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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM
NEAR COASTAL COMPONENT
1993 VIRGINIAN PROVINCE EFFORT

FIELD OPERATIONS
and
SAFETY MANUAL

by

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ABSTRACT

The Environmental Monitoring and Assessment Program (EMAP) is a Nation-wide program 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. As a component of the Near-Coastal (EMAP-NC) Program, annual sampling will be conducted in the Virginian Province (Cape Cod, MA to Cape Henry, VA). The 1993 Field operations are scheduled to begin in July 26, 1993.

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 six 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, transmission, fluorescence and Photosynthetically Active Radiation) as well as sediment and water samples, and fish. 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 as 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 Project Manager. As [if] methods change, an updated version of the pertinent section[s] will be prepared and provided to the field crews.

In addition quick reference handbooks will be supplied to the Field crews for procedures and protocol for research vessel and mobile lab operations. Handbooks will be comprised of specific condensed chapters of the Field Manual.

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Portions of this document were copied from other EMAP-NC documents (Holland, 1990; Schimmel, 1990; and Strobel, 1990).

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INTRODUCTION

1.1 Introduction

The Environmental Monitoring and Assessment Program (EMAP) was designed to provide a quantitative assessment of the regional extent of environmental problems by measuring status and change in selected indicators of ecological condition. 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. As stated in the 1990 Near Coastal Program Plan (NCPP: Holland, 1990), when fully implemented EMAP will answer the following questions:

- What is the status, extent, and geographical distribution of the Nation's important ecological resources?
- What proportion of these resources are declining or improving? Where, and at what rate?
- What are the factors that are likely to be contributing to declining condition?
- Are control and mitigation programs achieving overall improvements in ecological conditions?
- Which resources are at greatest risk to pollution impacts?

EMAP has been divided into several ecosystems including surface fresh waters, rangelands and deserts, forests, wetlands, agroecosystems, Great Lakes, and estuaries. All the above goals and questions are relevant to each ecosystem, including estuarines.

The purpose of this document is provide detailed instructions on all field sampling methods for the EMAP-Estuaries Virginian Province effort in 1993.

1.2 The Estuaries Program

The Estuaries portion of EMAP (EMAP-E) is a joint EPA/National Oceanic and Atmospheric Administration (NOAA) Program that is designed to eventually monitor the waters, sediment, and biota of the Nation's bays, sounds and estuaries. 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.

The goals of EMAP-E, as outlined in the 1990 Near Coastal Program Plan (Holland, 1990) are as follows:

- Provide a quantitative assessment of the regional extent of estuarine environmental problems by measuring pollution exposure and ecological condition,
- Measure changes in the regional extent of environmental problems for the Nation's estuarine ecosystems,
- Identify and evaluate associations between the ecological condition of the Nation's estuarine ecosystems and pollutant exposure, as well as other factors known to affect ecological condition (e.g., climatic conditions, land use patterns), and
- Assess the effectiveness of pollution control actions and environmental policies on a regional scale (i.e., large estuaries like Chesapeake Bay and Long Island Sound)and nationally.

In addition to meeting the overall goals of EMAP, EMAP-E is addressing specific environmental problems such as: low dissolved oxygen (DO) 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-lived 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 may include (but are not limited to): widely fluctuating and often acutely toxic low DO concentrations; reduced water clarity; presence of nuisance algal blooms; alterations in benthic biomass, abundance, and species composition; and reduced acreage of submerged aquatic vegetation (SAV).

1.2.3 Contamination

The problem of contamination is manifested in several ways, including: (1) the chemical contamination (residues) of anthropogenic materials or excessive, naturally-occurring materials that result in unacceptable concentrations in marine sediments, water, and biota; (2) pathogen contamination of sediments, water, and biota generally through human waste; and (3) toxicity of water, sediment, and biota caused by excessive amounts of either chemicals or pathogens. The overall effect may be to reduce resource numbers, diversity, and 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 estuarine environment is a critical problem. Specifically, habitats such as wetlands and SAV have been significantly reduced, thereby 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 buffer coastlines from the direct effects of coastal storms.

1.2.5 Cumulative Impacts

The cumulative effects of the above stressors on estuaries is 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 EMAP-Estuaries Virginian Province Sampling Effort

The EMAP-E Virginian Province is the biogeographical region extending from Cape Cod, MA to Cape Henry, VA.

As a first step, a Demonstration Project (DP) was conducted in the Virginian Province in 1990 to address several issues prior to full implementation in 1991. The objectives of the DP were to:

- 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 an EMAP design.

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

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

- Develop, evaluate, and refine sampling methods for indicators of environmental quality.

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

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

This year is the fourth year of sampling in the Virginian Province, and the lessons learned and the data collected during previous field seasons were used in the development of the sampling plan described in this document.

SECTION 2
OVERVIEW OF FIELD SAMPLING ACTIVITIES

2.1 Sampling Period

The Index Period for Virginian Province sampling activities will be begin on July 26, 1993. An attempt will be made to complete all sampling prior to September 18. The Index Period was determined following an evaluation of the Demonstration Project data. These data show the benthic organisms in Long Island Sound typically do not respond to low dissolved oxygen conditions until late in July.

2.2 Sampling Design

The EMAP-Estuaries sampling design combines the strengths of systematic and random sampling with our understanding of estuarine systems. It provides a design that will allow probability-based estimates of the status of the Nation's estuarine systems, the variability associated with that status, its spatial and temporal components, and the temporal trends associated with changes in these systems.

The objective of the sampling design is to provide a statistically defensible strategy for collecting information about selected indicators of ecological condition 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 2.6 km^2. The Virginian Province list frame was subdivided into three sampling sub-populations (classes) representing small estuaries and tidal rivers, large tidal rivers, and large estuaries. The EMAP-Estuaries sampling design is based on a single, annual sampling season of each of these classes during the Index Period. Addition information on the sampling design can be found in the Near Coastal Program Plan (Holland, 1990).

2.2.1 Regionalization

The EMAP-E sampling frame represents bays, sounds, and estuaries spanning the entire coastal extent of the United States. The large number and often broad expanse of the sampling units makes straightforward sampling of the entire frame annually or in multi-year cycles impractical. The large number of potential sampling sites across the Nation requires that a regionalization scheme be developed in order to subdivide these sites into manageable sampling units.

The objective of the EMAP-E regionalization scheme is to formulate a hierarchical structure for partitioning the estuarine ecosystems of the United States based on the physical characteristics of those areas (primarily climatic and oceanographic). The regionalization is based on physical criteria rather than biotic criteria because the objective is to define whole ecosystems, which are constrained by their physical components and boundaries, rather than to define the distributional aspects of one or a few species.

This regionalization serves two purposes. It provides a data collection structure for organizing the storage of data and for demonstrating areas where data indicate wide-spread ecological problems. Second, it delineates geographical zones about which predictions on the status and trends of environmental conditions may be made at various levels of resolution. The regionalization scheme proposed for EMAP-E is analogous to that adopted by NOAA and the U.S. Fish and Wildlife Service. (See Figure 2.1, taken from Holland [1990]).

The EMAP-E regionalization is based on two primary factors: major climatic zones and prevailing oceanic currents. Both of these physical characteristics have numerous underlying physical and geological components that could be specifically enumerated. However, the composite of these characteristics results in the climatic zones and ocean current locations. The climatic zones are based on Beasley and Biggs (1987) conceptualization, and the ocean current delineation is based on Terrell (1979).

The regionalization consists of seven coastal regions within the continental United States, plus six additional regions encompassing Alaska, Hawaii, the Pacific territories; and the Great Lakes (Figure 2.1). The first to be monitored was the Virginian Province which includes the wide expanse of irregular coastline from Cape Cod, MA to Cape Henry, VA, and includes a number of large estuarine systems (e.g., Long Island Sound, Hudson River/ Raritan Bay, Delaware Bay, Chesapeake Bay).

2.2.2 Classification Scheme

Virginian Province estuarine waters were classified into three size categories: large estuaries, large tidal rivers, and small estuarine systems. (See the NCPP [Holland, 1990] for further details). These three classes represent estuarine systems with different behavior in relation to potential stressors. Moderate and small systems would be more similar within class than across classes once they are adjusted for major physicochemical variability (e.g., salinity, sediments). In addition, it makes sense to monitor the estuarine status of a particular size range in terms of potential

Figure 2.1. EMAP-NC Biogeographical Provinces.

management consequences. The size classification uses the following associative criteria:

Large Estuaries: Surface area > 260 km^2 and aspect (Length/Average Width) < 20; 12 systems included. Examples: Chesapeake Bay, Long Island Sound, Buzzards Bay.

Large Tidal Rivers: Surface area > 260 km^2 and aspect > 20; 5 systems included. 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 > 2.6 km^2 and < 260 km^2; 132 systems included. Examples: Barnegat Bay, Mystic River, Maurice River, Baltimore Harbor.

2.3 Indicators of Ecosystem Health

The primary goal of EMAP is to provide an assessment of overall ecosystem condition. To accomplish this goal, 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-E 1993 Virginian Project effort 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 Project is to provide the information needed to assess the reliability, sensitivity, and variability of these indicators, and to develop appropriate sampling methods. Developmental indicators are:

- dissolved oxygen concentration,
- 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.

2.4 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. Although 1993 represents the fourth year of sampling in the Virginian Province, new systems are scheduled for sampling, therefore, reconnaissance is still an important component of the field effort.

SECTION 3
DESCRIPTION OF FIELD TEAMS

3.1 Personnel

Three teams of field personnel are required to accomplish all sampling activities. Each of these teams is comprised of two 4-person crews. Each crew is made up of a Crew Chief (or a Pilot and Chief Scientist), and crew members. One Crew Chief from each team 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 employed by universities under the Cooperative Agreement. The two crews comprising a team work alternating schedules, six consecutive days on and six days off.

Team Leaders are responsible for the overall operation of their teams, including tracking equipment and supplies, maintenance, and progress made in sampling activities. Crew Chiefs and Chief scientists are responsible for assuring the quality of the data collected and for the daily communications with the EMAP-VP Command Center (including the transfer of electronic data - see Section 12). Crew Chiefs and Pilots are responsible for the day-to-day operation of all field gear and for safety. When the Crew Chief and Chief Scientist are the same person, the Crew Chief will generally delegate many of the day-to-day activities to a Science Officer.

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.

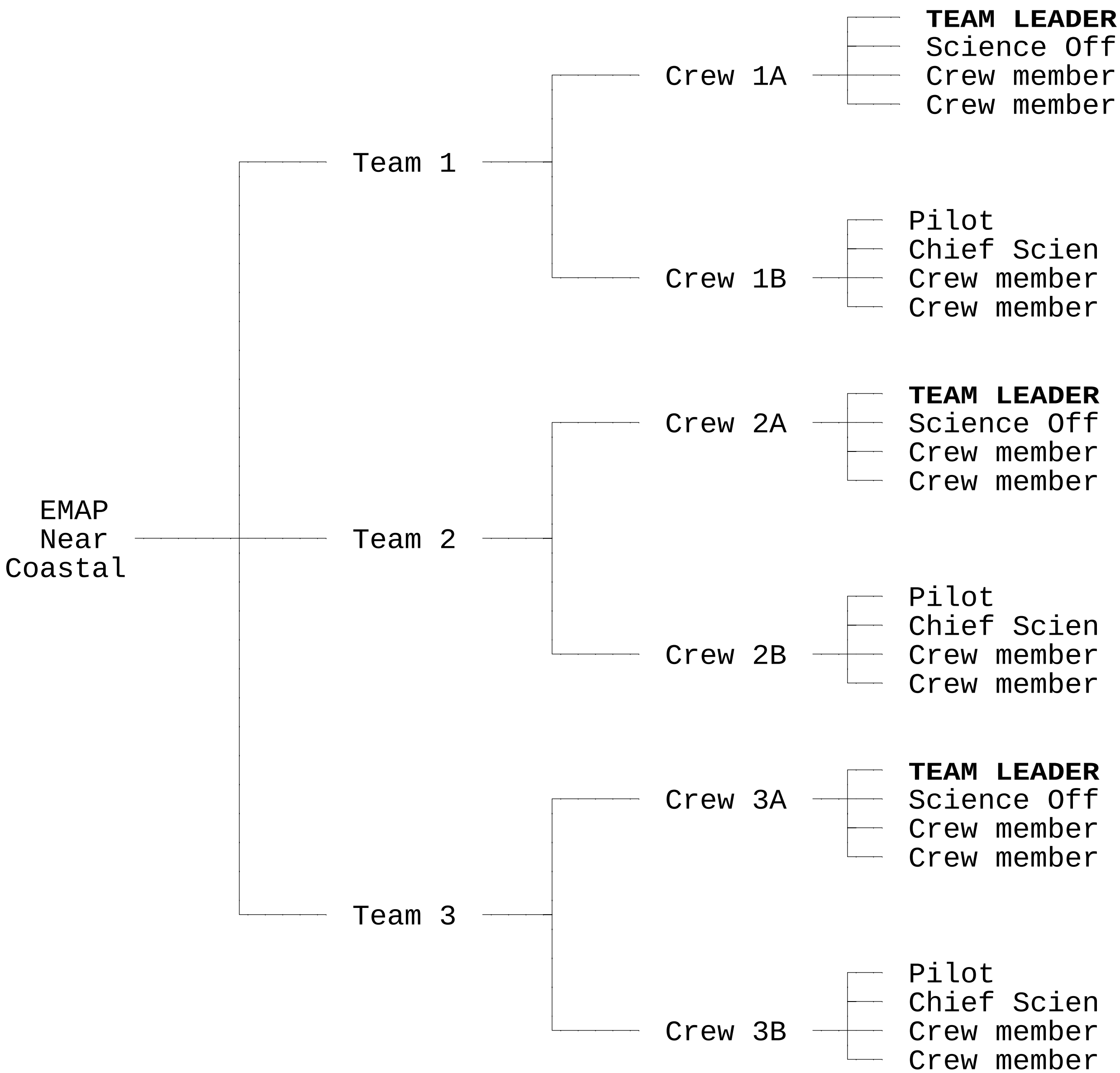


Figure 3.1. Personnel distribution of Field Crew for the Virginian Province Project.

3.2 Station Assignments

As stated above, three teams are needed to sample all stations during the Project. Team 1 is responsible for all stations from Cape Cod west to the Hudson River, including those stations in New York Harbor. Team 2 has been assigned those stations in New Jersey, Pennsylvania, all stations in Delaware, those stations along the Delaware/Maryland coast, and stations in the Maryland portion of the Chesapeake Bay north of the Potomac River. 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. A listing of stations, by team, can be found in Section 13.

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 mini-van, two field computers, marine-band VHF radios, a cellular telephone, one Sea-Bird CTD profiling instrument, one benthic grab sampler, two *Go-Flo* water sampling bottles, two trawl nets, and all additional supplies necessary to successfully complete sampling for all indicators. A complete list of equipment is provided in Appendix A.

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 two 155 Hp commercial Johnson outboard engines, a mast and boom assembly, a hydraulic winch, and a self-contained power supply to run the hydraulics. The on-board navigation system consists of a Loran C unit 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 video echo sounder, a tool kit, and all required and suggested safety equipment. Although replacements are available on most gear, no spare vessels will be available in 1993.

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 CB radio, 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 CB radio, 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 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.

3.3.6 Trawl Nets

Each team is provided with three 16-meter, high-rise trawl nets.

3.3.7 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.

3.3.8 Grab Sampler

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

3.3.9 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 VGA-LCD screen (no glare screen), a external modem with adjustable baud rate, 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.

3.4 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 3.2 and below. The names and phone numbers of appropriate personnel are listed in Section 23.

1. The Crew Chief is directly responsible for all field activities conducted by his/her crew. If the Crew Chief and Chief Scientist are different people, the Crew Chief or Pilot is solely responsible for safety, maintenance, and boat operations; and the Chief Scientist for the collection of data.

2. ALL CHANGES IN THE SAMPLING PLAN THAT ARE OUTSIDE THE JURISDICTION OF THE CHIEF SCIENTIST ARE COMMUNICATED TO THE TEAM BY THE FIELD COORDINATOR (FC) OR THE PROJECT MANAGER. (See Section 18 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 Chief Scientist AS SOON AS POSSIBLE.

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

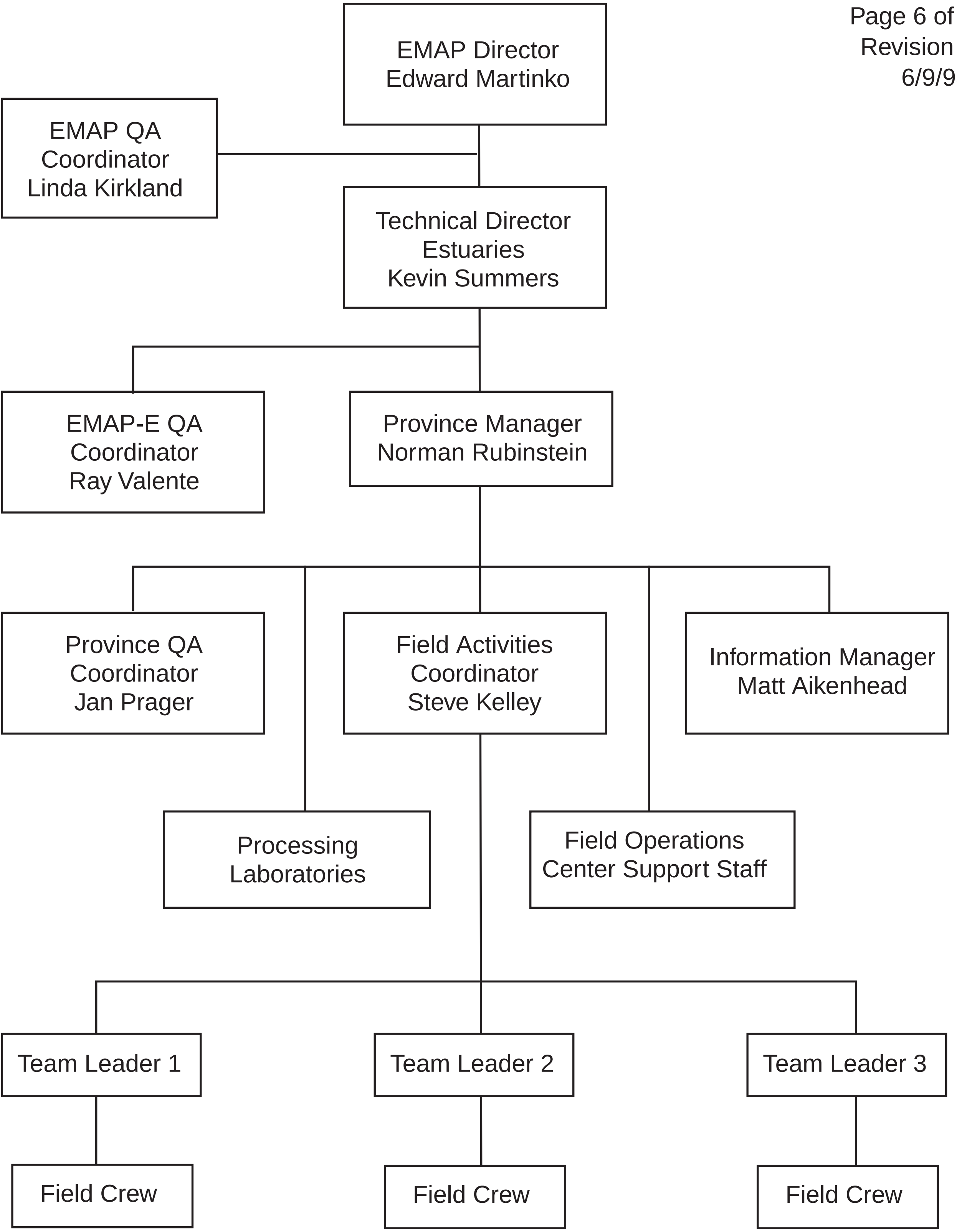


Figure 3-2. Management structure for the 1993 EMAP-E Virginian Province monitoring.

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 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 rules of the road for marine vessels, first aid, hazardous material handling techniques, and basic marine fire fighting. Cardiopulmonary resuscitation (CPR) certification is required as part of training.

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, OR IMMEDIATELY PRIOR TO, FIELD ACTIVITIES IS ABSOLUTELY PROHIBITED.

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), an eyewash kit, 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, eyewash kit, 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 or Pilot 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 one hour, 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 four 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 or Pilot 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 four 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 four 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 and Dietrich's fixative (formalin, acetic acid, and alcohol). 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 is 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, boots, 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 B. First aid information is listed on these sheets. The appropriate MSDS should be read before handling any hazardous material.

Dry ice is carried in the bed of the pickup truck. 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 gas. 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 Project 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. 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 along with rubber boots. Eye protection or face shields may also be appropriate, as are boots and protective coveralls or foul weather gear.

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.

SECTION 5
TRAINING

Proper training of all laboratory and field personnel in their respective duties is an important aspect of the project. Training can be segregated into four sets of activities: Crew Chief/Pilot training, Chief Scientist training, formal crew training (classroom and structured demonstrations) and dry runs. All training for the project falls under the general jurisdiction of the Project Manager; specific training in select technical areas is delegated to those responsible for indicators and/or specific activities.

5.1 Crew Chief/Pilot Training

Intensive training of Crew Chiefs and Pilots will be conducted from May 17 to May 30, 1993. This will include navigation, computer operation, vessel operation, operation and maintenance of the electronic instruments. One week of training will be in Narragansett, RI and one week will be field training and reconnaissance in the respective sampling areas

5.2 Chief Scientist/Science Officer Training

Training of Chief Scientists and Science Officers will be conducted from June 14 to June 20, 1993. This training will include computer system operations, sampling and shipping procedures, and an overview of the scientific principles behind the sampling. Greater emphasis will be placed this year on CTD cast quality assurance. This training will include classroom, laboratory, and field activities. Chief Scientist/Science Officer training will be conducted by SAIC, ROW, URI, and external consultants as needed.

5.3 Crew Training

Formal crew training will begin on June 21, 1993 and continue through July 22 at URI. CPR certification will be required during crew training. Formal training will include all other aspects of safety (including first aid), sampling and shipping procedures, boat operation, navigation, and maintenance. Training will be conducted by EPA, SAIC, ROW, URI and external consultants as needed. Training will consist of classroom, laboratory, and field activities.

Crews will participate in at least five days of "dry runs" following the completion of formal training. The "A" crews will practice the week of July 12, and the "B" crews the following week. Teams 1, 2 and 3 will work in the New England area and be certified in Narragansett Bay. The purpose of the dry runs is to provide the crews the opportunity to integrate activities and practice full sampling days, including boat, mobile laboratory, and shipping activities. The Chief Scientists will serve as the primary instructors during this phase.

