching "clean" surfaces such as the steering wheel while wearing gloves that have been in contact with contaminated materials.

3. During trawling and benthic sampling, wear foul weather gear and boots to minimize the possibility of contaminated material contacting the skin.

4. As sample containers are handled on-site and are therefore contaminated on the outside, place these containers in clean plastic bags and seal them. Do not handle the bags with contaminated gloves.

5. When removing sediment from grabs it is often necessary to have your face close to the sample. In this case, surgical masks should be worn to reduce the possibility of inhalation of particulates.

7. Following the completion of sampling, the boat and all gear should be thoroughly rinsed to remove any contaminated sediment. As soon as possible (back at the dock, enroute to an uncontaminated station, etc.), the boat and all gear should be scrubbed with detergent and rinsed with CLEAN seawater or fresh water. Nets can be towed (mid-water) at a clean site with the cod end open to rinse them.

8. All personnel should wash their hands with detergent and clean water following removal of the gloves or contact with any contaminated surface.

9. In the event that bare skin comes into contact with contaminated sediments, the sediment should be washed off of the skin with detergent and clean water as soon as possible. If clean water is not available, ambient water can be used since the level of contamination in the water is always significantly lower than that of the sediment.

10. As a general rule at all stations, food should always be protected from coming in contact with boat surfaces. When working at contaminates sites, the crew should elect to refrain from eating lunch until they can return to the dock and wash their hands.

Table 4.1. EMAP-NC sites where contamination is known or suspected. Crews should take precautions to prevent skin contact with sediments collected at these sites. Stations marked by an asterisk (*) are known to be highly contaminated. In addition, all stations in urbanized areas should be treated as potentially contaminated sites.

Station #	Location	Hazard
099*, 132*	New Bedford Harbor	High levels of PCBs and heavy metals
081	Bear Creek	Sewage discharge
082	Colgate Creek	Industrial discharge (PAHs and organochlorines)
088, 172	Anacostia River	Sewage discharge
182, 183	Potomac River	Industrial discharge
139, 140, 090	Back River	Sewage discharge
164*, 165*, 86*, 202, 203	Elizabeth River	Generally degraded with PAHs, metals and organochlorines
134, 135	Baltimore Harbor	Generally degraded with metals and organochlorines
227-233	Delaware River	Generally degraded with metals, PAHs and organochlorines
094*	Arthur Kill (NJ)	Generally degraded with metals, PAHs and organochlorines

Table 4.1 (continued).

Station #	Location	Hazard
102*, 147*	Hackensack River	Generally degraded with metals, PAHs and organochlorines
103*	Passaic River	Generally degraded with metals, PAHs and organochlorines
098*	Black Rock Harbor	Generally degraded with metals, PAHs and organochlorines
173,174	Upper NY/NJ Bay	Generally degraded with metals, PAHs and organochlorines
177, 199, 101, 212-218, 198	Hudson River	PCB contamination

SECTION 5
TRAINING

Proper training of all laboratory and field personnel in their respective duties is an important aspect of the Demonstration Project. Training activities can be segregated into formal (classroom and structured demonstrations) and informal (field proficiency) units. All training for the DP falls under the general jurisdiction of the DP Manager; specific training in select technical areas is delegated to those responsible for indicators and/or specific activities.

Training is being conducted primarily by staff from the University of Rhode Island's (URI) Marine Advisory Service and Fisheries Department. They have wide-ranging experience in training scientific personnel in collection techniques, small boat handling, etc.

Training will begin on May 29th and continue to June 15th for a total of three weeks.

The informal or field proficiency training consists of demonstrating competence in the practical aspects of field activities. All field crew members must be able to swim and will be required to demonstrate that ability. By the end of the course all crew members must show proficiency in towing and launching the boat; using the navigation system; locating stations; entering and retrieving data from the computer; using all sampling gear; first aid procedures; and general safety practices.

The training schedule is outlined in Figure 5.1. During training the class is divided into two groups designated on the schedule as "A" and "B". In general, while one group is in the classroom, the other is in the boats on the water practicing skills learned in the classroom.

Figure 5.1. EMAP-NC Demonstration Project training schedule.

On the first day of training all participants are requested to complete a questionnaire on their skills. This is used to assign responsibilities for certain activities and determines who will undergo more intense training on certain topics. For example, those crew members with experience in fish taxonomy are designated as the taxonomists for their crews and are exposed to more intense training in fish taxonomy than other personnel. This is necessary as it is not possible to fully train a novice in fish taxonomy in the limited time available.

SECTION 6
LAND-BASED FACILITIES

All DP sampling activities are conducted on the water from small boats. It is necessary to have a network of land-based support facilities to assure efficient operation of the sampling effort. This network consists of three tiers.

6.1 Mobile Laboratories

The lowest level in the network is the mobile laboratory. Each team is equipped with a 15-foot parcel van to serve as this facility. This is used for storing supplies and equipment, and as a staging area, communications center, and packaging and shipping center. Boat personnel must maintain constant contact with the crew member manning the mobile lab, and all contact from the Field Operations Center will be to this lab via cellular telephone.

6.2 Base Facilities

Base Facilities can also be categorized as resupply depots. All extra supplies, such as sample bottles, are stored at these facilities for transport to the teams as needed. The EPA's Environmental Research Laboratory in Narragansett, Rhode Island (ERL-N) serves as the Base for Team 1. The Base for Team 3 is Versar, Inc. in Columbia, MD. Team 2 is serviced by both these facilities. These sites also serve as a place for crew members to park their personal vehicles, and therefore, as a rendezvous point for crews returning to duty.

6.3 Field Operations Center

All field operations are coordinated from the Field Operations Center (FOC) located at ERL-N. The Data Base Management Team, VAX computer, Field Coordinator, and DP Project Manager are all located at this facility. ERL-N also serves as the main base for storing back-up equipment such as boats, trucks, CTDs, etc. During non-sampling periods, all equipment is stored at ERL-N.

SECTION 7
PROFESSIONALISM

During field operations, crews will be driving vehicles identified by their license plates as U.S. government vehicles, and operating and towing boats clearly labeled "United States Environmental Protection Agency." This puts the field crews in the public eye, and makes it imperative that they act professionally at all times.

7.1 General Contact with the Public

As representatives of the U.S. EPA, field crews should deal with the general public in a courteous manner at all times. Field personnel should take the time to answer questions regarding EMAP, and provide a copy of the Information Pamphlet, pointing out the Toll-Free number they can call for additional information.

The field crews must also remember that what they say about the program directly impacts public perception of EMAP. Negative statements about the program, methods employed, or the gear used will not be tolerated. It is the responsibility of the Crew Chiefs and Team Leaders to assure that all contact with the general public results in a positive portrayal of the program.

It is especially important to take the time to properly describe the goals of the program to any fisherman that expresses an interest. A fisherman's livelihood is totally dependent on his/her ability to operate successfully in local waters. The sight of a U.S. government research vessel sampling in those waters may instill a fear that the researchers will determine that the water is polluted, thereby closing them to fishing. The result would be putting the fisherman out of business. Field crews are the "front line" in terms of correctly communicating the goals of EMAP. The manner in which the crews interact with the fishermen is critical in allaying their fears and gaining their trust and assistance. Along the same line, whenever a fisherman's gear (lobster or crab pots) are caught in a trawl, every attempt should be made to return it to the same area from which it was snagged.

When possible, the field crew should render assistance to other boaters in need of help. ALL FIELD OPERATIONS MUST CEASE IMMEDIATELY WHEN THE CREW IS IN A

POSITION TO RENDER ASSISTANCE IN LIFE OR LIMB THREATENING EMERGENCIES. The crew should use their resources, such as the portable telephone, to assist in any emergency, whether EMAP personnel are directly involved or not.

7.2 Operation of Motor Vehicles

Any time a person is operating a U.S. government vehicle, he/she must realize that "the public is watching them." Many people would not hesitate to complain to the Agency if they felt that a government vehicle was being operated improperly. Therefore, all traffic laws, especially speed limits, must be carefully observed. The driver must operate the vehicle in a responsible manner, acting courteously to other drivers and pedestrians.

7.3 Operation of Boats

As with motor vehicles, field crews must operate the EMAP boats in a professional manner at all times. At no time should the boats be operated in a discourteous, reckless, or unsafe manner. These are work boats; therefore, water skiing (between stations), fishing, or any other activity that could be perceived by the general public as a "waste of their tax dollars" is prohibited. It is the responsibility of the Crew Chief to assure this.

7.4 Radio Operation

Radio operations are an important part of daily activities. Radio communications are frequently monitored by the Coast Guard and the general public, therefore, it is imperative that proper procedures be followed in a professional manner. Call signs and the name of the boat must always be used, profanity is prohibited, and all communications must be restricted to the proper channels. Details on the operation of radios are included in Section 9. The working channel assigned to EMAP by the FCC (Channel 82A) is shared by other U.S. government operations, therefore all communications should be as concise as possible and communications should be restricted to official business. It is the responsibility of the Crew Chief to assure that proper procedures are followed.

7.5 Waste Disposal

Garbage generated by the field crews must be disposed of properly. At no time should anything that did not come out of the trawl or dredge be thrown into the water. Boats and mobile labs are equipped with garbage pails which is where all trash generated should be placed for proper disposal on shore (in a public trash receptacle). At no time may trash be disposed of in private receptacles.

Following trawling operations, a potentially large quantity of dead fish or fish parts will need to be disposed of. The contents of a trawl should be returned to the water, however, and the Crew Chief should be considerate of other boaters and choose a location away from pleasure boats, public beaches, or docks to perform this processing. Dead carcasses should be disposed of at sea in open areas. Disposal on land should be avoided.

SECTION 8
VEHICLE OPERATIONS

Because of the EMAP DP sampling scheme, crews must drive considerable distances over roads of varying quality. It is important that all crew members be capable of operating all vehicles in a safe manner.

8.1 General Guidelines

There are a number of general "common sense" guidelines that field personnel should follow regardless of which vehicle they are operating:

1. Observe all posted speed limits.

2. Reduce speed during rain or reduced visibility.

3. Never follow too closely, even if following another EMAP vehicle. The old rule of one car length per 10 mph should be observed, and this should be doubled on slippery pavement or when trailering the boat.

4. Avoid driving on or near the center yellow line. The width of the boat significantly exceeds that of the towing vehicle, therefore, although the truck is on the right side of the road, the trailer may be straddling the center line.

5. Be aware of road regulations. The mobile lab and boat trailer are not permitted on Parkways and other roads on which commercial vehicles are excluded.

6. Be aware of the minimum overhead clearance for the vehicle being driven. When towing the boat the clearance is 11 feet.

7. Always act courteously towards other drivers.

8. Never drive in a reckless manner.

9. NEVER DRIVE AFTER DRINKING ANY ALCOHOLIC BEVERAGES.

10. Never drive when overly tired. Following a long day on the water it is more appropriate to stay in a motel and drive the following morning rather than that evening.

11. Never drive when on prescription drugs that might impair your reactions.

12. If an accident is observed, and you are in a position to render assistance (if it is needed), do so. Make sure that your vehicle is out of the way and will not hamper emergency vehicles or traffic flow around the scene. Use the portable telephone in the mobile laboratory to call for assistance. REMEMBER YOUR FIRST AID!!! UNLESS THE VEHICLE IS IN DANGER OF CATCHING FIRE, **AN INJURED OCCUPANT SHOULD NEVER BE MOVED FROM THE VEHICLE UNLESS HE/SHE HAS BEEN PROPERLY ATTENDED TO BY QUALIFIED MEDICAL PERSONNEL!!!!** If you are qualified to treat a patient, and begin treatment, you are OBLIGATED BY LAW to remain with that patient until he/she is turned over to someone of equal or higher qualification.

13. Be careful where you park the vehicles. Try to avoid parking in high crime areas and always make sure all valuable gear is stored in a secure area.

8.2 Procedures Following an Accident

If one of the EMAP vehicles is involved in an accident, the following procedures must be followed:

1. All vehicles in the convoy should stop. Vehicles other than the one involved in the accident should pull off to the side of the road.

2. The portable telephone should be used to call for assistance. Inform the emergency operator of the following information:
   a. the exact location of the accident;

b. the approximate severity of the accident (fender bender, rollover, etc.);
c. whether there are any obvious injuries (e.g., two serious injuries);
d. any other information needed.

3. The person making the call MUST stay on the line with the emergency operator until the operator hangs up. THE FIELD PERSON SHOULD NEVER HANG UP THE PHONE UNTIL THE EMERGENCY OPERATOR TELLS HIM/HER TO. The person making the call should provide the operator with the telephone number (including access code) so the operator can call back if necessary.

4. **THE FIRST PRIORITY IS ALWAYS THE SAFETY OF THE FIELD CREW AND THE GENERAL PUBLIC**. Injuries must be attended to immediately.

5. REMEMBER YOUR FIRST AID!!! UNLESS THE VEHICLE IS IN DANGER OF CATCHING FIRE, **AN INJURED OCCUPANT SHOULD NEVER BE MOVED FROM THE VEHICLE UNLESS HE/SHE HAS BEEN PROPERLY ATTENDED TO BY QUALIFIED MEDICAL PERSONNEL!!!!** If you are qualified to treat a patient, and begin treatment, you are OBLIGATED BY LAW to remain with that patient until he/she is turned over to someone of equal or higher qualification.

6. When the police arrive, complete an accident report, providing any documentation required. Insurance information should be provided, in advance, by the SAIC or VERSAR personnel coordinator.

NOTE: Vehicles carrying U.S. government license plates (pickup truck and boat trailer) do not carry vehicle registration. The police officer should be informed of this, and that the vehicle is officially registered to:

United States Environmental Protection Agency
Environmental Monitoring and Assessment Program
27 Tarzwell Drive
Narragansett, RI 02882
1-(800)-NET-EMAP or (401) 782-3000

7. Notify the Field Coordinator AS SOON AS POSSIBLE of any accidents. Depending on the severity, operations may be postponed, or replacement equipment and/or personnel sent to the team.

8.3 Trailering Guidelines

Although the boat itself is only 24-feet long, adding in the outboard engines and brackets, and the trailer tongue brings the trailer package up to over 30 feet. Attached to the pickup truck, the entire package is over 50-feet long. Operators must keep this in mind, both when changing lanes on the highway and when maneuvering around corners. The following guidelines should be noted:

1. Whenever changing lanes or turning corners, observe the side view mirrors to assure that the back of the trailer has clearance.

2. Each day, and each time the trailer is disconnected and then reconnected to the truck, a check of the trailer lighting system must be performed. This includes checking taillights, directional signals, and brake lights. Each time the crew departs for a new location, the security of the hitch must be checked. This involves checking the hitch locking mechanism, the padlock, safety chains, boat tie down, and that all gear in the boat (especially the mast and boom assembly) is properly secured. Appropriate checklists are included in Appendix C.

3. Observe posted speed limits at all times.

4. Remember that the trailer is wider than the truck. Make sure there is sufficient lateral clearance in parking lots.

5. Note the required overhead clearance for the boat (11 feet - posted in the truck over the driver's sun visor). Care must be exercised when driving down back roads with overhanging trees.

6. Whenever the trailer is being backed up, one of the crew members must act as a spotter to direct the driver. The spotter must stand in a position to see the back of the trailer and must be visible to the driver.

7. When backing up the trailer, remember that it turns in the OPPOSITE direction from the truck. A simple rule for backing up is to turn the steering wheel in the direction opposite to the direction you wish the trailer to go.

8. To assure proper functioning of the trailer, it should be washed down with fresh water as frequently as possible. This could be done at a self-service car wash, AS LONG AS THE OVERHEAD CLEARANCE IS SUFFICIENT TO ACCOMMODATE THE BOAT. Maintenance, as described in Section 16, must also be followed.

8.4 Operation of Winch

Each pickup truck is equipped with a front bumper-mounted winch. This winch is used to pull the truck and boat up ramps that are too steep and slippery for four- wheel drive alone. If the winch is needed, the following procedures should be followed:

1. Connect the remote control unit to the winch.

2. Release the winch brake and pull out the needed amount of cable.

3. Attach the end of the winch cable to an appropriate object as close to ground level as possible. This should be something strong enough to remain fixed in place. A large tree or cement post would be appropriate. The cable should not be wrapped around the object. Use a chain, and then connect the cable to the chain.

4. If an appropriate object is not available for connecting the winch cable to, the mobile lab can be used. Back the lab to just above the top of the ramp. Place the transmission in Park, engage the parking brake, and place chocks behind all four wheels. Attach the winch cable to the trailer hitch or frame on the mobile lab.

5. Take up slack in the cable (maintaining tension whenever the winch is pulling cable in).

6. With the winch operator standing clear of the cable, start taking up on the winch. At the same time, place the pickup truck in Low gear. Between 4WD/low range and the winch, the boat should be pulled up the ramp.

7. When the winch is no longer needed, take up the remaining cable. Maintain tension on the cable during this process and make sure that it spools properly.

8. Disconnect the remote control from the winch and place it in the glove compartment.

SECTION 9
OPERATION OF BOATS

9.1 Weather Conditions

Local weather conditions will be a factor influencing whether or not to sample on a given day, at a particular site. If a small craft advisory has been issued by the Coast Guard, sampling may be cancelled until the advisory has been lifted. However, there are some stations located in sheltered areas which may be sampled during high wind conditions. If conditions are deemed unsuitable by the Crew Chief, sampling will be postponed until conditions improve. The primary concern at all times is the safety of the crew and equipment. In the event that distant sites within a sampling region are inaccessible due to local weather conditions, a more sheltered site may be chosen for sampling providing the safety of the crew and equipment is assured, and the site is within the scheduled sampling region. The following information is provided as a general guideline for determining the safety of sampling on a given day.

Before launching:

1. Obtain the latest weather forecast from local and NOAA Weather broadcasts (see below for more information regarding NOAA broadcasts).

2. Note any warning signals at local Coast Guard stations.

3. Remain on shore unless the boat can be safely navigated under the expected weather conditions.

4. If conditions are acceptable for safe boat operation, leave instructions with the mobile unit on shore to contact the boat with the marine radio or cellular phone in the event of an oncoming storm.

5. Prior to departure from the dock, notify the Field Coordinator (FC) of any changes.

While underway:

1. Keep an eye out for changing conditions. These would include: darkness, fog, threatening clouds (thunderstorm or squall), steady increases in wind velocity or wave height, or sudden changes in wind direction.

2. Continue to monitor NOAA weather broadcasts.

3. If caught in a thunderstorm, retreat to cabin, avoid touching ungrounded metal objects or more than one grounded object at the same time, and be sure all crew members have PFDs securely fastened.

4. If severe weather is approaching or conditions begin to deteriorate, discontinue sampling and head for port. If there is time to safely reach the launch site, do so, otherwise proceed to the nearest safe harbor.

5. Notify the Field Coordinator of any changes to the sampling schedule.

NOAA Weather Radio broadcasts continuously on VHF-FM stations. Forecasts are normally updated every three to six hours. During situations when weather conditions are changing rapidly, forecasts are updated more frequently. Broadcasts include the weather patterns for the region, marine forecasts and warnings for coastal waters, special bulletins in the event of severe weather, and reports on tidal conditions.

9.2 Launching and Recovering Procedures

Launching and recovering the boat are procedures with which all crew members must be familiar. It is important to follow a set routine to avoid lost sampling time which may result from injuries or damaged equipment. The following procedures outline the basic steps for launching and recovering the boat. Checklists are included in Appendix C.

Launching:

1. Check the boat ramp to be sure there are no obstacles, such as other boaters, people, or debris.

2. Check all drainage plugs and tighten as necessary. Drainage plugs are located at the bottom apex of the transom and on the bottom of the outboard bracket.

3. Raise the motors if they are not already in the full-tilt position. Release the safety latch so the motors are supported in the tilt position by the hydraulic trim unit.

4. Remove the tie-down strap.

5. Disconnect the trailer lights to minimize the chance of an electrical short in case saltwater leaks into one of the lights, or in case there is a cut in a wire.

6. Engage 4WD if the ramp is steep or slippery, or if traction is in any way uncertain.

7. Locate the end of the ramp to avoid backing the trailer over the edge.

8. Slowly back down the ramp until the boat can safely be launched. One crew member must act as a spotter for the driver. He/she must be in a position to watch the back of the trailer, and must be visible to the driver.

9. Remove the safety chain connecting the boat to the trailer.

10. Have two crew members hold the bow and stern lines to guide the boat when it is lowered into the water.

11. Carefully lower the boat into the water by slowly releasing the winch brake. No power supply is needed; the weight of the boat should be enough to slide the boat into the water.

12. Secure the boat to the dock in a place which will not interfere with other boat traffic.

13. Park the vehicle with the trailer in an appropriate parking space.

14. Assemble the mast and boom as described in Section 9.3.

15. Check the gas level in the boat.

Recovering:

1. Secure the boat to the dock and unload sampling equipment.

2. If there are any overhead obstacles (e.g., low power lines), lower the mast and boom assembly prior to recovering the boat. If the area over the ramp is clear, the mast assembly can be left up during the recovery process. Also determine where the rig can be parked during the process of lowering the mast. Make sure there is adequate overhead clearance between the ramp and the "de-rigging" area.

3. Empty the bilge of any accumulated water.

4. Engage 4WD low range on the truck.

5. Locate the end of the ramp to avoid backing the trailer over the edge. When clear, back the trailer down the ramp and connect power supply to winch.

6. Have one or two crew members guide the boat with bow and stern lines.

7. Have the third crew member drive the boat into position at the rear of the trailer. The driver should keep the boat in gear at low speed (one motor in gear, one idling in neutral) to maintain position until the winch cable can be attached. It is important to keep the boat running to maintain position, particularly when there are strong or gusting winds, or strong currents. Once the cable is attached and the

winch engaged, stop the motors and raise them to full tilt position.

NOTE: If the boat is listing to one side (generally port due to the weight distribution) it will most likely come up on the trailer leaning to that side. It is important that gear be located on the deck in such a manner as to equalize the weight distribution.

