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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM
NEAR COASTAL COMPONENT
1991 VIRGINIAN PROVINCE EFFORT

FIELD OPERATIONS
and
SAFETY MANUAL

by

C.J. Strobel
Science Applications International Corporation
27 Tarzwell Drive
Narragansett, Rhode Island 02882

S.C. Schimmel
United States Environmental Protection Agency
Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882

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Project Officer
Patricia Gant

Environmental Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Narragansett, Rhode Island 02882

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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 purpose of this project is to produce data to be used in the characterization of the bays and estuaries of the Virginian Province, and to evaluate logistics, indicators, sampling methods, etc. 1991 Field operations are scheduled to begin in July, 1991.

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

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

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Portions of this document were copied from other EMAP-NC documents (Holland, 1991; Schimmel, 1990; and Strobel, 1990).

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SECTION 1
INTRODUCTION

1.1 Introduction

The Environmental Monitoring and Assessment Program (EMAP) was designed to periodically assess the ecological condition and health of the Nation's ecological resources. As a regulatory agency, the U.S. Environmental Protection Agency (EPA) is charged with the mission to set environmental policy, obtain funds for research and development, and evaluate the efficacy of environmental regulations in preserving the Nation's natural resources. EMAP provides a strategy to identify and bound the extent, magnitude, and location of environmental degradation and improvement on a regional scale. As stated in the 1990 Near Coastal Program Plan (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, and near coastal waters (continental shelf, estuaries, and salt marshes). All the above goals and questions are relevant to each ecosystem, including near coastal waters.

The purpose of this document is provide detailed instructions on all field sampling methods. Two versions of this document will be available: the unabridged training version and an abbreviated version for use in the field which contains only the pertinent information needed to successfully complete sampling activities.

1.2 The Near Coastal Program

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

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

- Provide a quantitative assessment of the regional extent of coastal environmental problems by measuring pollution exposure and ecological condition,

- Measure changes in the regional extent of environmental problems for the nation's estuarine and coastal ecosystems,

- Identify and evaluate associations between the ecological condition of the nation's estuarine and coastal 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, major coastal regions like the mid-Atlantic and Gulf Coasts) and nationally.

In addition to meeting the overall goals of EMAP, the estuaries component of the Near Coastal Program (EMAP-Estuaries) is addressing specific environmental problems. The problems specifically applicable to estuarine waters are: 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-living vertebrate and invertebrate species (e.g., reduced species composition and biomass) and allow for the existence of smaller, opportunistic species that may not be as compatible with ecosystem stability or human needs.

1.2.2 Eutrophication

The process of eutrophication - the over-enrichment of water bodies with nutrients and minerals that results in an excess in primary production - can cause severe reductions in the overall stability and productivity of that water body. Symptoms of stress associated with eutrophication 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; changes in shellfish growth or survival; and reduced acreage of submerged aquatic vegetation (SAV).

1.2.3 Contamination

The problem of contamination is manifested in several ways, including: (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 the near coastal system 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-NC Virginian Province is the biogeographical region extending from Cape Cod, MA to Cape Hatteras, NC; however, the EMAP-Estuaries Virginian Province sampling effort (EMAP-VP) includes only those systems north of Cape Henry, VA. Albemarle Sound (NC) falls within the Virginian Province, but because it is a component of the larger Pamlico Sound system (which extends south of Cape Hatteras), it will be sampled as part of the Carolinian Province Program.

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 near coastal 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.

As described in the Demonstration Project Field Activities Report (Schimmel and Strobel, 1991), the DP succeeded in accomplishing these goals. The lessons learned and the data collected 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 22, 1991. An attempt will be made to complete all sampling prior to September 1, however, data generated during the Demonstration Project indicate that sampling throughout September would be acceptable. The Index Period was determined following an evaluation of the DP data. These data show the benthic organisms in Long Island Sound typically do not respond to low dissolved oxygen conditions until late in July. Several stations (LTS transects - see section 12) will be sampled during training dry runs. This will occur from July 8 to July 19, 1991. All LTS sites are located in the Chesapeake Bay where the Index Period can begin earlier. Therefore, to reduce the work load during normal sampling, these stations will be sampled early.

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 unbiased 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 to collect information concerning the Near Coastal indicators and their variability. The design will remain flexible to alternative future uses and yet is logistically reasonable and implementable.

In developing the sampling design, a list frame was used to represent the population of estuaries in the United States. This list frame was subdivided to represent all estuarine systems within the Virginian Province with a surface area greater than 1.0 square mile. The Virginian Province list frame was subdivided into three sampling sub-populations representing small estuaries and tidal rivers, large tidal rivers, and large estuaries. The EMAP-Estuaries sampling design is based on a single, annual sampling season (i.e., index period) of each of these classes. Addition information on the sampling design can be found in the NCPP (Holland, 1990).

2.2.1 Regionalization

The Near Coastal sampling frame represents coastal entities spanning the entire coastal extent of the United States (i.e., tidal estuaries, embayments, tidal wetlands) as well as offshore coastal waters to a distance of 100 miles (i.e., all offshore regions within U.S. territorial waters with depths less than 200 m). The large number and often broad expanse of the Near Coastal sampling units (e.g., estuaries, embayments, sounds, tidal rivers, coastal marshes, tidal wetlands, ocean) makes straightforward sampling of the entire sampling 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-NC regionalization scheme is to formulate a hierarchical structure for partitioning the coastal 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.

The Near Coastal 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-NC is analogous to that adopted by NOAA and the U.S. Fish and Wildlife Service. (See Figure 1.1, taken from the NCPP [Holland, 1990]).

The Near Coastal 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; six additional regions encompassing Alaska, Hawaii, and the Pacific territories; and the Great Lakes (Figure 1.1). In its initial phases, EMAP Near Coastal will monitor estuarine status and trends in the seven regions of the continental United

States. The first to be monitored was the estuaries of the Virginian Province.