The Field Coordinator, VP QA Coordinator, or the EMAP-NC QA Coordinator will visit each crew during dry runs to conduct QA audits. This exercise will be used to "certify" crews as being ready to conduct sampling activities according to sampling procedures, safety standards and QA protocols.

Following the completion of dry runs, the crews will return to their respective base location for a review and critique of that week's activities.

SECTION 6
LAND-BASED FACILITIES

All 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 foundation of 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 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 Horn Point Lab of the University of Maryland. 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 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 and operating vessels identified as property of the U.S. government. The field crews should understand that they will be perceived as representatives of the federal government. 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 and the EPA. 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.

Hazardous wastes generated, such as waste formalin, must be disposed of properly as described in Section 22.

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

During field operations, 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.

14. Prior to moving any vehicle check around it to make sure everything is clear. THIS IS ESPECIALLY IMPORTANT WITH THE MOBILE LAB. **MAKE SURE THE VHF ANTENNA IS DOWN PRIOR TO MOVING THE MOBILE LAB!!!!!**

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 for each vehicle by the field 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)-732-2305 or (401) 782-3000

7. Emergency information for each crew member will be on file in all field computers, as well as at the FOC and with the Field Coordinator

8. 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.

9. Field Crew members are not permitted to drive any vehicle carrying U.S.

government license plates. Designated federal employees should be the operators of these vehicles. Specific instructions and procedures are outlined in an information packet which should be kept in the glove compartment at all times. The EPA Program Manager should be contacted immediately after any accident involving these vehicles.

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 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 and weight distributing bars 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 A.

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 (particularly the brakes) 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. As of 1992 the trailers will be supplied with a "Brake Bath" system, which provides a hose-hookup and will automatically rinse the brakes when properly connected to a fresh water source. Maintenance, as described in Section 19, must also be followed.

8.4 Operation of Winch

Each EPA 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 (more detailed instructions can be found in the owners manual located in the truck's glove compartment):

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 (e.g. anchor 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.

8.5 Operation of the Citizens Band (CB) Radios

Each truck and mobile laboratory are equipped with CB radios to provide for communications between the crew members in those vehicles. As with vessel radio operations, crews are expected to conduct themselves in a professional manner when using the CB radios. Operators not familiar with the operation of these units or the proper protocols for using them should consult the owners manual. CB radios operate on channels 1-40. Channel 9 is reserved for emergencies and should be used only for that purpose. As all channels are shared, communications should be kept as concise as possible. Channel 19 is generally reserved for traffic information. Only information regarding traffic (accidents, backups, etc.) should be transmitted on this channel. EMAP vehicles should routinely monitor 19 to determine the best travel routes. CB radio operators have adopted the "10-code' for standard communications (Table 8.1). To initiate communications, wait for a pause in transmissions and request a break. Transmit messages in a professional manner and always act courteously to other users. Priority must always be given to emergency transmissions. These radios should aide crews during land travel between staging locations.

Table 8.1. Commonly used 10-codes

Code	Meaning	Code	Meaning
10-1	Receiving poorly	10-13	Advise on road/weather conditions
10-2	Receiving well		
10-3	Stop transmitting	10-20	What is your location?
10-4	OK	10-21	Call by telephone
10-7	Out of service	10-33	Emergency traffic
10-8	In service	10-36	Correct time
10-9	Repeat	10-41	Switch to channel __
10-10	Standing by	10-62	Cannot understand

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 canceled 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. Notify the Field Coordinator (FC) of any changes in schedule during the morning call-in (see Section 12).

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 A.

9.2.1 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. Check the scupper plugs, and screw to close as necessary. Scupper plugs should not be tightened!

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

5. Remove the tie-down strap.

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

7. 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.

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

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

10. 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.

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

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

13. 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.

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

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

16. Check the gas level in the boat.

9.2.2 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 gusty winds, or strong currents. Once the cable is attached and the winch engaged, stop the motors and raise them to full tilt position.

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 electric winch, if used should always be used in the double pull mode.** An emergency hand winch is provided in case of failure of the electric winch. This winch provides for two gear settings, as well as a free-spool setting.

   NOTE: To eliminate unnecessary winch operation the vessels may be powered up the trailer with the outboard engines tilted up. This operation should only be attempted with the discretion of the crew chief. Care should be taken to assure personal safety during this maneuver.

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 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. Check for any hull damage. Remove or secure any loose objects on the deck or in the cabin. 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 latch and lower the engines until they are resting on the latch 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 TO MAKE SURE THE MOBILE LAB VHF ANTENNA IS DOWN.**

23. 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 Antenna Set-Up

The mast assembly consists of a mast with a boom, five stays, three lines leading off the boom and a radar antenna dome. 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 mast should always be raised and securely fastened with stays during the launching and hauling of the vessel to minimize stress on the aluminum mast. The set-up and take-down procedures for the mast assembly are described below.

9.3.1 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. Be particularly mindful that the hydraulic lines are not pinched, and that the turnbuckles (attached to the stays) are not 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 mast 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 BOAT SHOULD NEVER BE USED WITHOUT ALL OF THE MAST STAYS BEING SECURED. The mast flexes very easily and can create metal fatigue.**

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.

9.3.2 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. Loosen turnbuckles and detach all stays (side stays first) and remove the bolt from the center mast bracket, while supporting the mast in the upright position.

4. Lower the mast assembly onto a supporting cross board and securely lash in place. Great care should be observed while lowering the mast because the radar dome resides on the top of the mast assembly

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. **The mobile lab VHF antenna must also be lowered and stored inside the lab.**

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 A) 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., grab sampler, 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 in route 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 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.

9.5.1 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.

9.5.2 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. **It is very important to observe 'reduce speed' and 'no wake' signs.**

9.5.3 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, consult appropriate charts of the local area for anchoring restrictions and 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.

9.6 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 D. Call signs for all EMAP vessels and a list of the channels authorized for our use can be found in Figure 9.1. Transmissions from the mobile laboratory are only permitted when the lab is stationary. The need to remove the antenna during transit should make transmissions while the vehicle is in motion impossible.

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
9	156.450	Radio check, calling
12	156.600	Port operations
13	156.650	Bridge to bridge communications
14	156.700	Port operations
16	156.800	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.

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!

9.7 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 top of the mast). 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. Radar can also be used to determine ranges needed during dead reckoning.

9.8 Winch Operation

Operations involving the hydraulic winch and capstan are the most dangerous. All personnel must be equipped with a hard hat when working on deck during hydraulic operation. Life jackets are always required. Each boat is equipped with a hydraulic winch and capstan which is run by an air-cooled gas-powered motor located just behind the cabin on the port side. The winch 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. Pull out 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 if the engine is cold.

5. Depress the starter button (an emergency pull cord is also available).

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.

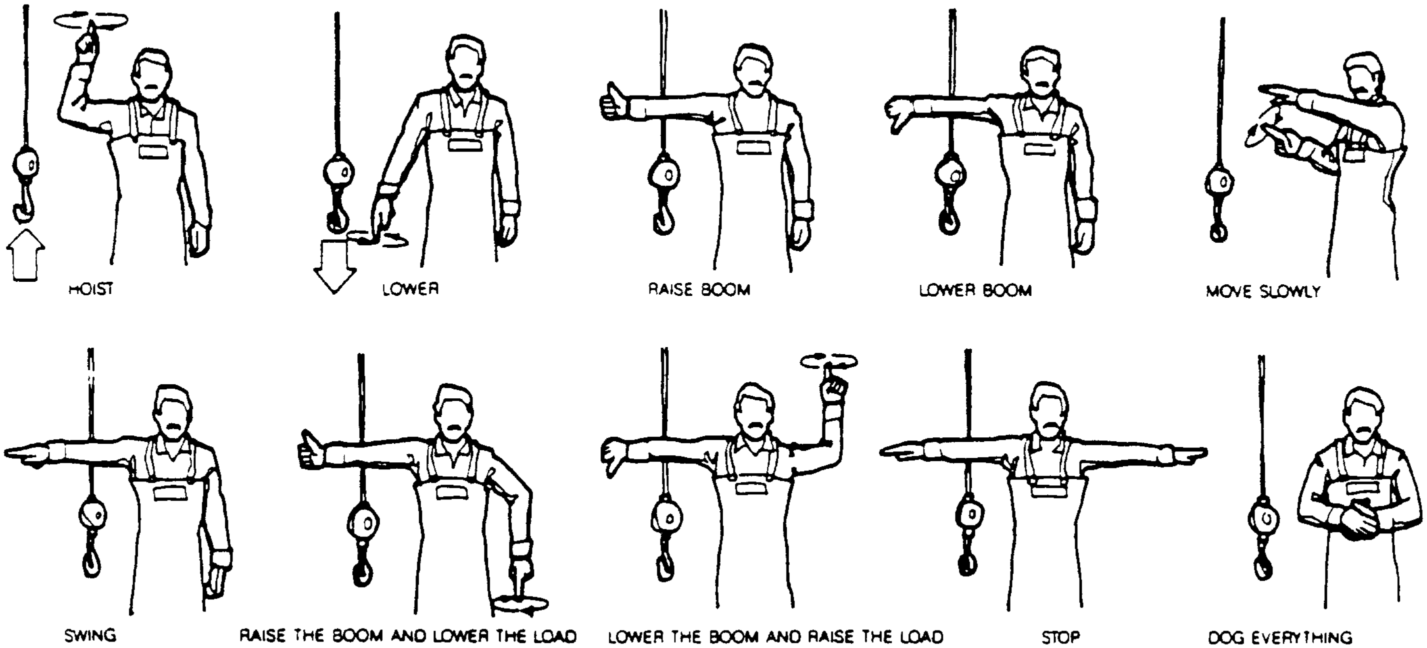
The levers controlling hydraulic power are located inside the cabin on the rear bulkhead. The starboard lever controls the winch and the port lever controls the capstan. The winch will not free-spool, so power must be supplied to lower, as well as raise, gear. The speed at which the winch or capstan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

HAND SIGNALS FOR USE IN DIRECTING WINCH OR CRANE OPERATORS



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.

9.9 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. Towing another vessel is discouraged but assistance can be provided using extreme caution. In the case of an EMAP vessel requiring a tow, a towing service should be contacted. For liability reasons a passerby should not be used.

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 (911 with cell phone) 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.

9.10 Equipment Failure/Repair

The best way to assure proper functioning of the equipment is to adhere to the routine maintenance schedule (Section 19). When equipment fails to operate, check the most obvious solutions first before attempting a major overhaul. The most obvious reasons for equipment failure are loss of electrical power or fuel.

9.10.1 Outboard Motors

If the outboard motor will not start or if it suddenly stops, 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 a motor fails and cannot be easily repaired notify the FC to arrange to have the boat repaired or replaced.

9.10.2 Hydraulic Winch

If the Briggs and Stratton that powers the hydraulic winch fails to operate, check the fuel, spark plugs, and power supply. If needed, use the pull cord to start the motor. 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.

9.10.3 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 1535 laptop computers. One computer is located in the mobile lab for the land crew member's activities and the other computer is placed on the boat where it is interfaced with the Loran, GPS, CTD and/or Hydrolab units and a barcode reader. This chapter provides a summary of boat computer system procedures and references to the appropriate sections of the Field Computer System User's Manual (Part 1) for more detailed information.

The boat computer system consists of two separate computer programs, one for acquiring navigation data from the Loran and GPS instruments (EDAS or Environmental Data Acquisition System Program) and one for collecting and cataloging EMAP sample data (EMAP NC-VP program). Both programs are accessed by selecting the **Navigate to a Station** option from the **Main Menu**. The resulting menu display is the **EDAS Menu**. Refer to the EDAS manual (SAIC, 1991) for more information on the EDAS program procedures and to Chapter 11 of this document for navigation procedures.

The EMAP NC-VP program options are embedded in the **Environmental Sampling** Menu. Detailed procedures for collecting and cataloging data are provided in the Field Computer System User's Manual, Part 1. The following table briefly describes the functions of each menu selection and lists the appropriate section of the manual for more information.

Menu Item	Description	Section
Station Setup	Station location and general data	3.2
Hydro. Deploy	Long term deployment data	N/A
Hydro. Retrv.	Long term retrieval data	N/A
CTD	Setup, download CTD	3.3.1
Profile Hydro.	Substitute Hydro. for CTD	3.3.2
Benthic	Catalogue benthic grab data	3.4
Sed. Chemistry	Catalogue sediment chem. data	3.5
Fish Trawl	Time trawl and catalogue data	3.6

On shore options of the EMAP NC-VP computer program including data editing, reviewing, fish and shipment cataloging and communications are all accessed from other options from the **Main Menu** and are not required for normal boat operations. For more information on these items, refer to the Field Computer System User's Manual, Part 2.

SECTION 11
NAVIGATION SYSTEM

11.1 Introduction

The EMAP navigation system assists the boat operator in navigating to a station, and provides for automatic storage of position data once the station is reached. The system is entirely menu driven for ease of operation. Specific details on the operation of the navigation component of the computer system can be found in SAIC (1990) and other electronic navigation manuals. This chapter provides an introduction to, and operation procedures for, the navigation system.

11.2 Navigation System Components

The navigation system consists of three components: Northstar Loran receiver, Raytheon Global Positioning System (GPS) receiver, and a GRiD laptop computer. The Loran uses shore-based radio transmitters (referred to as Master and Slave stations) combined with a shipboard receiver to track low-frequency signals. The Loran displays the time delay (TD) between signals from 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. The Loran transmits the TD data to the computer. The Loran also calculates and displays the latitude and longitude from the TDs.

The GPS receiver employs the use of the Navstar/GPS system. This is a satellite-based radio navigation system designed to provide global, 24 hour-per-day, all weather, accurate position data for navigators worldwide. GPS system satellites, which operate in fixed circular orbits around the Earth, broadcasts signals which contain two types of data: ephemeris and almanac. Ephemeris data represents the precise orbital parameters of a specific satellite. Almanac data contains the health and approximate location of each satellite. The GPS receiver collects this data from any satellite that does not have an obstructed view, then uses it to locate other satellites that should be visible at the receiver's location. Simultaneous access to a minimum of three satellites is required for precise determination of a GPS position fix (latitude-longitude), velocity, and other satellite data. A precise position is obtained by accurately measuring the distance between the user and system satellites whose positions at the instant of measurement are known. Spheres of position are then mathematically generated, and their common intersection accurately represents the system user's position. Continuous tracking of each satellite signal allows the GPS receiver to perform timing adjustments and corrections to the position.

The GPS system is currently in an intermediate stage of development with only 18 of 21 satellites in service. Full coverage (24 satellites) will not be available for several more years. The accuracy of the system can be up to 15 meters, however, the U.S. Department of Defense has implemented a policy called "Selective Availability" (SA). When SA is randomly turned on, the accuracy is degraded as much as 100 meters by introducing small errors in the transmitted signals without the user knowing it.

The GPS unit transmits Lat/Long data to the computer navigation system. This data could be used to calibrate the navigation system in the computer to correct for positional biases, and offsets between the present and charted positions, provided SA was not active.

The Grid laptop computer contains an integrated navigation system which interacts with the Loran and the GPS. It averages biases to calculate accurate calibration factors, and stores parameter files for each station sampled. Sampling protocol dictates that sampling be performed within 50 meters of the assigned station location, and therefore, the computer navigation system should be used at every station. The only exception should be when one of the components fails. In this case, either the Loran, GPS, dead reckoning (in river systems), or LOPs (lines of position) should be used to locate the station.

The Crew Chief is required to maintain a navigation log for all stations. The navigation log will contain Loran and GPS lat/longs, Loran TDs, SNRs, slave stations, calibration factors, compass bearings and ranges from the anchored station position, and any other observations or deviations from the navigation protocol. Ranges and bearings of recognizable objects (bridges, lighthouses, water tanks, etc.) that are also on the chart should be recorded. Use the hand-held compass for the bearings and the radar for the ranges. This information would be used to validate the coordinates produced by the navigation system.

11.3 Global Positioning Systems

The following steps outline the initialization and use of the Raytheon GPS receiver. Initialization normally needs to be done only once, but it is a good idea to check the these parameters at the beginning of the season or if there is a suspected problem.

11.3.1 GPS Initialization

A. Turn the GPS on and set the position switch to the INIT mode. Scroll through the following parameters without resetting them, by pressing the <ENT> key. The parameters include current position, time, date, and antenna height. A flashing parameter can be changed, if required, by entering the appropriate numeric keys as described below.

B. Set your approximate current position (within about 1 nm). Enter the values as DD MM.mm (degrees and decimal minutes). Make sure the Lat/Long values scroll all the way across the screen, and enter any terminating zeros in the values. While entering the Lat/Long, confirm that the correct hemisphere is displayed next to the number (should be N and W). If not, change the hemisphere with the <+> and <-> keys. Press <ENT> when finished with each value.

C. Set the time. This is in GMT (Greenwich Mean Time) which is 4 hours ahead of local time during the summer (therefore if your current local time is 13:00 hours, GMT will be 17:00 hours). Set the date, using the format YYMMDD, and enter any zeros as needed. (Note the unusual format of the date value, and be careful to enter it correctly. Also be aware that if you initialize the unit after 20:00 hours local time, the date will be the NEXT day in GMT.) Enter the local time offset from GMT, which in our case is -4.00 hours. Press <ENT> when finished with each value.

D. Set the antenna height at the distance of the antenna above sea level, using an approximate value of 4 meters. Press <ENT> when finished.

E. Once the initialization parameters are set to your satisfaction, turn the position switch to the SAT mode. The GPS should remain in this mode throughout the day unless a position is required.

11.3.2 GPS Use and Status

A. Following initialization, the GPS receiver will acquire and download tracking information from all currently available satellites. The time it takes for this process to happen will vary, but should be no longer than 15 minutes.

B. The status display of the GPS will provide you with a variety of information. See the GPS manual for the display format. Individual satellite information can be cycled through by pressing the <#> key while in SAT mode.

The GPS display parameters are as follows:

- Satellite number: the number of the satellite for which information is displayed.

- Status: status of the satellite. 0 = searching, 1 = tracking, 2 = data download from satellite complete.

- Received Signal Level: the strength of the satellite signal. The higher the better. The range is from 0 to 99.

- Azimuth Angle: angle of the satellite from true North.

- Elevation Angle: elevation above the horizon of the satellite. A satellite below 5 degrees will be tracked (but not accepted) by the GPS until its height is adequate.

- Normal Satellites: the number of normal satellites currently in operation.

- Dilution of Precision (DOP): this is a statistic representing the quality of the position information being output to the computer. It is most important to observe the DOP, since the higher the value the more degraded the position solution. For system calibration, DOP should be LESS THAN 5, for navigation with the LORAN and GPS on-line, DOP should be LESS THAN 10. If DOP is greater than 10, the GPS should be taken off-line from the navigation system.

- Visible Number of Satellites: the total number of satellites currently visible to the receiver.

- Satellite Numbers used for Position Fix: these start as two lines of 4 dashes. As the satellites are acquired, they are replaced by the satellite numbers being tracked. Note that these numbers will only be displayed if 3 or more satellites are being tracked.

C. If the satellite coverage is currently not sufficient to provide position information, the time window when coverage will be adequate can be checked. To do this press the <CHNG> key twice. The bottom of the display will show the time window when coverage will be available for a 2-dimensional solution. These times will be in your LOCAL time.

D. The EDAS (Environmental Data Acquisition System) is configured to OUTPUT position information in the North American 1983 (NAD-83) datum. However, it expects that the INPUT from the GPS will be in the WGS-72 datum. Therefore, set the GPS datum to WGS-72 by turning the position switch to LAT/LONG. Press the <CHNG> key twice. Press the <#> then <5> to change the GPS datum to WGS-72. The datum need only be set once - it will be saved in memory, even after the GPS has been turned off.

11.4 LORAN

This section describes the use of the Northstar 800 Loran and its important features relative to the use of the EDAS. It is recommended, however, to review and consult the manufacturer's manual. The Loran is controlled by the keypad functions on the front panel and by command numbers.

11.4.1 Loran Keypad Functions

The following is a list of the most commonly used command numbers and their functions:

3 Speed Averaging

20 Step Loran Track Point +10ms

68 Monitor Loran TDs and Signal-to-Noise Ratios (SNRs)

73 Serial number of Loran processor

80 Step Loran Track Point -10ms

85 Show TDs in hundredths

86 Show TDs in tenths

88 Lat/Long in hundredths of minutes

89 Lat/Long in seconds

90 Loudness of Alarms

99 Display SNR

11.4.2 Loran Set Up and Operation

The Loran should be turned on for several minutes to allow the unit to lock on to suitable Loran C signals. Each time the unit is powered, it displays a self-test sequence. Any error messages should be attended as soon as possible. The **LOCK** indicator should appear after the unit has tracked a signal.

Several parameters should be checked and/or corrected prior to using information from the Loran. These parameters should not change after initialization. Consult the Northstar manual for reference.

1. Check for the proper chain by pressing the **GRI** function. The 9960 chain is for the Northeast.

2. Check the alarm volume and adjust so that it is audible and can be distinguished from other component signals. Press **COMMAND** and key **90**. Each of the 5 alarms can be adjusted from **0** (off) to **8** (loud).

3. The Signal-to-Noise Ratios (SNRs) should be checked periodically especially after the unit is turned on. Press **COMMAND** and key **99** on the keypad. The Loran will display the TD on the upper readout, and the SNR of that signal on the bottom readout. To check other TD lines, press the upper **SELECT**. Press the lower **SELECT** to change the SNR format. The numerical format (0-999) is the preferred display. The use of SNRs for determining TD lines is described in the section **11.6 EDAS Calibration**.
4. The Speed Averaging Period calculates the averaging time in minutes for the COG and SOG displays. Note that this value does not affect the positional speed of the vessel indicator on the computer screen. Press **COMMAND** and key **3**. The number of minutes will appear and should be **4**. If it is not, enter this number and press **ENT** to establish the course and speed averaging period.

Once the Loran is set up with the accepted parameters, it is ready to transmit correct navigation information to the computer. The following paragraphs describe the basic commands and use of the Northstar Loran.

Press **POSITION** to display the current position in one of two formats: TDs or lat/long. Press **POSITION** again to display the other format. Press **SELECT** when in the TD format to display other lines. It is recommended to check the SNRs of these TDs as they are displayed.

Course and speed is displayed by pressing **COURSE**. COG is on the top display and SOG is on the bottom display. This function is generally used during the trawling operations.