8. Pull the boat onto the trailer with the winch. Keep clear of the cable to prevent injury in the event of cable or hardware failure. NOTE: The winch should always be used in the double pull mode.

9. Continue to guide the rear of the boat with the stern line.

10. Once the boat is in position on the trailer, secure it with the safety chain.

11. Drive slowly up the ramp to remove boat and trailer from the water. On very steep or slippery ramps, even four-wheel drive may not be sufficient to pull the boat up the ramp. In such a case, use the winch mounted on the front bumper of the truck to help. See Section 8.4 for details.

12. Use the power winch to snug the boat into final position for trailering.

13. Lower and secure the mast assembly and antennae if this procedure has not yet been done. Refer to Section 9.3 for details on lowering the mast assembly.

14. Secure the tie-down strap.

15. Reconnect and check the trailer lighting system.

16. Check the trailer safety and brake chains.

17. Inspect the boat. Remove any loose objects. Be sure the mast assembly is securely lashed to the boat and that all antennae are either tied down or locked in the lowered position. Make sure all electronics are secured.

18. Engage the engine safety latches and lower the engines until they are resting on the latches and not on the power trim cylinder.

19. Store any remaining gear in the vehicles.

20. Disengage 4WD. First shift out of 4WD then disengage the front hubs.

21. The boat should now be ready for transport to the next site.

22. Check oil and gas levels to plan for the next fuel stop. (When possible, defer filling the tank until near the next site to avoid trailering a full tank of gas.)

9.3 Mast Assembly and Antennae Set-Up

The mast assembly consists of a mast with a boom, five stays, and three lines leading off the boom. Set-up and take-down of the mast assembly are most easily accomplished while the boat is on land; however, at some ramps limited overhead clearance (trees or power lines) may make it necessary to raise the mast after the boat has been launched. The set-up and take-down procedures for the mast assembly are described below.

Mast assembly set-up:

1. Remove all tie-down straps.

2. Remove the retaining bolt from the mast support bracket on the cabin roof.

3. Pull slack from the center line which runs from the mast to the boom.

4. Slowly raise the mast and boom into an upright position, paying particular attention to the hydraulic lines at the base of the mast. Be sure the hydraulic lines are not pinched or damaged as the mast is raised into position.

5. Once the mast is upright, bolt it into position in the support bracket on the cabin roof.

6. Secure the three forward masts with stays to the bow and forward corners of the cabin using shackles and turnbuckles. Secure the side support stays using shackles and tighten turnbuckles until all cables are taut. Forward turnbuckles should be tightened before those for the side support stays. **THE MAST SHOULD NEVER BE USED WITHOUT ALL STAYS BEING SECURED.**

7. Lower the boom with the center line to approximately 45 degrees from vertical, and secure in this position by lashing to the mast cleat.

8. Tighten port and starboard boom lines and secure to cleats.

Mast assembly take-down:

1. Loosen port and starboard boom lines.

2. Raise boom with the center line, then pivot to one side and secure.

3. Detach all stays (side stays first) and remove the bolt from the center support bracket.

4. Lower the mast assembly onto a supporting cross board and securely lash in place.

There are three antennae on each boat for the various electronic gear. These need to be raised when the boat is launched and lowered for transport between sites. All three are tightened and loosened with a lever. While afloat, the antennae should be locked in the upright position. During transport, the antennae should be locked and lashed (if possible) in the lowered position.

9.4 Gear Check-Out and Loading

Since much of the sampling gear is loaded onto and removed from the boat on a daily basis, it is important to maintain a careful record of available gear. When loading the boat, carefully follow the gear checklist (Appendix C) to avoid leaving essential items behind. Once the

necessary gear has been assembled, inspect for damage and replace as needed. When loading the boat, securely lash heavy and bulky gear (e.g., rocking chair dredge, trawl net) in a manner which minimizes obstruction on the deck. Fragile and valuable equipment (e.g., Sea-Bird CTD, Hydrolab DataSonde 3 dataloggers, GRiD computers, cameras) should be securely lashed or stowed to prevent damage enroute to the sampling stations. All other gear should be loaded and stowed where appropriate.

While sampling and loading or unloading equipment, make note of any supplies which need to be replenished or damaged gear which needs to be replaced. Contact the Field Operations Center when supplies are needed and make arrangements to pick them up or have them delivered.

9.5 Navigation System

The Loran-C uses shore-based radio transmitters (referred to as Master and Slave stations) combined with shipboard receivers to track low frequency signals. The Loran displays the time difference (TD) between the Master and Slave stations, allowing several lines of position to be plotted. Using navigational charts and the TDs obtained on the shipboard receiver, the boat's position can be determined from where these TD lines intersect.

Each boat is also equipped with a Global Positioning System (GPS) unit to aide in navigation. This unit uses satellite signals to determine position. The utility of this instrument is, at present, limited. Only a portion of the satellites necessary have been put into orbit, therefore, use of this instrument is limited to those hours of the day during which one the existing satellites is overhead. As more satellites are launched, GPS will become a more valuable tool.

Each team is supplied with a GRiD laptop computer containing an integrated navigation system. This system interfaces with both the Loran and the GPS. It provides for an averaging of multiple calibration factors, and is capable of storing parameters files for each station sampled. Sampling protocol dictates that sampling be performed as close as possible to each designated sample site, therefore, the computer navigation system should be used at every station. The only exception should be when a major component of the system (Loran or computer) fails. In that case, either the Loran, GPS, or dead reckoning (in river systems) should be used to locate the station. The use of any system other than the computer navigation system requires an explanation

in the log. A description of this system, and instructions for operating it, are included in Section 10 and SAIC (1990).

9.6 General Policies Underway

All personnel should be aware of general boating and navigational rules. Some of the more important rules are:

1. Anchored vehicles have the right of way over moving vessels.

2. Sailboats have the right of way over power boats (except when under power).

3. If overtaking another boat, it is your responsibility to remain out of their way.

4. When approaching another boat head-on, stay to the right and pass port to port, unless you are far enough apart to safely pass starboard to starboard.

5. When crossing paths, the boat to the right has the right of way.

The following is a simplified list of vessels which have the right of way over vessels listed below it.

1. Overtaken vessel.
2. Vessel not under command.
3. Vessel restricted by its ability to maneuver.
4. Vessel constrained by draft.
5. Fishing vessel (fishing or trawling, not trolling).
6. Sailboat.
7. Powerboat.

Required Personnel

At least two crew members must be on board the vessel at all times. The only exception is for moving the boat short distances, PROVIDING NO SAMPLING ACTIVITIES ARE TO BE PERFORMED.

Speed Regulations

Always travel at a safe speed. EMAP boats are capable of high speed, therefore, restraint must be exercised. The boats were equipped with twin engines to allow for the completion of sampling activities in the event that one engine fails, NOT so the crews could travel between stations at 40 mph. This speed will be dependent on a number of conditions, including weather conditions, visibility, and amount of boat traffic. Reduce speed when passing marinas, anchored boats, and swimming areas. Observe reduced speed and no wake signs.

Anchoring

Avoid anchoring the boat in a busy, narrow channel or anywhere it could obstruct normal boat traffic. Don't block launching ramp areas. Also, look for signs denoting an underwater cable. Do not anchor in the vicinity of such a cable.

Additional information on navigational skills and boat operation can be found in a number of references, including:

1. Nynex Boater's Directory, 1990, Volumes 1-4, Published by Nynex Information Resources. (provides only general information)

2. Boating Skills and Seamanship, 1988. U.S. Coast Guard Auxiliary, U.S.A.

9.7 Radio Operations

The operation of marine radios is governed by regulations of the Federal Communications Commission (FCC). There are specific procedures for placing calls to other vessels, and for

answering calls to your vessel. Monitor Channel 16 when the marine radio is on. All calls originate on Channel 16; however, only emergency transmissions are permitted on that channel. To call another ship or the mobile lab, follow these procedures:

1. Switch the radio to channel 16. Listen to make sure you are not interrupting another conversation, then transmit:

   NAME OF BOAT YOU ARE CALLING

   THIS IS NAME AND CALL SIGN OF YOUR BOAT

   OVER

   If you get no response, repeat two or three times.

2. When the boat you are calling responds, state:

   SWITCHING TO 82A (working channel)

3. Switch to channel 82A and listen to make sure you are not interrupting another conversation.

4. Conduct routine conversation, trying to limit it to three minutes or less. At the end of your conversation state:

   NAME AND CALL SIGN OF YOUR BOAT OUT

5. Switch back to channel 16.

A request for a radio check should be initiated on Channel 16 and then switched to Channel 82A if additional conversation is desired. Routine radio checks made by the boat should be to the mobile lab. The Coast Guard should never be contacted for a routine radio check.

As U.S. government vessels, all EMAP boats are subject to regulations that differ from those specified for recreational and commercial boaters. A permit to operate the boat radios has been obtained and must be carried on board at all times. A copy of this permit is included in

Appendix E. Call signs for all EMAP vessels and a list of the channels authorized for our use can be found in Figure 9.1.

OPERATING PROCEDURES FOR DISTRESS CALLS

There are three spoken radio emergency signals:

1. Distress signal: **MAYDAY**. Mayday is used to indicate that a mobile station is threatened by GRAVE and IMMINENT danger and requests immediate assistance.

2. Urgency signal: **PAN PAN** (correct pronunciation is PAHN-PAHN). Used when the safety of the vessel or person is in jeopardy, such as "man overboard."

3. Safety Signal: **SECURITY**. Security is used for messages concerning the safety of navigation or giving important meteorological warnings.

If you hear any of these messages while monitoring Ch 16, listen, don't transmit, and be prepared to help if you can.

To issue a distress call, use Ch 16:

1. Say MAYDAY (3 times).
2. This is the R/V _____ (3 Times).
3. Give VHF call numbers (1 time).
4. Give location (Latitude-Longitude, LORAN, bearings off marker, etc.).
5. Briefly describe nature of distress (i.e., what is wrong, and what kind of help is needed.
6. Describe your boat - length, type, hull color.
7. Keep repeating until someone acknowledges your call.

REMEMBER: ONLY ISSUE A DISTRESS CALL IN A GRAVE EMERGENCY!

ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM
BOAT RADIO FREQUENCY ASSIGNMENTS

CALL SIGNS

R/V CYPRINODON	**WRH 4387**
R/V ARBACIA	**WRW 8803**
R/V MYSIDOPSIS	**WRM 8373**
R/V CHAMPIA	**WRG 3330**
MOBILE LABS	**KB 2053**

FREQUENCY ASSIGNMENTS

CHANNEL	TRANSMIT FREQ. (Mhz)	TYPE OF OPERATION
6	156.300	Intership safety
12	156.600	Port operations
13	156.650	Bridge to bridge communications
14	156.700	Port operations
16	156.800	Calling, safety and DISTRESS
20	157.000	Port operations
22A	157.100	Communications with Coast Guard
67	156.375	Bridge to bridge - Louisiana
82A	**157.125**	**Working channel US govt. only**

In addition, all public correspondence channels (marine operator) can be used: 24, 25, 26, 27, 28, 84, 85, 86, and 87

Figure 9.1. Listing of radio call signs and authorized frequencies.

9.8 Radar Operation

Each boat is equipped with a radar unit to aid in navigation under reduced visibility. Radar consists of a display unit (mounted in the cabin) and a Radome antenna (mounted on the cabin roof). When operating, the antenna emits microwaves in a 360° sweep. These microwaves bounce off of dense objects, are then received by the antenna, and transmitted to the display unit. Consult the owner's manual for proper operation of this unit.

Microwaves of sufficient energy have been shown to damage the retina of the eye. Although the energy of the microwaves emitted by the radar units used by EMAP is low (a "safe" distance from the unit is two feet for extended periods of time), the radar unit should not be operated while personnel are standing on the rear deck.

9.9 Winch Operation

Each boat is equipped with a hydraulic winch and capstan which is run by a gas-powered motor located just behind the cabin on the port side. Although the winch is simple to use, the operator must be aware of the power generated by the hydraulics and the dangers involved in the operation of the gear. The operator of the winch must be aware of all activities being conducted on-board the deck when the winch is being used. All personnel on the deck must be careful to stay out of the bite of the cable, and personnel in the cabin must be careful to not accidentally engage one of the winch control levers.

To start the Briggs and Stratton engine supplying power for the hydraulics:

1. MAKE SURE THE CONTROL LEVERS ARE IN THEIR NEUTRAL POSITION.

2. Push down on the kill switch located on the aft shelf in the cabin.

3. Set the engine's throttle lever for greater than half throttle.

4. Engage the choke (located on top of the engine on the port side).

5. Depress the starter button.

6. As soon as the engine starts, push in the choke lever.

Once the engine is running, power can be supplied to the winch. Great care must be taken to assure that hands, clothing, or gear do not get caught in the winch or any of the blocks the wire is traveling through.

The levers controlling hydraulic power are located inside the cabin on the rear bulkhead. The starboard lever controls the winch and the port lever controls the capstan. The winch will not free-spool, so power must be supplied to lower, as well as raise, gear. The speed at which the winch or capstan operate is controlled by how far the lever is moved.

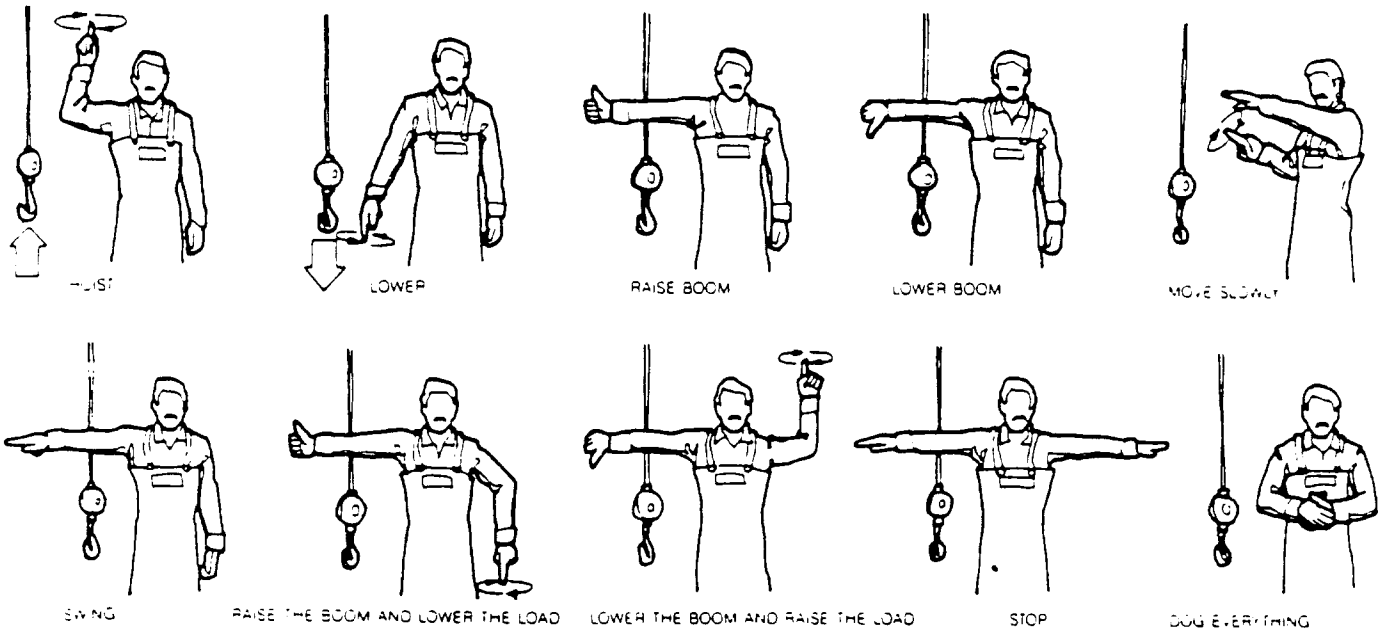
During winch operation, the operator must not only observe the activities of the crew on the deck, but must also watch the winch to assure that it is spooling properly. If necessary, a wood 2x4 can be used to guide the spooling wire back on track.

ALL STAYS MUST BE PROPERLY FASTENED AND TIGHTENED ANY TIME THE MAST AND BOOM ASSEMBLY IS USED.

The noise created by the Briggs and Stratton engine makes verbal communication between the winch operator and the deck crew difficult and unreliable. To assure the safety of the crew members on the deck, hand signals should be used. These signals are shown in Figure 9.2.

9.10 Emergencies/Accidents

Emergencies or accidents may occur in the course of sampling which may or may not involve EMAP boats or personnel. In the case where non-EMAP personnel are in an emergency situation, EMAP crews are required to render assistance if there is danger of loss of life or limb of those involved. In such an instance, crews should take the appropriate action (e.g., administer first aid and/or CPR, tow the boat to safety, radio for help) necessary to protect those involved. Under circumstances where there is no immediate danger of loss of life or limb (e.g., boaters with mechanical problems) EMAP crews should inform the Coast Guard or a local towing service of the problem and give the location and a description of the disabled vessel. If the disabled vessel is near a marina and if it will not result in a major loss of sampling time, in the interest of public relations, crews should render assistance.



Hand Signals–Where verbal communications are impossible or are likely to be interferred with by other noises, the crew should utilize a standard set of hand signals. Where the winch operator doesn't have a clear view of the load, one competent crewman should give signals, not the whole crew

Figure 9.2. Hand signals used during winch operation.

If EMAP personnel are in an emergency/accident situation, take appropriate action to reduce the immediate danger to those involved. In the case of a physical problems (e.g., man overboard, hypothermia, seasickness, sunburn, heatstroke, fish bites or stings, etc.) take the appropriate lifesaving, first aid, or CPR measures and call for help if necessary. In an accident situation where there is no immediate danger of loss of life or limb, notify the FC and the mobile unit of the problem and take measures necessary to rectify the situation (e.g., call for help, head for port). If an emergency or accident is serious enough to return to port, notify the mobile unit on shore and arrange to have an ambulance or other necessary emergency equipment in port upon arrival.

9.11 Equipment Failure/Repair

The best way to assure proper functioning of the equipment is to adhere to the routine maintenance schedule. When equipment fails to operate, however, check the most obvious solutions first before attempting a major overhaul. The most obvious reasons for equipment failure are loss of power or fuel.

Outboard Motors

If the outboard motor(s) will not start or if they suddenly stop, check the fuel and oil levels. If fuel and oil levels are adequate, inspect the electrical system for poor connections and the condition of the spark plugs. Tighten any loose connections and clean any contact points that appear to be excessively corroded. If attempts to restart fail after inspecting the fuel and power supply, refer to the owner's manual. If only one motor fails, continue transit or sampling with the working motor and notify the mobile unit and FC to make arrangements for repairs or replacement. If both motors fail, notify the mobile unit, have the boat towed to port, and notify the FC to arrange to have the boat repaired or replaced.

Hydraulic Winch

If the hydraulic winch fails to operate, check the fuel, spark plugs, and power supply. If proper functioning is not restored, consult the owner's manual. In the case where the trawl net is in the water and the winch fails, attempt to retrieve the net manually and proceed as described above. Notify the FC immediately if a winch fails.

Navigational/Electronic Equipment

In the event of navigational/electronic equipment failure, check fuses and inspect power supply for loose connections. Also check to be sure antennae are not damaged or lost. Consult the owner's manual if the above steps fail to correct the problem and notify the FC. Use backup methods (Loran or dead reckoning) to locate the station where appropriate.

In general, crews should be capable of trouble shooting many problems. In many cases the problem could be as simple as a loose or broken wire. Each boat is equipped with a multi-meter that can be used to check the continuity of wires. Attempts to use gear should be abandoned only after every attempt has been made to correct the problem on-board.

SECTION 10
ON-BOARD COMPUTER SYSTEM

Each team is supplied with two GRiD model 1530 laptop computers. One is generally located on the boat and the other in the mobile lab. These computers contain an integrated data management/navigation system, which interfaces the Loran and GPS navigation instruments with the computer and a bar code reader. This integrated system eliminates the possibility of transcription error in the recording of station coordinates or sample numbers. Detailed instructions on the operation of the system can be found in SAIC (1990) and Beaulieu (1990).

The computer system is entirely menu-driven. All programs are accessed from within the navigation system. The navigation system is designed to receive data from the boat's Loran and GPS units, process and correct those data, automatically store coordinates and sampling information, and assist in navigation to the station. Upon the first visit to a station, the unit is calibrated and a parameters file created. Calibration of the navigation system is more accurate than calibration of the Loran as several readings should be taken and averaged. Once this file is created, it can be recalled upon each visit to that station, making additional calibration unnecessary.

The computer navigation/data storage system must be used at each station, unless the system fails to operate. Even without input from the Loran the system can be used to record sampling events without the coordinates. Failure to use this system will result in the need to hand-enter data at the FOC. This may result in a delay in analysis of the data due to the time involved in entering and checking data. As the time available to analyze data is short, the computer system should be used to its maximum potential by all field crews.

10.1 Data Acquisition System

The entire computer system is run through the Data Acquisition System (DAS). It is difficult to separate this from the Navigation System as the two are interconnected. Essentially the DAS is the master system, one component of which is the Navigation System. The DAS is entirely menu driven. It allows for the automatic storage of sample information through the

Navigation System or via alternate routes. One example of this is the component used for the entry of fish data. On the boat this information is recorded on data sheets. The following day it is entered into the computer by the shore person through the fish data option on the DAS. The DAS also allows for the calibration of electronic instruments (CTD and DataSonde 3) from outside of the Navigation System.

Daily electronic communications with the ERL-N VAX computer is an important part of data collection. This is also controlled by the DAS which allows for automatic transfer of data and messages late at night when the phone rates are lower and the phone lines generally less noisy.

Although the DAS is fairly simple to operate, the complete documentation is too extensive to be included in this document. Please refer to Beaulieu (1990) for complete instructions.

10.2 Navigation System

Details on the operation of the navigation component of the computer system can be found in SAIC (1990). This system both assists the boat operator in navigating to the station, and provides for the automatic storage of position data once the station is reached. The system is entirely menu driven for ease of operation.