The Virginian Province includes the wide expanse of irregular coastline from Cape Cod, MA to Cape Hatteras, NC 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 management consequences. The large size category was expected to be rather small in number and thus adequate samples would be expected to fall within each large estuarine system to permit rough status estimates of these individual large estuaries (e.g., Chesapeake Bay, Long Island Sound). The size classification uses the following associative criteria:

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

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

Small Estuarine Systems: All remaining estuarine systems within the Virginian Province with surface areas > 1.0 mi^2; 132 systems (total surface area = 1490 mi^2). 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 health. To accomplish this goal for the near coastal ecosystem, a number of "indicators" of ecosystem health have been proposed. These indicators have been classified as core, developmental, or research indicators.

Core indicators are those for which there presently exists sufficient data to define the sensitivity and reliability of responses to stress with a high degree of confidence. The variability of core indicators over the Index Period is expected to be small. Core indicators for the EMAP-NC 1991 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,
- contaminants in fish flesh,
- gross pathology of fish, and
- fish community composition.

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

- continuous measurements of dissolved oxygen concentration,
- histopathology of fish populations,

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.

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, Chief Scientist, and crew members. One of the Crew Chiefs also serves as the Team Leader, who is ultimately responsible for all equipment and activities assigned to his/her team. This design is outlined in Figure 3.1.

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

The two crews comprising a team work alternating schedules, each working six consecutive days then having six days off. This six-day work schedule is a function of the need to deploy dataloggers at each station for three days, resulting in six-day sampling windows.

Team Leaders are responsible for the overall operation of their teams, including tracking equipment and supplies, maintenance, and progress made in sampling activities. Chief scientists are responsible for assuring the quality of the data collected and for the daily communications with the EMAP-NC Command Center (including the transfer of electronic data - see Section 11). Crew Chiefs are responsible for the day-to-day operation of all field gear and for safety. In most cases the Crew Chief will also serve as the Chief Scientist, therefore no distinction will be made in this document unless necessary. 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 senior member of his/her crew.

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

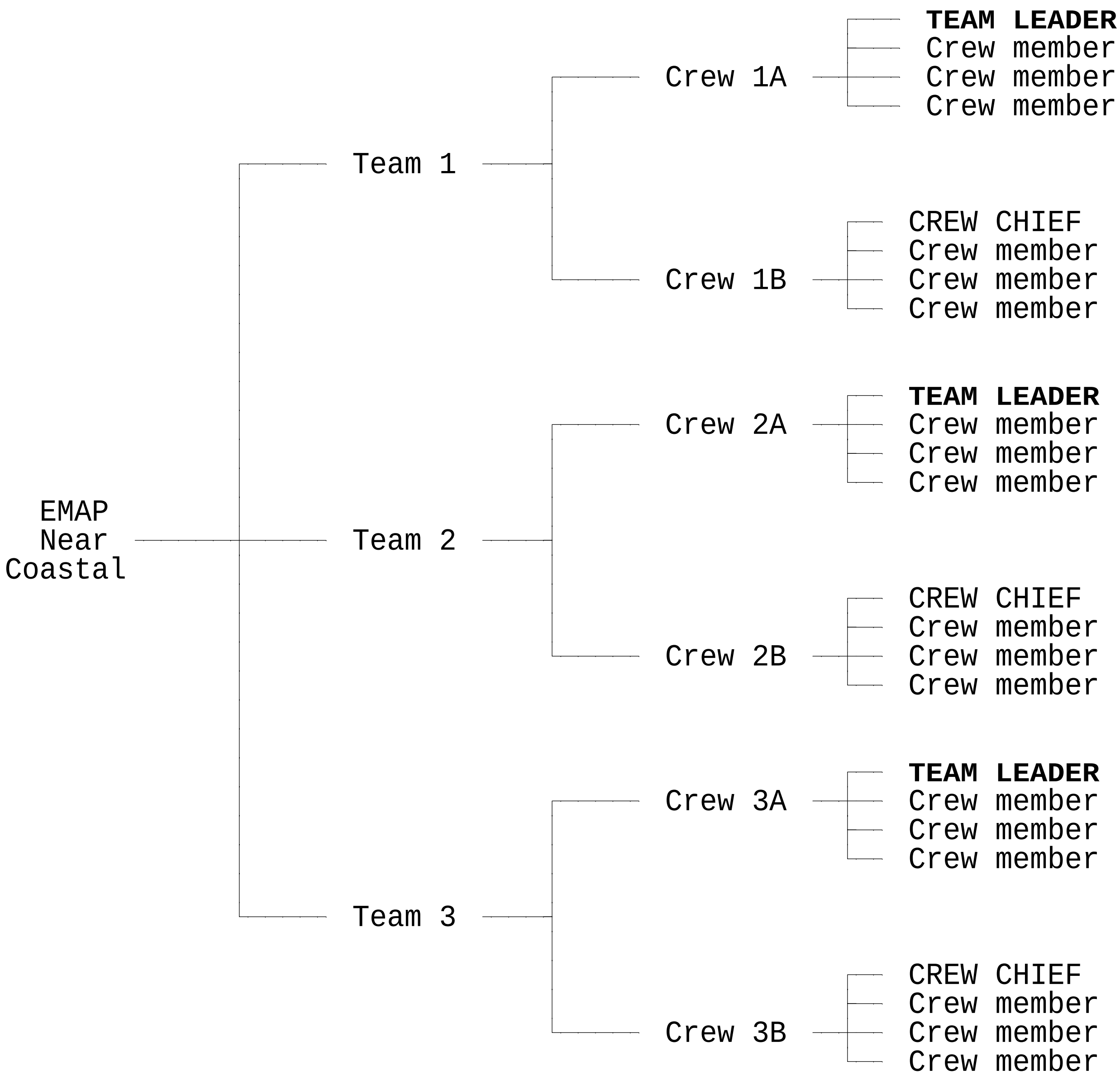


Figure 3.1. Manpower distribution for the Virginian Province Project.