Several warning indicators advise you when you should exercise caution due to Loran signal condition. The Signal-to-Noise Ratio **(SNR)** indicator appears whenever the numeric SNR is less than 64 (i.e., a very poor signal). It also appears when the receiver is searching for a signal.

The cycle indicator **(CYC)** appears whenever the Northstar is not sufficiently confident it is tracking the correct 10-ms cycle of a Loran pulse, and may read high or low by 10, 20, or 30 ms. This generally appears after the unit is turned on, and disappears several minutes after the a signal is acquired. Although the **CYC** indicator does not necessarily mean it is tracking the wrong cycle, a degree of uncertainty is implied, and therefore, you should exercise caution. To increase or decrease the cycle of a Loran pulse by 10 ms, press **COMMAND** and key either **20** (step up) or **80** (step down). Then press the upper **SELECT** to display the TD you want to step.

The Blink (**BLNK**) indicator is displayed whenever Loran transmitters detect errors in the signal. The TD with the **BLNK** indicator should never be used.

The **LOCK** status indicator, although not a warning indicator, indicates that the receiver will not jump to another 10-ms track point. If it is off, you should periodically check the TD for cycle jumps.

11.4.3 Loran Errors

1. LORAN Sn (serial number) Correction

If the LORAN display reads "Error NEED Sn" when the unit is turned on or during normal operation, enter CLR and wait for the diagnostics test to complete its cycle.

The unit will display "SN -----".
Enter the five digit serial number which can be found on the Loran processor.
Then press **ENT** twice.
The unit should return to the position or course display.
Turn off and on to ensure the commands worked.
Enter command 73 to check for the proper S/N. The **"bd no."** should be "0".

Possible sources of the problem:

A) Lightning storm,

B) Newly charged battery,
C) Spike through Newmar NavPac when starting the outboards or the Briggs.

2. Frozen Display Head

If the display characters are scrambled and/or the keys are inoperable, check the computer TDs for changes in the Loran input. It may be possible to use the system if the display locks, but not recommended. Turn the Loran unit off and then on to correct this problem. If there are any further problems or questions call the FOC or Digital Marine at (617) 897-6600 and ask for George.

11.5 Computer Navigation System

The computer should be configured with the LORAN data able in COM4 and the GPS data cable in COM3 before starting the navigation system. The LORAN and GPS receivers should also be powered up and operating correctly.

11.5.1 System Parameters

The computer requires the input of a position (lat/long) and a station number in order to navigate to any specific location. It will load a default set of navigation parameters, which you can modify and save to a new file. Note that setting up the system parameters can be done at any time, and does not require the Loran or GPS to be connected to the computer.

1. Select **"System Parameters"** from the EDAS menu. The station will be either **"Default.PMS"** or **"XXX.PMS"**. If you want to enter a new station, or change either the station number or its corresponding lat/long, see below.

2. Select **"Load Parameters"**, answer **<Y>**es then type only the number of the desired station without the ".PMS". The convention for the filenames is as follows: **XXX.PMS**, where **XXX** is the station number. Leading zeros are not required.

   -If you are entering the station data for the first time, then the computer will indicate that the file does not exist **"Unable to load XXX.PMS"**. Press any key, and the computer will ask if you want to make a new file from the default parameters. Answer <**Y**>es. The **"Define Station"** menu will appear.

   -If you have previously created the file, then the computer will load the appropriate navigation parameters.

3. Enter the appropriate latitude and longitude if you create a new file. Confirm that the location is **N**orth for latitude and **W**est for longitude. Press <**ESC**> to exit. Enter <**Y**>es to re-initialize if you want to save any revised coordinates.

4. When finished, press <**ESC**> and select **"Save Parameters"** to save the new station parameters. Then enter <**Return**> and <**ESC**>.

11.5.2 EDAS Display and Function Keys

The computer navigation system will display up to four symbols, each representing the following:

>	ships position (cross hair)
⊕	station (ellipse with cross)
Δ	waypoint (triangle)
□	destination (rectangle).

The function keys are used for the navigation graphics as well as other functions. The following list explains the function key options:

F1 Help - Explanation of Function Keys, press Space Bar to see second page, press again to exit the help menu.

F2 Displays the GPS, LORAN, and Kalman Filter status. Note these only display the status, you cannot change any item using F2. The GPS display consists of the Error, Lat/Long, Satellites, and the HDOP. The Loran display consists of the Bias and TD for each Loran line. This Loran display should be monitored during calibration. The Kalman Filter displays the online/offline status of the Loran and GPS.

F3 Advance waypoint destination to the next waypoint.

F4 Append ship's position as a waypoint, and allows you to enter a description of the waypoint.

F5 Not used

F6 Redraw graphics display with ship at center.

F7 Redraw graphics display at half present scale.

F8 Redraw graphics display at double present scale.

F9 Not used

F10 Not used

Shift F1 Displays Present Position to Station, and includes Lat/Long, Average Speed, Range, and Bearing.

Shift F5 System reset. Resets parameters to those saved in the Parameters file for the current station.

Ctrl F10 Monitor Telegram views GPS or Loran data by typing **DTCGDP** or **DTCLDP**, respectively.

11.6 EDAS Calibration

The navigation system must be calibrated for every station in order to meet the sampling accuracy protocol of 50 meters. One of two types of calibration, SYSTEM and POINT, is required to meet this goal. SYSTEM calibration uses the vessel's present position, according to the GPS, to generate calibration factors for LORAN generated TDs. This is generally performed prior to leaving the dock or when arriving at station. POINT calibration creates calibration factors, which are the differences between the measured and theoretical LOPs from the LORAN. However, this requires the boat to be positioned at a fixed point with known coordinates (e.g., range marker or lighthouse).

POINT calibration is the preferred method due to the variability and lack of good GPS coverage. SYSTEM calibration should only be used when the GPS DOP level is $\leq$ 5, and for navigating when the DOP is $\leq$ 10, and when you suspect is the Loran is not displaying quality data. The GPS should be OFFLINE when the DOP is >10 (see section *11.3.2 GPS Use and Status*). For both types of calibration, the boat should be stationary and preferably tied to a dock.

The LORAN Cal Factors generated by either method are constant over a limited area, up to 20nm, provided there is no strong interference with the LORAN signals. **It is, however, strongly recommended to calibrate at a location nearest to and most representative of the station location.** For example, if you are at a dock in a large bay and plan to sample a station in the center of the bay, calibrate at a fixed ATON that may also be in the bay, not at the dock.

For either calibration, the computer should be using the TDs with the optimum crossing angles and strongest SNRs. The method of determining the selection of Loran lines will be described below.

11.6.1 System Calibration

This procedure (although not recommended) can be followed when the criteria for System Calibration are met as described above.

1. Confirm that the navigation system is receiving data from the LORAN and GPS units. Do this by pressing <Ctrl F10>, then typing "DTCLDP" to display the LORAN telegram. Check the GPS telegram by pressing <Ctrl F10> and typing "DTCGDP". If both the LORAN and GPS are transmitting data, select **"Navigate to Station"** from the main menu.

2. Select **"Kalman Filter"**, and turn BOTH the GPS and the LORAN C **OFFLINE**. This is done by moving to each item and pressing <RETURN>. <ESC> back to the EDAS menu. Select **"Process Noise"**, and change **"Speed Variability"** to 1.00 and **"Speed Response Time"** to 15.00. Press <ESC> twice to exit.

3. Select **"Positioning Systems"**, then select **"Loran C Navigation System".** The GRI should be 9960. Select **"Calibrate"**, then select **"Reset"**, and answer <Y> to reset. <ESC> and answer <Y> to save the cal factors (this will save the zeroed out cal factors). <ESC> back to the EDAS menu.

4. Select **"Kalman Filter"** again, and turn the GPS **ONLINE**. Leave the LORAN OFFLINE. <ESC> back to the EDAS menu.

5. Select the **"Positioning System"**, **"Loran C Navigation System"**, and **"Calibrate"**. Press <F2> twice, to display the bias and TD for each LORAN chain. These will update continuously. Wait until the bias becomes stable, and then the system can be calibrated.

6. Select **"System Calibration"**. Answer <Y> to calibrate. Record all the cal factors for the LORAN chains being used. Press <ESC> and answer <Y> to save the Cal Factors. At this point the Cal Factors will be applied to the LORAN data, and the Loran bias should approach zero. Press <ESC> to return to the EDAS menu.

7. Select **"Kalman Filter"**, and turn the LORAN C **ONLINE**. Leave the GPS ONLINE. <ESC> back to the EDAS menu. The system is now ready to navigate using both calibrated LORAN and GPS. (NOTE: see Section

11.6.3 Important Calibration Notes.)

11.6.2 Point Calibration

The use of Point Calibration requires that 1) the boat is located at a known fixed location (e.g., range marker, lighthouse, etc.), and 2) the datum of the coordinates is NAD-83. To convert chart Lat/Longs from the NAD-27 datum to the NAD-83 datum positions, see Section *11.6.4 Datum Conversion Using the Geodetic Utilities*.

When calibrating, it is highly recommended to choose the "best" TD lines for the computer. This is accomplished by selectively turning TD lines on or off in the computer navigation system. The computer requires two lines at minimum be turned ON, however three lines are preferable. It is most unlikely to acquire four lines due the distance of the slave stations and the poor angles of the lines. The "best" lines are determined by high SNRs and angles of the TD lines that approach right angles. A low SNR value (100-300) is not necessarily bad - it just takes longer for the Loran to extract quality positional data from weak signals. Although Loran lines are not present on all charts, the crossing angles can be determined from smaller scale charts of nearby areas.

The process for turning TD lines on and off is as follows:

1. Select **System Parameters**, **Positioning Systems**, **Loran C Navigation System**, **Database**, and then **Edit Database**. You should also display the Loran Status by using the **F2** key.

2. Enter **E** to edit or check the status of a TD line (Master, Whiskey, Xray, Yankee, or Zulu).

3. Enter the first letter of the desired TD line to display the status. Use the **RETURN** key to change the **ON-LINE/OFF-LINE** status.

4. To accept the current display, press **ESC** three times. The Loran lines will change when you escape back to the **Database** menu.

5. Save these parameters by selecting **System Parameters** and **Save Parameters**. The navigation system is now ready for Point Calibrating.

The process for Point Calibrating is as follows:

1. Confirm that the navigation system is receiving LORAN data from the receiver. Do this by pressing **<Ctrl F10>**, then typing **"DTCLDP"** to display the LORAN telegram. If the LORAN is transmitting data, select **"Navigate to Station"** from the EDAS menu.

2. Select **"Kalman Filter"**, and turn BOTH the GPS and the LORAN C **OFFLINE**. This is done by moving to each item and pressing **<RETURN>**. **<ESC>** back to the EDAS menu.

3. Select **"Positioning Systems"**, then **"LORAN C Navigation System"**. The GRI should be 9960. Select **"Calibrate"**, then select **"Reset"**, and answer <**Y**> to reset. **<ESC>** and answer **<Y>** to save the cal factors (this will save the zeroed out cal factors). **<ESC>** back to the EDAS menu.

4. Select **"Kalman Filter"** again, and turn the LORAN **ONLINE**. Leave the GPS OFFLINE. **<ESC>** back to the EDAS menu.

5. Select the **"Positioning System"**, **"LORAN C Navigation System"**, then **"Calibrate"**. Press the **F2** key twice in order to monitor the TD bias of each line. Enter the Latitude and Longitude of your known position. Select **"Point Calibration"** and press **<SPACE>** to begin the averaging. When the average Cal Factors stabilize, press **<SPACE>** to stop the averaging. Record the **Average Values** of the LORAN chains being used in to the navigation log. Press **<ESC>** and answer **<Y>** to save the Cal Factors. At this point the Cal Factors will be applied to the LORAN data. Press **<ESC>** to return to the EDAS menu.

6. The system is now ready to navigate using only the calibrated LORAN. (See section *11.6.3 Important Calibration Notes*)

11.6.3 Important Calibration Notes

Be aware that the GPS will ALWAYS output navigation data to the EDAS, regardless of the quality of that data. Therefore if the DOP goes high, or satellites are lost, the position information coming into the EDAS will not be good.

** It is up to you, the operator, to determine the quality of the GPS reception. **

At the time of POINT calibration, raw GPS data should be manually recorded in the event that the Loran signal is lost or disrupted during the day. In this case, the GPS may be switched on and the Loran switched off in the Kalman filter. The correction factor from the Loran could then be applied to the GPS to achieve a more accurate position. However, when Loran is working properly we recommend that you not use GPS.

If the GPS coverage window is small (i.e., the satellite coverage will not be adequate the whole time you are on the water) or the DOP is high (greater than

10), then navigate with just the calibrated LORAN. (GPS **OFFLINE** and LORAN **ONLINE** in the Kalman Filter.)

If the GPS coverage is good but the LORAN reception is not, then navigate with the GPS alone. (GPS **ONLINE** and LORAN **OFFLINE** in the Kalman Filter).

It is highly recommended to save your **System Parameters** anytime you make a change to the calibration parameters.

It is also recommended to enter the correct magnetic variation within the **Parameters** menu which is in the **Navigation** option.

11.6.4 Datum Conversion Using the Geodetic Utilities

When doing a POINT calibration with the LORAN, it is necessary to read your position from a chart. If the chart coordinates are in WGS-72 or NAD-27 (North American 1927), they need to be converted to the NAD-83 (North American 1983) datum. To convert Lat/Longs between datums, use the Geodetic Utilities as follows:

1. From the EDAS menu select **"Geodetic Utilities"**, and then select **"Datum Conversion"**.

2. **"Datum 1"** is the datum you are converting FROM (i.e. the chart datum). Press <RETURN> to scroll through the available datums. Select **"North American 1983"**.

3. **"Datum 2"** is the datum you are converting TO. You should always select **"North American 1983"** (NAD-83). Press <RETURN> to scroll through the available datums.

4. **"Latitude 1"** is the latitude from which you are converting. Press <RETURN>, enter the latitude, and press <RETURN> again. Repeat this process with **"Longitude 1"**. Each time a value is entered the screen will update. (Disregard the **Height** value.)

5. The converted Lat/Longs are **"Latitude 2"** and **"Longitude 2"**. Record these values, and use them as the latitude and longitude entries for the POINT calibration. Press <ESC> to exit.

11.7 Navigating within EDAS

The navigation component of the system allows the pilot to accurately navigate the vessel to a designated position. After the system is calibrated, it provides positional updates every 2-3 seconds. Information is displayed within a series of menus with options to change navigation parameters. The graphic display uses several symbols to represent different operational units and parameters.

It is important to calibrate prior to using the navigation system. You must also confirm that the parameters (Loran on-line, magnetic variation, etc.) are set, and that the appropriate station is entered in the **System Parameters** menu under **Load Parameters**.

Routes and waypoints should be saved and recorded in either the Loran or the GPS. This provides a means of navigation if the computer becomes disabled or if you must navigate in foggy conditions.

When arriving at a station, all available position data, including ranges and bearings, must be recorded. This will aid other crews to find the exact positions should they return to that station. When taking a compass bearing, it is recommended to stand on the aluminum deck hatch so that deviation caused by metal on the boat is standardized on all boats. The following is a description of the commands, menus, and displays necessary to navigate to a station.

Select **Navigation** from the **EDAS** menu. The options of this menu are described as follows:

CRT Display - This selection gives the option to choose a particular location (waypoint, present position, station, or destination) to be displayed at the screen center. Select **Center** to view these options. Use the arrow keys to select an option. A lat/long position can also be entered as the center. Press **ESC** to accept the options and exit. The symbol of the selected location will appear at the screen center.

Destination - This option is used to designate a destination which may be either a previously defined location (station, waypoint, or display center) or a Lat/Long position. If you select a station, it will be the station as in the System Parameters. You can also select a waypoint that was previously entered in the same database with that station.

Parameters - Under this menu, you can selectively turn the waypoint route selection on or off using the **Auto Update** option; change the **Direction** of the route to either **Forward** or **Backward**; change the **Update Radius** to specify the distance (in meters) from your vessel to the intended waypoint at which the system will update to the next waypoint number; and input the amount of **Magnetic Variation** for a particular area.

Waypoints - This option allows you to edit and create waypoints within a database file. The database file number is the same as the station number. Select **Edit Database** to enter or edit a waypoint. Press **E** to edit. Both the **id** number, which is the waypoint number, and the **Lat/Long** can be changed. Press **ESC** to accept any changes.

Monitor - This option displays navigational information relative to the assigned Destination. The Monitor display is very useful when underway.

SECTION 12
COMMUNICATIONS

The Virginian Province 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.

12.1 Electronic Transfer of Data

Due to the complexity of the 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 external Codex 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, the QA Coordinator, the 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. Experience of past years shows that 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 Section 8 of Part 2 of the Field Computer System (1992).

12.2 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:

1-800-732-2305

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 is available by pager. Phone calls to the "800" number are automatically forwarded to an answering machine. Crews should try to make these communications as concise as possible because of limited time available on the tape.

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. Crews are provided with copies of the phone log sheet used in the FOC (included in Appendix G). They should complete these sheets prior to placing the phone call to assure they have all the required information readily available. Whenever possible, crews should place their daily call during the morning.

Through the use of the portable phones, the Field Operations Center should be able to contact each team at any time. The land-based crew member will also carry a portable phone, allowing the FOC staff to contact him/her as well. The Field Operations Center can utilize the Marine Operator to contact crews as a last resort.

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.

12.3 Ship-to-Shore Communications

Both the boats and mobile laboratories are equipped with marine-band VHF radios and portable phones. 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. Communications between the boat and mobile laboratory were frequently unavailable during the Demonstration Project due to poor radio reception. The boat antenna has been raised to the top of the mast, and the mobile lab antenna has been relocated to a considerably higher position. The lab antenna now requires lowering prior to departure from the staging area. These modifications should significantly increase the range of operation of these units. FCC REGULATIONS PROHIBIT THE MOBILE LAB FROM TRANSMITTING ON ANY MARINE FREQUENCY WHILE THE LAB IS IN MOTION. The need to lower the lab's antenna during transit should effectively prevent such unauthorized use.

In addition, it is highly recommended that the mobil phone be carried on the vessel to insure good communication.

12.4 Truck-to-Truck Communications

Citizen's Band radios in the mobile labs and pick-up trucks should allow for more efficient transmitting between staging areas since directions or changes in planned routes due to traffic congestion can be communicated between vehicles. As with all radio communications, proper etiquette must be followed. Additional information is provided in Section 8.1

SECTION 13
SAMPLING SCHEDULE AND STATION TYPES

13.1 Sampling Schedule

Sampling activities for the 1993 Virginian Province Project are scheduled to begin on Monday, July 26, 1993. The Index Period has been divided into six-day "windows", corresponding to crews' six-day work periods. Within each window, crews will sample a predetermined cluster of approximately seven stations. Stations have been clustered according to proximity and logistical considerations. Which cluster is sampled in a given window has been quasi-randomly determined, i.e. the selection is random, however, logistical guidelines have been applied to the process. For example, the selection of clusters at opposite ends of a crew's region in two consecutive windows would result in a re-draw, thereby reducing the burden on the crew to travel long distances in limited time.

Crews should make every effort to sample all stations in the cluster within the prescribed six-day window. If a station cannot be sampled, a decision will be made by the Project Manager as to whether to drop the station or sample it at the end of all other sampling activities. Crews should not sample any additional stations within a window without permission from the Field Coordinator.

13.2 Station Types

Several different types of stations will be sampled during the Project. The locations of all stations are provided in Table 13.1. Specific instructions on obtaining samples are covered in the following chapters. A flow chart outlining the activities conducted at a station is included below.

13.2.1 Base Sampling Sites (BSS)

Base Sampling Sites (BSS) are randomly chosen sites that will be used to characterize the water quality of the Province. BSS are visited once during the index period. Sampling activities at Base stations are as follows:

a. Perform a CTD cast with bottom and surface YSI measurements
b. Collect a surface and bottom water sample for chlorophyll
c. Collect a water sample for total suspended solids analysis from the surface
d. Collect benthic biology and grain size samples (three)

e. Collect sediment organics, sediment metals, AVS (acid volatile sulfides), sediment toxicity, and grain size samples (generally one each).
f. Perform a fish trawl and process for species composition, and pathology. At predetermined Base stations located in small estuaries certain species of fish will be collected for spleen macrophage aggregate analysis.
g. Perform additional trawls as necessary to obtain the required number of fish for pathology.

13.2.2 Long Term Trend (LTT) Stations

These are Base Sites that are revisited yearly to establish Long Term Trends at individual locations. The sampling activities are identical to those described for BSS. LTT stations are visited twice during the index period, with the same activities are performed on both visits. Visits must not be in consecutive windows and are preferably at least 12 or more days apart.

13.2.3 Replicate (REP) Stations

The locations of these spatial replicates are randomly assigned to a randomly selected subset of 1993 tidal river sub-segments and 1993 small systems. Sampling at these replicates is identical to that at a Base Station. If lack of time is a problem in finishing off all stations anticipated for a particular window, REP stations have a slightly lower priority and should be dropped first.