Prior to use the system must be calibrated. This consists of positioning the boat at a location of known coordinates (e.g. the end of a dock showing on a nautical chart) and inputting the known latitude and longitude. The system will automatically average TDs (Time Delays) and calculate a calibration factor. This calibration factor is then stored and can be used for all stations in close proximity. The distance over which this calibration factor is valid is dependent upon the body of water in which the boat is operating and the existance of conditions which could distort the TDs (such as electrical power lines). Once a station is "set up", the calibration factor is associated with that station and saved in its parameters file. For each subsequent visit to that station, that file is called up and the system is automatically calibrated.

Once on station, the system allows for the automatic storage of coordinates and time of each component of the sampling activity. In addition, the system prompts the user for sample numbers upon the collection of each sample. In most cases, the user should use the bar code

reader and supplied barcodes for inputting this information. Again, the purpose of this is to eliminate transcription error.

SECTION 11
COMMUNICATIONS

The Demonstration Project is a complex effort involving activities in field and laboratory sites separated by hundreds of miles. Good communications are critical to the efficiency, and possibly the ultimate success, of the Project. Several communication nets have been incorporated into the program. These include electronic transfer of data, communications between the boat and mobile lab, and communications between the field crews and the Field Operations Center.

11.1 Electronic Transfer of Data

Due to the complexity of the DP sampling program, it is important that data collected in the field be transferred to the Field Operations Center on a daily basis. This electronic data consists of any data and information entered into the on-board computer, including data collected from DO monitoring instruments, sample numbers, daily logs, sample shipments, etc.

This communication is directly linked between the GRiD computer and the ERL-N VAX. Communications are established using the GRiD's internal modem and the PROCOMM Plus communications package. The Kermit subroutine is used to upload and download data and information. Once a link has been established, transfer is automatic. If data or notes are flagged by the field crew, the FC, DP Project Manager, and the Data Base Manager are notified automatically by the VAX the next time one of them logs onto the computer.

Any information that the Field Operations Center wishes to transfer to the crews is automatically downloaded to their GRiD during this session.

The transfer of electronic information is performed daily by each team. Because a phone line (not a portable phone) is required, these communications are performed at night after sampling activities have been completed. All information should be uploaded to the VAX on the day it is collected. In many cases this is not possible due to poor phone lines or motels with "hard-wired" phones. In these cases, data should be uploaded as soon as possible i.e. the next evening.

Details on the electronic transfer of data can be found in Beaulieu (1990).

11.2 Communications with the Field Operations Center

In addition to electronic communications, verbal communications between the field crews and the Field Operations Center should be conducted on a daily basis. Each team is equipped with a portable cellular telephone to simplify these communications, however, because of the cost involved in using a cellular phone, the person calling in should attempt to locate a pay phone first. If one is not available, then the cellular phone should be used. The EMAP Field Operations Center has been assigned a Toll-Free "800" phone number to further simplify communications. That number is:

1-800-NET-EMAP

Any problems in the field should be relayed immediately to the FC by the crew member manning the mobile laboratory. On weekends, or in the evening, the FC and DP Project Manager are available by pager. Phone calls to the "800" number are automatically forwarded to an answering/paging service. With the exception of problems, communications with the Field Operations Center should generally be conducted during normal working hours.

The information required by the Field Operations Center are the stations (and event numbers) sampled on the previous day, the stations being sampled on that day, and the stations the crew expects to sample on the following day. Also required is any shipping information from that, or the previous, day, including sample type, where it was shipped, and both the shipment ID number and the Federal Express tracking number.

Through the use of the portable phones, the Field Operations Center should be able to contact each team at any time. In areas where cellular phone service is not available, the Field Operations Center can utilize the Marine Operator.

As phone calls placed through Marine Operators are very expensive, teams should restrain from using the Marine Operator unless Cellular phone service or pay phones are not available.

Use of the portable cellular telephones is restricted to official and emergency calls. Since there is a charge for incoming as well as outgoing calls, spouses and/or friends are not to call on the portable phone except in the event of an emergency. Portable phones can be used to report any emergency, whether it involves the crew directly or not.

11.3 Ship-to-Shore Communications

Both the boats and mobile laboratories are equipped with marine-band VHF radios. Any problems or changes in itinerary should be communicated between the boat and mobile lab using Channel 82A. As this frequency is shared by other U.S. government operations, transmissions should be kept to a minimum. This radio is also used to communicate with other boat traffic and port operations as required. The mobile lab radio should be used only to communicate with the boat, or, in an emergency, the marine operator. FCC REGULATIONS PROHIBIT THE MOBILE LAB FROM TRANSMITTING ON ANY MARINE FREQUENCY WHILE THE LAB IS IN MOTION.

SECTION 12
DESCRIPTION OF STATION TYPES AND SAMPLING ACTIVITIES

Several different types of stations will be sampled during the DP. In addition, the activities at certain stations are different during different sampling intervals. The locations of all stations are provided in Appendix B. A summary of the activities to be performed at each station type, during each interval, can be found in Table 12.1.

12.1 Base Sampling Sites (BSS)

Base Sampling Sites (BSS) are randomly chosen sites that will be used to characterize the water quality of the Province. The Base Sampling Sites were selected by overlaying a grid on the entire Virginian Province and randomly selecting stations from the cells in the grid. The activities performed at these sites are dependent on the interval in which the site is visited. BSS are sampled in each of the three sampling intervals.

12.1.1 **BSS - Interval 1**

BSS Interval 1 activities are as follows:

a. One CTD cast is performed, and data collected on temperature, salinity, DO, pH, transmissivity, fluorescence, and PAR.
b. One fish trawl is performed and the contents processed for species composition and abundance, gross external pathology, and tissue chemistry.

Table 12.1. Listing of the Activities and Samples Obtained at all Stations During the Demonstration Project.

INTERVAL 1

	STATION TYPE[a]						
SAMPLE TYPE	LTDO DOM	DOV	BSS	IND	ITE	ITE/BSS	SUPPL
CTD cast	S	S	S				
QC check	S	S	S				
susp. solids	S	S	S				
chl a	S	S	S				
review data	S	S	S				
Retrieve Hydro.	S	S					
dump data	S	S					
QC check	S	S					
Water Toxicity							
Benthic Biology	3						
grain size	3						
Sediment Chem.							
Sediment Tox.							
grain size							
Fish Trawl	2		1				
Identify	S		S				
Gross Path.	S		S				
Histo. Path.	S		S				
Histo. Ref.*							
Chemistry	S		S				
Bivalve Dredge							
Identify							
Chemistry							
Deploy Hydro.	S	S					
QC check	S	S					

(continued)

Table 12.1 (Continued).

INTERVAL 2

	STATION TYPE[a]						
SAMPLE TYPE	LTDO DOM	LTDO DOV	BSS	IND	ITE	ITE/BSS	SUPPL
CTD cast	S	S	S	S	S	S	S
QC check	S	S	S	S	S	S	S
susp. solids	S	S	S	S	S	S	S
chl a	S	S	S	S	S	S	S
Retrieve Hydro.	S	S					
QC check	S	S					
Water Toxicity					S	S	
Benthic Biology	3		3	3	3	3	3
grain size	3		3	3	3	3	3
Sediment Chem.	S		S		S	S	S
Sediment Tox.	S		S		S	S	S
grain size	S		S		S	S	S
Fish Trawl	2		1		2	2	1
Identify	S		S		S	S	S
Gross Path.	S		S		S	S	S
Histo. Path.	S		S		S	S	S
Histo. Ref.[*]					S	S	
Chemistry	S		S		S	S	S
Bivalve Dredge							
Identify							
Chemistry							
Deploy Hydro.	S	S					
QC check	S	S					

(continued)

Table 12.1 (Continued).

INTERVAL 3

	STATION TYPE[a]						
SAMPLE TYPE	LTDO DOM[**]	DOV	BSS	IND	ITE	ITE/BSS	SUPPL
CTD cast	S		S		S	S	
QC check	S		S		S	S	
susp. solids	S		S				
chl a	S		S		S	S	
Retrieve Hydro.							
QC check							
Water Toxicity							
Benthic Biology	3						
grain size	3						
Sediment Chem.							
Sediment Tox.							
grain size							
Fish Trawl	2		1				
Identify	S		S				
Gross Path.	S		S				
Histo. Path.	S		S				
Histo. Ref.[*]							
Chemistry	S		S				
Bivalve Dredge	S		S		S	S	
Identify	S		S		S	S	
Chemistry	S		S		S	S	
Deploy Hydro.							
QC check							

[*] Histo. Ref. = non-diseased fish saved for reference histopathological analysis

[**] Activities are the same as in Interval 1, except DataSondes are no longer deployed

[a] DOM = monitoring at LTDO station; DOV = service visit at LTDO station; BSS = Base Sampling Site; IND = Index site; ITE = Indicator Testing and Evaluation Site; SUPPL = Supplemental site. In the table, S = sampled, and a number indicates the number of samples collected.

12.1.2 **BSS - Interval 2**

BSS Interval 2 activities are as follows:

a. One CTD cast is performed, and data collected on temperature, salinity, DO, pH, transmissivity, fluorescence, and PAR.
b. Approximately eight sediment grab samples are obtained and processed for benthic species composition and biomass, sediment chemistry, and sediment toxicity.
c. One fish trawl is performed and the contents processed for species composition and abundance, gross external pathology, and tissue chemistry.

12.1.3 **BSS - Interval 3**

BSS Interval 3 activities are as follows:

a. One CTD cast is performed, and data is collected on temperature, salinity, DO, pH, transmissivity, fluorescence, and PAR.
b. One fish trawl is performed and the contents processed for species composition and abundance, gross external pathology, and tissue chemistry.
c. One tow with a rocking chair dredge is performed and the bivalves collected processed for species composition and tissue chemistry.

12.2 Long-Term Dissolved Oxygen (LTDO) Monitoring Sites

LTDO sites are Base Sampling Sites at which Hydrolab DataSonde 3 deployable data loggers are deployed for approximately 60 days. These sites are revisited every 10 days and the deployed unit replaced with another calibrated DataSonde. Each revisit to one of these sites can be categorized as either a Monitoring visit or a Service visit.

12.2.1 **LTDO Monitoring - Interval 1**

LTDO (Interval 1) monitoring activities are performed on only one of the revisits. The activities are as follows:

a. The DataSonde unit is retrieved and the data reviewed.
b. One CTD cast is performed and data collected on temperature, salinity, DO, pH, transmissivity, fluorescence, and PAR.
c. Three sediment grab samples are obtained and processed for species composition and biomass.
d. Two fish trawls are performed and processed for species composition and abundance, gross external pathology, and tissue chemistry.
e. The replacement DataSonde unit is deployed.

12.2.2 **LTDO Service - Interval 1**

LTDO (Interval 1) Service activities are performed on the remaining two visits to each LTDO Site as follows:

a. The DataSonde unit is retrieved and the data reviewed.
b. One CTD cast is performed and data collected on temperature, salinity, DO, pH, transmissivity, fluorescence, and PAR.
c. The replacement DataSonde unit is deployed.

12.2.3 **LTDO Monitoring - Interval 2**

LTDO (Interval 2) Monitoring activities are identical to those described for "BSS - Interval 2" with the addition of retrieving and deploying DataSondes, and performing a second fish trawl. These activities are performed on one of the revisits to these stations during Interval 2.

12.2.4 **LTDO Service - Interval 2**

LTDO (Interval 2) Service activities are identical to those described for Interval 1. On the last visit to an LTDO station during the second interval, the DataSonde is retrieved and no replacement deployed.

12.2.5 **LTDO Monitoring - Interval 3**

Although DataSondes will no longer be deployed during Interval 3, some additional activities are performed at the LTDO stations during the third period. These stations are sampled as BSS stations (see Section 13.1.3), with an additional fish trawl being performed and processed for species composition and abundance, gross external pathology, and tissue chemistry. Three

sediment grab samples are also collected and processed for species composition and biomass.

12.2.6 **LTDO Service - Interval 3**

During Interval 3 there are no DataSondes deployed, therefore, there are no service visits during this interval.

12.3 Index (IND) Stations

Index Stations are located in depositional environments in the vicinity of Base Sampling Sites. The purpose of these stations is to determine if the BSS is representative of "worse case" conditions within a grid cell. These stations are only sampled during the second interval, and must be sampled on the same day as the associated BSS. The activities at Index Stations are as follows:

a. One CTD cast is performed as described for BSS.
b. Three sediment grab samples are obtained and processed for species composition and biomass.

12.4 Supplemental Stations

Supplemental stations are sampled only during the second interval, with the activities being identical to those described for BSS in Interval 2 (Section 12.1.2). Supplemental stations will be used to produce estimates of variance for small estuarine systems. Supplemental stations located within the Delaware Bay system are at a density of approximately four times that of other large estuarine systems being sampled in the DP. The information gathered will be used to determine the spatial sampling scale necessary to adequately represent the ecological condition in large estuarine systems and large tidal rivers in the Virginian Province.

12.5 Indicator Testing and Evaluation (ITE) Stations - Interval 2

Indicator Testing and Evaluation stations are chosen specifically because of the environmental conditions at that site. They can be classified in a 2x2 matrix by DO (low versus high) and sediment chemical contamination. Therefore, there are four sites per matrix. Separate matrices have been created for the three salinity classifications (polyhaline, mesohaline, and oligohaline) in both the northern region (east of the Hudson River) and the southern region (south of the Hudson). This results in a total of 24 possible sites. For the DP, only 23 of these have

been identified. ITE Stations are selected to provide reference information on how indicators perform in areas of known high or low DO and sediment contaminant levels. Several ITE Stations are located at Base Sampling Sites. ITE Stations are only sampled during the second and third intervals. The Interval 2 activities performed are identical to those described for BSS in Interval 2 (Section 12.1.2), plus:

a. A surface water sample is collected for water column toxicity testing.
b. Sediment profile photographs are obtained (only at selected stations as the camera will be rotated among teams).
c. A second fish trawl is obtained and processed for species composition and abundance, pathology, and tissue chemistry. In addition to the diseased fishes saved for histopathological examination, non-diseased reference fishes are also saved as described in Appendix F.
d. One tow with a rocking chair dredge is performed and the bivalves collected processed for species composition and tissue chemistry. This is performed only at ITE Stations that are **NOT** BSS. Those that also serve as Base Sampling Sites will be sampled for this parameter in the third interval.

12.6 ITE Stations - Interval 3

Some ITE stations are also Base Sampling Sites. Those that are also BSS are sampled as BSS in Interval 3. Those that only serve as ITE stations are sampled as follows:

a. One CTD cast is performed and data collected on temperature, salinity, DO, pH, transmissivity, fluorescence, and PAR.
b. One tow with a rocking chair dredge is performed and the bivalves collected processed for species composition and tissue chemistry.

SECTION 13
SAMPLING ACTIVITIES AND PROCEDURES

All field sampling activities are conducted during the June-September Index Period. Stations are sampled for water column toxicity; dissolved oxygen (DO); chlorophyll *a*; photosynthetically active radiation (PAR); turbidity; benthic species composition and biomass; sediment chemical contamination and toxicity; fish community composition, gross external pathology and chemical contamination; and abundance and chemical contamination of bivalves. As described in Section 12, not all analyses are performed at all stations.

13.1 Preparations for Sampling

Each morning, preparations are made for that day's sampling activities. After driving all vehicles to the boat ramp, the boat is launched, checked out, and all supplies loaded. A checklist (included in Appendix C) is used to assure that all gear has been loaded and all boat systems are functioning properly. Prior to departing, all personnel should meet to discuss the agenda for that day. The Crew Chief should provide the crew member remaining on shore in the mobile laboratory with an itinerary for the boat.

13.2 Locating Stations Using the Computer Navigation System

Each boat is equipped with a computer navigation system to assist in locating stations. This system allows for the automated storage of station coordinates for each station visited. In addition, this system contains additional software for accessing and storing electronic data from the Sea-Bird CTD and the Hydrolab DataSonde 3.

After launching the boat and loading supplies, the GRiD computer is installed in the boat, connected to the boat's 12v DC power supply and to the Loran and GPS units. The computer is turned on and the system booted up. The navigation system is initialized and calibrated as per the detailed instructions in SAIC (1990).

Following calibration, the station coordinates are retrieved as a waypoint and the navigation system used to steer towards that station as per the instructions in SAIC (1990).

13.3 Order of Sampling Activities

Once the station is located, the boat is anchored and sampling begins. Listed below is the order of sampling activities at a station where all types of samples are collected. The activities performed at most stations will only be a subset of these. See Table 12.1 for a listing of the types of activities performed at each station type. Following this listing are sections describing the individual activities in more detail. Flow charts outlining these methods and the order of sampling activities at each station type can be found in Appendix G.

1. Record the station coordinates by prompting the computer.

2. Record any notes on the station; weather, etc.

3. Retrieve deployed DataSonde unit and transfer data to the on-board computer.

4. Perform a CTD cast, transfer the data to the on-board computer, and review the data.

5. Collect water for the water column toxicity analysis (only at Indicator Testing and Evaluation Stations).

6. Take sediment/water interface photographs using the sediment profile camera (only at selected Indicator Testing and Evaluation Stations).

7. Take approximately eight sediment grabs using the Young-modified Van Veen grab sampler. Three grabs are sieved and the organisms preserved in formalin for laboratory analysis. The top two centimeters of the remaining grabs are composited, homogenized, and split for chemical and toxicological analyses.

8. Perform one 10 minute fish trawl. Identify and measure fish; observe all individuals ≥75mm in fork length for evidence of pathology (preserve diseased fish and, at ITE Stations, preserve healthy fish to serve as a reference). Freeze [on dry ice] up to five fish from each target species for chemical analyses. At Indicator Testing and Evaluation and LTDO Stations, a second trawl is performed and processed in the same manner.

9. Perform one 5-minute tow with the rocking chair dredge to collect large (≥25 mm) bivalves. Bivalves are identified and measured, and placed on dry ice [by species] for chemical analysis.

10. Deploy replacement DataSonde unit. This is not to be performed until all trawling and dredging operations have been completed. DataSondes are not deployed if the CTD cast shows the bottom DO to be zero.

11. Return to shore with samples and package them for shipment as appropriate. Also, perform a QC check on the retrieved DataSonde 3.

13.4 Obtaining Dissolved Oxygen Profile

The first activity performed at every station (other than LTDO stations) is using the Sea-Bird SeaLogger CTD to obtain a vertical profile of the water column for salinity, temperature, dissolved oxygen (DO) concentration, transmissivity (estimate of suspended solids concentration), fluorescence (estimate of chlorophyll *a*), and PAR (a measurement of the intensity of light in the range of wavelengths used by algae in photosynthesis).

At LTDO stations, the Hydrolab DataSonde 3 is retrieved prior to anchoring and profiling.

The Sea-Bird SeaLogger CTD unit is a self-contained array of instruments capable of measuring all the parameters mentioned above. The core of the unit is a data logger which stores all data collected by the individual probes. The entire array runs off of internal batteries, therefore it does not require any electronic connection to the boat during operation. Supplied with the instrument is the software required for communicating with the data logger and for uploading data

to the on-board computer. Specific instruction on the operation of the CTD are included as Appendix H.

Each day, prior to sampling activities, a Quality Control (QC) check is performed. This can be performed at the dock, in a protected area, or on station depending on weather conditions and where it is most convenient for the crew. The procedure is as follows:

1. Connect the CTD to the end of the winch cable with a shackle, and **TIGHTEN THE PIN**. Use siezing wire to assure the shackle does not open. Make sure a "pinger" is attached to the unit.

2. Connect the CTD to the on-board computer and enter the Sea-Bird SeaSoft software. Erase all earlier data stored in the data logger, and prepare the CTD for data collection.

3. Manually turn the unit "on" and perform a QC check on the pH probe using a pH 7 reference buffer (make sure the grounding wire is in the pH buffer).

4. Lower into the water to just below the surface. Real-time data should be displayed on the computer screen.

5. Allow the CTD to run for at least one minute for the DO probe to reach thermal equilibrium after being out of water.

6. Collect a water sample from the same depth as the intake for the CTD's pump. This sample is collected using the *Go-Flo* bottle used in the collection of water for toxicity analysis (see Section 13.6). Unlike the procedure described in Section 13.6, the bottle can be deployed in the "open" position. This sample is used to verify the calibration of the CTD's DO probe. Freeze the computer screen at the time the water sample is collected.

7. Bring the unit back on board and turn "off".

8. Once retrieved, open the upper valve of the *Go-Flo* bottle and place the outlet hose into a 300 ml biological oxygen demand (BOD) bottle. The end of the hose should be approximately ¾ of the way down the bottle. Allow the water to enter

the bottle **SLOWLY** and overflow (at least two volumes i.e., 600 ml). The sample is then analyzed for DO using the Winkler technique described in Appendix I. Two water samples are collected for DO determination. Only one need be analyzed unless an error is suspected. Titrations should be conducted as soon as possible at the dock. Check the salinity of the sample (to the nearest 1 ppt) using a refractometer and the temperature using a stem thermometer.

9. Compare CTD values frozen on the computer screen in step 6 with those measured in steps 2 and 8 for pH, salinity, and temperature. If they do not agree within 0.5 pH unit, 2 ppt, and 2 °C, respectively, the process must be repeated. If, after a second attempt, the unit still produces erroneous numbers, calibration will be necessary. This procedure is described in Appendix H. If the value obtained from the Winkler does not agree with the CTD value to within 1 mg/l, all DO data collected that day are flagged.

10. The Crew Chief always has the option of proceeding, even if the QC values exceed the acceptable error; however, he/she is required to enter his/her name and an explanation into the computer. The computer automatically flags the data collected under these circumstances.

11. Reset the instrument so it is ready for the first station, disconnect the data cable, and install the dummy plug and locking sleeve.

At each station, the general procedures for collection of data are as follows. More specific information on the operation of the CTD can be found in Appendix H.

1. Connect the CTD to the end of the winch cable with a shackle, and **TIGHTEN THE PIN**. Use siezing wire to assure the shackle does not open. Make sure a "pinger" is attached to the unit.