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, excluding those stations in New York Harbor. Team 2 has been assigned those stations in New York Harbor, all stations in New Jersey and Pennsylvania, all stations in Delaware, those stations along the Delmarva Peninsula, 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. Maps of these regions are included as figures 3.2 to 3.4. A listing of stations, by team, can be found in Appendix A.

3.3 Equipment

Each team is provided with all the equipment and supplies required to perform all sampling activities. This includes a 24-foot boat on a trailer, a four-wheel drive (4WD) pick-up truck to tow the boat, a 15-foot parcel van to serve as a mobile laboratory, a station wagon, two field computers, marine-band VHF radios, a cellular telephone, one Sea-Bird CTD profiling instrument, one benthic grab sampler, two *Go-Flo* water sampling bottles, two trawl nets, 8 deployable DO monitoring instruments (Hydrolab DataSonde 3 dataloggers), and all additional supplies necessary to successfully complete sampling for all indicators. A complete list of equipment is provided in Appendix B.

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 a 155 Hp commercial Johnson outboard engine and a 25 Hp emergency engine, a mast and boom assembly, a hydraulic winch, and a self-contained hydraulic power supply. 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 tool kit,

Figure 3.2. Map of sampling area for Team 1.

Figure 3.3. Map of sampling area for Team 2.

Figure 3.4. Map of sampling area for Team 3.

and all required and suggested safety equipment. One completely outfitted spare boat is stored at ERL-N, and will be transported overnight to any team who needs a replacement.

3.3.2 Boat Trailers

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

3.3.3 Four-Wheel Drive (4WD) Pickup Trucks

A one-ton 4WD pickup truck is used to tow the boat. One spare is located at ERL-N as a backup, and to tow the spare boat. Trucks are equipped with a 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 Mini van

A mini van is provided for transporting crew members to and from the Base Facility when they go off and on duty.

3.3.6 CTD

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

3.3.7 Deployable Data Logger

Each team is supplied with eight Hydrolab DataSonde 3 deployable data loggers equipped to measure salinity, temperature, DO, pH, and depth. A DataSonde will be deployed for up to three days at each Base Sampling and Long-Term Trends site. Each team is also supplied with spare parts for these units.

3.3.8 Trawl Nets

Each team is provided with three 16-meter, high-rise trawl nets, and one smaller net that can be used in congested areas.

3.3.9 Water Sampling Bottles

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

3.3.10 Grab Sampler

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

3.3.11 Laptop Computers

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

3.4 Chain-of-Command

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

1. The Crew Chief is directly responsible for all field activities conducted by his/her crew. If the Crew Chief and Chief Scientist are different people, the Crew Chief 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 15 for a description of allowable changes.) The teams accept technical direction from no other persons.