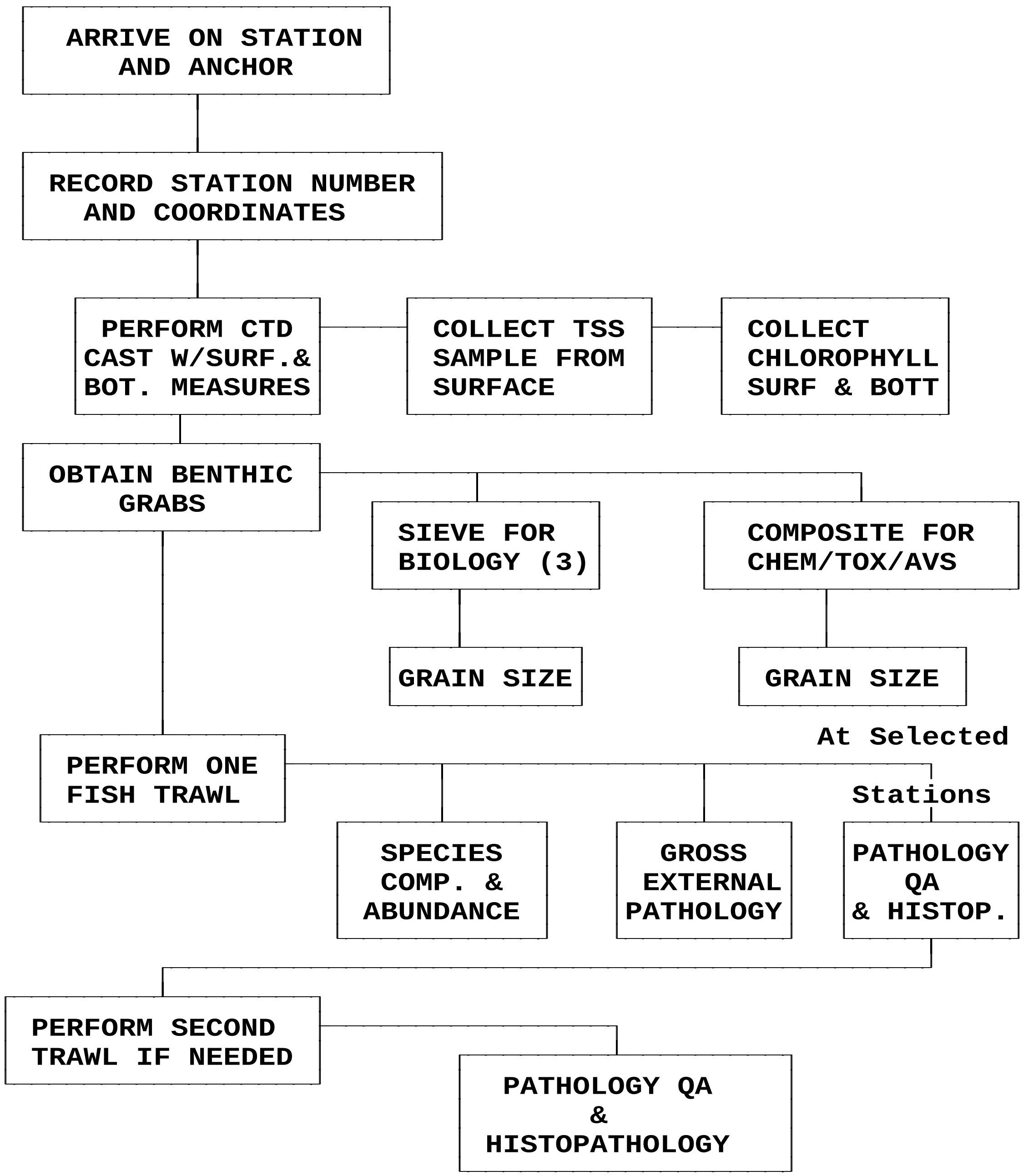


Figure 13.1 Field Sampling Activities at Base, Replicate and Long Term Trend Sites

Table 13.1. Listing of 1993 EMAP-VP stations by team.

Team 1 Stations.

Sta. #	Class Size	Estuary Name	Latitude (DD	MM	SS.SS)	Longitude (DD	MM	SS.SS)
		Buzzards Bay						
720	BSS	BUZZARDS BAY	41	34	54.00	70	54	27.60
721	BSS	BUZZARDS BAY	41	35	10.80	70	41	8.40
		Block Island Sound						
698	BSS	BLOCK ISLAND SOUND	41	7	40.80	72	5	43.80
699	BSS	BLOCK ISLAND SOUND	41	8	6.00	71	52	31.80
700	BSS	BLOCK ISLAND SOUND	41	8	30.00	71	39	19.20
706	BSS	BLOCK ISLAND SOUND	41	16	43.20	71	46	31.20
707	BSS	BLOCK ISLAND SOUND	41	17	6.00	71	33	16.80
712	BSS	QUONOCHOTAUG POND	41	20	48.00	71	42	52.20
		Eastern Long Island Sound						
683	BSS	HEMPSTEAD BAY	40	38	55.00	73	28	34.00
689	BSS	NAPEAGUE HARBOR	41	0	47.46	72	2	54.48
690	BSS	GARDINERS BAY	41	3	31.20	72	8	53.40
		Long Island Sound						
025	LTT	LONG ISLAND SOUND	41	0	43.20	73	14	32.40
079	LTT	LONG ISLAND SOUND	41	10	29.40	72	42	21.60
685	BSS	LITTLE NECK BAY	40	46	20.00	73	45	34.00
686	BSS	OYSTER BAY	40	53	53.76	73	30	55.41
687	BSS	LONG ISLAND SOUND	40	55	51.00	73	30	33.60
688	BSS	LONG ISLAND SOUND	40	56	27.00	73	17	25.80
693	BSS	LONG ISLAND SOUND	41	5	9.00	73	11	38.40
695	BSS	LONG ISLAND SOUND	41	5	42.60	72	58	28.20

696	BSS	LONG ISLAND SOUND	41	6	14.40	72	45	18.00
697	BSS	LONG ISLAND SOUND	41	6	45.00	72	32	7.20
702	BSS	NEW HAVEN HARBOR	41	14	46.20	72	56	12.00
703	BSS	LONG ISLAND SOUND	41	14	54.60	72	39	24.60
704	BSS	LONG ISLAND SOUND	41	15	25.20	72	26	13.20
705	BSS	LONG ISLAND SOUND	41	15	52.20	72	12	58.80
709	BSS	FISHERS SOUND	41	19	36.60	71	56	23.40
713	BSS	THAMES RIVER	41	21	1.80	72	5	28.20

Hudson River

173	LTT	UPPER NY/NJ BAY	40	38	48.00	74	3	30.00
215	LTT	HUDSON RIVER	41	44	0.00	73	56	42.60
681	BSS	LOWER NY/NJ BAY	40	32	0.00	74	4	21.00
682	BSS	ARTHUR KILL	40	32	58.80	74	14	52.20
684	BSS	PASSAIC RIVER	40	44	23.00	74	7	6.00
694	BSS	HUDSON RIVER	41	5	18.00	73	53	57.00
710	BSS	HUDSON RIVER	41	19	51.60	73	58	35.40
719	BSS	HUDSON RIVER	41	34	39.60	73	57	13.80
726	BSS	HUDSON RIVER	41	56	7.80	73	56	54.00
727	BSS	HUDSON RIVER	42	11	30.00	73	51	27.00
735	REP	ARTHUR KILL	40	38	49.50	74	10	48.00

Nantucket Sound

711	BSS	MENEMSHA POND	41	20	9.52	70	46	21.19
714	BSS	CAPE POGE BAY	41	23	15.61	70	27	47.84
715	BSS	VINEYARD SOUND	41	26	38.40	70	47	21.00
716	BSS	NANTUCKET SOUND	41	27	7.80	70	20	45.60
717	BSS	NANTUCKET SOUND	41	27	20.40	70	7	27.60
722	BSS	POPPONESSETT BAY	41	35	42.00	70	27	53.00
723	BSS	NANTUCKET SOUND	41	35	38.40	70	14	29.40
724	BSS	NANTUCKET SOUND	41	35	49.80	70	1	9.00

Narragansett Bay

718	BSS	NARRAGANSETT BAY	41	34	16.20	71	21	4.80
725	BSS	PROVIDENCE RIVER	41	48	41.40	71	23	53.40
737	REP	PROVIDENCE RIVER	41	43	16.00	71	21	46.80

Table 13.1 (continued).

Team 2 Stations.

Sta. #	Class Size	Estuary Name	Latitude (DD	MM	SS.SS)	Longitude (DD	MM	SS.SS)
		Chesapeake Bay - Maryland						
45	LTT	TANGIER SOUND	38	9	37.80	76	1	33.60
58	LTT	CHESAPEAKE BAY	39	7	45.00	76	16	52.80
136	LTT	MIDDLE RIVER	39	18	18.00	76	24	36.00
631	BSS	CHESAPEAKE BAY	38	5	16.20	76	4	4.80
633	BSS	MANOKIN RIVER	38	7	45.00	75	53	25.00
640	BSS	WICOMICO RIVER	38	15	1.20	75	50	32.00
642	BSS	NANTICOKE RIVER	38	19	40.80	75	53	40.80
649	BSS	CHOPTANK RIVER	38	35	47.40	76	3	54.00
650	BSS	CHESAPEAKE BAY	38	37	59.40	76	21	33.00
652	BSS	TRED AVON RIVER	38	42	54.00	76	6	51.00
658	BSS	EASTERN BAY	38	55	10.80	76	16	48.00
661	BSS	CHESTER RIVER	39	1	31.20	76	11	18.00
667	BSS	CHESAPEAKE BAY	39	21	31.80	76	8	37.20
670	BSS	SUSQUEHANNA FLATS	39	28	49.20	76	4	13.20
672	BSS	NORTHEAST RIVER	39	34	1.20	75	57	33.00
		Cheapeake Bay - Virginia						
623	BSS	CHESAPEAKE BAY	37	48	25.20	76	1	39.00
624	BSS	POCOMOKE SOUND	37	49	21.60	75	49	10.80
		Delaware Bay						
178	LTT	DELAWARE RIVER	40	10	0.00	74	43	40.80
654	BSS	DELAWARE BAY	38	51	25.20	75	13	10.20
660	BSS	DELAWARE BAY	39	0	15.60	75	7	55.20
663	BSS	DELAWARE BAY	39	8	15.60	75	15	21.60
664	BSS	DELAWARE BAY	39	9	6.00	75	2	37.80

666	BSS	DELAWARE BAY	39	16	15.60	75	22	50.40
668	BSS	DELAWARE BAY	39	24	15.00	75	30	19.80
673	BSS	DELAWARE RIVER	39	42	41.40	75	29	45.00
675	BSS	DELAWARE RIVER	39	52	1.30	75	12	51.12
677	BSS	DELAWARE RIVER	40	8	30.03	74	43	57.59
678	BSS	DELAWARE RIVER	40	1	4.20	75	2	0.00
734	REP	DELAWARE RIVER	40	7	39.00	74	44	30.00

Delaware Coast

150	LTT	DELAWARE COAST	38	35	36.00	75	6	42.00

Maryland Coast

634	BSS	CHINCOTEAGUE BAY	38	8	52.80	75	13	57.00
641	BSS	SINEPUXENT BAY	38	19	0.00	75	6	34.00
732	REP	SINEPUXENT BAY	38	19	34.75	75	6	1.66

New Jersey Coast

659	BSS	CAPE MAY HARBOR	38	56	58.50	74	53	40.59
669	BSS	REED/ABSECON BAY	39	24	25.00	74	27	53.00
671	BSS	LITTLE EGG HARBOR	39	33	28.00	74	19	12.00
676	BSS	TOMS RIVER	39	56	40.20	74	11	0.00

Table 13.1 (continued).

Team 3 Stations.

Sta. #	Class	Size	Estuary Name	Latitude (DD	MM	SS.SS)	Longitude		
			Chesapeake Bay - Maryland						
050	LTT		CHESAPEAKE BAY	38	0	43.8	76	6	36.00
188	LTT		POTOMAC RIVER	38	44	12.00	77	2	0.00
630	BSS		CHESAPEAKE BAY	38	4	18.00	76	16	36.00
637	BSS		POTOMAC RIVER	38	13	11.40	76	42	4.80
638	BSS		CHESAPEAKE BAY	38	13	12.60	76	11	34.20
643	BSS		POTOMAC RIVER	38	20	36.60	76	58	51.50
644	BSS		CHESAPEAKE BAY	38	21	9.00	76	19	4.80
645	BSS		POTOMAC RIVER	38	25	8.40	77	16	23.40
647	BSS		CHESAPEAKE BAY	38	29	4.20	76	26	36.60
648	BSS		PATUXENT RIVER	38	29	10.80	76	39	30.60
651	BSS		POTOMAC RIVER	38	41	6.60	77	6	13.20
653	BSS		CHESAPEAKE BAY	38	45	54.60	76	29	6.60
655	BSS		POTOMAC RIVER	38	54	10.64	77	4	24.10
657	BSS		CHESAPEAKE BAY	38	54	49.80	76	24	1.80
733	REP		POTOMAC RIVER	38	54	3.60	77	3	57.60
			Chesapeake Bay - Virginia						
060	LTT		CHESAPEAKE BAY	37	42	55.20	76	16	36.60
601	BSS		CHESAPEAKE BAY	36	56	54.00	76	6	39.00
602	BSS		JAMES RIVER	37	0	25.80	76	31	57.00
603	BSS		CHESAPEAKE BAY	37	4	50.40	76	14	4.20
604	BSS		CHESAPEAKE BAY	37	5	48.60	76	1	43.80
606	BSS		JAMES RIVER	37	12	2.40	76	41	20.40
607	BSS		CHESAPEAKE BAY	37	12	46.20	76	21	30.00
608	BSS		CHESAPEAKE BAY	37	13	45.00	76	9	8.40
609	BSS		JAMES RIVER	37	18	7.80	77	0	0.00
610	BSS		JAMES RIVER	37	18	23.40	77	15	1.20
611	BSS		YORK RIVER	37	20	34.80	76	37	25.80
612	BSS		CHESAPEAKE BAY	37	22	39.60	76	4	11.40

613	BSS	JAMES RIVER	37	24	15.60	77	23	37.20
615	BSS	CHESAPEAKE BAY	37	30	36.60	76	11	37.80
616	BSS	CHESAPEAKE BAY	37	31	34.20	75	59	13.20
617	BSS	CHESAPEAKE BAY	37	38	32.40	76	19	5.40
618	BSS	CHESAPEAKE BAY	37	39	31.20	76	6	39.00
619	BSS	CHESAPEAKE BAY	37	40	28.20	75	54	12.60
620	BSS	CORROTOMAN RIVER	37	42	27.00	76	28	54.00
621	BSS	RAPPAHANNOCK RIVER	37	56	35.02	76	50	47.36
622	BSS	CHESAPEAKE BAY	37	47	27.00	76	14	7.20
626	BSS	CHESAPEAKE BAY	37	56	21.60	76	9	6.60
627	BSS	TANGIER SOUND	37	57	19.20	75	56	37.20
628	BSS	RAPPAHANNOCK RIVER	38	5	13.01	76	58	56.91
632	BSS	RAPPAHANNOCK RIVER	38	9	43.31	77	5	16.92
635	BSS	RAPPAHANNOCK RIVER	38	11	59.50	77	13	22.48
639	BSS	RAPPAHANNOCK RIVER	38	14	56.00	77	15	51.17
728	REP	JAMES RIVER	37	17	20.40	77	59	32.00
729	REP	YORK RIVER	37	31	30.00	76	47	16.00
730	REP	CORROTOMAN RIVER	37	40	57.72	76	27	50.76
731	REP	RAPPAHANNOCK RIVER	38	4	51.00	76	57	21.60

SECTION 14
DISSOLVED OXYGEN, SALINITY AND TEMPERATURE

14.1 Sea-Bird Sealogger CTD

The first activity performed at every station is obtaining a vertical profile of the water column for salinity, temperature, dissolved oxygen (DO) concentration, light transmission, chlorophyll *a* fluorescence, and PAR (a measurement of the intensity of light in the range of wavelengths used by algae in photosynthesis) using the Sea-Bird SeaLogger CTD.

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.

The CTD unit is a very sensitive device. Crews need to be particularly careful to avoid sudden shocks when handling this unit. Because of the weight of this unit two people should always be involved in carrying the CTD to and from the vessel. The magnetic ON/OFF switch of this unit is also very sensitive. Attempts to turn the unit ON or OFF should be in one smooth definitive motion. Do not rapidly throw the switch ON and OFF in an attempt to "wake it up". This will thoroughly confuse the unit, delay sampling and cause further irritation to the crew.

14.2 YSI Model 58 Dissolved Oxygen Meter and Probe

The YSI will be used to take oxygen measurements from surface water and from bottom water collected in a GO-FLO bottle. In addition, the YSI will be used for a weekly QC check of the CTD. The following information details the maintenance and operation of the YSI Model 58 Dissolved Oxygen Meter.

14.2.1 Initial Setup of The YSI

1. The YSI Model 58 has two separate sets of batteries, one for the oxygen meter and the other for the stirrer. Both sets consist of 4 D-size Alkaline batteries. These are accessed by removing the four screws on the back

panel then carefully pulling the meter back away. The upper battery holder is for the oxygen meter, the lower holder for the stirrer batteries. Note that the stirrer batteries will probably require more frequent replacement, whereas the meter batteries will most likely last throughout the entire field season. Observe correct polarity whenever changing batteries in either holder.

2. When the YSI meter batteries are low, the LOWBAT warning will show **continuously** on the display (the LOWBAT warning may flash momentarily as the meter knob is turned off, but this is normal). The initial appearance of LOWBAT indicates about 50 hours of meter battery life. The normal life for the meter batteries is about 1000 hours.

   To check the YSI stirrer batteries, turn and hold the STIRRER knob to the BATT CHK position. If the LOWBAT warning shows **continuously** on the display then the stirrer batteries should be changed. The initial appearance of the LOWBAT warning in the BATT CHK position indicates 5 hours or less of stirrer battery life. The normal life for the stirrer batteries is about 100 hours.

3. While the meter is still open, observe the position of the sliding switch in the upper right hand corner of the meter. This switch sets the meter sensitivity for the type of membrane on the oxygen probe. The switch should be in the middle position, set for a 1 mil ("standard") membrane.

4. Close the meter housing and gently tighten the corner screws. DO NOT OVER TIGHTEN these screws, as they are easily stripped. As you close the meter, work the rubber gasket so that the outer edge overlaps both halves of the housing.

14.2.2 Changing the YSI Probe Membrane

The procedure for changing the YSI probe membrane is similar to that for the HydroLab membrane. However there are some differences, so it's important to be familiar with both procedures. The YSI membrane should be changed weekly. Visual inspection is the best indication of when to change the membrane: if the membrane is fouled, wrinkled, cut, has bubbles underneath it, or the gold cathode is tarnished...then it's time. Try to schedule membrane replacement at the end of a field day, or the night before. This allows the membrane more time to "relax" and equilibrate.

1. Prepare the electrolyte by dissolving the KCl crystals in the dropper bottle with distilled water. Fill the bottle to the top.

2. Unscrew the sensor guard, and remove the O-ring and membrane. Rinse the sensor with distilled water and then with electrolyte. Gently wipe the gold cathode ring with a kim-wipe or paper towel.

3. Fill the sensor with electrolyte. If you're a "rightie", grasp the sensor in your left hand with the pressure compensating vent to the right. Successively fill the sensor body with electrolyte, then pump the diaphragm with the ERASER end of a pencil or with some similar soft, blunt tool. Continue filling and pumping until no more air bubbles appear. Tap the sensor with the pencil to free any bubbles trapped on the sides.

4. Remove a membrane from the "standard membrane" package (DO NOT use the HydroLab membranes - they are different). Secure the membrane under your left thumb. Add a few more drops of electrolyte to the sensor to form a meniscus over the gold cathode.

5. With the thumb and forefinger of your other hand, grasp the free end of the membrane.

6. Using a continuous motion, stretch the membrane UP, OVER, and DOWN the other side of the sensor. Stretching forms the membrane to the contour of the probe.

7. Secure the end of the membrane under the forefinger of the hand holding the probe.

8. Set the O-ring on the membrane above the probe, and using your thumb and index finger, roll the O-ring down over the probe until it is seated. Try not to touch the membrane surface while doing this. Gently tug at the exposed corners to remove all wrinkles, then trim away the excess membrane below the O-ring and replace the sensor guard. Inspect the membrane to make sure there are no <u>bubbles, wrinkles</u>, or <u>cuts</u>.

9. The probe should be stored in the open-ended plastic bottle provided for that purpose. Moisten the sponge or paper towel in the end of the storage bottle to prevent the membrane from drying out. <u>The membrane needs to relax for a minimum of 12 hours following installation.</u>

14.2.3 Calibration of the YSI Oxygen Meter

The YSI should be calibrated before sampling at EACH station, and the meter and attached probe should be turned on for **at least 15 minutes** prior to calibration or sampling. In practice this means turning the meter on at the beginning of the day and leaving it on (with the possible exception of very long transit periods between stations). On field days when the probe is not being used leave the meter in the % switch positions (or, in the case of the model 57, in the 0-10 MG/L position).

1. Calibration will be done in the probe storage/calibration chamber. Confirm that a moist piece of towel or sponge is present in the bottle. Remove any water droplets from the membrane surface by drying with the corner of a paper towel.

2. Set the function switch to ZERO, and when the display reading has stabilized, readjust display to read 0.00.

3. Reset the function switch to % mode. When the display reading has stabilized, unlock the O2 CALIB control locking ring and adjust the display to read 100%. Relock the locking ring to prevent inadvertent changes. Avoid exposing the calibrated probe to large thermal changes, such as from direct sunlight or lying on a hot deck.

14.2.4 Operation of the YSI Oxygen Meter

In general the YSI will be used to confirm the proper operation of the CTD.

1. Calibrate the YSI (See above; section 14.2.3.

2. Remove the storage/calibration chamber and the sensor guard, and CAREFULLY screw the probe into the stirrer. The probe membrane should NOT touch the stirrer blades. Membrane damage occurs most often when the probe is being inserted or removed from the stirrer. If a measurement isn't to be taken immediately, wrap the stirrer-probe unit in a moist towel and set it out of the sun.

3. Set the function switch to 0.01 MG/L mode.

4. To perform a surface YSI check hang the probe next to the CTD DO probe with the stirrer ON. Set the YSI salinity from refractometer reading. Record temperature from a thermometer, and DO from the YSI on the "CTD CAST DATA SHEET".

5. To perform the bottom dissolved oxygen check of the CTD do the following:

   A. Collect a bottom water sample in the GO-FLO bottle.

   B. Draw out a small sample from the bottle and measure the salinity using the refractometer. Set the SALINITY switch to this value, and record the salinity on the **"CTD CAST DATA SHEET"**.

   C. Insert the stirrer-probe unit into the GO-FLO bottle and turn the stirrer ON.

   D. When the meter reading has stabilized, record the oxygen value on the **"CTD CAST DATA SHEET"**.

   E. Remove the probe, turn the stirrer OFF, rinse the probe with freshwater, replace the storage bottle, and store the unit out of sunlight.

14.2.5 YSI Mobil Lab QC Check

A QC check of the YSI will be preformed once each sampling cycle. This should be done before the CTD QC check, since the YSI is used to QC the CTD. YSI QC data should be recorded on the **CTD/YSI QC DATA SHEET**. This information MUST also be transferred to the computer, and should be done immediately following the CTD QC check.

1. Air calibrate the YSI as outlined above (see section 14.2.3 CALIBRATION OF THE YSI OXYGEN METER).

2. Bubble a bucket of freshwater for at least 2 hours to allow it to become air saturated. Put the calibrated YSI stirrer-probe unit into the bucket and turn the stirrer ON. The SALINITY switch should be set to 0.

3. When the meter has stabilized, record the YSI oxygen and temperature readings.

4. Insert a thermometer into the bucket and record the ambient water temperature.

5. Siphon a water sample from the bucket into three BOD bottle, and do a Winkler titration on two samples. If they differ significantly titrate the third sample (see appendix D). (NOTE: As part of the titration process, the thiosulfate should be calibrated.) Record the Winkler oxygen value.