2. Swing the instrument over the side, turn it on, and lower it to just below the water surface.

3. After allowing the instrument to reach thermal equilibrium (at least one minute), collect a surface water sample with a *Go-Flo* bottle or a bucket, and lower the CTD through the water column at a rate of approximately one meter per second until it reaches the bottom. Use the depth finder to "observe" the unit as it descends. Prevent the CTD from impacting the bottom by stopping its descent when it is approximately one meter or less from the bottom. Allow the unit to collect data for two minutes, then raise it to the surface, turn it off, and bring it back into the boat. Process the water sample collected for chlorophyll *a* and suspended solids as described in Section 13.4.1.

4. Following completion of the CTD cast, connect the CTD to the on-board computer and upload the data using the Sea-Bird software. This software bin averages the data over one-meter intervals, and should be instructed to use only the downcast data. Upcast data are generally not as accurate as the downcast data because of the orientation of the probes.

5. After data are stored in the on-board computer, view the DO data on the screen using the Sea-Bird software. If, for any reason, the cast was not successful, all steps are repeated up to a total of three attempts.

6. Record appropriate data on the DO data sheet. This includes the bottom salinity and if the bottom DO is zero.

13.4.1 Processing of Samples for Suspended Solids and Chlorophyll *a* Analyses

Water samples collected for the determination of suspended solids and chlorophyll *a* analyses are processed as follows:

<u>Suspended Solids (ITE stations only)</u>

1. Shake the *Go-Flo* bottle to assure no sediments have settled.

2. Fill the supplied 625 ml plastic container with water from the bottle, place an appropriate bar code label on it, and place it on ice.

3. Record the sample number on the data sheet.

Chlorophyll *a* (all stations)

1. Install a 25 mm glass fiber filter (type GF-F, 0.7 μm nominal pore size) in the syringe filtering apparatus. Place several drops of a saturated $MgCO_3$ solution on the filter pad.

2. Fill the 60 ml syringe and apply pressure to force the water through the filter. Repeat as necessary until the filter pad takes on a greenish color. Following filtration, blow one syringe of air through the filter pad to dry it.

3. Record the volume filtered.

4. Using forceps, carefully remove the filter pad from the filtering apparatus, fold it in half twice (into quarters), and wrap it in aluminum foil. The filter pad must be handled with clean forceps as contact with the skin can cause the degradation of chlorophyll.

5. Place the foil-wrapped sample in a small zip-lock bag, write the sample number on the bag, and place the bar code label (with the backing paper) inside the bag. This is done because dry ice freezes the adhesive on the bar code label and it may fall off. Record the sample number on the data sheet.

6. Place the sample in a cooler on dry ice and keep frozen at -20°C.

13.4.2 Safety Considerations

The CTD is fairly heavy; therefore, care should be taken when deploying or retrieving this unit from the end of the boom under adverse weather conditions. The only other danger to the user is from the operation of the winch, which is covered in Section 9. In addition, care should be taken not to damage the instrument.

13.4.3 Quality Assurance

As the CTD is a delicate electronic instrument, certain precautions are necessary to assure proper operation. All instructions should be followed closely. QC calibration checks must be performed daily. If the instrument falls out of calibration, it must be calibrated according to the instructions in Appendix H before any data are collected.

The transformation of transmissivity and fluorescence voltage readings to suspended solids and chlorophyll is dependent on the characteristics of the particulates in the water column. The chlorophyll and suspended solids samples will be used in determining these relationships.

13.4.4 Contingencies

1. If the water depth is too shallow ($\leq$ 3 meters) to obtain a profile, suspend the unit just above the bottom and collect data for two minutes (following a one minute warm-up period). This must be noted in the computer log, and the Field Coordinator notified.

2. If the CTD fails to function properly, the Hydrolab Surveyor instrument should be used to obtain a profile. Record data at one meter intervals on the back of the data sheet. These data can then be entered into the computer in the comment section.

3. Any time a contingency plan is initiated, the FC must be notified. In the case of equipment failure, the FC should be notified immediately so arrangements can be made for shipping back-up equipment.

13.5 Operation of the DataSondes

Hydrolab DataSonde 3 dataloggers are deployed at 30 stations for intervals 1 and 2 (units are deployed at only 24 stations during Interval 2). Due to battery limitations and physical and biological fouling, these units must be serviced every 10 days. Servicing simply consists of: (1) retrieving the unit; (2) deploying the replacement; and (3) performing QC checks on both units.

Upon arrival at an LTDO station the first activity performed is the retrieval of the Hydrolab DataSonde 3 datalogger. This is performed prior to anchoring at the station. The last activity performed at these stations is the deployment of the replacement unit. Instruments are deployed **AFTER** trawling is completed to eliminate the possibility that the units could be accidentally caught by the trawl and damaged.

Detailed instructions for the operation of these instruments are included in Appendix J. Below are general instructions for deploying these units.

13.5.1 Deployment Criteria

In certain cases, deployment of the DataSonde 3 will not be performed. Following the collection of the Sea-Bird CTD data described in Section 13.4, those DO data are examined. If the DO of the bottom water is zero mg/L, no DataSonde 3 will be deployed at that station. Under anoxic conditions, hydrogen sulfide (H_2S) is produced. High levels of H_2S rapidly (within minutes) can lead to sulfide poisoning of the DO probe. Once a probe is poisoned, any data produced by that probe is worthless, and the probe is permanently damaged.

13.5.2 Quality Control Check

Prior to deployment, and following retrieval, a QC check is performed on each DataSonde unit. The check on the retrieved unit provides information on the performance of the unit over the period of deployment. All DataSonde QC checks are performed at the dock. Air calibration requires a stable platform to prevent water from splashing on the DO membrane, making calibration (or checking) on-board the boat difficult, if not impossible. QC checks are performed as follows.

<u>Unit Being Deployed</u>

1. Remove the storage cup covering the probes and examine them for irregularities such as a wrinkled DO membrane or bubbles in the DO probe. If any irregularities are noted, this unit is set aside and another one is chosen and examined.

2. Install the calibration cup, connect the DataSonde to the computer, and enter Procomm communications.

3. Fill the cup with 0.5M KCl standard and record the temperature of the solution as measured with a stem thermometer.

4. Record the temperature and conductivity as it appears on the computer screen. The conductivity should read 58.6 mS/cm. If it is off, recalibrate the unit to this value.

5. Discard the sample in the cup, pour in a pH 7 buffer, and check the pH and DO calibration as described in Appendix J (air calibration for DO). Record these values on the data sheet. If DO is off by more than 2%, or pH by more than 1 pH unit, recalibrate the unit.

Unit Being Retrieved

The QC check on the retrieved unit is performed in the same fashion, except the unit is not recalibrated. All measured and machine values are recorded on the appropriate data sheet.

13.5.3 Deployment

1. Connect the unit to the on-board GRiD computer and initiate communications using Procomm. Erase all data stored in the DataSonde 3 and set the unit to log data at 30-minute intervals beginning approximately 15 minutes following the actual deployment. The unit should be set to record until 1991. This allows the unit to continue to record data past the 10 day period in case the crew is late in retrieving it. (NOTE: This step can be performed at the dock during the QC check).

2. Disconnect the unit from the computer. As soon as the data cable is disconnected from the DataSonde 3, **THE PROTECTIVE CONNECTOR CAP MUST BE INSERTED OVER THE CONNECTOR PINS AND THE LOCKING SLEEVE INSTALLED**. The dot and line on the protective cap are lined up with the **WIDE** pin and the cap is firmly pushed down. The cap is then "burped" by applying pressure to the top of the cap and then working down the cap to the bottom. The user should hear a snap as air trapped under the cap is expelled.

3. Remove the storage cup covering the probes and examine them for irregularities such as a wrinkled DO membrane or bubbles in the DO probe. If any irregularities are noted, this unit is set aside and another one is chosen and examined.

4. Determine the appropriate amount of mooring cable based on the water depth, assemble the mooring, and attach the DataSonde 3 to the mooring so that the probes will be located one meter above the bottom. Attach a "pinger" to the protective cage. Use siezing wire on all shackles.

5. Gently lower the unit and mooring assembly over the side of the boat and log the event on the data sheet. Note, in the boat's log, the exact TDs at the point each of the clump weights hits the bottom. Record the coordinates of the DataSonde 3 on the data sheet.

13.5.4 Retrieval

1. Upon arrival at an LTDO station, retrieve the yellow marker buoy. Record the coordinates of this buoy on the data sheet.

2. Run the soft line through the snatch block at the end of the boom, and then three times around the capstan. Using the capstan (**CAREFULLY - SEE INSTRUCTION IN SECTION 8**), retrieve the entire array.

3. Anchor the boat.

4. Remove the DataSonde from the protective cover.

5. Remove the probe cage and replace with the storage cup (filled with TAP water).

6. Examine the probes for evidence of damage or fouling. Note any evidence of this on the data sheet.

7. Connect the DataSonde to the on-board computer and transfer the data using Procomm plus.

8. Complete the data sheet.

9. Using the DataSonde 3 utility built into the navigation system, review the data to assure that the upload worked properly. If any irregularities are noticed, a note must be made in the computer log. Data collected after the DO dropped to 0 mg/L are questionable and should be flagged in the data base. It may also be necessary to replace the probe, depending on the results of the QC check.

10. Perform a QC check at the dock.

13.5.5 Servicing Units

Following retrieval of a DataSonde unit, transport it to the mobile laboratory where it is scrubbed with detergent to remove fouling organisms. Examine all probes for damage and fouling, and replace damaged probes as necessary. It is especially important to examine the conductivity probe. Fouling of the orifices can easily go un-noticed. Replace the DO probe Low-Flow membrane according to the instructions in Appendix J.

If the data record shows that the DO dropped to 0 mg/L at any time, there is a good chance that the probe was damaged. If the QC check demonstrates that the probe is still functioning properly, a note should be made in the equipment log and that unit observed carefully following its next deployment. If the probe fails to meet calibration standards, the probe must be replaced as per instructions in Appendix J.

On the following day (at least 12 hours following replacement of the membrane), replace the batteries and calibrate all probes as described in Appendix J. During calibration, the unit should be operated off of external power to conserve the batteries. However, external power should be momentarily disconnected and the battery voltage of the internal batteries noted. If this is less than 15 volts, the batteries should be replaced.

13.5.6 Safety Considerations

No special safety precautions are warranted for this instrument. The only danger to the user is from the operation of the winch, which is covered in Section 8. However, care should be taken not to damage the instrument.

13.5.7 Quality Assurance

As the DataSonde is a delicate electronic instrument, certain precautions are necessary to assure proper operation. All instructions should be followed closely. QC calibration checks must be performed each time a unit is deployed or retrieved.

Both batteries and the DO probe's Low-Flow membrane must be replaced between deployments. Calibration of the DO probe must be performed no earlier than 12 hours after the installation of a new membrane. This allows adequate time for the membrane to "relax." Calibrating the probe before the membrane has had time to relax can result in collection of inaccurate data.

13.5.8 Contingency Plans

1. If the water depth is less than 2m, no DataSonde unit can be deployed. Some stations can be relocated to deeper water. See Section 15 for more information on relocating stations.

2. At least two calibrated DataSondes should be carried on-board whenever an LTDO station is visited. This allows for one back-up instrument in case one fails. Units that fail to operate properly should be repaired immediately. Replacement of probes can be performed in the field according to the instructions given in Appendix J. All repairs must be noted in the equipment log.

3. Relocation of any station or equipment failure should be reported to the FC as soon as possible.

13.6 Collection of Water Samples for Toxicity Testing - Research Indicator

Samples for water column toxicity testing are collected only at Indicator Testing and Evaluation Stations. These stations are sampled only during Interval 2.

Crews should avoid sampling at ITE stations on Fridays and Saturdays. As water toxicity samples must be shipped on the day following collection, avoiding sampling on Fridays and Saturdays will eliminate the need to ship samples via an air cargo service on weekends.

Following the collection of DO data, a water sample is collected for toxicity testing. This must be performed prior to "bottom related" activities (sediment grabs or trawling) to assure that bottom sediments are not resuspended and collected along with the water sample. A General Oceanics *Go-Flo* sampler is used for obtaining these samples. The procedure is as follows (see Figure 13.1 for more detailed instructions on the operation of this gear):

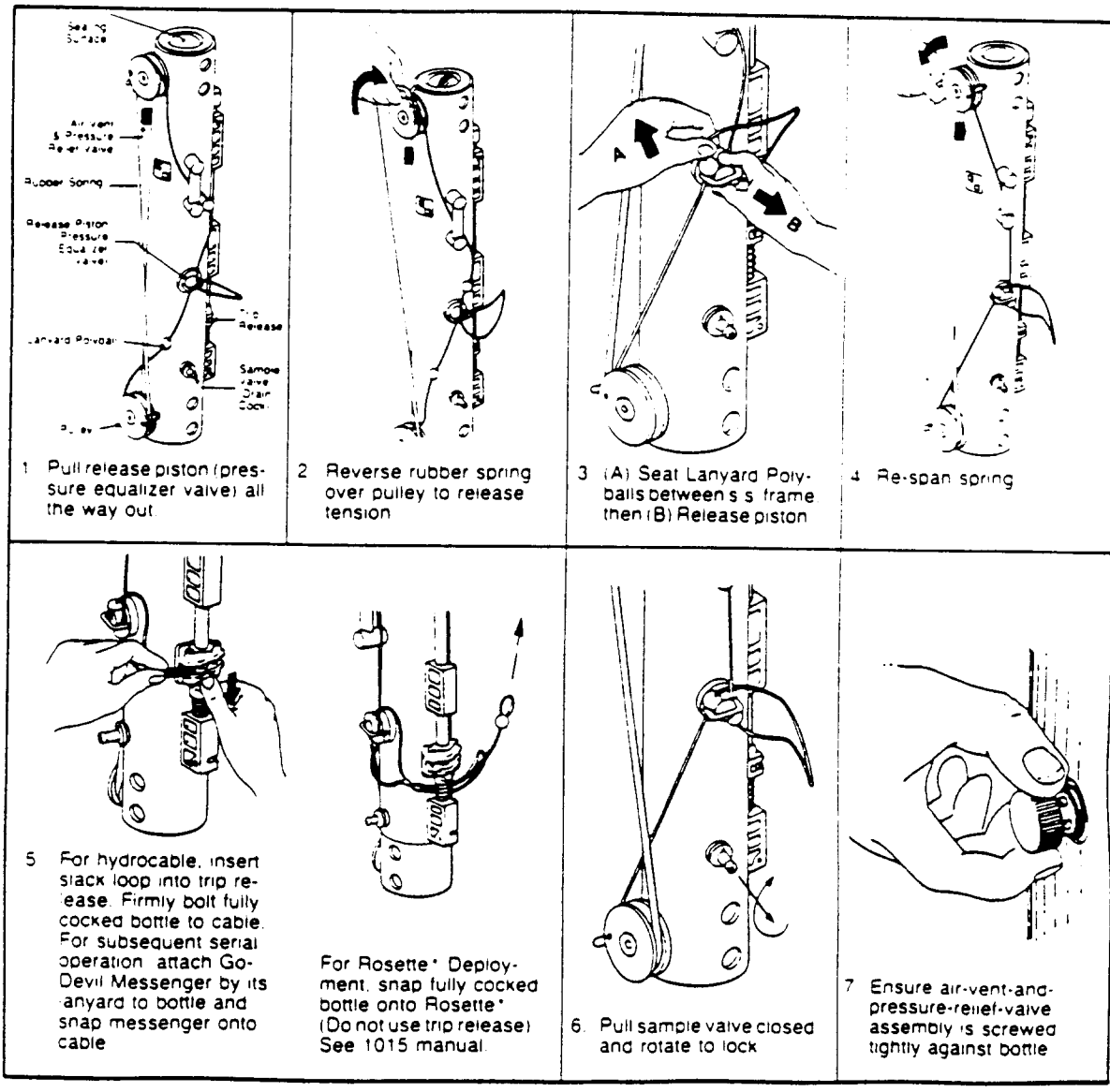
1. Attach the sampling bottle to the end of a calibrated, weighted line. Generally, this line will be the stainless steel winch cable.

2. Fully cock the sample bottle. This is a two-step process. First, cock the unit so that the ends are OPEN and the unit can be tripped by the messenger. Second, pull the rubber springs further until the ends of the bottle are CLOSED. The plastic balls on the tripping mechanism should be locked behind the release piston. When the bottle is set, the large balls on the ends of the sampler should be in the closed position. This prevents water from entering the bottle as it is immersed, thereby preventing contamination by the surface microlayer.

3. Lower the bottle into the water until the top is approximately 0.3 meters below the surface. Force the boat hook between the release piston and its protective cage, depressing the piston. This will trip the first mechanism, thereby opening the bottle. Lower the bottle to mid-depth then raise it and repeat until it has been rinsed by traveling at least 5 meters through the water column in the OPEN position. DO NOT ALLOW THE BOTTLE TO COME WITHIN APPROXIMATELY 0.3 METERS OF THE SURFACE IN THE OPEN POSITION. DOING SO COULD RESULT IN CONTAMINATION BY THE SURFACE MICROLAYER, WHICH COULD BE CONTAMINATED BY ENGINE EXHAUST.

4. Position the rinsed bottle approximately one meter below the surface, attach the messenger to the line and allow it to slide down the cable and trip the bottle.

5. Return the bottle to the boat, loosen the top valve, and drain approximately 200 ml of water through the bottom and into a 1 gallon Cubitainer to rinse it. Pour off this rinse and repeat for a total of three times, then drain the remainder into the Cubitainer.



1 Pull release piston (pressure equalizer valve) all the way out.

2 Reverse rubber spring over pulley to release tension.

3 (A) Seat Lanyard Polyballs between s.s. frame then (B) Release piston.

4 Re-span spring.

5 For hydrocable, insert slack loop into trip release. Firmly bolt fully cocked bottle to cable. For subsequent serial operation attach Go-Devil Messenger by its lanyard to bottle and snap messenger onto cable.

For Rosette* Deployment, snap fully cocked bottle onto Rosette* (Do not use trip release) See 1015 manual.

6. Pull sample valve closed and rotate to lock.

7 Ensure air-vent-and-pressure-relief-valve assembly is screwed tightly against bottle.

8. Lower bottle rapidly to below depth at which opening of ball valve is hydrostatically actuated.

9 Do not stop descent of bottle either at air-sea interface or at any depth less than nominal depth (10 meters, 33 ft.)

10 Recovery: Let air into bottle by rotating air-vent-&-pressure-relief assembly counterclockwise.

Insert gas may be injected: Remove air-vent-&-pressure-relief assembly. Connect gas pressure line. (use part S1080-AFIT.) Suggested working pressure, 2 to 5 psi. In no case exceed 15 psi!

11 For use with reversing thermometers, see operating instructions for model 1000-3 reversing thermometer assembly.

Figure 13.1. Operation of the General Oceanics *Go-Flo* water sampling bottle.

MAINTENANCE

Replace black power cord (spring) when its force drops 25% below initial values of 9 lbs for 1.7 to 2.5-l bottles, 15 lbs for 5- to 12-l bottles, and 20 lbs for 20- to 100-l bottles, as indicated on an in-line tensiometer (such as a handheld hanging scale to weigh fish).

In high sediment-laden water, do not grease working parts. (Grit trapped in grease scours sealing surfaces.)

Inspect O-rings for damage.

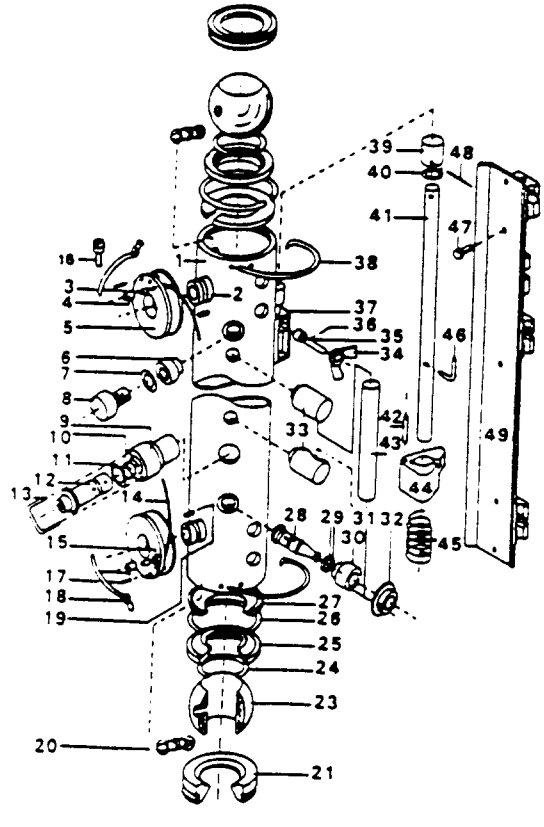
Wash bottle with fresh water after use and before storage.

Caution: If solvents other than water are used to clean bottles, test solvents first on small non-critical area of PVC or Teflon coating.

Store bottles with valves in *final closed position*.

After extended storage, especially before every deployment, make sure that all moving parts and seals are free to perform. (Remove outer cap rings and valve balls, then slide inner seal ring up and down several times to relieve "O" ring from any preset or grease displacement.) Samplers with screw-type cap require additional torque.