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

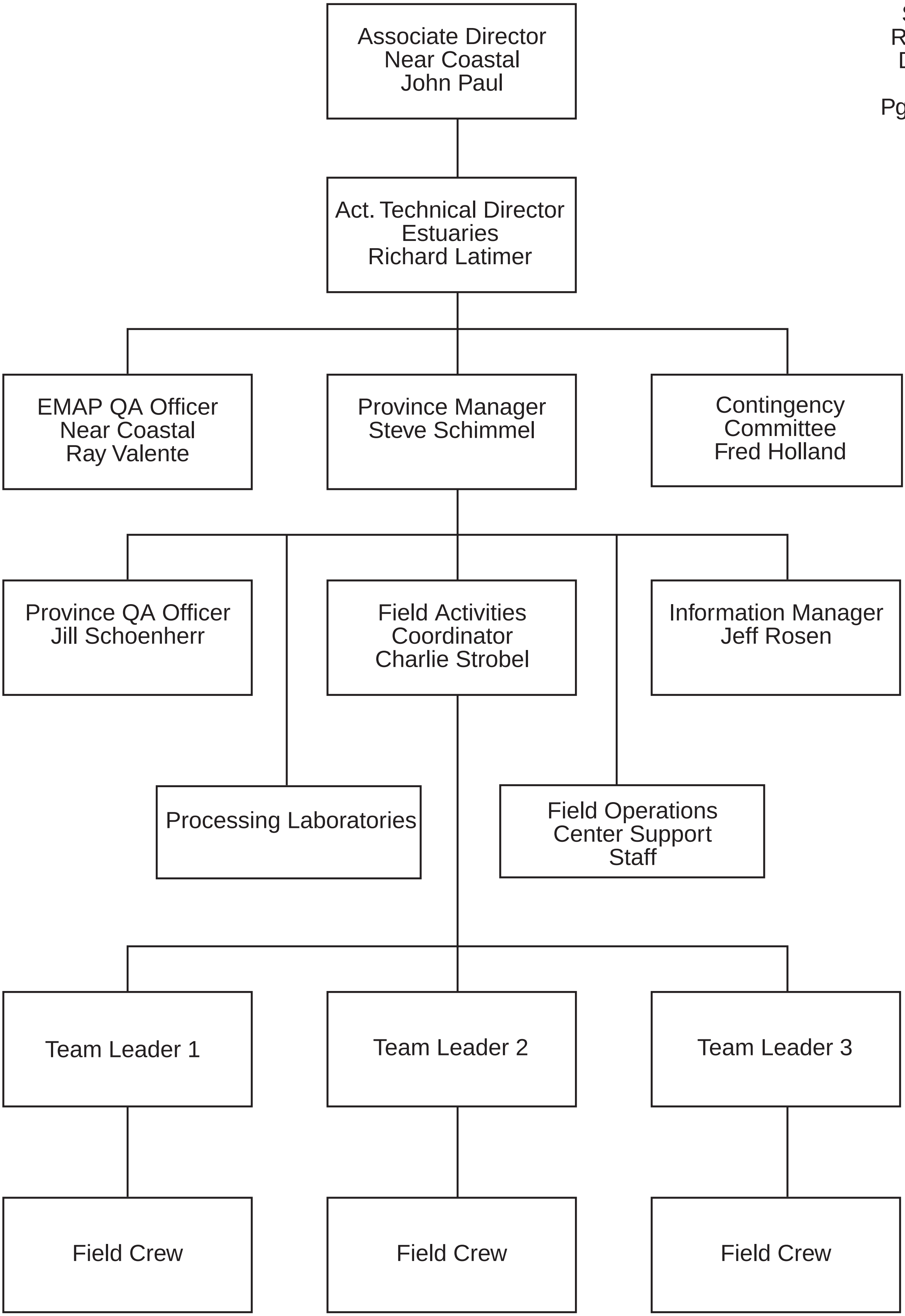


Figure 3.5. Management structure for the 1991 EMAP-NC Virginian Province monitoring.

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 first aid, cardiopulmonary resuscitation (CPR), basic lifesaving techniques (water rescue), and basic marine fire fighting.

4.2 Swimming Proficiency Requirement

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

4.3 Priorities

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

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

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

4.4 Accidents

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

4.5 Personnel Emergency Information

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

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

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

4.6 Operation of Equipment

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

At no time should anyone operate heavy gear (such as the hydraulic winch or boat) while under the influence of any prescription drugs that could impair reactions. Likewise, CONSUMPTION OF ALCOHOLIC BEVERAGES DURING, 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 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 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, 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 C. First aid information is listed on these sheets. The appropriate MSDS should be read before handling any hazardous material.

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

4.13 Proper Handling of Potentially Hazardous Samples

Several of the stations to be sampled during the 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. Stations representing a known or suspected health hazard are listed in Table 4.1. In addition, any station in or around an urban environment should be treated as a potentially contaminated site.

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

1. Always wear protective rubber or Viton gloves. Eye protection or face shields may also be appropriate, as is 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.

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

Station #	Location	Hazard
376*, 378*	Harlem River	Generally degraded with metals, PAHs and sewage
375, 377	Flushing Bay	Generally degraded with metals, PAHs and sewage
370, 371	Jamaica Bay	Sewage discharge
421, 419	Taunton River	Sewage discharge
188, 333	Potomac River	Industrial and sewage discharge
355-367	Delaware River	Generally degraded with metals, PAHs and organochlorines
368, 369	Raritan River	Generally degraded with metals, PAHs and sewage
372, 373*	Kill van Kull (NJ)	Generally degraded with metals, PAHs and organochlorines
173	Upper NY/NJ Bay	Generally degraded with metals, PAHs and organochlorines
384, 397, 411, 422, 424, 215	Hudson River	PCB contamination
306, 312	Breton Bay	Sewage discharge

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 three sets of activities: Crew Chief/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 (Chief Scientist) Training

Intensive training of Crew Chiefs and Chief Scientists will be conducted at ERL-N from June 3 to June 14, 1991. This will include navigation, computer operation, operation and maintenance of the electronic instruments, sampling and shipping procedures, and an overview of the scientific principles behind the sampling (such as the characteristics of an acceptable CTD cast). Crew Chief training will include classroom, laboratory, and field activities. Crew Chief training will be conducted by EPA, SAIC, CSC, and external consultants as needed.

5.2 Crew Training

Formal crew training will begin on June 17, 1991 and continue through July 3 at two locations. All SAIC personnel (Teams 1 and 2) will be trained at ERL-N, and Versar personnel (Team 3) at Versar in Columbia, MD. Formal training will include all aspects of safety (including CPR and first aid), sampling and shipping procedures, boat operation, navigation, maintenance, and navigation. Training will be conducted by EPA, SAIC, CSC, Versar, and external consultants as needed. Training will consist of classroom, laboratory, and field activities.

Crews will participate in four days of "dry runs" following the completion of formal training. The "A" crews will practice the week of July 8, and the "B" crews the following week. Teams 1 and 2 will work in Narragansett Bay, and Team 3 in the Chesapeake 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. In some instances, the data collected will be used in the characterization of portions of the Virginian Province.

The Field Coordinator, VP QA Coordinator, and the EMAP-NC QA Officer will visit crews 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 and QA protocols.

Following the completion of dry runs (friday of each week), the crews will return to their respective base location for a review and critique of that weeks 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 lowest level in the network is the mobile laboratory. Each team is equipped with a 15-foot parcel van to serve as this facility. This is used for storing supplies and equipment, and as a staging area, communications center, and packaging and shipping center. Boat personnel must maintain constant contact with the crew member manning the mobile lab, and all contact from the Field Operations Center will be to this lab via cellular telephone.

6.2 Base Facilities

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

6.3 Field Operations Center

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

SECTION 7
PROFESSIONALISM

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

7.1 General Contact with the Public

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

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

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

When possible, the field crew should render assistance to other boaters in need of help. ALL FIELD OPERATIONS MUST CEASE IMMEDIATELY WHEN THE CREW IS IN A POSITION TO RENDER ASSISTANCE IN LIFE OR LIMB THREATENING EMERGENCIES. The crew should use their resources, such as the portable telephone, to assist in any emergency, whether EMAP personnel are directly involved or not.

7.2 Operation of Motor Vehicles

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

7.3 Operation of Boats

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

7.4 Radio Operation

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

7.5 Waste Disposal

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

Hazardous wastes generated, such as waste formalin, must be disposed of properly as described in Section 20.

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, by the SAIC or VERSAR personnel coordinator.