6. Tolerances for passing the YSI QC check are as follows:

   - Temperature: +/- 2 C
   - Oxygen: +/- 0.5 mg/l

If a YSI fails to pass any of the QC checks, repeat the above procedures one time. If the YSI still fails, change the probe unit and try again. Repeated failure with a new probe unit may indicate that the YSI meter is bad. Contact Steve Kelly at the FOC immediately.

14.3 CTD Dockside QC Checks

A QC check of the CTD (and the YSI) will be performed once each sampling cycle, from a convenient dock or sheltered location. The **CTD/YSI QC DATA SHEET** should be used to record all values taken during the CTD QC check.

1. If not already done, do the YSI QC check (see appendix F, section 5.0) and calibrate the YSI (see above).

2. Set up the CTD in realtime mode. To do this, connect the data cable to the CTD, select **"Instruments Menu"** from the main menu, select **"CTD"**, and select **"Realtime CTD/YSI QC Check"**. Answer <N> when asked about changing the acquisition or display parameters. You will be prompted to turn on the CTD switch. NOTE: DO NOT turn on the CTD until just before you are ready to lower it into the water. (As with a real deployment, this will allow air to bleed out of the tubing system before the pump kicks in.)

3. Once the CTD is on, lower the instrument into the water. The computer screen should change to a display of numbers updated every 2 seconds. Allow the CTD to equilibrate in the water - this may take up to 10 minutes, depending on the temperature difference between the deck and the water. Watch the "Oxygen Temp" and "Temperature" numbers. When they are within 0.5° C, the unit is equilibrated.

4. Take a bucket water sample from next to the CTD, check the salinity with a refractometer and record this value.

5. Put the calibrated YSI over the side next to the bottom of the CTD. Adjust the YSI salinity to the refractometer salinity, then record the YSI temperature and oxygen (as the AMBIENT values) and the CTD temperature, oxygen and salinity.

6. Bring the CTD back on deck, but leave the magnetic switch ON, and leave the computer in real time mode. Rinse off the pH probe with distilled water and some pH 10 buffer, then insert the probe in the pH 10 buffer. Confirm that an electrical connection exists between the top of the pH probe and the buffer solution. Record the CTD pH reading.

7. The CTD may now be turned OFF, the sensors rinsed with freshwater, and all probe covers replaced. Exit from the real time mode with <Ctrl F1>, then answer <N> to the restart question.

8. When prompted enter the appropriate barcode number for the CTD. At this point the computer will display the **"CTD/YSI QC Information"** menu. Fill in ALL pertinent data and copy all the CTD QC check values to the computer data sheet (the differences between the CTD and the AMBIENT readings will be automatically calculated. At this point you should also enter the YSI QC check data (see above).

9. The tolerances for passing the CTD QC check are as follows:

- Salinity:	± 3 ppt
- Temperature:	± 2°C
- Oxygen:	± 0.5 (mg/l)
- pH:	± 0.5 pH units

If a CTD fails to pass any of the QC checks, repeat the above procedures one time. If the CTD still fails, contact Steve Kelly at the FOC immediately. If CTD DO is off by > 0.3 contact the FOC regarding recalibration.

14.4 Obtaining CTD Profile (See Figure 14.1)

14.4.1 Setup and Initialization Procedures

During the surface and bottom soaks of the cast, independent measurements are collected at the respective depths with a YSI meter according to the instructions in above. Great care must be taken to avoid altering the oxygen concentration of the bottom samples. Enter the DO concentration and temperature into the computer. These data serve as backup measurements for the CTD, and a QC check on the CTD instrument.

At each station, the general procedures for collection of data are as follows:

1. Connect the CTD to the end of the winch cable with a shackle, and **TIGHTEN THE PIN**. Make sure a "pinger" is attached to the unit. A 50 pound weight should be hanging approximately one meter below the unit, and two floats attached to the top. This will prevent the unit from impacting the bottom. Once the weight hits the bottom the unit will float one meter above.

2. Select **"CTD Cast"** from the "Environmental Sampling" menu. The computer will prompt for connection to the CTD. The computer will attempt to communicate with the CTD. If successful, computer will display **"CTD Menu"**. If communication is not established, you will be asked if you want to retry. Answer <Y>. If communication still cannot be established, check your connections and try again.

3. For the FIRST cast of the day select **"Initialize CTD"**. Answer <Y> to clear the CTD memory. At this point logging will be initialized, and the CTD time and date will be reset to match the computer time and date.

4. If this is NOT the first cast of the day, OR if you have completed "Initialize CTD", select **"Prepare For Next Cast"**.

5. Confirm that the magnetic switch is in the OFF position and press <ESC>. At this point the computer will check and display the CTD main battery voltage and availability of free memory, then place the CTD in quiet state. If the voltage or memory capacity are low a warning message will be displayed. You can still elect to continue the cast, or take action to correct the problems.

- To correct a low voltage problem, change the batteries (See 14.5 CTD MAINTENANCE AND CLEANING).

- To correct a full memory problem, initialize the CTD.

NOTE: Make certain that all files have been saved or they will be lost.

6. Disconnect the CTD when prompted, and prepare for deployment.

14.4.2 Deployment

1. Disconnect the data cable, and replace the dummy plug (be careful NOT to bend the CTD pins). The bump on the side of the plug should be aligned with the thick pin. Finger tighten the locking sleeve on the dummy plug. Confirm that the magnetic switch on the CTD is in the OFF position. Attach the cocked Go-flow bottle to the side of the CTD in preparation for collecting a bottom water sample. For stations > 10 m simultaneous bottom sampling may be difficult. Bottom water sample may need to be taken after the CTD cast is completed.

2. Prior to actually putting the CTD in the water, run through the following checklist:

A. Remove the distilled water loop from the conductivity cell, and connect the tube from the oxygen probe. Remove all rubber stoppers.

B. Check the transmissometer and fluorometer lens to make sure they are clean. Use only Kim-wipes or lens paper to clean them. **Do not wipe dry lenses if there is salt on them.**

C. Carefully unscrew the bottom of the bottle covering the pH probe, and slide it straight down off the probe. If you can't reach the plastic bottle, first remove the sensor guard cage by unscrewing it.

D. Remove the black plastic cap covering the PAR light sensor.

E. Attach the ballast weight and floatation if they are to be used. Secure the winch shackle to the metal ring at the top of the frame, and raise the CTD to the rail.

F. Slide the magnetic switch DOWN into the ON position, and <u>immediately</u> lower the CTD into the water.

3. Attempt to position the boat so that the PAR sensor (the small white sphere) is NOT shaded. This may involve holding the CTD away from the boat with a boat hook.

4. After allowing the instrument to reach thermal equilibrium (at least 4 minutes), hang the YSI probe over the side next to the CTD to measure the dissolved oxygen and temperature with the calibrated YSI. Collect a sub surface water sample with a bucket, and measure the salinity with the refractometer. Process the water sample collected for total suspended solids. Record the temperature and DO immediately prior to descent of CTD.

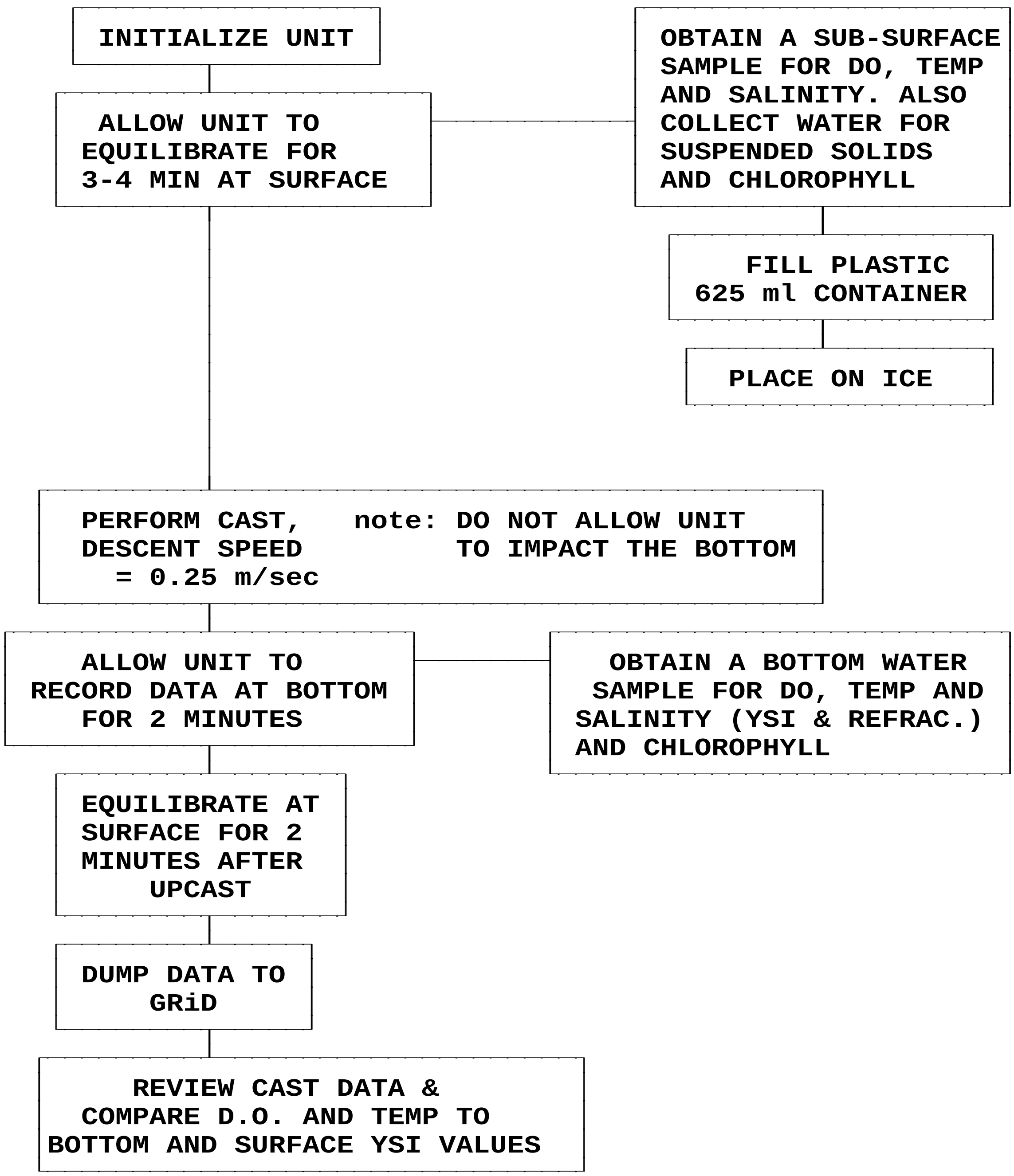
5. Lower the CTD through the water column at a rate of approximately 0.25 meter per second until it reaches the bottom.

6. When you feel the CTD bottom weight touch, the wire will go slack, stop lowering and hold the CTD at the bottom for at least 2 minutes. Pay careful attention to the wire, and make sure the CTD isn't bounced or dragged across the bottom. The bottom weight/buoy system should ensure that the CTD sensors never actually touch the bottom, and therefore won't become plugged with mud. Collect a water sample with the Go-flow bottle attached directly to the CTD.

7. Raise the CTD to just below the surface and let it collect data for at least 2 minutes. As the CTD comes out of the water, slide the magnetic switch UP to the OFF position. Check the conductivity and temperature probes for damage and/or obstructing mud or stones. Rinse the conductivity cell and DO probe with DI water. Reconnect the distilled water loops to the oxygen and conductivity sensors, and carefully cap the pH and PAR probes. Remove the dummy plug from the data port. Dry of the port and re-connect the cable, and download the data

8. Measure the dissolved oxygen and temperature of water sample collected with the Go-flo with the calibrated YSI, and measure the salinity with the refractometer.

Figure 14.1 PERFORMING A CTD CAST



14.4.3 Retrieving Data

1. Select **"Download Cast"** from the CTD Menu. Reconnect when prompted if not already connected. The computer will establish communication with the CTD, display the cast headers in the scroll window, and request the cast number to be downloaded. Enter the appropriate cast number. This will normally be the highest number (i.e. the latest cast). If there is only one cast stored in the CTD, the cast will automatically be downloaded.

2. If downloading in the Mobil Lab, enter station and event number.

3. The computer will present a series of graphical displays of each sampled parameter plotted against depth. At present, YOU MUST RECORD ON THE "CTD CAST DATASHEET" A CTD SURFACE AND BOTTOM D.O., A CTD SURFACE AND BOTTOM SALINITY, A CTD SURFACE AND BOTTOM TEMPERATURE, AND A CTD BOTTOM DEPTH. These numbers can be read from the graphical displays.

- To change parameter displays, press <ENTER>. Currently, you can move forward with the <F8> or <ENTER> and backward with <F7> through the displays.

- To scroll through the data in a parameter display, use the arrow and page keys. Page keys work by holding the <Fn> key down, and pressing <PgUp> or <PgDn>.

- To dump a screen display to the printer, make sure the printer is on-line, then hold the <Fn> key down and press <PrtSc>.

4. After you have viewed all the profiles, press <ESC> and the computer will ask if you want to accept this cast. Answer <Y> or <N>.

- "NO" will return you to the "First" or "Second Visit Menu".

- "YES" will bring up the "Field Crew's Station Info. screen".

5. Enter ALL the appropriate information, including the CTD DO, salinity, temperature and CTD bottom depth as recorded on the data sheet. Press <F5> to save and record the data. Answer <Y> if the page is correct. At this point more log files will be copied to the A: drive, and the computer will return to the "First" or "Second Visit Menu".

6. After data are stored in the on-board computer, view the DO data on the screen using the software supplied. Compare the bottom DO to the value obtained by the YSI. If surface or bottom CTD DO measurements differ by greater than 0.5 mg/l repeat the cast. If measurements from the second cast do not agree, flag the data. The cast can still be accepted if the other measurements appear reasonable.

7. After sampling is finished for the day, the CTD should be thoroughly rinsed down with freshwater.

14.5 CTD Maintenance and Cleaning

1. As often as possible, flush the entire CTD with fresh water.

2. Keep the distilled water loop on the conductivity cell, and keep the oxygen sensor moist (it does not need to be full of water, just in a humid environment.

3. To clean the conductivity cell and the oxygen probe, put a few drops of the Triton X-100 cleaner into their respective tubes, and allow to soak over night. The tubes should be flushed with water before deployment. NEVER use a brush or tool to clean the inside of the conductivity cell.

4. When the data cable is not in use, keep it coiled.

5. Handle the CTD with care - some of the sensors are more delicate than others, and can be damaged by bouncing the unit on deck, or by letting the unit fall over, etc.

14.6 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.

14.6 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 three 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 surface and bottom DO value obtained from the YSI meter will be used in data assessment for the DO concentration. In addition the Hydrolab unit will be deployed to profile salinity, temperature and pH. The operation of the Hydrolab is described in Appendix E.

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.

SECTION 15
SEDIMENT COLLECTIONS

15.1 Sediment Collections

Sediments are collected for a variety of analyses. Three samples are collected for benthic species composition, abundance, and biomass. 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, benthic biology grabs should not be collected consecutively, but rather interspersed among the chemistry/toxicity grabs. While a biology grab is being processed (sieved), grabs should be collected for chemistry/toxicity.

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 has been Kynar®-coated (similar to Teflon) and is therefore 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. NOTE: The sampler must be washed with Alconox prior to use at a station.

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.

5. 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 7 centimeters (see Figure 15.1). 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 mud, 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.

6. Carefully drain overlying water from the grab.

7. Enter notes on the condition of the sample into the computer and on the data sheet. Options on smell, texture, etc. are available via menus.

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.

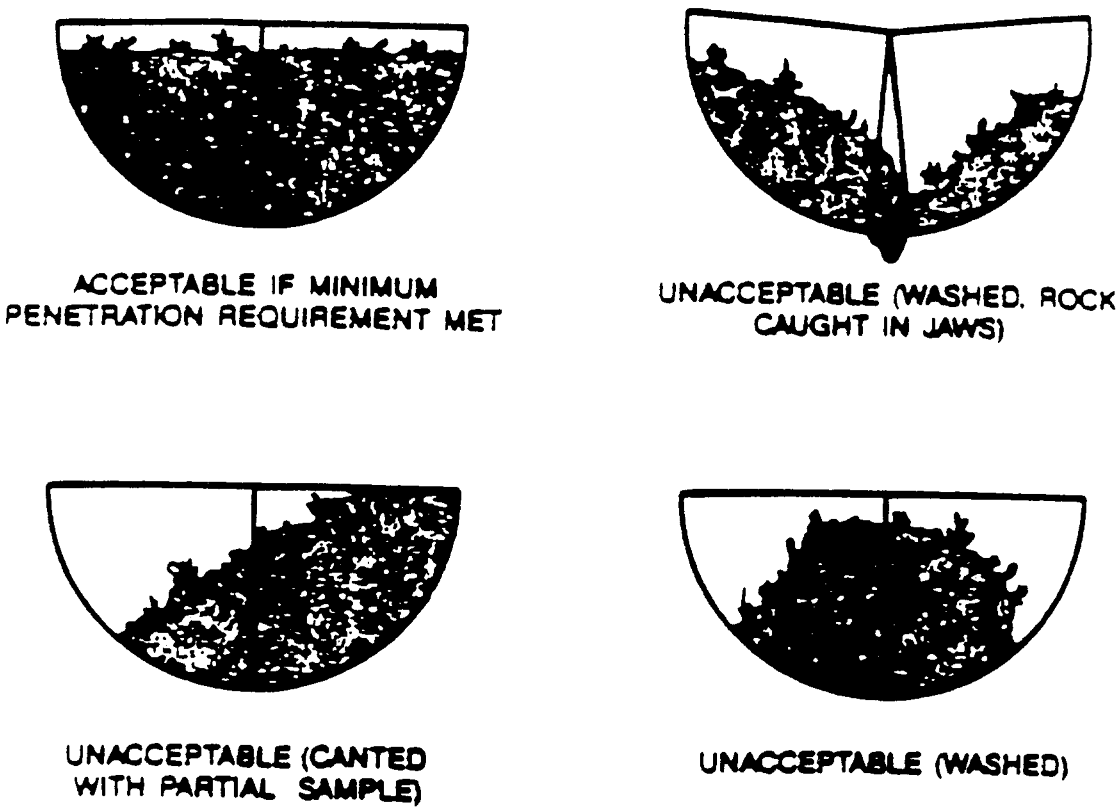
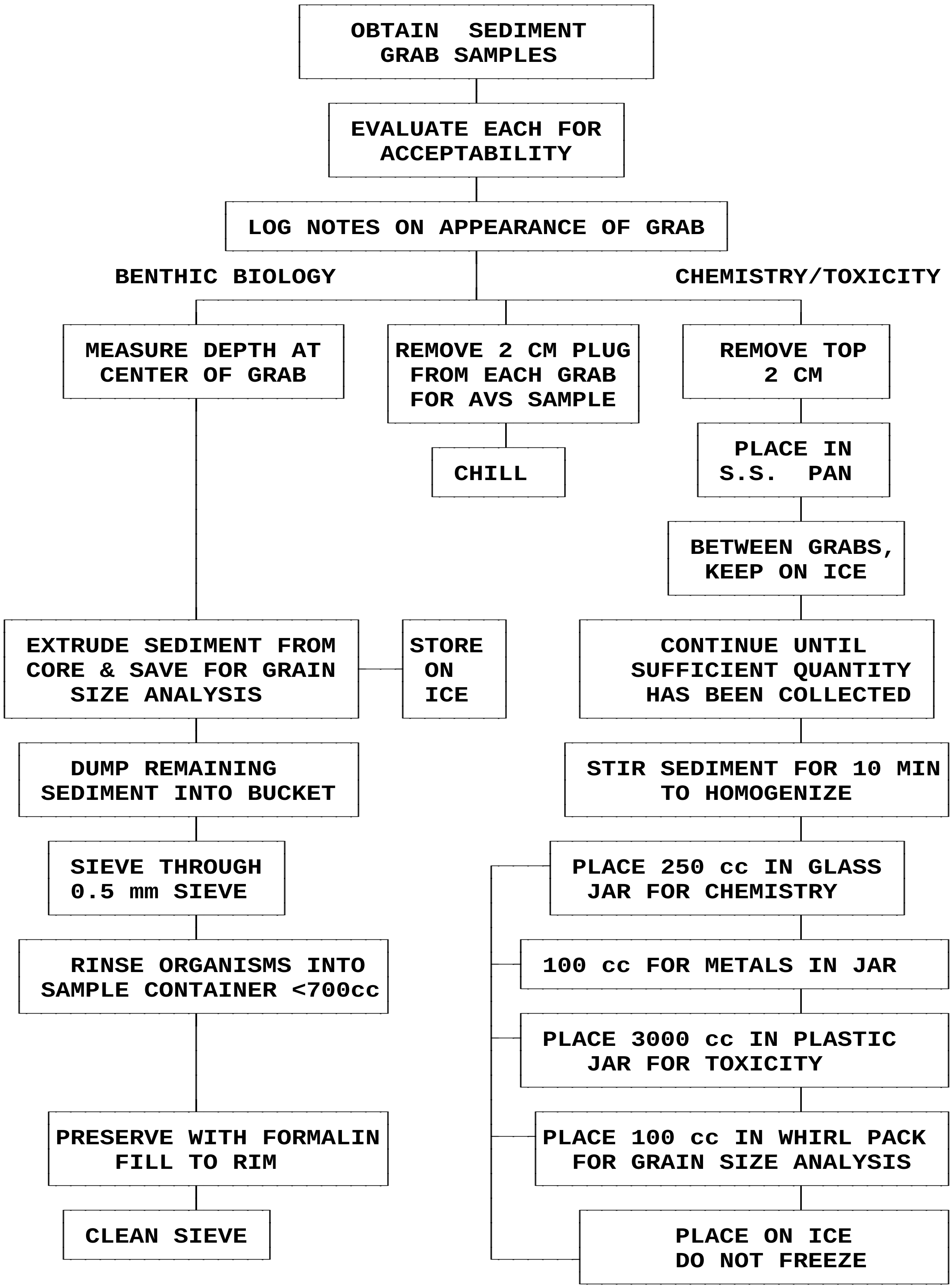


Figure 13.2. Quality assurance criteria for obtaining grab samples. Only those samples meeting QA criteria are retained. Those not meeting these criteria are discarded.