PARTS



ITEM	DESCRIPTION	QT
1	BODY	1
2	PULLEY BUSHING	2
3	1/8 NICROPRESS SINGLE HOLE	2
4	HEAT SHRINK	2
5	SPRING PULLEY	2
6	BUSHING, PRESSURE A/VENT	1
7	"O" RING 81-0396	1
8	A/VENT & PRESSURE VALVE	1
9	PRESSURE VALVE BUSHING	1
10	SPRING	1
11	"O" RING 81-0025	1
12	PRESSURE VALVE	1
13	"U" BRACKET	1
14	LANYARD 1/8	1
15	FLAT WASHER	2
16	SCREW	4
17	ROLL PIN 12x1.0	2
18	RUBBER SPRING	1
19	ANCHOR PIN	2
20	BALL KEY	2
21	BALL ENTRAPMENT	2
22	"O" RING	2
23	SEALING BALL	2
24	"O" RING	2
25	FLOATING SEAL	2
26	"O" RING	2
27	SILICONE SEAL	2
28	VALVE BODY PETCOCK	1
29	"O" RING PETCOCK	2
30	BUSHING, PETCOCK	1
31	LOCK PIN, PETCOCK	1
32	PULL DISC PETCOCK	1
33	HANDLE POST	2
34	WING NUT	3
35	WIRE CLAMP BOLT	3
36	ROLL PIN 12x.5	3
37	BLOCK P.V.C.	3
38	LOCKING LANYARD	2
39	PUSH ROD CAP	1
40	"O" RING 81-0395	1
41	PUSH ROD	1
42	RELEASE PIN "1"	1
43	CARRYING HANDLE	1
44	THUMB BLOCK	1
45	PUSH ROD SPRING	1
46	RELEASE PIN "L"	1
47	MTG. BLOCK BOLT	5
48	ROLL PIN, PUSH ROD	1
49	MTG. WELDMENT	1

Figure 13.1. (continued)

6. Enter the bar code number from the Cubitainer on the data sheet.

7. Store the Cubitainer on ice (not dry ice) in an insulated box until shipped. The sample should be kept cold (4°C), NOT frozen.

13.6.1 Safety Considerations

Although the *Go-Flo* bottle is fairly easy to operate, the user must be aware of the dangers involved in operating this piece of equipment. The rubber spring can cause the end caps (hollow balls) to close with a substantial amount of force. Fingers caught in the ends of the bottle when it closes could easily be crushed and severely damaged.

13.6.2 Quality Assurance

Between stations, bottles must be scrubbed with Alconox detergent and thoroughly rinsed with deionized (DI) water. At the station being sampled, the bottle must travel at least 5 meters through the water column IN THE OPEN POSITION to rinse off any residual contaminants (including the detergent).

Care should be taken during rinsing so that the bottle does not hit the bottom or breach the surface.

13.6.4 Contingency Plans

If the depth of the water is insufficient to properly rinse the bottle, hold the open bottle in the horizontal position under the surface of the water and allow water to flow through it for one minute. This can be accomplished by using the boat hook to hold up the bottom of the bottle. This must be recorded in the log.

13.7 Operation of the Sediment Profile Camera - Research Indicator

The sediment profile camera is used only at selected Indicator Testing and Evaluation Stations. One camera and a technician to operate it will visit one team. When used, the photographs are taken prior to any other benthic sampling to avoid disruption of the sediment surface.

13.8 Sediment Collections

Sediments are collected for a variety of analyses. Three samples are collected for benthic species composition, abundance, and biomass. Approximately five additional sediment grabs are collected for chemical analyses and for use in acute toxicity tests (actual number needed may vary based on the required volume). To minimize the possibility of biasing results, a random number generator has been used to determine which of the eight grabs collected are sieved for determination of benthic species composition, abundance, and biomass, and which are composited for chemistry and toxicity testing.

Grab samples 2, 5, and 6 are processed for species composition, abundance, and biomass. Samples 1, 3, 4, 7, 8... are processed for chemistry and toxicity testing.

A 1/25 m^2, stainless steel, Young-modified Van Veen Grab sampler is used to collect sediments for benthic analyses. The sampler is constructed entirely of stainless steel and is appropriate for collecting sediment samples for both biological and chemical analyses. The top of the sampler is hinged to allow for the removal of the top layer of sediment for chemical and toxicity analyses. This gear is relatively easy to operate and requires little specialized training.

Listed below is the protocol for obtaining sediment samples.

1. Using the washdown pump, thoroughly rinse the inside of the grab sampler with seawater from the station being sampled.

2. Attach the sampler to the end of the winch cable with a shackle and **tighten the pin**. An auxiliary link is also installed to provide added assurance against loss of the equipment. Attach a pinger to the grab.

3. Attach one set of weights to the sampler. These can be removed, or additional weights added depending on the sediment type. The grab is then cocked.

4. Lower the grab sampler through the water column such that travel through the last 5 meters is no faster than 1 m/sec. This minimizes the effects of bow wave disturbance to surficial sediments. The descent of the sampler can be watched on the depth finder.

5. Log the grab on the data sheet.

6. Retrieve the sampler and lower it into its cradle on-board. Open the hinged top and determine whether the sample is successful or not. A successful grab is one having relatively level, intact sediment over the entire area of the grab, and a sediment depth at the center of at least 5 centimeters (see Figure 13.2). Grabs containing no sediments, partially filled grabs, or grabs with shelly substrates or grossly slumped surfaces are unacceptable. Grabs completely filled to the top, where the sediment is in direct contact with the hinged top, are also unacceptable. It may take several attempts using different amounts of weight to obtain the first acceptable sample. The more weight added, the deeper the bite of the grab. In very soft muds, pads may be needed to prevent the sampler from sinking in the mud. If pads are used, the rate of descent near the bottom should be slowed even further to reduce the bow wave.

7. Enter notes on the condition of the sample as necessary. Notes should include the presence of large objects, organisms, etc.

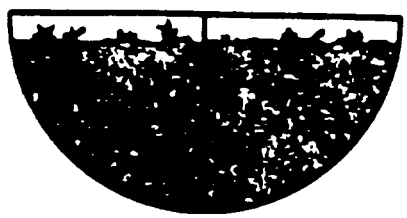
8. Process the grab sample for either benthic community analysis or chemistry/toxicity testing as described below.

9. Repeat steps 4-8 until all samples are collected. To minimize the chance of sampling the exact same location twice, after three grabs are taken (whether successful or not), move the boat 5 meters downstream by letting out the appropriate length of anchor line.

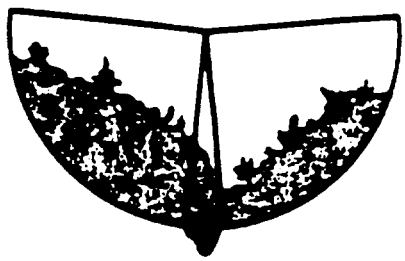
13.8.1 Field Processing of Samples for Benthic Community Assessment

Grab samples (2, 5, and 6) to be used in the assessment of macrobenthic communities are processed in the following manner:

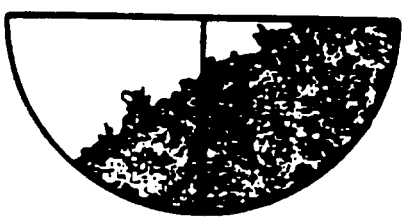
1. Record the sample number of the grab when logging the event (Section 13.8, Step 5). The sample number is taken from the bar code label on one of the Nalgene containers designated for sediment community samples. MAKE CERTAIN THAT THIS BOTTLE REMAINS WITH THIS SAMPLE.



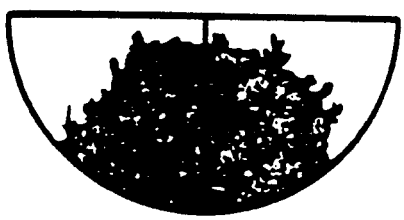
ACCEPTABLE IF MINIMUM PENETRATION REQUIREMENT MET



UNACCEPTABLE (WASHED, ROCK CAUGHT IN JAWS)



UNACCEPTABLE (CANTED WITH PARTIAL SAMPLE)



UNACCEPTABLE (WASHED)

Figure 13.2. Quality assurance criteria for obtaining grab samples. Only those samples meeting QA criteria are retained. Those not meeting these criteria are discarded.

2. Measure the depth of the sediment at the middle of the sampler and record the value on the data sheet. The depth should be ≥5 cm. Record descriptive information about the grab, such as the presence or absence of a surface floc, color and smell of surface sediments, and visible fauna on the data sheet for this sample.

3. Insert a small (2.5 cm diameter, 15 cm long), clear plastic core into a random location within the sampler and extract a core sample. Measure the depth to the black layer of sediment within the core and record on the data sheet. Extrude the sediment from the core tube into a "Whirl Pack." Place an appropriate bar code label on the Whirl Pack. Record the sample number on the Whirl Pack, and store for later analysis to determine the relative proportion of silt and clays versus sands. The sample should be stored on ice (NOT dry ice) as the sample should be refrigerated at 4°C, not frozen.

4. Process the remainder of the grab for benthic community analyses. Dump the sediments into a basin and then into a 500 µm mesh sieve. Place the sieve into a table (sieve box) containing water from the sampling station. Agitate the tray in the sieve box thus washing away sediments and leaving organisms, detritus, sand particles, and pebbles larger than 500 µm. This method minimizes mechanical damage to fauna that is common when forceful jets of water are used to break up sediments. A gentle flow of water over the sample is acceptable.

5. Gently rinse the contents of the tray to one edge and, using a funnel, rinse the contents into the plastic screw-top bottle from which the sample number was scanned in Step 1. If the quantity of sample exceeds the capacity of the container, place the remainder of the sample in a second, unlabeled container. Using a waterproof marker, write the
sample number on the second container and tape the two together. Note on the data sheet that the sample consists of more than one container.

6. Carefully inspect the sieve to ensure that all organisms are removed using forceps (if necessary) to transfer fauna from the sieve to the bottle containing the proper sample number.

7. Ten percent buffered formalin is used to fix and preserve samples. Rose Bengal stain should be added to the solution. The final concentration (including any dilution by seawater rinses) must be at least 5 percent formalin.

8. Prior to sieving the next sample, use copious amounts of forceful water and a stiff brush to clean the sieve, thereby minimizing cross-contamination of samples.

13.8.2 Field Processing of Sediments for Chemistry and Toxicity Testing

In addition to the three grabs collected for benthic community analyses, approximately five grabs are collected for chemical analyses and toxicity testing. The top two cm of these five grabs are removed, homogenized, and split for chemistry and toxicity testing. These samples are processed as follows:

1. As each grab is retrieved, carefully examine it to determine acceptability as described above in Section 13.8, Step 6. Record notes on the appearance of acceptable samples, and carefully remove and discard large, non-living surface items such as rocks or pieces of wood.

2. Teflon utensils are used to remove sediments from grab samples for these analyses. All items must be rinsed with ambient seawater, followed by acetone, before use. Acetone rinsing must be performed over a bucket. Acetone dissolves fiberglass, therefore, care must be exercised to assure that it does not come in direct contact with the boat. Dispose of the acetone properly (see Section 20.3).

3. Remove the top two cm of sediment using a Teflon utensil. Care should be taken to keep a minimum of one cm from the edge of the sample to reduce the possibility of contamination from the sampler. Place the sediment removed in a Teflon pan and place the pan in a cooler on ice (NOT dry ice). The sample must be stored at 4°C, NOT FROZEN.

4. Repeat this procedure for all five grabs, compositing the sediment in the same Teflon pan until at least 3,000 cc of sediment has been collected.

5. Homogenize the sediment by stirring with a Teflon-coated spatula for 10 minutes.

6. Using the Teflon spatula, carefully place 200 cc of sediment in a 250 ml amber glass bottle for chemical analysis. CARE MUST BE TAKEN TO ASSURE THAT THE INSIDE OF THE BOTTLE, BOTTLE CAP, AND THE SAMPLE ARE NOT CONTAMINATED. Record the sample number, wrap the jar in "bubble wrap" to protect it from breakage, and place the sample on ice (NOT dry ice). To reduce the possibility of breakage, the sample should be stored at 4°C, NOT FROZEN.

7. Record the sample number and any additional information on the data sheet.

8. At approximately 10 percent of the stations, three additional 200 cc sediment samples are also collected for duplicate analyses (1) and for analysis by a referee laboratory (2). These samples are collected from the same composite as per the directions in Step 6. The FC will notify the crew at which stations this sample needs to be collected.

9. Attach an appropriate bar code label to a Whirl-Pack, place approximately 100 cc of sediment in it for sediment grain size analysis, and record the sample number. Store this sample on ice (NOT dry ice).

10. Using the Teflon-coated spatula, remove 1,500 cc of sediment and place it in a two liter Nalgene container for toxicity testing. Record the sample number on the bottle, and place the sample on ice (NOT dry ice). The sample must be stored at 4°C, NOT FROZEN.

At stations where the bottom salinity is below 10 ppt (determined from the CTD cast), two toxicity samples are required. All sediment remaining in the Teflon beaker (following removal of chemistry and grain size samples) is divided among two Nalgene containers. Each should contain a minimum of 1,000 cc of sediment.

13.8.3 Safety Considerations

All sediment grab samplers are dangerous pieces of equipment. Once the device is cocked, it could accidentally trip at any time. The operators must be careful not to place hands or fingers in a position where they could be damaged (or amputated) in the event that the device trips prematurely.

The sampler is a heavy piece of equipment (especially when full). The operators must take care when deploying or retrieving this gear under adverse weather conditions. A grab sampler swinging wildly at the end of a boom can be very dangerous.

13.8.4 Quality Assurance

There are a number of steps that can be taken to ensure the integrity of the samples collected.

1. The interior surfaces of the grab sampler (including the underside of the hinged top) must be rinsed prior to use to assure that no sediment remains from the previous station.

2. Prior to use, all Teflon supplies which are to come into contact with samples must also be properly cleaned.

3. ASSURE THAT THE PROPER BAR CODE LABELS ARE AFFIXED TO ALL SAMPLES.

4. At selected sites, "blanks" for chemistry will be obtained. Leave an empty glass chemistry jar open for a short period of time, mimicking the treatment it would receive if a sample was to be placed in it. Then seal the jar and record the sample number. This jar is then treated in the same fashion as all other chemistry samples.

5. Care should be taken to assure that the sediment saved for chemical and toxicological analyses is collected only from the top two cm of the grab.

6. Care must be taken to assure that the chemistry sample does not become contaminated. This requires great care in extracting the sample, homogenizing it, and placing it in the proper container. If it is raining when the sample is collected,

all activities should be conducted under a tarp to prevent contamination of the sample by rain water.

13.8.5 Contingency Plans

It is recognized that at certain stations, the sediment type will prevent the collection of sediment samples. If a single "acceptable" grab sample cannot be obtained after five attempts, or if ≥70 percent of the attempts are unsuccessful, then additional attempts are abandoned and no sediment samples collected. All other samples should be collected. This must be noted in the log and the FC notified as soon as possible.

13.9 Fish Trawls

After all required sediments are collected, one or two trawls (depending on the station type) are made to collect fish for species composition and relative abundance, tissue chemistry, and for pathological examination.

A fish trawl is a funnel-shaped net that filters fish from the near bottom waters. Fish are herded by ground wire and doors into the mouth of the funnel where fish are captured. The basic components of a trawl net are described briefly below.

The doors of the net provide spreading power to the net. Water pressure against the doors force them to spread the wings of the trawl. The wings are the beginning of the webbing and form the mouth of the funnel on two sides of the net. The wings are bordered on top and bottom by a headrope and a footrope, respectively. For a single warp rig, each end of the headrope, or top line, is attached directly to the upper ring on the back of the doors. Each end of the footrope, or bottom line, is attached to the bottom ring of the doors. For strength and weight, a sweep is attached to the footrope. At the bosom, or apex of the curve of the mouth, the wings attach to the body of the net. The top portion of the body has an overhanging panel, or square, which prevents fish from escaping over the top panel of the trawl. Continuing back toward the terminus of the net are the first and second bellies which are normally symmetrical top and bottom. The bellies contribute most of the body of the net, and therefore make up most of the taper. Attached to the second belly is an extension panel that serves to guide the catch into the cod-end or bag. The cod-end is the rear portion of the trawl net which serves as a collecting bag

for all that is captured by the trawl. To ensure capture of small organisms, a cod-end liner of very small mesh is often used.

Fish are collected using a high rise sampling trawl with a 16-meter footrope with a chain sweep. Tow duration is 10 minutes with a towing speed of 2-3 knots against the prevailing current. Speed over the bottom should be 1-3 knot. Fish are sorted and enumerated, examined for evidence of gross pathological conditions, and selected specimens retained and properly processed for tissue chemical analysis. Subsampling of fish is conducted as necessary. The outline below describes the specific protocol to be followed during trawling operations. The procedures include: net deployment, vessel operation while under tow, net retrieval, and sample processing.

13.9.1 Trawl Preparation

1. Inspect the trawl net for holes, including cod-end liners, and mend/replace as necessary prior to departure from the dock. Inspect all hardware for wear and replace as needed. All connections should be made securely and tightened with a wrench. Do NOT rely on hand tightening shackles, bolts, or other fasteners.

2. Lead the winch wire from the drum through the turning block on the mast assembly and through the snatch block at the end of the boom.

3. Attach the bridle to the winch wire with a shackle. Wind both legs of the bridle onto the main winch drum from the storage spool, while maintaining tension on the wire. All bridle connections should be tightened with a wrench.

4. Arrange the net on the deck with the cod-end aft and the head rope on top. Close the terminus of the cod-end by using the "cow bell" apparatus and pucker line. Allow the cod-end liner and aft portion of the cod-end to extend through the pucker line. Tighten the pucker line and secure the "cow bell" by hammering the trigger mechanism into place. This line should pass through the rings at the back of the cod end and around the net just in front of these rings. Coil the float line from the cod-end to the float, and position it on the net for easy access.

5. Attach the legs of the net to the trawl doors. The top leg of the net is the extension of the headrope and must be secured to the top aft ring of the door. The bottom leg is the extension of the sweep and must be secured to the bottom aft ring of the door. One bridle wire should be attached to each door at the towing point of the chain harness. Shackles should be used for all connections.

13.9.2 Net Deployment

1. After all preparation steps have been completed, the Crew Chief should determine the direction of current flow and survey the probable trawl track for potential hazards, such as other vessels, deployed commercial fishing gear (nets, pots, etc.), shallow water, or unsuitable substrate. In addition, depth, weather, and sea conditions should also be evaluated prior to each trawl. The decision as to whether or not to collect a sample is the responsibility of the Crew Chief.

2. The boom should be positioned out over the starboard gunnel with a enough incline for the doors to clear the rail. Lead the bridles through the snatch block on the boom, raise the doors with the winch, and bring them to rest on the gunnel (starboard door forward, port door aft). Circle the boat slowly to starboard. When the starboard side is down current, deploy the float and safety line attached to the cod-end. Flake the net into the water from the cod-end to the wings. Check to make sure that the legs of the net are not twisted before continuing deployment. Pay out wire until the doors are well behind the engines. Swing the boom to the centerline then lower the boom, releasing tension on the snatch block (the wire should now be on the goalpost assembly). Head slowly into the current (e.g., 1 knot) and continue to pay out wire until appropriate warp length is obtained (consult Table 13.1 for the proper amount of wire to be released based on water depth). Great care should be taken to prevent fouling of the propeller with the net. Care should also be taken to maintain tension on the tow warp to avoid fouling the net on bottom.

Table 13.1. Amount of Winch Wire to be Used for Trawling and Dredging

FISH TRAWL

Water depth (ft)	Ratio of line to water depth (including the 125' bridle)
≤50	7:1 (minimum of entire bridle out)
50-75	5:1
≥ 75	3:1

ROCKING-CHAIR DREDGE

Water depth (ft)	Ratio of line to water depth
≤50	5:1
≥50	3:1

13.9.3 Trawling

1. As soon as the required warp length is reached, the winch operator should inform the Crew Chief that the net is ready for towing. The Crew Chief then visually resurveys the trawl track, records the time, coordinates depth and other pertinent information, and begins the tow. An attempt should be made to trawl along a uniform depth contour. Recording of the time and coordinates is performed automatically by the computer system upon prompting. These must also be entered on data sheets.

2. Boat speed should be 2-3 knots. Speed over bottom, as measured by Loran position, should be between 1 and 3 knots. If it becomes apparent that these conditions will not be met, the net should be retrieved and a different trawl direction tried.

3. During the trawl tow, the Crew Chief should monitor the depthfinder for potential obstructions or sudden changes in depth. If a hazard is identified or a hang up occurs, the net should be retrieved and another tow attempted approximately 100 m from the initial trawl track. If three unsuccessful attempts are made, or 1.5 hours effort is expended, trawling operations should be aborted. If a successful 10 minute trawl cannot be accomplished, process fish collected from a shorter trawl and note the duration on the data sheet. Although the species composition data may not be used, chemistry and pathology data would still be valid.

4. The duration of all trawls should be 10 minutes from the time the pay-out of warp is completed until the time hauling begins.

13.9.4 Net Retrieval

1. Record the time and coordinates at the end of the tow.

2. Haul back the wire until approximately 10 meters of the bridle is still out. Throttle back and raise the boom so the wire clears the goal post assembly. Turn the boat slightly to starboard and move the boom over the starboard side (the boom should be controlled by the vangs during this process). Take in wire until the doors are at

the block. Remove the splitting strap attached to the port door, and run the line through a second block on the boom and through the capstan head. Switch the hydraulic power to the capstan, and retrieve the cod-end of the net, being careful to not foul the props. With the cod-end on deck, drag the remainder of the net over the gunnels from the extension to the wings. When the entire net is on deck, lower the doors to the deck and secure them. If the net is nearly empty, both the doors and the net can be hauled in by hand. If the net is full and cannot be split and brought in, retrieve the cod-end float and pull the line in with the capstan until the cod-end can be tripped and dumped.

3. Coil the cod-end float line and tie the coil. Disconnect the doors from the net and the bridle and stow them. Flake-fold the net with the wings on the bottom and the cod-end on top, and tie the entire package (including the float) with the splitting strap.

13.9.4 Criteria for Voiding Tows

A sample will be considered void if one or more of the following conditions occur:

1. A tow cannot be completed because of hangdown, boat malfunction, vessel traffic, or major disruption of gear. However, a tow will be considered acceptable if the net must be retrieved after at least 8 minutes due to impending hazards, as long as the net is retrieved in the standard manner.

2. Boat speed or speed over bottom is beyond the prescribed, acceptable range.

3. The cod-end is not tied shut.

4. If the tow continues for more than two minutes beyond the ten-minute tow duration, or is discontinued less than eight minutes following the start.

5. The net is filled with mud or debris.

6. A portion of the catch is lost prior to processing.

7. The tow wire, bridle, headrope, footrope, or up and down lines parted.

8. The net is torn (>30 bars in the tapered portion, >20 bars in the extension or cod end, or multiple tears that, in the opinion of the Crew Chief, may have significantly altered the efficiency of the net).