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

United States Environmental Protection Agency
Environmental Monitoring and Assessment Program
27 Tarzwell Drive
Narragansett, RI 02882
1-(800)-732-2305 or (401) 782-3000

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

8.3 Trailering Guidelines

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

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

2. Each day, and each time the trailer is disconnected and then reconnected to the truck, a check of the trailer lighting system must be performed. This includes checking taillights, directional signals, and brake lights. Each time the crew departs for a new location, the security of the hitch 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 B.

3. Observe posted speed limits at all times.

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

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

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

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

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

8.4 Operation of Winch

Each pickup truck is equipped with a front bumper-mounted winch. This winch is used to pull the truck and boat up ramps that are too steep and slippery for four- wheel drive alone. If the winch is needed, the following procedures should be followed (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 11).

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 B.

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. If not already installed, install the 25 Hp emergency engine.

4. Raise the motor if it is 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. 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.

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

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

9. 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.

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

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

12. 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.

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

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

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

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

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

8. Pull the boat onto the trailer with the winch. Keep clear of the cable to prevent injury in the event of cable or hardware failure. **NOTE: The electric winch 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.

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

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

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

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

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

14. Secure the tie-down strap.

15. Reconnect and check the trailer lighting system.

16. Check the trailer safety and brake chains.

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

18. Remove the 25 Hp emergency engine and store in the truck.

19. Engage the engine safety latch and lower the engine until it is resting on the latch and not on the power trim cylinder.

20. Store any remaining gear in the vehicles.

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

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

23. **CHECK TO MAKE SURE THE MOBILE LAB VHF ANTENNA IS DOWN.**

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

9.3 Mast Assembly and Antennae Set-Up

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

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, paying particular attention to the hydraulic lines at the base of the mast. Be sure the hydraulic lines are not pinched or damaged as the mast is raised into position.

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

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

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

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

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

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

9.5 Navigation System

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

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

Each team is supplied with a GRiD laptop computer containing an integrated navigation system. This system interfaces with both the Loran and the GPS. It provides for an averaging of multiple calibration factors, and is capable of storing parameters files for each station sampled. Sampling protocol dictates that sampling be performed as close as possible to each designated sample site, therefore, the computer navigation system should be used at every station. The only exception should be when a major component of the system (Loran or computer) fails. In that case, either the Loran, GPS, or dead reckoning (in river systems) should be used to locate the station. The use of any system other than the computer navigation system requires an explanation in the log. A description of this system, and instructions for operating it, are included in Appndix L and SAIC (1991).

Because problems with the navigation instruments were identified during the Demonstration Project, each Crew Chief is required to maintain a navigation log containing ranges and bearings for all stations. Hand-held compasses can be used for the bearings and the radar for the ranges. This should be used to validate the coordinated produced by the boat electronics.

9.6 General Policies Underway

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

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

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

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

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

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

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

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

9.6.1 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.

9.6.2 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. Observe reduced speed and no wake signs.

9.6.3 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, look for signs denoting an underwater cable. Do not anchor in the vicinity of such a cable.

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

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

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

9.7 Radio Operations

The operation of marine radios is governed by regulations of the Federal Communications Commission (FCC). There are specific procedures for placing calls to other vessels, and for answering calls to your vessel. Monitor Channel 16 when the marine radio is on. All calls originate on Channel 16; however, only emergency transmissions are permitted on that channel. To call another ship or the mobile lab, follow these procedures:

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

   NAME OF BOAT YOU ARE CALLING

   THIS IS NAME AND CALL SIGN OF YOUR BOAT

   OVER

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

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

   SWITCHING TO 82A (working channel)

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

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

   NAME AND CALL SIGN OF YOUR BOAT   OUT

5. Switch back to channel 16.

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

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

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.

ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM
BOAT RADIO FREQUENCY ASSIGNMENTS

CALL SIGNS

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

FREQUENCY ASSIGNMENTS

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

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

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

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!

9.8 Radar Operation

Each boat is equipped with a radar unit to aid in navigation under reduced visibility. Radar consists of a display unit (mounted in the cabin) and a Radome antenna (mounted on the 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.

9.9 Winch Operation

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

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

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

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

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

4. Engage the choke.

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.

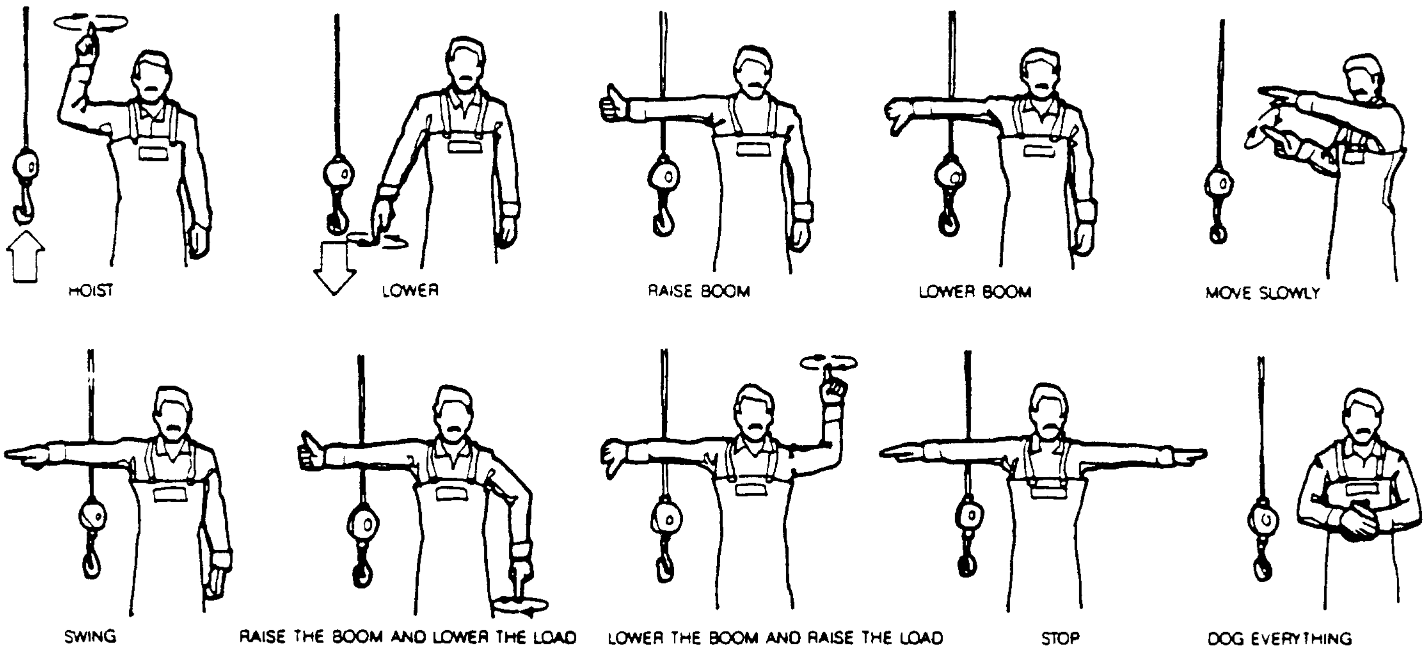
The levers controlling hydraulic power are located inside the cabin on the rear bulkhead. The starboard lever controls the winch and the port lever controls the capstan. The winch will not free-spool, so power must be supplied to lower, as well as raise, gear. The speed at which the winch or capstan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