Figure 15.2 SEDIMENT COLLECTIONS



15.1.1 Field Processing of Samples for Benthic Community Assessment

Grab samples to be used in the assessment of macrobenthic communities are processed in the following manner:

1. Assign a sample number to the sample, affix the label to the sample jar, and scan the number into the computer using the bar code reader.

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 $\geq$7 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 in the computer.

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. Extrude the sediment from the core tube into a "Whirl Pack." If an insufficient amount of sediment has been extruded to fill the Whirl Pack half-way, the repeat until the pack is full. 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. Extreme care must be taken to assure that no sample is lost over the side of the sieve.

5. Drain the water from the sieve box and gently rinse the contents of the tray to one edge. Using either your fingers or a spoon, GENTLY scoop up the bulk of the sample and place it in the plastic screw-top bottle from which the sample number was scanned in Step 1 (which should be placed in the sieve or a bucket in case some of the sample spills over). Rinse the outside of the sample jar into the sieve, then, using a funnel, rinse the contents into the jar. The jar should be filled no higher than the 700 ml mark. If the quantity of sample exceeds 700 ml, 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 in the computer that the sample consists of more than one container.

6. Carefully inspect the sieve to ensure that all organisms are removed using fine 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. A 100 % buffered, stained stock formalin solution should be mixed according to the recipe in Table 15.1. 100 ml of the formalin should be added to each sample jar, and a teaspoon-full of borax added to assure saturation of the buffer. FILL THE JAR TO THE RIM WITH SEAWATER TO ELIMINATE ANY AIR SPACE. This eliminates the problem of organisms sticking to the cap because of sloshing during shipment. Gently invert the bottle to mix the contents and place in the dark. If the sample occupies more than one container, tape all the sample bottles containing material from that grab together.

9. 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

Table 15.1. Directions for mixing stock solutions of formalin.

Chemical	Volume Desired	Total Quantity
100% formalin stock (stained and buffered)		
Rose Bengal stain	8 ℓ	1/4 teaspoon
Borax	8 ℓ	8 heaping tablespoons
100% formalin	8 ℓ	two gallons

15.1.2 Field Processing of Sediments for Chemistry and Toxicity Testing

In addition to the three grabs collected for benthic community analyses, additional grabs are collected for chemical analyses and toxicity testing. The top two cm of these grabs are removed, homogenized, and split for chemistry and toxicity testing. Because of contamination concerns these samples are removed and processed in the order described below:

1. As each grab is retrieved, carefully examine it to determine acceptability as described above in Section 15.8, 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.

NOTE: Great care must be taken to avoid contamination of this sample from atmospheric contaminants. The Briggs and Stratton engine must be turned off and either the boat engine turned off or the boat maneuvered to assure the exhaust is down wind.

2. A clean stainless steel spoon and a uncontaminated syringe are used to remove sediments from grab samples for these analyses. All items must be washed with Alconox and rinsed with ambient seawater before use.

3. **ACID VOLATILE SULFIDES** - Use a uncontaminated 60 cc syringe to extract the top two centimeters of material from undisturbed surficial sediment. An appropriate number of plugs must be taken from each chemistry grab in order to fill a 125 ml plastic jar to the bottom of the threads (normally one plug/grab). In between grabs the jar must be sealed and placed in a cooler on ice. CARE MUST BE TAKEN TO PREVENT OXIDATION OF THE SAMPLE. Fill the sample container completely, leaving no head space. This sample must be refrigerated ASAP.

4. Remove the top two cm of sediment using the stainless steel spoon. Place the sediment removed in a stainless pot and place the pot in a cooler on ice (NOT dry ice). The sample must be stored at 4°C, NOT FROZEN.

5. Repeat this procedure, composite the sediment in the same stainless pot until a sufficient quantity of sediment has been collected for all samples. Stir sediment homogenate after every addition to the composite to insure adequate mixing. Keep the container covered and in the cooler between grabs.

6. Homogenize the sediment by stirring with a Teflon paddle for 10 minutes.

7. **ORGANICS** - Using a stainless steel spoon, carefully place 250 cc of sediment in a 500 ml 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. If not already in place, affix the label supplied with the bottle containing the lot number (this need not be recorded anywhere). 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.

8. **METALS** - Using a stainless steel spoon, place approximately 100cc of sediment into a pre-cleaned plastic (HDPE) sampling jar. Record the sample number and keep on ice at 4°C.

9. **SEDIMENT CHEMISTRY QA** - At one previously designated station per crew, three additional samples need to be collected for each of the following: 125 ml AVS, 250 ml organics and 125 ml metals are collected for duplicate analyses (1) and for analysis by a referee laboratory (2). Four plugs must be taken from each of chemistry grabs to fill each of the bottles at a constant rate following directions in step 3. QA samples for organics and metals are collected from the same composite as per the directions in Step 6. The FC will notify the crew at which station these samples need to be collected. In addition, one glass sample jar should be left open on the deck whenever the organics sample is exposed. This will serve as a blank.

9. **SEDIMENT GRAIN SIZE** - Attach an appropriate bar code label to a Whirl-Pack, and fill approximately half-way for sediment grain size analysis, and record the sample number. Store this sample on ice (NOT dry ice).

10. **SEDIMENT TOXICITY** - Using the stainless steel spoon, fill approximately 85% of the 1 gallon plastic container for toxicity testing with sediment (minimum volume required is 3000 ml). 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.

15.2 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.

15.3 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 washed and thoroughly rinsed prior to use to assure that no sediment remains from the previous station.

2. Prior to use, all Teflon and stainless steel 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 whenever the sample is exposed, 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 samples do 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.

7. Great care must be taken to avoid atmospheric contamination from engine exhaust. The Briggs and Stratton engine must be turned off and the boat maneuvered to assure the engine exhaust is down wind of the sample.

8. **The grab must be suspended off the deck at all times to avoid contamination.**

15.4 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 computer and the FC notified during the next scheduled call-in.

SECTION 16
FISH TRAWLS

After all required sediments are collected, one or more trawls are made to collect fish for species composition, relative abundance, and for pathological examination. In 1993, no fish will be collected for tissue analysis.

16.1 The EMAP Otter Trawl

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 top 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. 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.

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 processing.

Types of trawls can be defined as follows:

STANDARD TRAWL - This trawl is the "quantitative" trawl performed at all stations for community structure and abundance determination. One standard trawl should be performed at EVERY station. Any fish sample type can be taken from a standard trawl. Fish are identified, measured, and examined.

NON-STANDARD TRAWL - At selected stations non-standard trawls may need to be performed following the completion of a standard trawl to obtain a sufficient number of fish for *pathology QA or SMA*. All sample types EXCEPT PATHOLOGY can be obtained from a non-standard trawl. All fish are identified and counted.

The type of fish samples that will be collected are as follows:

Pathology Fish - These are fish observed by the field crew to have a gross external pathology (lump, growth, ulcer, and/or fin rot ONLY!!). ALL species are examined for external pathology, therefore, pathology fish may be of any species collected. Pathology Fish are collected during the standard trawl only.

SMA (spleen macrophage aggregate) fish - These are "randomly" selected fish collected only at pre-selected stations. SMA fish are selected by the crew after or during examination for gross external pathology and are free from external pathology (according to the collecting crew). Only those species listed on the list of pathology target species are collected for SMA.

Pathology QA fish - These are fish collected at the same selected stations to determine the crew's error rate. Pathology QA fish are NOT limited to target species.

Taxonomy QA fish - The first two individuals of EVERY species collected by each crew are preserved and sent back to ERL-N for verification by an expert taxonomist.

16.2 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, 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 end of the cod-end by using a cod-end knot. Check to make sure there is no escapement possibility through the cod end rings. The 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.

16.3 Net Deployment

1. After all preparation steps have been completed, the Crew Chief should check all resources available (chart, navigational aids, land marks etc.) to determine that there are no under water hazards. 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. With the starboard engine in neutral, 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 13.2 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. The starboard engine can be engaged when the gear is clear of the props and the doors spread.

Table 16.1. Amount of Winch Wire to be Used for Trawling and Dredging

Water depth (ft)	Ratio of line to water depth (including the 125' bridle)	Line out
10 (3 m)	7:1	Bridle only (38m)
20 (6 m)	7:1	Bridle+20' (44m)
30 (9 m)	7:1	Bridle+60' (56m)
40 (12 m)	6:1	Bridle+120' (75m)
50 (15 m)	5.5:1	Bridle+155' (85m)
60 (18 m)	5:1	Bridle+180' (92m)
70 (21 m)	4.6:1	Bridle+202' (100m)
80 (24 m)	4.2:1	Bridle+216' (104m)
90 (27 m)	3.8:1	Bridle+222 (106m)

16.4 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, initiates the computer trawl clock, 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.

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 depth finder 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, fish can still be collected from a shorter trawl for chemistry and pathology indicators.

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

16.5 Net Retrieval

1. After approximately 10 minutes of trawling and when the crew is prepared to haul back the computer should be prompted to end the trawl.

2. Haul back the wire until approximately 10 meters of the bridle is still out. Put the starboard engine in neutral. 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. Haul the cod end in by hand or use the capstan head to assist

16.6 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.

16.7 Criteria for Voiding Tows

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

1. A tow cannot be completed because of hang down, boat malfunction, vessel traffic, or major disruption of gear.

2. Boat speed or speed over bottom is outside 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).

16.8 Endangered Species

All species considered to be rare, threatened, or endangered (Table 16.2) should be processed immediately and released alive. At the discretion of the Chief Scientist, photographs may be taken to document the catch.

Table 16.2. 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

16.9 Sample Processing

Once a catch is brought on deck, fish are processed based upon the priority level for that sample type:

1. Pathology
2. Taxonomy QA
3. Pathology QA / SMA

16.9.1 Processing of Fish for Gross External Pathological Analysis

I. Gross examination of fishes: **(Ulcers, Growths, Lumps and Fin rot ONLY!)**

Crews will perform a "standard" trawl at **ALL STATIONS**. All individuals collected will be identified and counted, and the first 30 individuals of each species will be measured. All individuals measured (*i.e*. the first 30) that exceed 75 mm in length will be examined for evidence of gross external pathology (lumps, growths, ulcers, and fin rot ONLY). The examination is intended to be a rapid scan of the surface of individuals to be completed while other fish measures are being completed (i.e., identifying, enumerating, measuring). This scan should take no longer than 10-15 seconds per fish. Fish determined to show evidence of a pathology are assigned a sample number from the end of the chemistry range and processed appropriately (see below). The type of pathology will be noted on the data sheet and entered into the field computer. These are **PATHOLOGY FISH**. **Only fish collected in "standard" trawls are saved for pathology.**

II. Selection, killing and fixation for transfer:

Proper fixation of specimens is critical to the ultimate quality of the data obtained. Fish should be examined and fixed while still alive or shortly after death (within one hour of collection). Specimens should not be frozen or kept on ice at any time.

A. All specimens with gross lesions or other suspect conditions, as identified in Section I above, will be processed and coded individually. All these fish will be transferred as indicated below (Section III) to ERL-N for subsequent examination.

1. Carefully cut the entire length of the abdominal cavity open using scissors or a sharp knife. Gently insert the instrument into the abdomen near the anus and make an incision to the operculum. Cut with a lifting motion so that the incision is made from the inside outward, taking care not to injure the visceral organs. Remove the lateral musculature from one side of the animal's visceral cavity to facilitate the fixation of the internal organs. Make one or two cuts along the longitudinal axis of the livers of fishes larger than 15 cm, remove the opercula, and immerse in fixative (see step 5). This may require the gentle loosening and lifting of the liver prior to cutting the organ.

2. If the total length of the fish exceeds 15 cm, only a portion of the fish will be saved for laboratory analysis. Carefully cut, through the entire thickness of the fish, from the top of the operculum back along the spine, until a position behind the visceral cavity is reached, and then a 90° change in direction towards the anus. The head and viscera are then saved. Remove both opercula, and musculature covering the visceral cavity on one side.

The head and thorax can be separated at the esophagus if needed. Any abnormalities found on the remaining portion of the fish (which is to be discarded) are excised along with the surrounding tissue, and saved with the head and visceral cavity. For fishes smaller than 15 cm, the entire fish is saved.

4. If an external growth is present, measure it and slice through the lesion with one clean cut using a sharp razor blade.

5. Place the sample (whole fish or head, visceral cavity and abnormalities excised) in a plastic zip lock bag with multiple perforations. Assign an appropriate sample number to each fish, affix the bar code to a fish tag, and attach the tag to the fish. Record this number on the data sheet, along with all other pertinent information on that fish. Place the bag in a tight sealing plastic container with sufficient fixative to completely cover the specimen. Specimens should be fixed in Dietrich's fixative for one or two days.

IMPORTANT NOTE -

At no time should onion bags be used to contain fish saved for pathological examination. Plastic bags with at least 20 holes (from a hole punch) should be used. ALSO, wire ties should never be used to attach the tag to the fish. Plastic net twine can be pre-cut and used for this purpose.

- Dietrich's Fixative (to make ~5 gals.)
  37-40% Formaldehyde
  or 100% formalin .... 1500 ml
  Glacial Acetic Acid ...... 300 ml
  95% Ethanol .... 4500 ml
  Distilled water .... 9000 ml

6. Carefully record pertinent information relating to each individual sample on the data sheet.

III. Shipping of preserved specimens:

Wrap each specimen in cotton or cheese-cloth and saturate with Dietrich's fixative. Clearly label individual specimens with code tags wrapped up with the fish. Place wrapped fish in zip-lock plastic bags and assure that they are completely saturated with fixative. Pack wrapped and bagged specimen in buckets or other suitable containers and ship via appropriate carrier. Fish sent via courier should be double bagged packed in box with styrofoam packing and have a final plastic wrap that normally comes with each shipping box Fish can also be hand carried to ERL-N in liquid Dietrich's fixative without being wrapped in cheese cloth.

16.9.2 Taxon QA Fish

The first two individuals of every non-threatened species collected by each crew during the summer (from either trawl type) will be assigned a sample number from the ranges designated on the data sheets, recorded on the data sheet, and preserved. This fish should be preserved with the 10% un-stained formalin solution provided and shipped back to Charlie Strobel at ERL-N at the end of every shift.

16.9.3 Spleen Macrophage Aggregate

I. Collection of SMA fish:

Following the examination of fish for external pathology, **SMA FISH** will be selected by the crew. SMA fish are collected **<u>ONLY AT SELECTED STATIONS</u>**. Only target species are processed for SMA. The goal is to select up to fifteen individuals (>75mm length) of each of the three highest priority target species present at that station (see Table 16.3). These individuals are "randomly" selected from the pool of fish. From a standard trawl these fish have already "passed" the crew's pathology examination. Additional "non-standard" trawls should be initiated to collect additional fish, as needed. SMA fish collected from a non-standard trawl still need to be examined, for gross external pathologies. Pathologies should be recorded, but these fish should never be sent in as Pathology fish.

No more than two hours of trawling are required of the crews regardless of the number of fish caught. SMA fish are assigned a barcode number from a pre-assigned range, recorded on the data sheet, and processed appropriately.

Table 16.3 Prioritized SMA Pathology Target Species List

1. Winter Flounder
2. Summer Flounder
3. Hog Choker
4. Channel Catfish
5. White Catfish
6. White Perch
7. Spot
8. Atlantic Croaker

II. Fixation for transfer:

This process is very similar to that of Pathology fish. However because a SMA fish could also be used as Path QA fish (meaning the lab will have to be able to analyze for gross external pathologies) the fish must be in relatively “good” shape. Fish should not be cut up if they are to large. If a fish does not fit in a bucket than it will not be saved. Also, material should not be removed from the fish (i.e., belly flaps and opercula). Care must be taken to avoid any unnecessary damage to any musculature. Carefully cut the entire length of the abdominal cavity open using scissors or a sharp knife. Gently insert the instrument into the abdomen near the anus and make an incision to the operculum. Cut with a lifting motion so that the incision is made from the inside outward, taking care not to injure the visceral organs. Expose the visceral cavity to facilitate the fixation of the internal organs. The lateral musculature should be cut in such a way as to insure that there is adequate fixation, without removal of the flap. Viscera organs should be well exposed with out being injured. Opercula should not be removed.

16.9.4 Pathology QA Fish

I. Selection and fixation for transfer:

PATHOLOGY QA FISH will be randomly collected at the same **SELECTED STATIONS** (2 per crew). These fish will be collected to determine the error rate associated with crew member identification of gross external pathologies. Crews will be informed in advance as to which stations these fish should be collected at. In standard trawls, following the examination of fish and processing of Pathology fish, up to 20 individuals (>75mm length) of each target species present and 10 of all other species collected will be assigned a number from a pre-assigned range and processed in the same fashion as Pathology fish. Fish captured in non-standard trawls need to be examined for gross-external pathologies. If external pathologies exist, they should be noted on the data sheet. Fish collected fro SMA can be used for Pathology QA. If, for instance, 15 individuals of a target species are collected, than only 5 more additional individuals of that species need to be collected for PATH QA. As with SMA fish, additional trawling may be required, with the crews expected to spend up to two hours trawling at that site.

Fixation and preparation for shipment are identical to SMA fish. Care must be taken to avoid any unnecessary damage to any musculature. Carefully cut the entire length of the abdominal cavity open using scissors or a sharp knife. Gently insert the instrument into the abdomen near the anus and make an incision to the operculum. Cut with a lifting motion so that the incision is made from the inside outward, taking care not to injure the visceral organs. Expose the visceral cavity to facilitate the fixation of the internal organs.

16.9.5 General Processing

1. After all fish have been sorted, process fish for pathological examination as described above. Sampling for pathology, SMA and pathology QA are performed concurrently with the collection of composition and abundance data. Only fish are recorded. Crustaceans, other invertebrates, and trash are noted in the computer then discarded.

2. Measure, with a measuring board, the fork length to the nearest millimeter, of individuals of each species. If there are fewer than 30 individuals of a species, all individuals should be measured. 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 and later into the computer.

NOTE -

Dog fish -	stretched total length
Skates -	total length
Rays -	wing tip to wing tip, and total length
Unforked -	total length with out extraneous filaments

3. Enter data on the fish data sheets. Common names are acceptable. All data are entered into the computer in the mobile laboratory with common names (most are already listed in the computer). For fish not in computer list the scientific name must also be included on the data sheet.

4. 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 other 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.

5. After all processing has been completed, the Chief Scientist should review the trawl data sheet for discrepancies and inaccuracies. When any questions have been resolved, he/she 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.

6. 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 21). 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.

16.9 Quality Assurance

In order for the net to "fish" properly, the proper amount of winch cable must be let out. Consult Table 16.1 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 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, the first two individuals of each species collected will be preserved in 10% formalin and returned to ERL-N for verification of identification.

16.10 Contingency Plans

Considering the wide variety of environments to be sampled by EMAP, it is likely that towing a net will be impossible at some stations. If, due to repeated snags, a successful trawl cannot be performed within 2 hours of starting, no further attempts should be made. This is noted on the data sheet and the FC notified as soon as possible.

16.11 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.

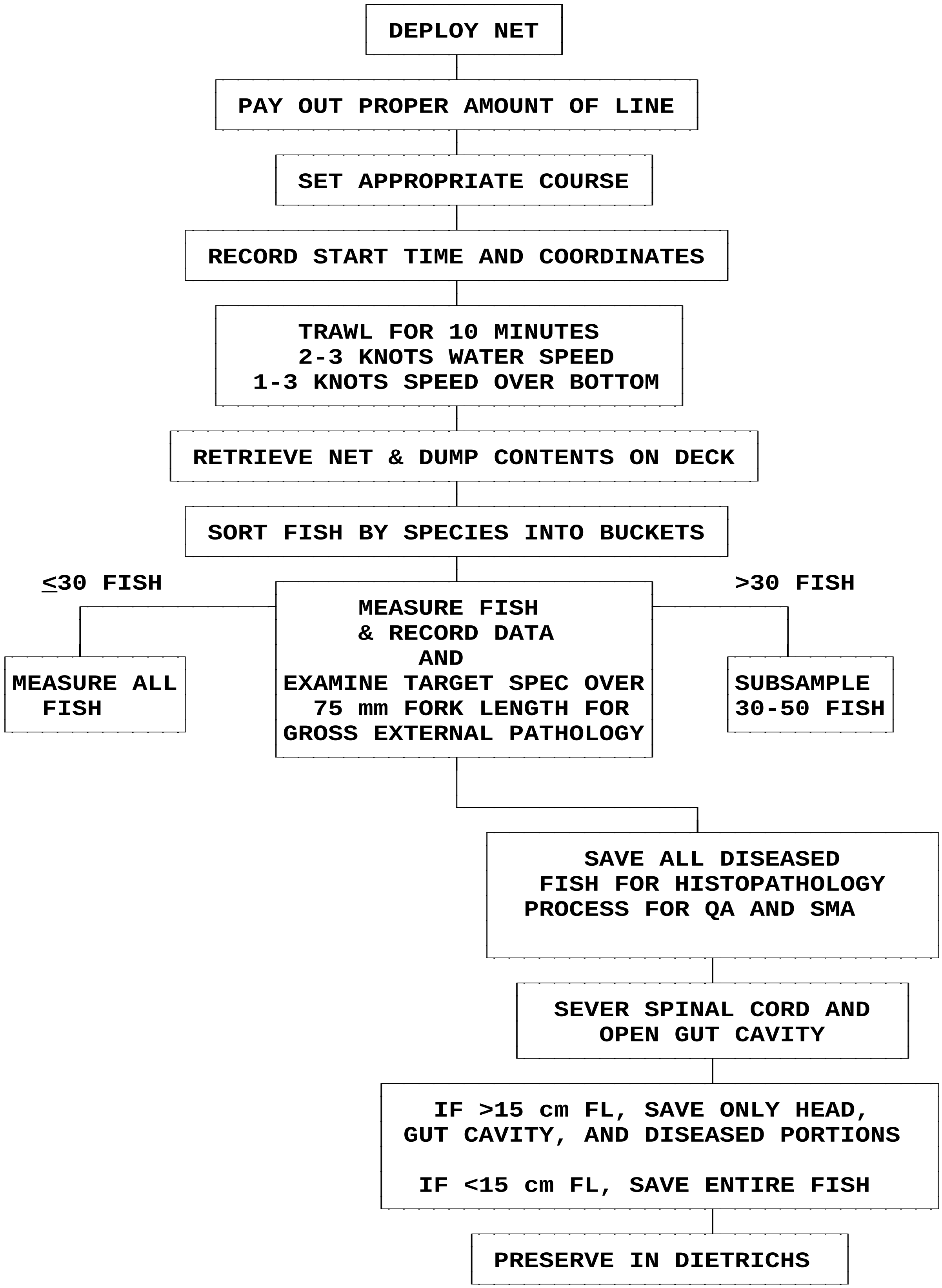


Figure 16.1 FISH COLLECTIONS - Repeat for pathology QA and SMA for up to 2 hours.