13.9.5 Sample Processing - Fish Species Composition and Abundance

1. When the net and otter boards are on the deck, remove all fish from the net and sort by species into buckets. Care should be taken to ensure that all fish and debris are removed from the net, including the wings, mouth of the net and the upper portion of the cod-end liner. A taxonomic key developed by the National Marine Fisheries Service (NMFS) is provided to assist field personnel in the proper identification of species.

2. All species considered to be rare, threatened, or endangered (Table 13.2) should be processed immediately and released alive. At the discretion of the Crew Chief, photographs may be taken to document the catch.

3. After all fish have been sorted, process fish for tissue chemistry and pathological examination as described in sections 13.9.6 and 13.9.7. Sampling for chemistry and pathology are performed concurrently with the collection of compostion and abundance data. Only fish are recorded. Crustaceans and other invertebrates are noted on the data sheet then discarded.

4. Measure (Fork Length) with a measuring board, to the nearest millimeter, individuals of each species. If there are fewer than 30 individuals of a species, all individuals should be measured. As fish are measured, they are examined for evidence of gross pathology (Section 13.9.7) and processed for chemistry (Section 13.9.6). If it is estimated that more than 30 individuals of a species were caught, a subsampling procedure should be used to measure between 30-50 individuals. Subsampling will be accomplished by randomly selecting fish from the buckets. All data are entered onto data sheets.

Table 13.2. List of endangered fish species that might be encountered in the Virginian Province. These fish should be measured and returned to the water immediately.

SPECIES	State protected in
Short nosed sturgeon	all (federal endangered species list)
Atlantic sturgeon	CT, NJ, RI
Atlantic salmon	CT
American shad	NJ
Striped bass	DE, MD

5. Enter data on the fish data sheets. Common names are acceptable for those species listed in Table 13.3. For all other species, scientific names are required as more than one common name may exist.

6. All fish not measured for length (i.e. those subsampled) are counted, either by direct count or weight-counts. When extremely large catches of schooling fish such as bay anchovy or clupeids are made, abundance may be estimated by weight-counts. At least 100 individuals should be weighed in a batch, and 2 batches should be weighed to determine mean weight per individual. All remaining fish should be weighed, and the total number of fish estimated and recorded on the data sheet. If two or more obvious size classes are present in a sample (e.g., young-of-year and adults), the size classes should be treated as separate species for the purpose of counting.

7. After all processing has been completed, the Crew Chief should review the trawl data sheet for discrepancies and inaccuracies. When any questions have been resolved, the Crew Chief signs the data sheets as being reviewed and the remaining portion of the catch can be returned to the water. When significant mortality occurs and the trawl site is in a highly visible area, the Crew Chief may elect to retain the catch until more discrete disposal can be accomplished. Under no circumstances should the crew give fish away to the general public.

8. On the following day, the crew member in the mobile laboratory enters all data into the computer and assures that it is properly associated with the correct station (see Data Management, Section 17). This crew member is also responsible for verifying the sample numbers of fish saved for chemistry and pathology, and providing the analytical laboratory with a computer printout of the size and species of each fish shipped.

OBS	COM_NAME	FNUMBER	SCI_NAME
1	ALEWIFE	33	ALOSA PSEUDOHARENGUS
2	AMERICAN EEL	384	ANGUILLA ROSTRATA
3	AMERICAN SHAD	35	ALOSA SAPIDISSIMA
4	ATLANTIC COD	73	GADUS MORHUA
5	ATLANTIC CROAKER	136	MICROPOGON UNDULATUS
6	ATLANTIC HERRING	32	CLUPEA HARENGUS
7	ATLANTIC MACKEREL	121	SCOMBER SCOMBRUS
8	ATLANTIC MENHADEN	36	BREVOORTIA TYRANNUS
9	ATLANTIC NEEDLEFISH	471	STRONGYLURA MARINA
10	ATLANTIC SILVERSIDE	113	MENIDIA MENIDIA
11	ATLANTIC STURGEON	380	ACIPENSER OXYRHYNCHUS
12	BANDED KILLIFISH	.	FUNDULUS DIAPHANUS
13	BAY ANCHOVY	43	ANCHOA MITCHILLI
14	BLACK HULLHEAD	.	ICTALURUS MELAS
15	BLACK DRUM	147	POGONIAS CROMIS
16	BLACK SEA BASS	141	CENTROPRISTIS STRIATA
17	BLUEBACK HERRING	34	ALOSA AESTIVALIS
18	BLUEFISH	135	POMATOMUS SALTATRIX
19	BLUEGILL	.	LEPOMIS MACROCHIRUS
20	BLUNTNOSE STINGRAY	18	DASYATIS SAYI
21	BROWN BULLHEAD	.	ICTALURUS NEBULOSUS
22	BULLNOSE RAY	19	MYLIOBATIS FREMINVILLEI
23	BUTTERFISH	131	PEPRILUS TRIACANTHUS
24	CHANNEL CATFISH	.	ICTALURUS PUNCTATUS
25	CLEARNOSE SKATE	24	RAJA EGLANTERIA
26	COMMON CARP	.	CYPRINUS CARPIO
27	CONGER EEL	63	CONGER OCEANICUS
28	CREVALLE JACK	570	CARANX HIPPOS
29	CUNNER	176	TAUTOGOLABRUS ADSPERSUS
30	FOURBEARD ROCKLING	83	ENCHELYOPUS CIMBRIUS
31	FOURSPINE STICKLEBACK	488	APELTES QUADRACUS
32	FOURSPOT FLOUNDER	104	PARALICHTHYS OBLONGUS
33	GIZZARD SHAD	426	DOROSOMA CEPEDIANUM
34	GOLDEN SHINER	.	NOTEMIGONUS CRYSOLEUCAS
35	GOLDFISH	.	CARASSIUS AURATUS
36	GOOSEFISH	197	LOPHIUS AMERICANUS
37	GRAY SNAPPER	590	LUTJANUS GRISEUS
38	HADDOCK	74	MELANOGRAMMUS AEGLEFINUS
39	HARVESTFISH	749	PEPRILUS ALEPIDOTUS
40	HICKORY SHAD	37	ALOSA MEDIOCRIS
41	HOGCHOKER	118	TRINECTES MACULATUS
42	INLAND SILVERSIDES	.	MENIDIA BERYLLINA
43	LITTLE SKATE	26	RAJA ERINACEA
44	LOOKDOWN	133	SELENE VOMER
45	MUMMICHOG	473	FUNDULUS HETEROCLITUS
46	NAKED GOBY	738	GOBIOSOMA BOSCI
47	NORTHERN KINGFISH	146	MENTICIRRHUS SAXATILIS
48	NORTHERN PIPEFISH	116	SYNGNATHUS FUSCUS
49	NORTHERN PUFFER	196	SPHOEROIDES MACULATUS
50	NORTHERN SEAROBIN	171	PRIONOTUS CAROLINUS
51	NORTHERN STARGAZER	179	ASTROSCOPUS GUTTATUS
52	OYSTER TOADFISH	185	OPSANUS TAU
53	PINFISH	640	LAGODON RHOMBOIDES
54	POLLOCK	75	POLLACHIUS VIRENS
55	PUMPKINSEED	.	LEPOMIS GIBBOSUS

Table 13.3 List of common fish species and their accepted common name.

Table 13.3 continued

OBS	COM_NAME	FNUMBER	SCI_NAME
56	RAINBOW SMELT	45	OSMERUS MORDAX
57	RED HAKE	77	UROPHYCIS CHUSS
58	REDBREAST SUNFISH	.	LEPOMIS AURITUS
59	ROUGH SILVERSIDE	475	MEMBRAS MARTINICA
60	SCUP	143	STENOTOMUS CHRYSOPS
61	SEABOARD GOBY	.	GOBIOSOMA GINSBURGI
62	SHORTNOSE STURGEON	379	ACIPENSER BREVIROSTRUM
63	SILVER HAKE	72	MERLUCCIUS BILINEARIS
64	SILVERY MINNOW	.	HYBOGNATHUS REGIUS
65	SMALLMOUTH FLOUNDER	117	ETROPUS MICROSTOMUS
66	SMOOTH DOGFISH	13	MUSTELUS CANIS
67	SPINY BUTTERFLY RAY	375	GYMNURA ALTAVELA
68	SPINY DOGFISH	15	SQUALUS ACANTHIAS
69	SPOT	149	LEIOSTOMUS XANTHURUS
70	SPOTTAIL SHINER	.	NOTROPIS HUDSONIUS
71	SPOTTED HAKE	78	UROPHYCIS REGIUS
72	STRIPED ANCHOVY	44	ANCHOA HEPSETUS
73	STRIPED BASS	139	MORONE SAXATILIS
74	STRIPED BLENNY	729	CHASMODES BOSQUIANUS
75	STRIPED BURRFISH	198	CHILOMYCTERUS SCHOEPFI
76	STRIPED CUSK-EEL	188	RISSOLA MARGINATA
77	STRIPED SEAROBIN	172	PRIONOTUS EVOLANS
78	SUMMER FLOUNDER	103	PARALICHTHYS DENTATUS
79	SOUTHERN KINGFISH	.	MENTICIRRHUS AMERICANUS
80	TAUTOG	177	TAUTOGA ONITIS
81	TESSELLATED DARTER	.	ETHEOSTOMA OLMSTEDI
82	WEAKFISH	145	CYNOSCION REGALIS
83	WHITE CATFISH	.	ICTALURUS CATUS
84	WHITE HAKE	76	UROPHYCIS TENUIS
85	WHITE PERCH	140	MORONE AMERICANA
86	WINDOWPANE	108	SCOPHTHALMUS AQUOSUS
87	WINTER FLOUNDER	106	PSEUDOPLEURONECTES AMERICANUS
88	YELLOW BULLHEAD	.	ICTALURUS NATALIS
89	YELLOW PERCH	.	PERCA FLAVESCENS
90	YELLOW SUCKER	.	CATOSTOMUS COMMERSONI
91	YELLOWFFIN FLOUNDER	.	LIMANDA FERRUGINEA

13.9.6 Processing of Fish for Chemical Analysis of Muscle

1. For taxa designated as target species (Table 13.4), measure, gut, and retain five individuals within the desired size range for future chemical analysis. Individuals are randomly selected from all those collected until five of the appropriate size have been selected. If no individuals in the primary size range were collected, individuals from the secondary size range closest to the primary size range should be selected. If only individuals outside the desired size range are obtained, those that are closest to the preferred size range are selected. As chemistry takes priority over saving fish for histopathology, any of the first five fish from each target species (in the appropriate size range) showing evidence of pathology are processed for chemistry, not histopathology.

NOTE: Even if a tow is voided for species composition and abundance, fish collected can still be processed for chemistry.

NOTE: When two tows are performed at a station (LTDO and ITE), the TOTAL number of each target species saved from both tows is still five. Therefore, if five are saved from the first tow, none should be saved from the second tow.

2. Place the fish on the cutting block and sever the spinal cord directly behind the head. Blot the fish dry using a paper towel.

3. Record on the data sheet the size, species, sample number (see Step 4), processing technique (see steps 5 and 6), and any other appropriate notes.

4. To assign a sample number, choose the next number in the series for that event designated as a fish chemistry sample (see Data Base Management section - Section 17). Record this number on the data sheet and clearly mark it on a waterproof tag using a waterproof marker.

5. The treatment of fish saved for chemical analysis is dependent on the size of the fish. For fish smaller than 30 cm, gut the fish, wrap it in aluminum foil, place the fish and the tag containing the sample number in a zip-lock bag, and place it in a cooler on DRY ICE.

Table 13.4. Listing of Target Species for Chemical Analysis (sizes are the target sizes for fish saved for chemical analyses).

SPECIES	PRIMARY RANGE (mm)	SECONDARY RANGE (mm)
Channel Catfish	200-300	300-400
Atlantic Croaker	200-300	300-400
Hogchoker	100-150	150-250
Summer Flounder	350-450	200-350*
Spot	150-250	100-150
White Catfish	200-300	300-400
Weakfish	300-400	200-300*
Winter Flounder	300-400	200-300*
Windowpane Flounder	300-400	200-300*
White Perch	150-250	100-150

* Indicates that this group contains fish that will be below the legal sportfish size limit in some states.

6. For fish larger than 30 cm, gut the fish; cut off the head and tail leaving a section no longer than 30 cm, and treat as described above. This is necessary because of limited storage space on board the boat. In no case should the filet knife cut into the section of fish saved.

7. All samples must be placed immediately on DRY ICE for freezing. Upon the addition of new samples to the cooler containing the dry ice, samples should be rearranged to assure that these samples are in contact with the dry ice so they will freeze rapidly. One option would be to use one cooler for freezing fish, and a second for storing them. This is dependent on the equipment carried on the boat, and therefore, the amount of space available.

8. Dispose of the remainder of the carcass overboard as described in Section 20.5.

13.9.7 Processing of Fish for Gross External Pathological Analyses

Examine all target species greater than 75 mm in fork length for evidence of disease. Diseased individuals are saved for laboratory examination, as are reference fish from Indicator Testing and Evaluation Sites. Complete instructions for processing fish for pathological examination are explained in Appendix F and in abbreviated instructions below.

1. While fish are still alive or fresh dead, inspect the skin, fins, eyes and branchial chambers for evidence of disease. Note abnormalities on the data sheet along with species name and total length.

2. Those fish with abnormalities are saved and preserved for histopathological analysis. Either the entire fish (if the total length is $\leq$ 15 cm; open visceral cavity), or the head, visceral cavity, and organs (if the total length is > 15 cm) is placed in a perforated plastic bag and assigned an appropriate sample number (see Section 17). This number is written in indelible ink on a waterproof tag and placed in the bag with the fish. The package is
then placed in a bucket containing Dietrich's fixative.

3. Record the sample number on the data sheet.

13.9.8 Safety Considerations

Operation of the trawl can be a dangerous operation. In addition to the dangers of using the winch and capstan, improper towing procedures could capsize the boat. The net should always be towed off the stern, with the winch cable passing through the towing bracket. Towing off the side of the boat can capsize it. Care must also be taken when pulling the net in over the side. If the net is full, the total weight may be too great to use the mast and boom.

When deploying the net, the crew must be careful not to entangle themselves or other gear in the net, bridle, or winch cable. This could result in serious injury or damage to equipment.

All trawling operations must be conducted in a manner consistent with maintaining the safety of the crew. The Crew Chief will determine when weather or sea conditions are unsafe for trawling.

In the event of net hang-ups on bottom obstructions, the Crew Chief must consider the safety of the crew before attempting to free the gear. A means to sever the tow line should be immediately available to the crew during all trawl operations. SEVERING THE LINE SHOULD ONLY BE PERFORMED AS A LAST RESORT AND WHEN THE LINE IS SLACK!!! SEVERING IT WHILE UNDER TENSION COULD RESULT IN WHIPLASH OF THE LINE AND SEVERE INJURY.

Before deploying the trawl, the Crew Chief should ensure that other vessels do not present a safety hazard during the tow. Whenever possible, the Crew Chief shall contact nearby vessels by marine radio to make them aware of the trawling operation. In addition, the marine radio should be monitored by the crew prior to and during trawl operations.

13.9.9 Quality Assurance

In order for the net to "fish" properly, the proper amount of winch cable must be let out. Consult Table 13.1 for the proper scope. Care must also be taken to assure that fish are not lost from the net during retrieval.

It is important that the tow time and speed be as close to the desired values (Section 13.9.2, steps 2 and 4) as possible. Any deviations should be noted on the data sheet.

In an attempt to determine the "true" percentage error associated with species identification and the determination of pathological conditions, individuals of each species collected will be preserved in Dietrich's fixative and returned to ERLN or VERSAR for verification of identification.

When processing fish for chemical analysis, it is important to assure that the filet knife does not penetrate the portion of the fish to be analyzed, i.e., the muscle contained in the mid-portion of the fish. If this should accidentally happen, the fish should be discarded and another processed.

13.9.10 Contingency Plans

Considering the wide variety of environments to be sampled by EMAP during the DP, it is likely that towing a net will be impossible at many stations. If, due to repeated snags, a successful trawl cannot be performed within 1½ hours of starting, no further attempts should be made. This is noted on the data sheet and the FC notified as soon as possible.

13.9.11 Collection Permits

Many states require scientific collection permits for the collection of fish using trawls. Permits issued for EMAP activities are carried on each boat. A permit must be presented to any appropriate state official that requests to see it.

13.10 Bivalve Tows

The major characteristics of the benthic macrofaunal community are being assessed using only three grab samples. This represents a surface area of only 1239 cm^2, which is inadequate to measure the occurrence and density of large infaunal species. Such species may prove to be a good indicator of ecosystem status and history, since these species are usually long-lived, slow growing, and appear to be absent in stressed environments. Therefore, an additional sample is collected at all Base Sampling and Indicator Testing and Evaluation Sites using a modified rocking chair dredge to collect large infauna found in the top 5 cm of sediment. Bivalves collected are also saved for possible future chemical analyses.

The rocking chair dredge chosen for this study is a 12-inch wide dredge with seven 1½-inch teeth. The cod-end is constructed of one-inch mesh polypropylene.

The sampling procedures are as follows:

1. Attach the dredge to the end of the winch line and attach a pinger to the dredge.

2. With the winch line passing through the snatch block at the end of the boom, lower the dredge into the water over the starboard side of the boat.

3. With the boat traveling at approximately 1 knot (speed over bottom), lower the dredge to the bottom. Continue to pay out line until the winch cable is BEHIND the boat and clear of the engines; stop the boat, remove the winch cable from the end of the boom, and place it on the goal post assembly mounted on the stern of the boat.

4. Feed out an appropriate amount of line (see Table 13.1) and continue towing the dredge at 1 knot for 5 minutes. Record the time and coordinates at the start of the tow.

5. When the tow is complete, record the final time and coordinates and haul in the dredge until the winch line descends at a steep angle behind the boat.

6. **STOP THE BOAT** and place the winch line through the snatch block.

7. Haul in the dredge (over the starboard side of the boat) and dump the contents on the deck of the boat.

8. Separate all bivalves from pebbles, broken shell fragments, and extraneous matter.

9. Identify mollusks to species and measure the shell length of all bivalves at the widest point. Shell length is the anterior to posterior distance across either valve. Also note in the sampling records the occurrence of any other large fauna. Where possible, and when time allows, attempts should be made to identify large (non-bivalve) individuals to species. Peterson's Guide (Morris, 1975) is used to identify

organisms collected. All information is entered onto the data sheets for transcription on the following day.

10. Up to 10 individuals of each species are saved for future chemical analyses. For these individuals, place rubber bands on each individual to keep the valves closed, then place bivalves, by species, in plastic bags. Assign a sample number (place label in bag) to each bag and record the number of individuals and species. Place the bags on dry ice for possible future chemical analysis.

11. On the following day, the crew member in the mobile lab enters all data from the data sheets into the field computer for uploading to the VAX.

13.10.1 Safety Considerations

The empty rocking chair dredge weighs approximately 150 pounds and has 1½-inch teeth on it. As with any heavy piece of equipment, the use under adverse weather conditions presents a danger. Great care should be taken when conditions cause the dredge to swing on the end of the boom.

Great care must be also taken when operating this device off of the side of the boat during deployment and retrieval. If the boat is moving and the dredge snags on the bottom, the potential for capsizing the boat exists. Towing the dredge should always be performed off of the stern through the towing bracket.

13.10.2 Quality Assurance

As with the fish, one individual of each species collected at each station is preserved in Dietrich's for verification of identification at ERLN or VERSAR. This check takes priority over chemical analysis, therefore, if only one individual is collected it is saved for QC.

13.10.3 Contingency Plans

Considering the wide variety of environments to be sampled by EMAP during the DP, it is likely that towing a dredge will be impossible at many stations. If, due to repeated snags, a successful tow cannot be performed within 45 minutes of starting, no further attempts will be made. This will be noted on the data sheet and the FC notified as soon as possible.

13.10.4 Collection Permits

Many states require scientific collection permits for the collection of shellfish using dredges. Permits issued for EMAP activities are carried on each boat. A permit must be presented to any appropriate state official that requests to see it.

SECTION 14
PACKAGING AND SHIPPING SAMPLES

After samples are collected, proper packaging and shipping procedures are critical steps in assuring the integrity of the samples. Failure to follow these procedures could result in the loss of valuable data. Each type of sample requires different handling as described below. Packaging and shipping are performed the day after samples are collected by the crew member in the mobile laboratory. He/she is responsible for assuring that the samples are delivered to Federal Express on weekdays or an appropriate air cargo carrier on weekends. For samples shipped on weekends (requiring pick-up at an airport), the field crew should notify the FC that the sample has been shipped, and provide him with pertinent information (such as flight number and time of arrival). The FC will then notify the appropriate laboratory so arrangements can be made to pick-up the sample at the airport. Proper scheduling of sampling activities (e.g., avoidance of ITE stations on Fridays and Saturdays) will eliminate the need for weekend shipments.

As samples are packaged for final shipment, the sample number of each sample is recorded in the computer. Upon completion of packaging, a unique tracking number (bar code label) is affixed to the SIDE of the box, and this number entered into the computer. The number must be placed on the side, not top, so as to not interfere with the Federal Express tracking system (which also uses bar codes). Before sealing the box, a computer printout of the shipment number and all enclosed sample numbers should be included in the box. The shipment data sheet should also be completed and sent to the Field Operations Center along with the next shipment of data sheets.

When the package is picked up by, or delivered to the carrier, the time, date, and carrier must be entered into the computer and associated with the tracking number. All this information is uploaded to the ERL-N VAX along with the daily data transmission. This allows the FC to track shipments and assure that samples shipped are received within the proper time frame.

Each team carries coolers with dry ice and blue ice to keep samples frozen or cool prior to shipment. Blue ice blocks are frozen by placing them on the dry ice.

Proper storage and shipment conditions are summarized in Table 14.1. Note that even shipments "hand carried" to the receiving lab require a shipment number and the completion of the appropriate shipment data sheet.