9.10 Emergencies/Accidents

Emergencies or accidents may occur in the course of sampling which may or may not involve EMAP boats or personnel. In the case where non-EMAP personnel are in an emergency situation, EMAP crews are required to render assistance if there is danger of loss of life or limb of those involved. In such an instance, crews should take the appropriate action (e.g., administer first aid and/or CPR, tow the boat to safety, radio for help) necessary to protect those involved. Under circumstances where there is no immediate danger of loss of life or limb (e.g., boaters with mechanical problems) EMAP crews should inform the Coast Guard or a local towing service of the problem and give the location and a description of the disabled vessel. If the disabled vessel is near a marina and if it will not result in a major loss of sampling time, in the interest of public relations crews should render assistance. If EMAP personnel are in an emergency/accident situation, take appropriate action to reduce the immediate danger to those involved. In the case of a physical problems (e.g., man overboard, hypothermia, seasickness, sunburn, heatstroke, fish bites or stings, etc.) take the appropriate lifesaving, first aid, or CPR measures and call for help if necessary. In an accident situation where there is no immediate danger of loss of life or limb, notify the FC and the mobile unit of the problem and take measures necessary to rectify the situation (e.g., call for help, head for port). If an emergency or accident is serious enough to return to port, notify the mobile unit on shore and arrange to have an ambulance or other necessary emergency equipment in port upon arrival.

9.11 Equipment Failure/Repair

The best way to assure proper functioning of the equipment is to adhere to the routine maintenance schedule (Section 16). 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.

9.11.1 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.

9.11.2 Hydraulic Winch

If 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.

9.11.3 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 1530 laptop computers. One is generally located on the boat and the other in the mobile lab. These computers contain an integrated data management/navigation system, which interfaces the Loran and GPS navigation instruments with the computer and a bar code reader. This integrated system eliminates the possibility of transcription error in the recording of station coordinates or sample numbers. Detailed instructions on the operation of the system can be found in Appendix L, SAIC (1991), and Beaulieu (1991).

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

The computer navigation/data storage system **must** be used at each station, unless the system fails to operate. Even without direct input from the Loran the system can be used to record sampling events without the coordinates being available on-line (although procedures require that they be hand-entered into the database). Additional information on the required method of data entry can be found in Section 17.

Bar code readers have also been supplied to facilitate data entry. Operation of the bar code readers is covered in Appendix M.

10.1 Data Acquisition System

The entire computer system is run through the Data Acquisition System (DAS). The DAS is the master system, one component of which is the Navigation System. The DAS is entirely menu driven. It allows for the automatic storage of sample information through the Navigation System or via entry on-board the boat or from data sheets in the mobile laboratory. One example of the later is the component used for the entry of fish data. Because of the complexity of data entry, especially the pathology observations, fish data are recorded on data sheets. The following day it is entered into the computer by the shore person through the fish data option on the DAS. The DAS also allows for the calibration of electronic instruments (CTD and DataSonde 3) from outside of the Navigation System.

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

Although the DAS is fairly simple to operate, the complete documentation is too extensive to be included in this document. Please refer to Beaulieu (1991) for complete instructions.

10.2 Navigation System

Details on the operation of the navigation component of the computer system can be found in SAIC (1991) and Appendix L. This system both assists the boat operator in navigating to the station, and provides for the automatic storage of position data once the station is reached. The system is entirely menu driven for ease of operation.

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

Once on station, the system allows for the automatic storage of coordinates and time of each component of the sampling activity. In addition, the system prompts the user for sample numbers upon the collection of each sample. In most cases, the user should use the bar code reader and supplied barcodes for inputting this information. Again, the purpose of this is to eliminate transcription error.

SECTION 11
COMMUNICATIONS

The 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.

11.1 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 GRiD's internal modem and the PROCOMM Plus communications package. The Kermit subroutine is used to upload and download data and information. Once a link has been established, transfer is automatic. If data or notes are flagged by the field crew, the FC, 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 from the Demonstration Project 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 Beaulieu (1991).

11.2 Communications with the Field Operations Center

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

1-800-732-2305

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 and DP Project Manager are 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 K). 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 pager, allowing the FOC staff to contact him/her even where cellular phone service is not available. 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.