SECTION 17
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 within several days of sample collection by the crew member in the mobile laboratory. He/she is responsible for assuring that the samples are delivered to Federal Express.

At the time of collection the lids of all sample bottles should be tightened and then sealed with electrical or sealing tape. 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 not to interfere with the Federal Express tracking system (which also uses bar codes). In addition to the Federal Express waybill, a mailing label should also be affixed to the box as an additional precaution against loss. A computer printout of the shipment number and all enclosed sample numbers should be included in a packing slip envelope affixed to the inside of the top flap of the box, or the top of the styrofoam packing box. The computer generated shipment data sheet should also be sent to the Field Operations Center along with the next shipment of data sheets and diskettes. Shipping information for field data sheets and diskettes should be filled out by hand on a separate shipment data sheet. Samples that are "hand-carried" require the same paperwork (less the airbill) and tracking as those shipped by commercial carrier.

17.1 Proper Packaging Methods

Proper packaging of samples is critical in assuring they arrive at the receiving laboratory in good condition. Improper packaging can result in damaged or lost samples. This is costly in terms of time and money. There are several important aspects of proper packaging: assembly of the shipping box, the amount of blue or dry ice needed, and proper packaging of the contents.

Each team is supplied with several sizes of insulated shipping boxes, which must be assembled in the field. Proper assembly is critical in assuring proper insulation. Several sizes of styrofoam are included for the top, sides, and bottom. As a tight fit is necessary, ONLY THE APPROPRIATE PIECES SHOULD BE USED. THERE SHOULD BE NO NEED TO CUT DOWN PIECES OF STYROFOAM

INSULATION. First, the bottom should be placed INSIDE the plastic bag, and then into the box. The sides should then be inserted, assuring the proper pieces of styrofoam are used. When completed, the correct order of materials from the inside out should be the styrofoam (again the pieces should **FIT TIGHTLY**), the plastic bag, then the cardboard box. It is important that the plastic bag be BETWEEN the styrofoam and the cardboard. Coolers are also supplied to the crews for shipping sediment toxicity and grainsize.

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 under the dry ice. Since chlorophyll is the only sample type that needs to be shipped on dry ice, amounts of 20 pounds (or less) of dry ice will be used. A general rule of thumb is atleast 5-10 pounds, with another pound for every pound of sample (ASSUMING THE SAMPLES ARE ALREADY FROZEN). The amount of blue ice needed to keep samples cool is approximately one pound per pound of sample. This should guarantee samples arrive frozen or cool (depending on the ice type) even if the shipment is delayed a day. Each mobile lab is supplied with a shipping scale to facilitate estimating the quantity of ice required. During storage on the boat and in the mobile lab, all chilled samples should be stored on wet ice rather than blue ice. Blue ice should be used only for shipping. Frozen samples should always be stored on dry ice.

In addition, it is recommended that the sample be sandwiched between refrigerant, i.e. dry ice should be packed both above and below the sample. **It is also important that the box contain a minimum of air space.** Therefore, packing material should be inserted above the top ice layer to fill the box.

A third consideration for all sample types (not just cooled or frozen samples) is proper packaging within the shipping box. During the Demonstration Project several shipments arrived broken due to improper packaging. While packing a shipment box, one should assume that the box will be improperly handled. All samples should be protected and sufficient packing material included to eliminate any possible movement of the samples within the box. All material that could possibly leak, such as water or sediment samples, should be sealed with sealing tape and packaged in zip lock bags. All glass sample bottles should be bubble wrapped and sealed in a zip lock bag. Grain size whirl packs should also be placed in a zip lock bag by station.

Proper storage and shipment conditions are summarized in Table 17.1. Federal Express requires a Dangerous Materials waybill for all shipments of formalin. Federal Express requires a class 9 placard, UN number, packing description and a emergency phone number for all shipments of formalin and dry ice.

Table 17.1.   Sample holding and shipping conditions

SAMPLE TYPE	HOLDING CONDITIONS	SHIPPING CONDITIONS
SEDIMENT BIOTA	PRESERVED IN FORMALIN	SHIP AT LEAST ONCE DURING SHIFT
SEDIMENT GRAIN SIZE	REFRIGERATED	* SHIP TWICE WEEKLY
SEDIMENT ORGANICS	REFRIGERATED	* SHIP TWICE WEEKLY
SEDIMENT METALS	REFRIGERATED	* SHIP TWICE WEEKLY
SEDIMENT AVS	REFRIGERATED	* SHIP TWICE WEEKLY
SEDIMENT TOXICITY	REFRIGERATED	* SHIP TWICE WEEKLY
SUSPENDED SOLIDS	REFRIGERATED	* SHIP TWICE WEEKLY
CHLOROPHYLL FILTER	FROZEN ON DRY ICE	SHIP AT LEAST ONCE DURING SHIFT
FISH PATHOLOGY	PRESERVED IN DIETRICHS	SHIP AT LEAST ONCE DURING SHIFT
FISH TAXONOMY QA	PRESERVED IN FORMALIN	SHIP AT LEAST ONCE DURING SHIFT

* Crews should attempt to ship as frequently as logistically possible. Samples MUST be shipped at least twice during a six-day shift.

17.2 Benthic Species Composition and Biomass Samples

Samples for benthic community analyses are preserved in formalin in the field. These samples are in plastic containers with tight fitting screw-top lids. As these samples are preserved, there is no need to keep them cool. These samples need not be shipped daily, however, they must be shipped at least once during a shift, preferably on the last day. These boxes should not weigh more than 50 pounds. The lid of each jar should be checked to assure that it is tight, and the lid taped with sealing tape. The bar code label of each container is then read and the samples placed in an insulated shipping box. The insulation 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. Be sure to pack all bottles upright, and to fill gaps with packing material. Benthic biology samples should be shipped Federal Express Standard Overnight. Overnight delivery is not required. Samples should be shipped to:

EMAP Sample Processing
Versar, Inc.
9200 Rumsey Road
Columbia, MD 21045
(301) 964-9200
Attention: 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. See the instructions for shipping Formaldehyde solution included below.

Instructions for Shipping Samples with Formaldehyde Solution:

Benthic Biology Samples, Pathology Samples, Taxon QA Samples

A. Dangerous Goods Waybill - See Example

Top Half of Waybill

1. Sender's Section: Fill in the Date and Your Name, confirm the sender's account number (0029-0901-4), the URI address, phone number and internal billing reference number (5-30875)

2. Confirm the recipient's shipping address and phone number

3. Payment Section: Confirm that Bill Sender Box (#1) is checked

4. Services Section: Check Standard Overnight Box, leave Freight Service and Instructions sections blank
Delivery and Special Handling Section: Check Dangerous Goods Box, Check Deliver Weekday, Fill in the weight of each package and the total number of packages and total weight of the shipment

Bottom Half of Waybill

1. Shipper's Certification: Check the IATA/ICAO Box

2. Proper Shipping Name: Formaldehyde Solution

3. Class or Division: 8

4. UN or ID No.: UN-2209

5. Subsidiary Risk: Leave Blank

6. Quantity and Type of Packing:
   (1) Fiberboard Box x ______ liters of Formaldehyde
   (1) Fiberboard Box x ______ liters of Formaldehyde
   (NOTE: Each liter sample jar contains approximately 0.1 liters of formaldehyde solution; therefore, if you are shipping 20 sample jars in two shipping boxes: one box containing 12 sample jars and the other containing 8 sample jars, you should fill in this section as follows:
   (1) Fiberboard Box x 1.2 liters of Formaldehyde soln.
   (1) Fiberboard Box x 0.8 Kg of Formaldehyde soln.

7. Packing Inst: (for up to 5 liters) : 818 III

8. Authorization: Leave Blank

9. Additional handling Information: Leave blank

10. Transport details: Cross out Cargo Aircraft Only

11. Shipment Type: Cross out Radioactive

12. Declaration: Fill in: Your Name and Title, Place and Date of shipment, Emergency Telephone Number (1-800-732-2305), and Your Signature

B. Proper Labeling of Shipping Boxes containing Samples with Formaldehyde Solution:

Benthic Biology Samples, Pathology Samples, Taxon QA Samples

1. Mark (or use labels) on all 4 sides and top of box: <u>THIS SIDE UP ↑</u>

2. Stick Number **8** placard label so that clearly visible on side of box

3. Mark the following on at least two opposing sides of box:

   Formaldehyde Solution

   UN 2209

   Emergency phone:

   1 (800) 732-2305

4. Be sure that each box has an Address Label with the URI address.

5. Be sure that each box has an Address Label with the correct address of the receiving facility.

For Benthic Biology:

EMAP Sample Processing
Versar, Inc.
9200 Rumsey Road
Columbia, MD 21045

Attention: Lisa Scott
(410) 964-9200

For Pathology:

EMAP Sample Processing
U.S. EPA ERL-N
27 Tarzwell Drive
Narragansett, RI 02882
Attention: George Gardner
(401) 782-3000

For Taxon QA:

EMAP Sample Processing
U.S. EPA ERL-N
27 Tarzwell Drive
Narragansett RI, 02882
Attention Sue Cielinski
(401) 782-3000

17.3 Sediment Chemistry and AVS Samples

Following collection, sediment samples for organics and metals chemical characterization should be refrigerated rather than frozen 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 as soon as possible, preferably on the day following collection. Weekend samples can be stored until the following Monday, providing they are properly stored. Sample bottles should be wrapped in bubble wrap to protect them from breakage, and sealed in a plastic zip lock bag. They should then be placed in an insulated box with an appropriate amount of blue ice. Chemistry "blanks" should be treated in the same manner.

Sediment AVS samples should be refrigerated immediately and shipped as soon as possible. Weekend samples can be stored until the following Monday, providing they are properly stored. Sample bottles should be packaged in zip lock bags and placed in an insulated box with an appropriate amount of blue ice. These samples should be well chilled at the time of shipping.

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

EMAP Sample Processing
U.S. EPA Research Containment Facility
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7286
ATTN: Nate Malof

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

EMAP Sample Processing

U.S. EPA Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Rich Pruell

17.4 Sediment Toxicity Samples

Sediment samples collected for sediment toxicity testing must be kept refrigerated (4°C), NOT FROZEN. Sample should be shipped at least twice per shift. Samples collected on weekends can be shipped on the following Monday, providing they are properly stored in the mobile lab. Containers are then placed upright, along with an appropriate amount of blue ice, in an insulated box.

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

EMAP Sample Processing

SAIC Environmental Testing Center
165 Dean Knauss Drive
Narragansett, RI 02882
(401) 782-1900
ATTN: Cornelia Mueller

17.5 Total Suspended Solids Samples

Total 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, the samples packaged in plastic zip lock bags and placed in a small, insulated box along with blue ice and shipped Federal Express Next Day Service to:

EMAP Sample Processing

Marine Ecosystem Research Laboratory
Graduate School of Oceanography
South Ferry Road
Narragansett, RI 02882-1197
(401) 792-6132
ATTN: Steve Kelly

17.6 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. These samples are contained in Whirl Packs and sealed with metal wraps. Tape should be placed around the ends of these wraps at the time of collection to prevent the metal tips from piercing one of the other bags. At a minimum, they should be shipped twice during a six-day shift. Whirl Packs should be placed in a ziplock bag and packed into an insulated box or cooler with an appropriate amount of frozen blue ice to keep the samples cool (place a thin layer of paper between the blue ice and the Whirl Packs to keep them 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

U.S. EPA Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Darryl Keith

17.7 Chlorophyll Samples

Water samples for chlorophyll must be filtered with in 12 hours of collection. Filters should be thoroughly dried, folded in aluminum foil, and sealed in a whirl pack and placed so that they are surrounded in dry ice. Samples should be shipped weekly (monday through thursday) on dry ice.

Instructions for Shipping with Dry Ice:

A. Use Regular Airbill - See Example

1. Sender's Section: Fill in the Date and Your Name, confirm the sender's account number (1069-6983-3), the SAIC address, phone number and internal billing reference number (01-0348-23-4204-50)

2. Confirm the recipient's name, shipping address and phone number

3. Payment Section: Confirm that Bill Sender Box (#1) is checked

4. Services Section: Check Priority Overnight Box /your packaging, leave Freight Service and Instructions sections blank
Delivery and Special Handling Section: Check Dry Ice Box and Fill in the total weight of dry ice for the shipment.

Some where on the airbill (possibly in box #3) you need to print the following:

Dry ice, 9, UN 1845, ___box X ___ Kg , 904 III
Dangerous goods - Shipper's declaration not required

Note: print the weight of the dry ice in Kg, not the box!

B. Proper Labeling of Shipping Boxes containing Dry Ice

1. Stick Number **9** placard label so that clearly visible on side of box

2. On the same side of the box the following information must be printed:

   Dry ice, 9, UN 1845, ___box X ___ Kg , 904 III
   Dangerous goods - Shipper's declaration not required

   Note: print the weight of the dry ice in Kg, not the box!

3. Be sure that each box has an Address Label with the FOC address.

4. Be sure that each box has an Address Label with the correct address of the receiving facility.

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

Marine Ecosystem Research Laboratory
Graduate School of Oceanography
South Ferry Road
Narragansett, RI 02882-1197
(401) 792-6132
ATTN: Steve Kelly

17.6 Fish Pathology, SMA and Pathology QA Samples

Fish samples retained for pathological and histopathological examination are kept preserved in Dietrich's fixative. It is therefore not necessary to ship fish samples daily, however, tissues do deteriorate in the fixative. Therefore, fish histopathology samples must be shipped AT LEAST WEEKLY, preferably on the last day of the crew's shift.

Fish for histopathological examination are wrapped in cheese cloth saturated in Dietrich's fixative, and placed in a zip-lock bag. Bags should be checked to assure a proper seal, to prevent leakage. Details can be found in Section 16. Fish are placed in an insulated box (the insulation is for protection, not thermal regulation), and shipped Federal Express, Standard Second Day Service to:

EMAP Sample Processing

U.S. EPA Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: George Gardner

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 shipment also requires a class 9 placard and an emergency phone number to be placed on the side of the box. Use the same shipping instructions outlined for the Benthic Biology Samples above.

17.7 Fish QA Samples

Fish samples retained for taxonomic verification are kept preserved in 10% formalin. It is therefore not necessary to ship fish samples daily, however, tissues do deteriorate in the fixative. Therefore, samples must be shipped AT LEAST WEEKLY, preferably on the last day of the crews shift.

Fish are wrapped in cheese cloth saturated in 10% formalin, and placed in a zip-lock bag. Bags should be checked to assure a proper seal, to prevent leakage. Fish are placed in an insulated box (the insulation is for protection, not thermal regulation), and shipped Federal Express. Use the same shipping instructions outlined for the Benthic Biology Samples above.

Samples are shipped to:

EMAP Sample Processing

U.S. EPA Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Charlie Strobel

17.8 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. Since modem communications frequently are not possible, diskettes must be shipped to the FOC daily.

All diskettes are placed in diskette mailers, and then into Fed Ex letter envelopes, and the envelope delivered to Fed Ex. The outside of the envelope should be clearly marked **COMPUTER DISKETTES - DO NOT BEND, X-RAY, OR EXPOSE TO MAGNETIC FIELDS**.

Data sheets should be xerox copied and shipped at least once a week. **NO DATA SHEETS SHOULD EVER BE SHIPPED WITHOUT BEING COPIED FIRST!**

Diskettes and Data Sheets are shipped to:

EMAP Field Operations Center

U.S. EPA Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000

ATTN: Elise Petrocelli

SECTION 18
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 or Pilot 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.

18.1 Adverse Weather Conditions

It is the responsibility of the Crew Chief or Pilot 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/PILOTS'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.

Because of the sampling schedule, careful planning by the Crew Chief/Pilot is critical. Predictions of inclement weather may necessitate a schedule change for a particular window. Likewise, visits to stations may be delayed because of weather. The manner in which sampling occurs during a window is up to the discretion of the Chief Scientist, leaving several possible avenues for dealing with poor weather.

18.2 Station Inaccessibility

Stations can be inaccessible for a number of reasons: they were incorrectly positioned on land or in water too shallow for the boat or they 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 A) cannot be relocated by the field crew. If the site is deemed unsamplable, the FC should be notified and the crew should move on to the next station.

2. Any inaccessible "Tidal River" station (see Appendix A) 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. The new coordinates must be recorded and the FC notified as soon as possible. If the station cannot be relocated, the FC should be notified and will advise the crew as to what to do.

3. Inaccessible stations located in "Small Estuaries" (see Appendix A) can be relocated by the Chief Scientist. 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 station can be relocated anywhere within the system, provided the location is representative of the conditions in that system (i.e. not near the end of an outfall pipe). If the station is successfully relocated, the new coordinates should be recorded, a note made in the computer log, and the FC notified.

18.3 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 the boat's engine fails while the crew is on the water, an attempt should be made to repair the engine. As soon as the engine fails, the FC must be notified IMMEDIATELY. Arrangements will be made to transport a spare engine 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 19
MAINTENANCE

The importance of proper maintenance of all gear cannot be over emphasized. Failure of any piece of major equipment 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.

Crew Chiefs and Pilots are required to maintain a maintenance log. At the end of every shift they will report boat engine hours, truck mileage and maintenance performed on the vehicles and equipment to the FC.

19.1 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. A wiring harness has been installed on each computer to eliminate the need to use the DB-9 connectors on the back of the computer. All serial connections should be made through the wiring harness. The computer should always be protected from salt water, and the keyboard skin MUST always be in-place.

19.2 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.

19.4 Boats, Motors and Vehicles

Maintenance schedules are described below:

SECTION 20
QUALITY ASSURANCE

EMAP-VP field crews are responsible for collecting a wide variety of data and samples to be used in the fulfillment of the Program's objectives. To meet these objectives, the Program's assessments of ecosystem health must be based on scientifically sound interpretations of the data collected. This, in turn, can only be accomplished if all participants strictly adhere to prescribed methods and quality assurance concerns. Since the field crews are the nodes from which all analyses begin, it is critical that field personnel pay close attention to the methods and concerns outlined in this document.

20.1 Data Quality Objectives

To achieve the goals of EMAP, and as required by EPA for all monitoring and measurement programs, objectives must be established for data quality based on the proposed uses of the data (Stanley and Verner, 1985). Data Quality Objectives (DQOs) are described in detail in the Quality Assurance Project Plan (Valente et al., 1992) and will only be briefly discussed here. DQOs are generally established for five aspects of data quality: representativeness, completeness, comparability, accuracy, and precision. It is important to note that the actions taken by field personnel can affect all five aspects of data quality.

20.1.1 Representativeness

Representativeness is defined as "the degree to which the data accurately and precisely represent a characteristic of a population parameter, variation of a property, a process characteristic, or an operational condition" (Stanley and Verner, 1985). Representativeness, as it applies to field operations, can be categorized into two tiers: the representativeness of a station relative to the system or cell within which it is located, and the representativeness of samples or data collected relative to that site.

Station location and the overall design were formulated to assure that the samples collected were representative of the conditions within the province. Because of the importance of design, crews must accurately locate stations and assure that appropriate steps are taken to relocate a station when it is inaccessible. Once a station is properly located, crews must take all precautions to assure that the samples and data collected are representative of conditions at that station. For example, a sediment chemistry sample contaminated by exhaust from the Briggs and Stratton engine is no longer representative of the sediments at that site.

20.1.2 Completeness

Completeness is defined as "a measure of the amount of data collected from a measurement process compared to the amount that was expected to be obtained under the conditions of measurement" (Stanley and Verner, 1985). In designing the sampling program the minimum number of sample points required for an assessment of the status and for the determination trends within the province was balanced against costs. As a result, a completeness goal of 90% was established. This means that 90% of the expected data MUST be collected to make a meaningful assessment.

20.1.3 Comparability

Comparability is defined as "the confidence with which one data set can be compared to another" (Stanley and Verner, 1985). The extensive documentation of methods found in EMAP manuals reflects the importance of comparability. The manner in which data and samples are collected directly impacts their comparability with EMAP data collected in other provinces, therefore, field crews must pay careful attention to following the methods described in this manual.

20.1.4 Accuracy and precision

Accuracy is defined as the difference between a measured value and the true or expected value and represents an estimate of systematic error or net bias. Precision is defined as the degree of mutual agreement among individuals measurements and represents an estimate of random error. Collectively these two aspects provide an estimate of the total error or uncertainty associated with individual measurements. In the context of many of the measurements made, accuracy cannot be defined because expected or true values do not exist. Once again, careful attention to the details of the sampling methods should provide accurate, precise data.

20.2 Quality Assurance Procedures

The EMAP-VP QA/QC program includes procedures that must be followed for virtually every aspect of data and sample collection and analysis. Those pertinent to field operations are outlined below. Each crew will be required to demonstrate proficiency in all aspects of field operations prior to the start of the data collection phase. This will consist of an examination at the end of training and field audits during dry runs. In addition, the QA Coordinator or Field Coordinator will visit each crew at least once during field operations. All components of sampling will be evaluated during visits.

0.2.1 Station Location

Despite the sophisticated electronic navigation instruments available on-board the EMAP vessels, crews must still take great care in locating stations. The most important step in assuring accuracy is the calibration of the computer system as described in Section 11. Calibrations must be done carefully, making sure that the known coordinates at the calibration location are correct, and that the calibration location is as close to the station as possible. Calibration factors are valid only for relatively short distances. Using properly calibrated Loran, the geodetic accuracy of the computer navigation system should be less than 50 meters.

A navigation log datasheet must be completed for each station. Included is information on both the station and the calibration site. Locational information from all instruments, as well as ranges and bearings, must be recorded on this data sheet. For consistency, all bearings (taken using a hand-held compass) should be obtained with the crew member standing on the aluminum deck plate. This datasheet should be returned to the FOC with all other datasheets, and will be used by the data management staff as a reference in case any station location is called into question.

When locating a station, the crew should attempt to drop the anchor as close to the expected station location as possible (*i.e.* $\pm$ 1 second). However, even more important than reaching the exact locations expected is being able to accurately report where we did sample.

Because some of the station types cannot be moved, and those that can be must be moved according to strict guidelines, an automated check of station location will be instituted by the ERL-N VAX computer as soon as data are uploaded. If the location of a station is questionable, a flag will be raised and the QA Coordinator notified the following morning.

During the field audits the QA Coordinator will check each crew's navigation procedures to assure that they comply with those mandated by the Program.