14.1 Benthic Species Composition and Biomass Samples

Samples for benthic community analyses are preserved in formalin in the field. These samples are in plastic Nalgene containers with tight fitting lids. As these samples are preserved, there is no need to keep them cool. These samples need not be shipped daily; they can be accumulated in the mobile laboratory until enough are collected to fill a box (probably every 2 to 3 days). These boxes should not weigh more than 50 pounds.

When enough samples have been accumulated, the lid of each one should be checked to assure that it is tight, and the lid taped with electrical tape. The bar code label of each container is then read, and containers are placed individually in zip-lock bags (in case of leakage). They are then placed in a large plastic bag in an insulated box. The larger bag is an additional precaution against leakage, and the insulation of the box is for protection rather than thermal regulation. As described above, a computer printout of the sample numbers included in this shipment is enclosed in the box. To assure blind processing of the samples, no additional information is provided to the analytical laboratory.

The box is then sealed and an appropriate shipping label affixed. Benthic biology samples should be shipped Federal Express Standard Second Day Service. Overnight delivery is not required. Samples should be shipped to:

EMAP Sample Processing
Versar, Inc.
9200 Rumsey Road
Columbia, MD 21045
(301) 964-9200
ATTN: Lisa Scott

As this shipment contains formalin, Federal Express requires that the appropriate boxes indicating dangerous goods be checked on the airbill. In addition, a Dangerous Goods Airbill and Shipper Certification form must be completed. This is available from the Agent picking up the shipment.

Table 14.1. Sample holding and shipping conditions

SAMPLE TYPE	HOLDING CONDITIONS	SHIPPING CONDITIONS
SEDIMENT BIOTA	PRESERVED IN FORMALIN	SHIP WHENEVER THERE ARE ENOUGH SAMPLES TO FILL A BOX
SEDIMENT GRAIN SIZE	REFRIGERATED	SHIP DAILY EXCEPT ON WEEKENDS
SEDIMENT CHEMISTRY	REFRIGERATED	SHIP DAILY EXCEPT ON WEEKENDS
SEDIMENT TOXICITY	REFRIGERATED	SHIP DAILY EXCEPT ON WEEKENDS
WATER TOXICITY	REFRIGERATED	SHIP DAILY INCLUDING WEEKENDS
SUSPENDED SOLIDS	REFRIGERATED	SHIP DAILY EXCEPT ON WEEKENDS
CHLOROPHYLL a	FROZEN	SHIP DAILY EXCEPT ON WEEKENDS
FISH CHEMISTRY	FROZEN	SHIP WHENEVER THERE ARE ENOUGH SAMPLES TO FILL A BOX
FISH PATHOLOGY	PRESERVED IN DIETRICHS	SHIP WHENEVER THERE ARE ENOUGH SAMPLES TO FILL A BOX
BIVALVE CHEMISTRY	FROZEN	SHIP WHENEVER THERE ARE ENOUGH SAMPLES TO FILL A BOX

Since some Team 2 and all Team 3 personnel are based at Versar, benthic biology samples collected by these teams can be delivered in person by crews going off-duty.

14.2 Grain Size Samples

Samples for grain size analysis are collected along with each sample collected for benthic biology and sediment chemistry/toxicity analyses. Samples for grain size analysis should be kept cool (4°C), but not frozen. They should therefore be stored in the mobile lab on ice or blue ice. These samples are contained in Whirl Packs and sealed with metal wraps. Tape should be placed around the ends of these wraps to prevent the metal tips from piercing one of the other bags.

Grain size samples should be shipped on the day following their collection. Whirl Packs should be placed into a large plastic bag and then into an insulated box with a block of frozen blue ice to keep the samples cool. The blue ice should be wrapped in a single layer of newspaper to prevent the samples from freezing.

Samples should be shipped Federal Express, Next Day Service. Samples collected on weekends can be shipped on the following Monday as long as they are properly stored in the mobile lab over the weekend. Samples should be shipped to:

EMAP Sample Processing
Versar, Inc.
9200 Rumsey Road
Columbia, MD 21045
(301) 964-9200
ATTN: Lisa Scott

Since some Team 2 and all Team 3 personnel are based at Versar, some grain size samples collected by these teams can be delivered in person by crews going off-duty.

14.3 Sediment Chemistry Samples

Following collection, sediment samples for chemical characterization can be either refrigerated or frozen. Refrigeration (at 4°C) is recommended because freezing greatly increases the likelihood of breakage of the glass container. It is also recommended that samples be shipped cool, but not frozen, for the same reason.

Sediment chemistry samples should be shipped on the day following collection. Weekend samples can be stored until the following Monday, providing they are properly stored. The lids of sample bottles should be tightened as necessary, then bottles wrapped in bubble wrap to protect them from breakage and placed in individual zip-lock bags (in case of leakage or breakage). They should then be placed in an insulated box with a block of blue ice. Chemistry "blanks" should be treated in the same manner.

Sediment chemistry samples, duplicates and blanks must be shipped Federal Express Next Day Service. Samples should be shipped to:

EMAP Sample Processing
U.S. Environmental Protection Agency
Research Containment Facility
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7150
ATTN: Elbert Hayes

Samples shipped for chemical analysis by a referee laboratory should be shipped to:

EMAP Sample Processing
U.S. Environmental Protection Agency
Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Rich Pruell

14.4 Sediment Toxicity Samples

Sediment samples collected for sediment toxicity testing must be kept refrigerated (4°C), NOT FROZEN. These samples are contained in plastic jars, so breakage is not a concern.

Sediment toxicity samples should be shipped on the day following collection. Samples collected on weekends can be shipped on the following Monday, providing they are properly stored in the mobile lab. To prepare the samples for shipment, the lids are tightened and taped. Containers are then individually placed in zip-lock bags, and placed, along with a block of blue ice, in a large bag inside an insulated box.

Sediment toxicity samples are shipped Federal Express Next Day Service to:

EMAP Sample Processing
U.S. Environmental Protection Agency
Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Glen Thursby

Since Team 1 members are based at ERL-N, some sediment toxicity samples can be delivered in person by crew members going off-duty.

14.5 Fish Chemistry Samples

Upon collection, fish chemistry samples are immediately frozen on dry ice. These samples should be shipped on the day following collection. Samples collected on weekends can be shipped on the following Monday, providing adequate storage space is available in the truck.

Fish samples are placed, frozen, in an insulated box containing one or two 12- pound blocks of dry ice (depending on the number of samples and the size of the box).

Samples must be shipped Federal Express Next Day Service. Since dry ice is being shipped, Federal Express requires that the appropriate boxes indicating dangerous goods be checked on the airbill. In addition, a Dangerous Goods Airbill and Shipper Certification form must be completed. This is available from the Agent picking up the shipment. Samples are shipped to:

EMAP Sample Processing
Bionetics Corp.
9634 Interocean Drive
Cincinnati, OH 45246
(513) 771-0448
ATTN: Lory Littlefield

14.6 Fish Histopathology Samples

Fish samples retained for histopathological examination are kept preserved in Dietrich's fixative. It is therefore not necessary to ship fish samples daily, depending on the available space in the mobile laboratory and the number of fish retained. In general, preserved fish will be shipped only when a sufficient number have been collected to fill a box (no more than 50 pounds per box).

Fish for histopathological examination are wrapped in cheese cloth saturated in Dietrich's fixative, and placed in a zip-lock bag along with a label containing the sample number. Bags should be checked to assure a proper seal, to prevent leakage. Details can be found in Appendix F. Fish are placed in a large plastic bag in an insulated box (the insulation is for protection, not thermal regulation).

Samples should be shipped Federal Express, Standard Second Day Service to:

EMAP Sample Processing
U.S. Environmental Protection Agency
Environmental Research Laboratory
Sabine Island
Gulf Breeze, FL 32561
(904) 934-9200
ATTN: Jack Fournie

As this shipment contains formalin, Federal Express requires that the appropriate boxes indicating dangerous goods be checked on the airbill. In addition, a Dangerous Goods Airbill and Shipper Certification form must be completed. This is available from the Agent picking up the shipment.

14.7 Chlorophyll and Suspended Solids Samples

Samples for chlorophyll *a* analysis are collected daily and frozen on dry ice. These samples simply consist of one filter pad for each analysis. Suspended solids samples are 625 ml water samples stored on ice. These samples must be shipped as soon as possible for filtration in the laboratory. The data generated by the analysis of these samples are needed to interpret the CTD data.

For shipment, samples are placed in a small, insulated box along with a piece of dry ice. The suspended solids samples should be wrapped in newspaper or "bubble wrap" to prevent them from freezing. On many occasions, these samples can be included along with sediments or water for toxicity testing. If this is the case, the filter pads and dry ice should be wrapped in newspaper, and placed in the box with the other samples. The newspaper should insulate the toxicity and suspended solids samples from the dry ice, and prevent them from freezing.

As long as the amount of dry ice in the shipment does not exceed five pounds, no additional paperwork is required by Federal Express. These samples are shipped Federal Express Next Day Service to:

EMAP Sample Processing
U.S. Environmental Protection Agency
Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Glen Thursby

Since Team 1 members are based at ERL-N, some of these samples can be delivered in person by crew members going off-duty.

14.8 Water Samples for Toxicity Testing

At each station, one four-liter water sample is collected for use in acute toxicity testing. These samples are contained in 1-gallon Cubitainers, and are maintained at approximately 4°C. Samples stored overnight in the mobile lab must be stored on wet or blue ice, NOT DRY ICE. Water toxicity testing must begin as soon as possible following collection, therefore all samples are shipped on the day following collection, including weekends.

To avoid the problems associated with weekend shipments, crews should attempt to avoid sampling Indicator Testing and Evaluation sites on Fridays and Saturdays.

The cap of each sample should be checked to assure that it is tightly screwed on, and all samples placed in a large plastic bag, in an insulated box with a block of blue ice.

Samples are shipped Federal Express Next Day Service, or, on weekends, via an appropriate air cargo service. For weekend shipments, the FC must be notified immediately of the shipping information so arrangements can be made for the samples to be picked up at the airport. Samples should be shipped to:

EMAP Sample Processing
U.S. Environmental Protection Agency
Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Glen Thursby

Any samples shipped on weekends via an air cargo service should be clearly marked **HOLD FOR PICKUP AT AIRPORT.**

Since Team 1 members are based at ERL-N, some water toxicity samples can be delivered in person by crew members going off-duty.

14.9 Bivalve Chemistry Samples

Bivalves collected for chemical analysis should be frozen on dry ice until shipped. Bivalves should be shipped on the day following collection; however, samples collected on weekends can be shipped on the following Monday, as long as proper storage conditions are maintained and space is available.

Bags of bivalves are placed in a large plastic bag and into an insulated box along with dry ice. The weight of the box should not exceed 50 pounds.

Since dry ice is being shipped, Federal Express requires that the appropriate boxes indicating dangerous goods be checked on the airbill. In addition, a Dangerous Goods Airbill and Shipper Certification form must be completed. This is available from the Agent picking up the shipment. Samples are shipped to:

EMAP Sample Processing
Bionetics Corp.
9634 Interocean Drive
Cincinnati, OH 45246
(513) 771-0448
ATTN: Lory Littlefield

14.10 Field Computer Diskettes and Data Sheets

All data and field notes are entered into the field computer daily. This information is electronically transferred to the ERL-N VAX, and stored both on the computer's hard drive and on a diskette. These diskettes serve as a back-up of the data set, and must be shipped to the EMAP Field Operations Center regularly.

Bar code-labeled diskettes should be shipped twice per week. All diskettes are placed in diskette mailers, the mailers placed in a Federal Express letter carrier along with data sheets, and then shipped Federal Express Standard Second Day Service. The outside of the envelope should be clearly marked **COMPUTER DISKETTES - DO NOT BEND, X-RAY, OR EXPOSE TO MAGNETIC FIELDS.**

Diskettes and data sheets are shipped to:

EMAP Field Operations Center
U.S. Environmental Protection Agency
Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Melissa Hughes

Since all Team 1 members and some Team 2 members are based at ERL-N, their diskettes can be delivered in person by crew members going off-duty.

SECTION 15
CONTINGENCY PLANS

It is recognized that any field program will be affected by factors outside the control of the sampling crews. Weather, equipment failure, errors in designating station locations, accidents, Coast Guard regulations, etc. can all prevent the field crews from obtaining samples at one or more stations. It is therefore necessary that a set of contingency plans be in place prior to the start of field operations. These options are described below. It is the responsibility of the Crew Chief to determine if a station is indeed not able to be sampled, and determine the proper action as described in the protocol herein. If there is any question as to the protocol to follow, the FC should be contacted immediately.

15.1 Adverse Weather Conditions

It is the responsibility of the Crew Chief to determine if weather conditions are bad enough to prevent sampling. The Crew Chief should evaluate all alternatives, such as changing the sampling plan to more protected areas and return to the prescribed schedule when the weather improves. Every attempt should be made to not waste an entire day; however, THE SAFETY OF THE CREW IS THE CREW CHIEF'S NUMBER ONE PRIORITY. Any deviations from the prescribed sampling plan should be reported to the FC BEFORE THE BOAT LEAVES THE DOCK. Several states require that the appropriate state permitting agency be notified when the field crew will be sampling at specific stations. Changes must be reported to them by the FC prior to the crew sampling that site.

Following the end of adverse weather that prevents the crew from sampling any stations, the crew should attempt to "catch up" by sampling an extra station each day, if possible. If this is not possible, the crew will abandon those stations and continue along the prescribed schedule. In this case, one or more DataSonde units may remain deployed for 20, instead of 10, days. This must be noted in the field log, both at the time the stations were scheduled to be sampled and at the time the DataSondes are actually retrieved. Any stations that could not be sampled in Intervals 1 or 2 due to weather should be sampled at the end of that period. There is no fixed schedule for Period 3, so no contingencies for weather are necessary.

15.2 Station Inaccessibility

Stations can be inaccessible for a number of reasons. One is that they were incorrectly positioned on land or in water too shallow for the boat. Such conditions will be determined during Reconnaissance and corrections made. Stations may be made inaccessible during sampling due to unforeseen circumstances such as a Coast Guard perimeter around an accident or oil spill. In any of these cases, the following rules should be followed:

1. Any inaccessible station located in a "Large Estuary" (see Appendix B) cannot be relocated by the field crew. If the site is deemed unsamplable during reconnaissance, the FC should be notified immediately. An alternate site will be selected and this information communicated to the crew. If the site becomes unsamplable during the target sampling period, the FC should be notified immediately, and the crew should move on to the next station. If an alternative station is chosen, the FC will notify the crew as soon as possible.

2. Any inaccessible "Tidal River" station (see Appendix B) can be relocated. The crew will move towards the river "spine" along a transect perpendicular to that spine. Attempts to relocate the station will be made at 10-meter intervals along that transect, up to a maximum of 50 meters from the original site. The new coordinates must be recorded and the FC notified as soon as possible. If the station cannot be relocated within 50 m, the FC should be notified and will advise the crew as to what to do. Tidal River Index sites should always be located in depositional environments within the river. If one is incorrectly located (grab sample comes up with sand instead of mud), the Crew Chief should contact the FC as soon as possible.

3. Inaccessible stations located in "Small Estuaries" (see Appendix B) can be relocated by the Crew Chief. Attempts should be made to relocate the station 25 meters east, then west, north, and south. If still inaccessible, repeat at 50 meters. If an accessible location is still not found, the Crew Chief should notify the FC as soon as possible. If the station is successfully relocated, the new coordinates should be recorded, a note made in the computer log, and the FC notified.

4. Indicator Validation Stations are chosen specifically because of the environmental conditions at that site. They can be classified in a 2x2 matrix by DO and sediment chemical contamination. These stations can be moved somewhat at the discretion of the Crew Chief, as long as he/she is certain that the environmental conditions are the same as those found at the preselected site. If there is any uncertainty, the FC should be contacted for advice. Again, any changes in the location of a station should be recorded, and the FC notified as soon as possible.

15.3 Equipment Failure

Contingency plans for failure of individual pieces of sampling gear are discussed in the sections describing the operation of the particular gear.

In the event that one of the boat engines fails while the crew is on the water, an attempt should be made to repair the engine. If repair is impossible, the entire day's sampling should be completed using the second engine. As soon as the engine fails, the FC must be notified IMMEDIATELY. Arrangements will be made to transport the spare boat to the crew before sampling begins on the following day.

If another critical piece of equipment (hydraulic winch, trailer, pickup truck) fails, the crew should attempt to repair it. If this is not possible, the FC should be notified IMMEDIATELY so arrangements can be made to deliver the back-up equipment.

SECTION 16
MAINTENANCE

The importance of proper maintenance of all gear cannot be understated. Failure of any piece of major equipment, especially in Interval 2 when the back-up equipment will be used by a fourth team, could result in a significant loss of data. Maintenance of equipment should be performed as described below. It will be the responsibility of the Team Leader to maintain a record of equipment usage, and assure that proper maintenance is performed at the prescribed time intervals.

16.1 Boat Trailers

Lubricate coupling mechanism, clean light connectors and contacts, oil winch motor, and grease wheel bearings at least weekly; flush brake mechanisms with fresh water frequently; and repack wheel bearings at major overhauls. The surge brake actuator and E-Z roller assembly both have grease fittings. These should also be greased weekly.

16.2 Boats

Wash with fresh water whenever possible, and check the integrity of lights, electrical connections, and hoses.

16.3 Outboard Engines

Twenty-hour dealer service should be performed prior to the start of field sampling activities. Replace spark plugs at 200-hour intervals, grease all fittings weekly, check hydraulic hoses and wiring harness daily, and lubricate throttle and shift linkages as needed. Major dealer service is required at 750-1000 hour intervals. This includes new water pump, head gasket, plugs, and timing. The crews should attempt to keep approximately the same number of hours on each engine by alternating the engine running while on station. The Team Leader will notify the FC approximately one week before expected dealer maintenance is required. The FC will make arrangements for the back-up boat to be delivered to the team, and their boat serviced by a dealer.

16.4 Electronics

No regular maintenance is required; remove at night and store, and check connectors each time the units are replaced.

16.5 Hydraulics

Wash engine and pump with fresh water when COLD; change engine oil at 100-hour intervals, replace plugs at 200-hour intervals, and check wire and hose connections daily. Hydraulic oil should be changed at major service intervals. No maintenance on winch or capstan beyond fresh water wash is required. Inspect winch wire for wear or damage, and replace as necessary.

16.6 Rigging

Fresh water wash whenever possible. Keeping all standing rigging taut, lubricate pivot points and sheaves with spray lube, and check fittings daily. Replace worn control lines and topping lift as necessary. All shackles will be fixed with seizing wire.

16.7 Vehicles

Maintain proper fluid levels, and change oil and filter at 5000 mile intervals. No major service intervals beyond the break-in period are expected during the field exercise.

16.8 GRiD Computers

The GRiD computers used on the boat and in the mobile laboratory are designed to be rugged; however, they should be treated as gently as possible. No maintenance is required other than properly exercising the Ni-Cd batteries. Ni-Cd batteries need to be exercised properly to prevent them from loosing their ability to maintain a charge.

Near the end of every third day, the crew member working in the mobile lab will disconnect his/her computer from external power (supplied by the laboratory's battery) and run it off of the computer's Ni-Cd battery until the battery goes completely dead. If the battery is properly charged, this should take two to two and one-half hours. Once the low battery light starts flashing, the operator should save whatever he/she is working on to avoid losing data.

After the battery is completely dead, it can be recharged from the truck's battery and later in the hotel room. Complete charging takes approximately 18 hours.

This schedule should result in each computer's batteries being run down and recharged every six days.

16.9 Sea-Bird CTD

The Sea-Bird CTD should require only minimal maintenance. The unit should be rinsed with fresh water at least daily. Whenever it is not in use, the conductivity probe should be covered with DI water. This is accomplished by filling the hose from the pump to the conductivity cell with DI. The DO probe must also be in a moist environment. Water in the above line should also keep the DO probe conditioned.

Based on the results of the QC checks, certain probes (most likely the pH probe) may need to be calibrated in the field. Instructions for calibration are included in Appendix L.

16.10 Hydrolab DataSonde 3 Data Logger

Maintenance of the DataSondes consists of the servicing performed at 10-day intervals. Probes are checked and cleaned with a brush and detergent, the DO membrane and the batteries replaced, and the unit calibrated. QC checks are also performed prior to deployment and immediately following retrieval. All information regarding maintenance is recorded in the equipment log in the computer.

SECTION 17
FIELD DATA BASE MANAGEMENT

Management of data in the field is of paramount importance. Without proper data management the quality of the data generated is questionable. Field data management for the DP consists of two categories: data sheets and electronic data.

All data (with the exception of electronic data from the CTD and DataSonde units) are recorded both on data sheets, and in the field computer. The ability to use the computer system in the field is being tested during the Demonstration Project. If successful, this will provide a rapid mechanism for sending data from the field to the laboratory via electronic transfer.

The computer system presently consists of a computer navigation system which contains menus for entering data (see SAIC, 1990 and Beaulieu 1990). This system provides for the automatic recording of coordinates, date, and time for each sample collected. Through the use of bar code labels on sample containers, and a bar code reader interfaced to the computer, the problem of transcription error during the entry of data into the computer has been virtually eliminated. At the present time this system is still being modified. Documentation will be included at a later time.

Since the computer system is still experimental, traditional data sheets are used for all data with the exception of electronic data. These data sheets, and instructions for filling them out are in Appendix K. Data sheets are provided in "event packages". An event is the sampling of one station on one day. Each return visit constitutes another event. An event package contains all the data sheets, diskettes, and bar code labels required for an event at a particular station type. The package for an LTDO monitoring event in Interval 1 would contain different material from a package for BSS in Interval 2.

17.1 SAMPLEID NUMBERING SCHEME

The sample numbering scheme for EMAP Near Coastal consists of a four to six digit **SAMPLEID** for each sample collected. The Sampleid is composed of an Event Number and a Sample Number. An Event is defined as a visit to a Station on a specific date. Each visit to a station must have a unique number associated with it because Stations are visited more than once during the three Intervals. The Event Numbers range from one (1) to three (3) digits and the Sample Numbers are consistently three (3) digits. Event Numbers always precede the Sample Number when forming a Sampleid. Event Numbers range from 1 - 820, while the Sample Numbers range from 000 to 350.