11.3 Ship-to-Shore Communications

Both the boats and mobile laboratories are equipped with marine-band VHF radios. Any problems or changes in itinerary should be communicated between the boat and mobile lab using Channel 82A. As this frequency is shared by other U.S. government operations, transmissions should be kept to a minimum. This radio is also used to communicate with other boat traffic and port operations as required. The mobile lab radio should be used only to communicate with the boat, or, in an emergency, the marine operator. Communications between the boat and mobile laboratory were frequently unavailable during the Demonstration Project due to poor radio reception. For 1991, 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.

11.4 Truck-to-Truck Communications

An addition in 1991 is the installation of Citizen's Band radios in the mobile labs and pick-up trucks. This should allow for more efficient transiting 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.

SECTION 12
SAMPLING SCHEDULE AND STATION TYPES

12.1 Sampling Schedule

Sampling activities for the 1991 Virginian Province Project are scheduled to begin on Monday, July 22, 1991. 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 six 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. As described below, Base Sampling Sites are visited twice within the window in which they are sampled.

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. If, once field operations begin, crews feel that the schedule is overly ambitious or not efficient, they should contact the Field Coordinator who will consult with the Project Manager.

12.2 Station Types

Several different types of stations will be sampled during the Project. The locations of all stations are provided in Appendix A, along with a listing of the windows in which they are sampled. Specific instructions on obtaining samples are listed in Section 13. Flow charts outlining these activities are included in Appendix F.

12.2.1 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 twice within a specific window. On the first visit to the station a Hydrolab DataSonde 3 data logger is deployed. This unit is retrieved on the second visit, ideally three days later. However, deployments of as short as one day are acceptable if logistical concerns (such as weather) make a longer deployment impossible. Other activities performed at Base Sites can be performed on either of the two visits at the Crew Chief's discretion. These activities are as follows:

a. Perform a CTD cast (on each visit)
b. Collect a water sample for total suspended solids analysis (TSS: one visit only)
c. Collect benthic biology and grain size samples (three)
d. Collect sediment chemistry, AVS (acid volatile sulfides), sediment toxicity, and grain size samples (generally one each).
e. Perform a fish trawl and process for species composition, chemistry, and pathology.
f. Perform additional trawls as necessary to obtain the required number of fish for chemistry.

12.2.2 Index (IND) Stations

Index Stations are located in depositional environments (muddy) in the vicinity of Base Sampling Sites in small estuarine systems. The purpose of Index Sites is to compare the results of sampling at random sites with that from sites specifically located in depositional zones. THE CHIEF SCIENTIST IS RESPONSIBLE FOR ASSURING THAT THESE STATIONS ARE LOCATED APPROPRIATELY. IF SEDIMENTS ARE FOUND TO BE INAPPROPRIATE, THE STATION MUST BE RELOCATED ACCORDING TO THE INSTRUCTIONS IN SECTION 15 - CONTINGENCIES. It is important that Index Stations be sampled in the same window as the associated BSS. The activities performed at IND sites are as follows:

a. Perform a CTD cast, including collecting a TSS sample.
b. Collect benthic biology and grain size samples (three)
c. Collect sediment chemistry, AVS (acid volatile sulfides), sediment toxicity, and grain size samples (generally one each).
d. Perform fish trawls for CHEMISTRY ONLY. Trawling activities should continue until the crew has obtained at least ONE individual of one of the target species for which all five individuals were collected at the associated BSS. If necessary, crews should continue trawling activities for up to 1½ hours to obtain these fish.

12.2.3 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.

12.2.4 Long Term Spatial (LTS) Stations

LTS sites are stations located along a transect radiating out from a LTT station. Individual sites are located at 0.25, 0.5, and 1.0 miles from the LTT site. Only a subset of LTT sites have LTS transects associated with them, and all are located in the Chesapeake Bay. Because of the sampling load during the normal Index Period, LTS stations will be sampled during the dry run phase of training. This was deemed acceptable for two reasons:

1. The crews conducting this sample were all involved in the Program in 1990 and are therefore familiar with the methods, and

2. The acceptable Index Period begins earlier in the Chesapeake Bay than in Long Island Sound (which was responsible for the July 22 start date), therefore sampling several weeks early will not compromise the utility of the data.

The activities performed at LTS sites are identical to those at BSS or LTT sites except no Hydrolab is deployed and no fish trawls are performed

12.2.5 Indicator Testing and Evaluation (ITE) Stations

Indicator Testing and Evaluation Stations are Base Sampling Sites where the degree of chemical contamination is known to be either high or low. The purpose of these stations is to provide for the testing of new indicators under known conditions. The activities performed at these sites are identical to those conducted at BSS, with the addition of saving "reference" fish (those not exhibiting any evidence of external pathology) for histopathological examination, as explained in Appendix E. If any additional indicators are added to the program, samples will be collected at ITE sites.

SECTION 13
SAMPLING ACTIVITIES AND PROCEDURES

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

All samples will be labelled with bar codes, and the numbers entered into the on-board computer via the use of an electronic bar code reader. Past experience has shown that manual entry frequently results in errors which greatly increases the time required for processing the data. The use of the bar code readers should eliminate such error and greatly increase the speed at which data can be processed by the Data Management Team. Therefore, use of the bar code readers is MANDATORY.

13.1 Preparations for Sampling

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

13.2 Locating Stations Using the Computer Navigation System

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

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

Following calibration, the station coordinates are retrieved as a waypoint and the navigation system used to steer towards that station as per the instructions in Appendix L.

Several problems with the navigation instruments have been recently identified, which could potentially result in inaccurate locational information. Therefore, Crew Chiefs are REQUIRED to maintain a navigation log which should contain dead reckoning data (ranges and bearings) that can later be used to verify coordinates. This information will not be entered into the database, however, it must be available to the FC or QA Officer upon request, and must be returned to the Field Operations Center following the completion of sampling activities.