20.2.2 Dissolved Oxygen

Determination of dissolved oxygen levels is one of the most critical measurements being made on the boat. The primary devices for obtaining these data are the SeaBird CTD and the YSI D.O. meter. Great care must be paid to the methodologies described in this manual to assure accurate measurements. It is especially important that the CTD not be allowed to hit the bottom during descent. Past experience with this unit has revealed that impacting the bottom may result in sediment being pulled up into the pumping system, thereby clogging it and producing erroneous results. Another concern is making sure that no air bubbles are trapped in the oxygen sensor. Bubbles in the sensor will result in an irregular profile.

Dissolved oxygen and pH sensors on the CTD are calibrated under controlled laboratory conditions by trained technicians following the procedures described in the SeaBird manual. Calibrations are conducted prior to the field sampling and as needed throughout the field season. The dissolved oxygen and pH sensors are checked for accuracy using Winkler titrations and pH standards, respectively, and fluorescence offsets are determined by comparison with a laboratory fluorometer using single-species algal cultures of known concentrations. Temperature, conductivity, light transmission, and photosynthetically active radiation sensors are calibrated by the manufacturer.

Because of the controlled conditions required for calibration of this instrument, this activity cannot be performed in the field by the crews. Crews are required to perform QC checks of the instrument. If a CTD fails a check it should be returned to the FOC for recalibration.

The proper field QA protocols for dissolved oxygen are listed below:

1. A QC check on the CTD must be performed once during each crew's shift. The unit is hung over the side of the boat and the readings are compared with those from a calibrated YSI meter for dissolved oxygen, thermometer for temperature, and refractometer for salinity. Back on the boat the pH probe is immersed in a pH 10 solution and the instrument reading recorded. The maximum acceptable differences between the CTD and reference measurements are 2 °C temperature, 3 ppt salinity, 0.5 mg/l dissolved oxygen, and 0.5 pH units. Exceedence of any of these tolerances should result in re-testing, and, if the unit still fails, it should be returned to the FOC for recalibration.

2. Once per shift (when the CTD is calibrated), a check on the YSI air calibration method is required. A bucket of seawater should be obtained and aerated for AT LEAST 2 HOURS. This should bring the water to saturation. The D.O. concentration (at full saturation) should be obtained from the saturation table provided. The YSI should then be air calibrated according to the manufacturers instructions, and the D.O. of the saturated water determined by the instrument. In addition, three (3) samples for Winkler titration must be taken from the bucket and titrated according to the instructions in Appendix D. Titrate 2 samples and if they are significantly different, titrate the third. All

values (table, Winkler, YSI) should agree to within 0.3 mg/l. Exceedence should result in repeating all steps a second time. If, after a second attempt, the YSI meter is still off by ≥ 0.3 mg/l, arrangements should be made for its replacement. If the difference is greater than 0.5 mg/l, the meter should not be used, and it should be returned to the FOC for repair.

NOTE: It is important to note that the chemicals used for the Hach titrations are sensitive. Cartridges of sodium thiosulfate, which is a light sensitive solution, must be kept in the dark when not in use. The standard solution of iodate-iodide used to check the accuracy of the hach titrations is subject to evaporation and heat. The solution should be kept in a dark container and as close to room temperature as possible.

3. Proper procedures must be followed when obtaining a Winkler sample. This includes inserting the siphon tube at least 2/3 of the way down into the BOD bottle and allowing three volumes of water to overflow. Because of the small volumes of titrant (sodium thiosulfate) used by the Hach method, it is critical that the person performing the titration be very careful during all steps. "Sloppy" titration of the sample will most likely produce results outside of the acceptable range. Because the concentration of the titrant may vary between cartridges, and each titrator may deliver slightly different amounts per "click", an "F factor" must be determined prior to each set of titrations.

4. Immediately prior to use at each station, the YSI meter is "air calibrated" according to the manufacturers instructions.

5. Proper procedures must be followed when obtaining a cast. This includes obtaining proper surface and bottom measurements using the YSI meter. If either the surface or bottom measurements from the two instruments differ by ≥ 0.5 mg/l, the cast should be repeated (including recalibration of the YSI). If they consistently differ by ≥ 0.3 mg/l, the FOC should be notified and a replacement CTD will be shipped to the crew. Temperature and salinity must also be checked with a thermometer and refractometer respectively, and any differences must fall within the tolerances listed in "1" above.

6. All necessary maintenance requirements must be adhered to. This includes proper replacement of the membrane on the YSI probe and allowing the membrane to relax prior to calibration.

20.2.3 Benthic Biology

Field crews are responsible for obtaining acceptable grab samples, sieving them on-board, and preserving the material retained on the sieve. First, they must be assure that all grabs processed are indeed acceptable according to the criteria described in Section 13. Second, they must make sure that no organisms are lost during any step, including transferring the sample to the sieve, and during sieving. Third, samples must be properly identified and preserved to assure they are received by the processing laboratory in acceptable condition.

20.2.4 Grain Size

Samples collected for grain size analysis require no special QA steps other than carefully following the directions in Section 15 and assuring proper storage.

20.2.5 Sediment Chemistry

Great care must be exercised when processing sediment samples collected for chemical analysis. Contamination of these samples can result in erroneous data, which can compromise the Program's ability to detect trends in the level of sediment contamination. The following steps MUST be taken to avoid contamination of the sample:

1. ALL utensils, bowls, grabs, etc. that come in contact with the sample must be washed with alconox prior to the collection of the first grab. Once washed, crews must take precautions to assure that they do not become contaminated (*e.g*. by laying the stainless steel spoon on the deck).

2. Only those utensils provided or approved should contact the sediments. Therefore, if additional mixing spoons are required they should NOT be obtained at the local supermarket.

3. As soon as any of the stainless spoons or bowls begin to rust they should be discarded.

4. Both the Briggs and Stratton and the outboard engines should be turned OFF whenever the sample is exposed to the air. Their exhausts carry high levels of contaminants which can be deposited on the sample. Sample collection onboard larger vessels will be particularly sucecptable to "fall out" from the exhaust stacks. Care should be taken to keep the stacks down wind of the sampling deck. In addition, a plastic tarp should be used to cover every

grab while remaining on deck (before and after sample extrusion).

5. Exposure of the sample to the atmosphere should be minimized. Whenever possible the sample should be covered because contamination from the atmosphere, even without the engines running, can be significant.

6. Rain water should not be allowed to contaminate the sample.

7. Excess seawater should be carefully drained from the surface of the grab by "cracking" the sampler slightly.

8. All grabs used in the composite must meet the criteria for an acceptable grab. It is especially important to make sure that the surface sediments did not wash out of the sampler.

9. Crews should be careful in removing the surficial layer, keeping as close to the two centimeter (2 cm) mark as possible.

10. Replicates and blanks should be collected as directed. Blanks consist of leaving an empty chemistry jar open to the atmosphere whenever the sample is exposed to the air.

11. Because of the potential for contamination, the chemistry samples should be the first ones removed from the homogenate.

12. Samples should be placed in a cooler on ice as soon as they are collected and recorded.

13. If the vessel is unable to anchor the position relative to station should be monitored carefully during benthic collection. A fix should be collected for every grab by the Navigation system at the operator's request.

20.2.6 AVS (Acid Volatile Sulfides)

The concentration of AVS in sediments is affected by the oxidation state of those sediments. Therefore, it is important that sediments retained for analysis of AVS be kept as close to nominal conditions as possible. This means minimizing the aeration of those sediments. Cores should be removed from each chemistry grab as soon as the grab is determined to be acceptable, placed in the appropriate container, and placed on ice. Fill to the top of the threads and chill as soon as possible. Because the AVS core is taken from grabs to be used in the chemistry homogenate, contamination of the grab sample is a concern. Therefore, a new, clean core must be used for each station (the same core can be used for each grab within a station). As with all chemistry utensils, great care must be taken to assure that the core does not become contaminated between grabs.

20.2.7 Sediment Toxicity

Since sediment toxicity samples are collected from the same homogenate used for sediment chemistry, the steps outlined above should be followed. In addition, because of the possibility of failure of a toxicity test, it is important that a full 3 ℓ of sediment be collected for analysis at each station. This will provide a sufficient volume of sediment for re-testing if necessary.

20.2.8 Fish Community Structure

All fish collected during field operations will be identified and measured. Only those crew members skilled in fish taxonomy should be responsible for the identification of species. The quality of identifications will be assured through rigorous training and testing prior to the start of field operations. Each crew must contain at least one member who possesses taxonomic expertise who will have the final say on all field identifications. As a check on the crew's ability to accurately identify fish, the first two individuals of each species collected by each crew will be preserved and shipped to ERL-N for verification by a qualified fish taxonomist. Erroneous identifications will be brought to the crew's attention prior to their next duty cycle.

Length measurements should be made as carefully as possible, with the crew chief periodically re-measuring some fish. During field QA audits the auditor will check the accuracy of measurements. All measurements should agree to within $\pm$ 5 mm.

20.2.9 Fish Pathology

The percent fish exhibiting signs of gross external pathology will be determined from field observations. As a check on each crew's ability to identify pathologies, any fish identified as having an external pathology will be sent to ERL-N for confirmation by an expert. In addition to these fish, all crews are required to preserve and ship SMA (spleen macrophage aggregate) and pathology QA fish which will be collected at selected stations. All of these fish will be examined by a qualified pathologist to determine the rate of "false negatives" (number of pathologies missed by the field crews).

Because the number of fish exhibiting external pathologies is expected to be small, and only a limited number of "QA" fish will be collected, it is critical that the crew be extremely diligent in their examinations. Fish pathology has proven to be an important indictor, but unfortunately it is one that is difficult to quality assure.

As with all other indicators, the crew's performance will be checked during QA audits.

20.2.10 Data Entry

Needless to say, proper recording is critical in assuring data of the quality required for the EMAP assessment. A sophisticated field computer system has been designed to assist in assuring that all data received by the data management team are correct, however, for this system to work properly it is important that crew members be very careful in their entry of information.

The final back-up against which all computer data sets will be compared is the data sheets. Crew members must make sure that all data sheets are **correctly, completely, and LEGIBLY filled out**. If the information on the data sheet is incorrect the final data used will also be incorrect. All data are transcribed from the data sheets into the field computer by a member of the crew and then checked by that crew member. Following entry and this first level check, IT IS THE RESPONSIBILITY OF THE CREW CHIEF OR THE CHIEF SCIENTIST TO REVIEW THE DATA AND ISSUE HIS/HER ASSURANCE THAT IT IS 100% CORRECT. Once the crew chief/chief scientist has "signed off" on a dataset it will be "locked" to prevent further editing by any crew member and uploaded to the ERL-N VAX. Once at the FOC, a number of automatic range checks will be performed, followed by a manual check (comparison with the datasheet).

In designing the 1992 computer system, ease of editing was a primary concern. This significantly reduced the number of data errors last year, and we are hopeful of an even lower rate of data errors this year.

SECTION 21
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 consists of two categories: written data sheets and electronic data.

Experience gained during the 1990 Demonstration Project and 1991 and 1992 sampling seasons demonstrated that the field computers were capable of withstanding the rigors of boat operations. In 1993 the use of the computer system is again MANDATORY. ALL DATA RETURNING TO THE FOC WILL BE IN ELECTRONIC FORMAT AND QUALITY ASSURED BY THE CHIEF SCIENTIST. However, as an added precaution, data will continue to be entered onto data sheets as well as into the computer (example data sheets can be found in Appendix G). In general all data except for the fish indicators will be entered directly into the on-board computer while on-station. The use of bar code readers will facilitate the entry of sample numbers and eliminate transcription errors. Because of the complexity, fish indicator information will be recorded on data sheets and entered into the computer in the mobile laboratory.

Although it is mandatory that all data be transmitted electronically to the FOC, the Chief Scientist has the option of using the boat computer system only for navigation, and entering ALL data into the mobile lab computer upon returning to the dock. If this option is exercised, IT IS HIS/HER RESPONSIBILITY TO ASSURE THE DATA SENT TO THE FOC IS ERROR FREE, i.e. no transcription errors were made. The on-board computer system, along with the bar code readers, have been provided as tools to assist the field crews in providing high quality electronic data. In other words, the use of the on-board computer system and bar code readers is highly recommended, and it is felt that the use of this system will be a considerable time-savings to the crews. Use of the navigation component for determining location remains mandatory.

It is the responsibility of the Chief Scientist to guarantee the quality of the data shipped to the FOC. At the end of each day it is his/her responsibility to review the data collected that day and "sign-off" on it.

All samples collected for the EMAP program must be tracked from their collection to the receipt of analytical results from laboratories. In order to accomplish the tracking of all samples collected, each sample will be assigned a unique identification number (SAMPLEID) composed of an event number followed by a sample number.

21.1 Sample Tracking Procedures

A variety of water, water quality, sediment, and biological samples are collected during the EMAP-Near Coastal Virginian Province sampling effort. These include physical samples (i.e., sediment and fish samples) and non-physical samples (i.e., fish trawl and CTD cast data). It is vital that all of these samples and data be tracked from collection to the receipt of analytical results. To accomplish this purpose, all samples collected are assigned unique sample identification numbers (SAMPLEIDs) composed of a four-digit event number (used instead of the station number to maintain blind sample analysis) and a three-digit sample number.

21.2 Event and Sample Numbers

All BSS and REP stations will be sampled once during the summer. During each station visit, a pre-determined set of samples will be collected. All of these samples will be linked by a single event number even if more than one station visit is required to collect the samples (i.e., if a fish trawl is not performed during the first station visit but the station is revisited and trawled the next day).

The same suite of samples will be collected during visits to BSS/LTT stations as are collected at BSS and REP stations. However, BSS/LTT stations will be sampled twice during the summer and a full suite of samples will be collected during each visit. Each suite of samples will be linked by a single event number; therefore, each BSS/LTT station will be associated with two event numbers.

Ranges of three-digit sample numbers have been assigned to each sample type (Table 21.1). The SAMPLEID uniquely assigned to each sample or activity will consist of an event number concatenated with one of the sample numbers in the appropriate pre-assigned range (except for SMA and PATH QA fish). Since SAMPLEIDs for physical samples will be barcoded, the entry of these IDs into electronic data sets by the field crews and receiving laboratories will be fast and accurate. Duplicate SAMPLEID barcodes will also be applied to data sheets for ease of data entry. A one- to three-letter sample type code will be imprinted on each barcode to make it easier for the field crews to identify which barcode is applied to each sample and data sheet. This sample number design will allow for the collection of extra samples (i.e., if a sample is damaged or lost) and will provide extra, pre-assigned sample numbers in case a SAMPLEID barcode is assigned to the wrong sample (a new barcode in the correct range will be placed over the incorrect barcode on the sample container and data sheet).

CTD cast SAMPLEIDs will be automatically entered by the computer system. These IDs will consist of the four-digit event number followed by "2", one digit in the range 1-9 indicating which field computer was used to download the cast, and one digit in the range 0-9 as a cast number. Although only one CTD cast is required per event, the cast number would be incremented by one for each additional cast performed and downloaded. For example, the first cast performed at event 3120 and downloaded on field computer number three would be automatically be assigned the SAMPLEID 3120230. CTD cast file names will consist of the cast SAMPLEID with the extension .HEX. If no CTD cast was performed, the SAMPLEID assigned to the water column measurements taken using the YSI meter, thermometer, and refractometer will consist of the event number followed by "200".

If there are not enough SAMPLEID barcodes for pathology, taxon QA, SMA or path QA fish, valid SAMPLEIDs must be assigned to these fish using the event number and sample numbers starting with 068 and continuing up through 199. These SAMPLEIDs must be written on the fish tags using permanent marker and also must be written on the data sheet.

Fish spleen macrophage aggregate (SMA) and pathology QA/QC (PQA) samples will be collected at two stations per crew (four stations per team, total of 12 stations). These samples are tracked using 1000 barcoded SAMPLEIDs (500 IDs per sample type) within a dummy event: 3200. The SMA fish will be assigned SAMPLEIDs 3200000-3200499, while PQA fish will be assigned SAMPLEIDs 3200500-3200999. The barcodes for these SAMPLEIDs will be divided three ways and distributed to the field teams in separate envelopes (about 165 barcodes for each sample type per team). These envelopes will also contain data sheets for recording fish data for non-standard trawls. The barcodes given to a team will be used for all four stations sampled by that team for these fish, regardless of crew number or fish species. This is not blind sample numbering scheme; all fish sent to the laboratory will be identified as PATH/TQA, SMA, or PATHQA.

Sediment QA/QC samples will be collected at one station per crew (total of 6 stations). These stations are not pre-determined; the crews will be notified of QA/QC stations prior to a QA sampling event. Sediment QA/QC samples are tracked using a blind numbering scheme consisting of three dummy events per QA/QC station. Barcodes for these samples will be provided in separate envelopes for each crew. One duplicate of each sediment organic, AVS, and metals sample is collected per dummy event for a total of nine QA/QC samples:

> Dummy Event 1: SAMPLEIDs for the duplicate sediment organics, AVS, and metals samples end in the same three digits as the samples collected for the real event (030, 033, and 036). These samples will be shipped with the QA blank bottle to the laboratory performing the routine sediment chemistry analyses.

Dummy Events 2 and 3: Two duplicates each of the sediment organics, AVS, and metals samples (total of six samples) will be sent to the reference laboratory for analysis. These SAMPLEIDs will end in 031, 034, and 037, respectively.

Envelopes containing all data sheets and SAMPLEID barcodes necessary for sampling each station (event envelopes) will be assembled for each field team. Since the suites of samples collected at each station type and size class are the same, any event envelope may be used for any station. If SMA and PQA samples will be collected, the barcodes and data sheets provided in extra envelopes will be used in addition to the regular event envelope. Additional event number ranges have been assigned to sediment quality assurance/quality control (QA/QC) samples, fish pathology QA/QC samples, and to crew training (dry run) events (Table 2).

21.3 Data Sheet and Diskette Tracking

Data sheets and diskettes from the crews will be tracked in the field and in the field operation center (FOC). Diskettes will be assigned barcoded SAMPLEIDs in the field in the same way as other physical samples. The crews will use each diskette for two days: one day in the boat computer and one day in the mobile lab computer. The diskettes will be shipped overnight to the FOC after all data on that diskette are verified against the data sheets by the field crews. Field data sheets for each event will also be shipped overnight to the FOC once all of the data for that event have been entered and verified. Any data sheet shipped must be photocopied prior to shipping. The diskettes and data sheets will be shipped separately to ensure that if either shipment is lost the field data will still arrive at the FOC.

Table 21.1 Sample number ranges assigned to each sample type.

Sample Type and Code	Sample Number Range	Barcoded?
Diskette (DK)	000-002	Yes
Suspended Solids (SS)	003-005	Yes
Benthic Grain Size (BG)	006-014	Yes
Benthic Infauna (BI)	015-023	Yes
Sediment Toxicity (ST)	024-026	Yes
Sediment Grain Size (SG)	027-029	Yes
Sediment Organics (SO)	030-032	Yes
Sediment AVS (SA)	033-035	Yes
Sediment Metals (SM)	036-038	Yes
QC Blank Bottle (BB)	039-041	Yes
Chlorophyll a-Surface (CHS)	042-044	Yes
Chlorophyll a-Bottom (CHB)	045-047	Yes
Fish Pathology/Taxon QA (PATH/TQA)	048-067	Yes
Extra Fish Samples	068-199	No
CTD Casts	200-299	No
Standard Fish Trawl	300	No
Non-standard Fish Trawls	400	No
Sediment Organics Duplicate (SO)	030	Yes
Sediment Organics Reference 1 (SO)	031	Yes
Sediment Organics Reference 2 (SO)	031	Yes
Sediment AVS Duplicate (SA)	033	Yes
Sediment AVS Reference 1 (SA)	034	Yes
Sediment AVS Reference 2 (SA)	034	Yes
Sediment Metals Duplicate (SM)	036	Yes
Sediment Metals Reference 1 (SM)	037	Yes
Sediment Metals Reference 2 (SM)	037	Yes
Fish Spleen Macrophage Agg. (SMA)	3200000-3200499	Yes
Fish Pathology QA (PQA)	3200500-3200999	Yes

Table 21.2. Event numbers assigned for the VA93 sampling season. The number of sampling events planned for the VA93 season is 146, including second visits to the 12 BSS/LTT stations. Two "extra" event numbers have been assigned for each field team (total of six extra events). Therefore, the total number of event numbers assigned for VA93 is 152. Extra VA92 bar codes will be used for dry run events.

Station/Sample Type	Event Number Range
Chemistry Duplicates	3000-3008
BSS, BSS/LTT, and REP Stations	3009-3160
Chemistry Reference 1	3161-3169
Chemistry Reference 2	3170-3178
SMA/PQA Dummy Event	3200

SECTION 22
WASTE DISPOSAL

Proper disposal of all wastes is an important component of 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.

22.1 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.

22.2 Detergent Washes

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

22.3 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. If shipped, the container will need a dangerous goods waybill.

22.4 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 23
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 Project Manager must be notified. The Project Manager is also the appropriate person to contact regarding general Program matters, affecting operations other than just field operations.

This structure is graphically depicted in Figure 3.5, and the proper chain-of- command discussed in Section 3.4. The names and phone numbers of contact personnel are listed below.

FIELD COORDINATORS

1-(800)-732-2305 (FIELD OPERATIONS CENTER)

STEVE KELLY

(401) 544-6319	**(PAGER)**
(401) 294-4291	**(HOME)**
(401) 792-6132	**(MERL)**

PROJECT MANAGER

MR. DARRYL KEITH

(401) 782-3135	**(OFFICE)**
(401) 789-7581	(HOME)

SECTION 24
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 CTD or grab sampler is deployed, a pinger is attached to the instrument. This will assist in locating it should the gear be lost.

Whenever gear is lost, the navigation system should be used to document that position as a way point (F4), to make future recovery attempts possible.

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.

24.1 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), 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.

24.2 Recovery of a Grab Sampler

If a grab sampler is lost, attempt to recover by grappling in the area where the sampler was dropped. 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. If the gear cannot be recovered, notify the FC immediately. He will arrange for shipment of spare equipment.

24.1 Recovery of a Trawl Net

When trawling in water less than 30 feet a cod-end float should be attached to back end of the trawl with sufficient line so as to provide reasonable scope. A small, trawl size, float should be used to eliminate unnecessary drag. This float will mark the location of the gear if the trawl line has to be cut or released prematurely. The line can be used to retrieve the trawl from a snag. If the water is too deep for the cod end line, then the grapple should be used to attempt retrieval.

SECTION 25
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