Unique Event Numbers have been assigned to each Station Class during each Interval, to Quality Assurance/Quality Control Samples and Extra Events (Table 17.1). Each Station Class for each Interval has been assigned a unique range of Event Numbers. The Station Class Event Numbers range from 1 - 249 and 320 - 694. The Event Numbers for the Quality Assurance/Quality Control Sediment Samples range from 250 - 319.

Each sample which is going to be collected has been assigned a unique Sample Number (Table 17.2). This sample number will always be associated with the same sample during each event. Sample numbers for activities on the boat range from 000 to 099. Sample Numbers 100 - 149 have been assigned to Fish Chemistry Samples for Fish Trawl 1. Sample Numbers 150 - 299 have been assigned to Fish Pathology Samples for Fish Trawl 1. Sample Numbers 300 - 349 have been assigned to Fish Chemistry Samples for Fish Trawl 2. Sample Numbers 350 - 499 have been assigned to Fish Pathology Samples for Fish Trawl 2. Sample Numbers 500 - 549 have been assigned to Bivalve Chemistry Samples.

Sample Numbers are assigned primarily to samples which must be tracked physically. These types of samples were assigned Sample Numbers first (000 - 026) because they require barcode labels associated with them. The barcode labels associated with an Event had to be sequential for printing purposes.

Some Sample Numbers, however, are associated with activities which have other data related to them. These include Sample Numbers associated with CTD and Hydrolab data retrieval, Fish Trawls and Bivalve Tows. These activities did not require a Sample Number for

Table 17.1. EVENT NUMBERING SCHEME FOR SAMPLES TRACKED WITH BARCODES

Three Extra Events are inserted at end of each range (1/CREW/STATION TYPE)

Station Class	Barcodes/ Event	# of Events	Barcodes/ Sta	Event Class Numbers	Sampleid Sequence Start	Sampleid Sequence End
LTDO:DOM1	14	33	462	185-217	185000	185013
					217000	217013
LTDO:DOS1	6	63	378	555-617	555000	555005
					617000	617005
BSS1	6	89	534	35-123	35000	35005
					123000	123005
LTDO:DOS2	6	75	450	620-794	620000	620005
					794000	794005
BSS2	25	89	2225	320-403	320000	320024
					408000	408024
LTDO:DOM2	25	27	675	404-430	409000	409024
					430000	430024
REP2	25	25	625	433-455	431000	431024
					455000	455024
SUPP2	25	9	225	456-464	456000	456024
					464000	464024
ITE2	27	15	405	220-234	220000	220026
					234000	234027
ITE/BSS2	27	11	297	235-245	235000	235027
					245000	245026
IND2	14	60	840	125-184	125000	125013
					184000	184013
LTDO:DOM3	14	33	462	1-33	1000	1013
					33000	33013
BSS3	6	89	534	465-553	465000	465005
					553000	553005

Station Class	Barcodes/ Event	# of Events	Barcodes/ Sta	Event Class Numbers
SEDCHEM DUPLICATE	1	20	20	300-319
SEDCHEM REF LAB-DUP1	1	20	20	250-269
SEDCHEM REF LAB-DUP2	1	20	20	275-294
EQPMNT	200	1	200	810
SHIPPING	1000	1	1000	820

Table 17.2. LIST OF SAMPLE NUMBERS AND SAMPLE TYPES

Snum	Description	Type	BC Loc	Snum	Descrip	Type	BC Loc
000	Diskette	Diskette	Disk	043	Fish Trawl 1	Counts/Lngths	Computer
				044	Fish Trawl 2	Counts/Lngths	Computer
001	Suspended Solids	Cubitainer	Cubitainer	045	Bivalve Tow	Counts/Lngths	Computer
002	Chlorophyll a	Filter pad	Bag				
003	Extra Barcode			100	Fish Chem/Trawl 1	Fish Specimen	Computer
004	Extra Barcode				to		
005	Extra Barcode			149	Fish Chem/Trawl 1	Fish Specimen	Computer
006	Extra Barcode						
007	Extra Barcode						
				150	Fish Path/Trawl 1	Fish Specimen	Computer
008	Grab 1 - Grain Size	Core	Whirl-Pak		to		
009	Grab 1 - Benthos	Jar	Jar	299	Fish Path/Trawl 1	Fish Specimen	Computer
010	Grab 2 - Grain Size	Core	Whirl-Pak				
011	Grab 2 - Benthos	Jar	Jar				
012	Grab 3 - Grain Size	Core	Whirl-Pak	300	Fish Chem/Trawl 2	Fish Specimen	Computer
013	Grab 3 - Benthos	Jar	Jar		to		
				349	Fish Chem/Trawl 2	Fish Specimen	Computer
014	Extra Barcode						
015	Extra Barcode						
016	Extra Barcode			350	Fish Path/Trawl 2	Fish Specimen	Computer
017	Extra Barcode				to		
018	Extra Barcode			499	Fish Path/Trawl 2	Fish Specimen	Computer
019	Grain Size:Homogenate	Core	Whirl-Pak				
020	Sed Chem-Samp	Glass Bottle	Glass Bottle	500	Bivalve Chemistry	Bivalve Species	Computer
020	Sed Chem-Duplicate	Glass Bottle	Glass Bottle		to		
021	Toxicity Testing 1	Bottle	Bottle	549	Bivalve Chemistry	Bivalve Species	Computer
022	Toxicity Testing 2	Bottle	Bottle				
023	SedChem:RefLab Dup1	Glass Bottle	Glass Bottle				
023	SedChem:RefLab Dup2	Glass Bottle	Glass Bottle				
024	Blank	Bottle	Bottle				
025	Water Toxicity	Cubitainer	Cubitainer				
026	Roll of Film	Film cannister	Cannister				
027	Picture 1	Negative					
028	Picture 2	Negative					
029	Picture 3	Negative					
030	Picture 4	Negative					
031	Picture 5	Negative					
032							
033	CTD QC	Sal/Temp/DO	Computer				
034	Hydrolab QC	Sal/Temp/DO	Computer				
035	CTD Cast #1	Sal/Temp/DO	Computer				
036							
037							
038	Hydrolab Retrieval	Sal/Temp/DO	Computer				
039	Hydrolab Deployment	Sal/Temp/DO	Computer				
040							
041							
042							

each piece of data associated with it. The CTD and Hydrolab data consist of DO, salinity, temperature and pH measurements, among others. Individual length measurements are associated with both the Fish Trawl and Bivalve Tow Sample Numbers.

For each Event there is a unique range of Sampleids composed of an Event number and a Sample Number (i.e., 185000 - 185013). These Sampleids identify the samples and data associated with the Event (Table 17.3). The length of the sequence of Sampleids associated with an Event depends on number of activities performed during the visit to the Station. Because the activities performed at a Station vary from Interval to Interval, some Events will have more Sampleids associated with it than others. Also, the Sampleids associated with an Event will not necessarily be in sequence as the Sampleids assigned to an Event are dependent on the activities performed at the Station and if the samples must be tracked physically.

17.1.1 BLIND SAMPLE NUMBER SCHEME

1. Required for Sediment Chemistry Quality Control Samples
    a. Taken at Six Station Classes in the Second Period
        1) Base
        2) Long-term DO
        3) Indicator Test and Evaluation
        4) Indicator Test and Evaluation/Base
        5) Replicate
        6) Supplemental
    b. Sediment Chemistry sample split into three additional duplicates at 5 % of the stations
        1) Duplicate 1 Split 2 - Primary Laboratory
        2) Duplicate 2 Split 1 - Reference Laboratory
        3) Duplicate 2 Split 2 - Reference Laboratory

2. **One-to-one relationship among Sample Numbers for Field Duplicates and Reference Lab Field Duplicates**
    a. Assign the identical Sample Numbers for the Blind Samples as have been pre-assigned to the Sediment Chemistry samples (Table 17.2).
        1) Assign Sample Number ***020 to Field Duplicates sent to the Primary Laboratory, i.e. the same sample number as a sediment chemistry sample

Table 3. SAMPLEID SEQUENCES FOR SAMPLES TRACKED WITH BARCODES

Station Class	Barcodes/ Event	# of Events	Sampleid Sequence Start	Sampleid Sequence End	Station Class	Barcodes/ Event	# of Events	Sampleid Sequence Start	Sampleid Sequence End
LTDO:DOM1	14	33	185000	185013	SEDCHEM DUPLICATE	1	20	300020	319020
			217000	217013					
LTDO:DOS1	6	63	555000	555005	SEDCHEM REF LAB-DUP1	1	20	250023	269023
			617000	617005					
BSS1	6	89	35000	35005	SEDCHEM REF LAB-DUP2	1	20	275023	294023
			123000	123005					
LTDO:DOS2	6	75	620000	620005	EQPMNT	200	1	810000	810199
			694000	694005					
					SHIPPING	1000	1	820000	820999
BSS2	25	89	320000	320024					
			403000	403024					
LTDO:DOM2	25	22	404000	404024					
			430000	430024					
REP2	25	25	431000	431024					
			455000	455024					
SUPP2	25	9	456000	456024					
			464000	464024					
ITE2	27	15	220000	220026					
			234000	234027					
ITE/BSS2	27	11	235000	235027					
			245000	245026					
IND2	14	60	125000	125013					
			184000	184013					
LTDO:DOM3	14	33	1000	1013					
			33000	33013					
BSS3	6	89	465000	465005					
			553000	553005					

2) Assign Sample Number ***023 to Field Duplicates sent to the Reference Laboratory

b. Create dummy sampling Events for blind samples within the pre-assigned Event Numbering Scheme (Table 17.1)

1) Duplicate 1 - Primary Lab: 300020 - 319020
2) Duplicate 2 - Reference Lab: 250023 - 269023
3) Duplicate 2 - Reference Lab: 275023 - 294023

c. One sample number from each range (2b1-2b3) will be assigned to each of the 60 samples

1) Three sample numbers will be placed in an envelope
2) There will be a total of 20 envelopes
3) The crews will be given the correct number of envelopes for the required number of Quality Control Samples to be taken in their region
4) This group of three numbers will be assigned to an event in the field, when required
5) A record will be maintained of which sample numbers were placed together in an envelope, so one sample number can be associated with another
6) A record will be maintained of which group of sample numbers were assigned in the field to an Event, so this group of numbers can be linked to the Event in the Data Base.

17.1.2 OTHER BARCODE NUMBERS

Barcode numbers have also been assigned for Equipment and Shipment of samples. The Equipment barcode numbers range from 810000 to 810199. Equipment barcodes were attached to CTDs and Hydrolabs. The barcode labels for the shipment of samples will be used to track packages of multiple samples shipped from the field to the laboratory performing the analyses. These numbers range from 820000 to 820999.

17.2 FORMS

Forms for all sampling activities have been created for EMAP Near Coastal VA-90. Each form corresponds to a specific activity and falls into one of three general categories: Reconnaissance, Samples and Shipment. Each form contains data specific to that activity which will eventually be entered into appropriate SAS data sets. Examples of the forms and the documentation associated with each particular form follow.

17.3 DISTRIBUTION

Barcodes and forms will be distributed to field crews for each Interval. The appropriate barcodes and forms for each Event will be packaged in envelopes marked with the Station Class, Event Number and Interval. The appropriate Event envelopes per Interval will be made up according to the Station Classes visited during an Interval. The Crews will randomly select the number of envelopes required per Interval for the Station Classes they are required to sample. In the field, a Crew will be at a Station on a particular day, having to perform specific activities according to the Station classification. The crew randomly selects an envelope for that particular Station Class and assigns an Event number. The Event number will be related to a Station on a particular date in the EMAP Near Coastal Data Base.

17.4 USE OF DISKETTES

One disk will be used per day to enter data into the GRIDs on the boats. This disk will contain data from one to several Events. The same disk will be used the next day in the mobile laboratory to record data from the same Events. Therefore, all the data from an Event will be on the same disk.

A. Use of diskettes on the boat:
   1) Use one (1) per day on the boat
   2) Label the diskette with the barcode sampleid (XXX000) of the first Event of the day
   3) Record all data from all Events during the day on the same diskette
   4) Record the **same diskette sampleid** on all other data sheets for that day

B. Use of diskettes in the mobile laboratory:
   1) Use the disk used on the boat the day before
   2) The diskette will have the barcode label on it from the Event's the day before
   3) Record the **date the data were entered and all Event Numbers for data entered on the diskette** on the disk label

C. At the end of the day:
   1) The two GRIDs are in the mobile laboratory
   2) Backup files according to the directions in the GRID WORKBOOK
   3) Send the data from the GRID **used in the mobile laboratory** to ERL-N via phone
   4) Send the diskettes to EPA ERL-N as required by the Field Operations Manual

SECTION 18
QUALITY ASSURANCE

One of the goals of EMAP is to detect changes (trends) in ecological resources and the physical condition of the Nation's near coastal environment. This requires that all data collected be as accurate as possible. To accomplish this, EMAP has instituted an extensive quality assurance (QA) program. Careful attention must be paid by the field crews to following all QA protocols. Protocols for individual analyses are discussed in the sections describing the collection of those data/samples.

The automation of certain phases of data collection (see Section 17) is in direct response to QA concerns, as is the sample tracking system described in Section 14.

QA steps performed on field activities are:

1. All crew members must demonstrate proficiency in the operation of all gear during training. This includes all aspects of data collection.

2. During field operations, all gear must be operated according to protocol. No "short cuts" may be taken. This includes conducting all required QC checks as described in Section 13.

3. At selected stations, duplicate sediment chemistry samples are collected for duplicate analysis, as well as analysis by a referee laboratory. Blanks are also shipped from certain stations.

4. Guidelines for packaging and shipping must be followed.

5. Both fish and bivalves will be saved and shipped to ERLN and VERSAR for identification by experts. The purpose of this is to attempt to determine the true percentage error in identifications.

SECTION 19
LOST GEAR

Lost gear can potentially have a significant effect on the sampling program. Crews should take every precaution against the loss of gear by properly tightening shackles and other connectors, but accidents are likely to happen.

Whenever a DataSonde, CTD, grab sampler, or dredge are deployed, a pinger is attached to the instrument. This will assist in locating it should the gear be lost.

If a piece of equipment is lost, attempts to recover it as described below should be followed. If the gear cannot be retrieved immediately, and a spare unit is carried by the team (even if it is on shore), the spare should be used to complete sampling activities. If a spare is not immediately available, sampling for all other indicators should continue, and a note made in the log that the samples that were to be collected by the lost gear were not collected.

Upon the loss of any gear, the FC should be notified immediately. Where appropriate, replacement equipment will be sent to the team. Attempts to recover gear are as follows.

19.1 Recovery of a DataSonde Mooring

It is very likely that the surface marking buoy for DataSonde moorings will be damaged, destroyed, or stolen at a number of sites. The mooring system was designed with this in mind. The two clump weights at the bottom of the mooring are separated by 100 feet of polypropylene line. If the surface buoy is missing, carefully (using the computer navigation system and a small marker buoy) mark the estimated location of each of the clump weights. Then drag a grappling hook between the buoys. If unsuccessful, initiate a search pattern using the grappling hook.

If the unit still cannot be located, attempts will be temporarily abandoned. Since trawling is still performed, the unit could still be recovered in the trawl. Following trawling, a new unit is deployed as per Section 13.6 and the Field Coordinator notified as soon as possible.

On the next visit to that station, an acoustic locator device will be supplied by the Field Operations Center. Locate the lost unit by attempting to pick-up the signal from the pinger. If located, use the grappling hook to snag the mooring. If it is not located after 30 minutes of searching with the locator device, abandon the search and the unit will be considered lost.

19.2 Recovery of a CTD

The CTD is a very expensive piece of equipment. If a unit is lost, all attempts must be made to retrieve it as soon as possible. As this is also a delicate instrument, grappling is inappropriate.

As soon as it is determined that the unit is no longer attached to the end of the winch cable, record the exact coordinates. Attach the trawl to the winch cable, and attempt to retrieve the unit by catching it in the net. If the CTD is recovered, thoroughly test it out to determine if it is damaged. If it passes a QC check, continue with sampling activities.

If the unit is recovered, and it has been damaged (visual damage or failure to pass the QC check), first attempt to repair it (i.e., calibrate it). If the damage cannot be repaired, notify the FC immediately and he will arrange for the back-up CTD to be delivered before the next day. Continue with sampling for all other indicators.

If recovered, regardless of the damage done, note the event in the computerized equipment log and notify the FC.

If the unit is not recovered after two attempts to catch it in the trawl, deploy a marker buoy at the exact location it was lost, and notify the Field Coordinator IMMEDIATELY. He will arrange for a commercial dive operation to recover the CTD. To avoid the possibility of damaging the lost unit, cease all sampling activities at this station.

19.3 Recovery of a Grab Sampler or Dredge

If either the grab sampler or dredge are lost, attempt to recover by grappling in the area where the sampler was dropped. The location of the dredge might be difficult to determine, depending the stage of operations in which it was lost. If the gear is successfully recovered, continue with sampling. If it cannot be recovered, continue sampling for all other indicators. Since trawling is still performed, the possibility exists that the grab could be caught in the net. No attempts to recover a dredge using a trawl net should be made. This could result in substantial damage to the net. If the gear cannot be recovered, notify the FC immediately. He will arrange for shipment of spare equipment.

If the gear is not retrieved, the FC will provide an acoustic locator device. On the next visit to that station or general area, attempt to identify the exact location of the gear using the locator. If located, deploy a marker buoy and attempt to grapple for the unit. If, after 30 minutes, the gear is not retrieved: (1) If the lost gear is the dredge, abandon additional attempts to recover it. (2) For the grab sampler, attempt to catch it in a trawl. The grab sampler is less likely to severely damage the net than is the dredge with it's teeth (and weight).

SECTION 20
WASTE DISPOSAL

Proper disposal of all wastes is an important component of DP field activities. At no time will any waste be disposed of improperly. It is the responsibility of the Crew Chief to assure that all garbage is disposed of correctly. Proper methods for the disposal of wastes generated during field activities are as follows.

20.1 Routine Garbage

Regular garbage (paper towels, plastic, discarded labels, etc.) is to be placed in the trash cans in the boats or mobile lab. This garbage is then disposed of on land by placing it in PUBLIC trash receptacles. In no case should trash be disposed of in PRIVATE receptacles without permission of the owner.

GARBAGE SHOULD NEVER BE THROWN OVERBOARD. This includes even small items such as the disposable strips from the whirl packs.

20.2 Detergent Washes

Detergent is used in the mobile lab to wash off retrieved DataSonde units. Only biodegradable detergents are to be used; therefore, the wash water can be disposed of on the ground. Be sure not to dump it on a lawn.

20.3 Solvents

Solvents are used on-board the boat to rinse the Teflon gear used to obtain sediment samples for chemistry. Only small volumes are used at any time. Rinsing should be performed over a bucket. Following rinsing, place the bucket with the solvent on the open deck, away from the hydraulic engine and cabin, and allow the solvent to evaporate. Solvents should never be disposed of overboard, and should never be allowed to come in contact with fiberglass. The solvents used are also very flammable, so assure that they are not used near an open flame or any gear that could generate a spark.

20.4 Formalin or Dietrich's Fixative

Great care should be exercised when working with these fixatives, as they are suspected carcinogens. Formalin and Dietrich's (which contains formalin, alcohol, and acetic acid) should never be disposed of in the field. There should be no reason to generate waste. Any fixative that is poured into a container and then not used should be poured back into the original storage container.

In the event that waste IS generated, it must be placed in an appropriate container and shipped (or driven) to ERL-N where it can be disposed of properly.

20.5 Fish Waste

Fish processed following a trawl should be dumped overboard. Large quantities of fish should never be disposed of on land. Discretion should be used in the disposal of fish at sea. Large quantities should not be disposed of in enclosed areas, or when numerous other boaters are close by. Fish should only be disposed of in open areas where disposal will not adversely affect either the ecology or aesthetics of an area. Under no circumstances should fish be given to the public.

SECTION 21
CONTACT PERSONNEL

The primary contact for all field-related activities is the Field Coordinator. Any technical questions, reports of accidents, injuries, equipment breakdown, etc. should be addressed to him.

In the event that the Field Coordinator is not available, the DP Project Manager must be notified. The DP Project Manager is also the appropriate person to contact regarding general Demonstration Project matters, affecting operations other than just field operations.

Strictly non-technical personnel matters can, at the discretion of the Team Leader or Crew Chief, be addressed to the appropriate contractor personnel coordinator. The FC must be notified of personnel problems or changes immediately, either by the Crew Chief or the personnel coordinator.

This structure is graphically depicted in Figure 3.5, and the proper chain-of- command discussed in Section 3.3. The names and phone numbers of contact personnel are listed below.

FIELD COORDINATOR
MR. CHARLES STROBEL
1-(800)-NET EMAP (FIELD OPERATIONS CENTER)
(401) 364-7457 (HOME)

DP PROJECT MANAGER
MR. STEVEN SCHIMMEL
1-(800)-NET EMAP (FIELD OPERATIONS CENTER)
(401) 789-5269 (HOME)

In the event that the "800" number is not forwarded to the answering service on weekends, that number is **(401) 782-1405.**

SECTION 22
REFERENCES

Beaulieu, J., 1990. Users guide for the EMAP Near Coastal Field Data Acquisition System. Computer Sciences Corp., Narragansett, RI.

Morris, P.A., 1975. The Peterson Field Guide Series: A Field Guide to Shells of the Atlantic and Gulf Coasts and the West Indies. W.J. Clench, ed. Houghton Mifflin Co., Boston. 330 pages.

SAIC, 1990. User guide for Environmental Data Acquisition System (EDAS V1.00). Science Applications International Corp., Newport, RI.

Schimmel, S.C.. 1990. Implementation plan for the Environmental Monitoring and Assessment Program Near Coastal Demonstration Project. ERL-N contribution No. 1164.

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