13.3 Order of Sampling Activities

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

1. Retrieve deployed DataSonde unit (second visit to BSS and LTT only).

2. Anchor and record the station coordinates by prompting the computer.

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

4. Perform a CTD cast, transfer the data to the on-board computer, and review the data. Included in this step in obtaining a bottom water sample for DO determination and collecting a TSS sample.

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

6. Perform one 10 minute fish trawl. Identify and measure fish; observe all individuals ≥75mm in fork length for evidence of pathology (preserve diseased fish and, at ITE Stations, preserve healthy fish to serve as a reference). Freeze [on dry ice] up to five fish from each target species for chemical analyses. Additional trawls may be necessary to collect a sufficient number of fish for chemical analysis.

7. Deploy replacement DataSonde unit (first visit to BSS and LTT stations only). This is not to be performed until all trawling operations have been completed. DataSondes are not deployed if the CTD cast shows the bottom DO to be zero.

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

13.4 Obtaining Dissolved Oxygen Profile

The first activity performed at every station is obtaining a vertical profile of the water column for salinity, temperature, dissolved oxygen (DO) concentration, transmissivity (estimate of total suspended solids concentration), fluorescence (estimate of chlorophyll *a*), and PAR (a measurement of the intensity of light in the range of wavelengths used by algae in photosynthesis) 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. Specific instruction on the operation of the CTD are included as Appendix G.

Prior to obtaining the profile, a bottom water sample is collected using a *Go-Flo* water sampling bottle and the dissolved oxygen concentration determined with a YSI meter according to the instructions in Appendix J. Great care must be taken to avoid altering the oxygen concentration of the sample. Enter the DO concentration into the computer.

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

1. Connect the CTD to the end of the winch cable with a shackle, and **TIGHTEN THE PIN**. Use seizing wire to assure the shackle does not open. 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 actually float one meter above.

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

3. After allowing the instrument to reach thermal equilibrium (at least three minutes), collect a surface water sample with a *Go-Flo* bottle or a bucket, and lower the CTD through the water column at a rate of approximately 1/4 meter per second until it reaches the bottom. Allow the unit to collect data for two minutes, then raise it to the surface, turn it off, and bring it back into the boat. Process the water sample collected for total suspended solids as described in Section 13.4.1.

4. Following completion of the CTD cast, connect the CTD to the on-board computer and upload the data.

5. 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 they do not agree within one mg/l, flag the data. The cast can still be accepted if the other measurements appear reasonable. If, for any reason, the cast was not successful, all steps are repeated up to a total of three attempts.

13.4.1 Processing of Samples for Total Suspended Solids Analysis

Water samples collected for the determination of suspended solids are processed as follows:

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

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

3. Record the sample number in the computer.

13.4.2 Safety Considerations

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

13.4.3 Quality Assurance

As the CTD is a delicate electronic instrument, certain precautions are necessary to assure proper operation. All instructions should be followed closely. QC calibration checks for DO, salinity, pH and temperature must be performed once per shift. If the instrument falls out of calibration, contact the FOC immediately for a replacement unit.

13.4.4 Contingencies

1. If the water depth is too shallow ($\leq$ 3 meters) to obtain a profile, suspend the unit just above the bottom and collect data for two minutes (following a 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 bottom DO value obtained from the YSI meter will be used in data assessment for the DO concentration.

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

13.5 Operation of the DataSondes

Hydrolab DataSonde 3 dataloggers are deployed at all BSS and LTT stations. Upon arrival at a station the first activity performed is the retrieval of the Hydrolab DataSonde 3 datalogger if one has been deployed. This is performed prior to anchoring at the station. The last activity performed upon the first visit to a station is the deployment of a unit. Instruments are deployed **AFTER** trawling is completed to eliminate the possibility that the units could be accidentally caught by the trawl and damaged.

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

13.5.1 Deployment Criteria

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

13.5.2 Quality Control Check

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

<u>Unit Being Deployed</u>

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

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

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

4. Record the temperature and salinity as it appears on the computer screen. The salinity should be within one o/oo of the value listed for that standard. If it is off, recalibrate the unit to this value.

5. Discard the sample in the cup, pour in a pH 7 buffer, and check the pH and DO calibration as described in Appendix I (air calibration for DO).

Record these values on the data sheet. If DO is off by more than 2%, or pH by more than 1 pH unit, recalibrate the unit.

Unit Being Retrieved

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

13.5.3 Deployment

A DataSonde must be deployed at all BSS and LTT stations for at least one, and preferably three, days. The mooring system is a two part mooring (Figure 13.1) consisting of the DataSonde unit and the surface float unit. The two are attached by a line along the bottom which is at least the water depth. This provides a "snag" line between the two weights in case the surface float disappears, as well as a deterrent to vandals. In shallow water the two components should be combined to the surface float is directly above the instrument.

It is the responsibility of the Chief Scientist to assess the station location and determine the risk of deploying a unit. The Chief Scientist has the latitude to move the location of deployment to protect the unit. For example, if the station is in the middle of a busy shipping channel the unit may be deployed closer to the edge, or the unit may be deployed in the center of the channel with a longer bottom line so the surface buoy is outside of the channel. Whatever solution is imployed, the Chief Scientist must be reasonably certain that the bottom conditions at the actual station are the same as at the point of deployment.

The procedures for deployment are as follows:

1. Connect the unit to the on-board GRiD computer and initiate communications. The menu system allows for several options. Setting logging run will automatically set all the appropriate parameters. (NOTE: steps 1-2 are most likely done at the dock immediately following the QC check).

2. Disconnect the unit from the computer. As soon as the data cable is disconnected from the DataSonde 3, **THE PROTECTIVE CONNECTOR CAP MUST BE INSERTED OVER THE CONNECTOR PINS AND THE LOCKING SLEEVE INSTALLED**. The dot and line on the protective cap

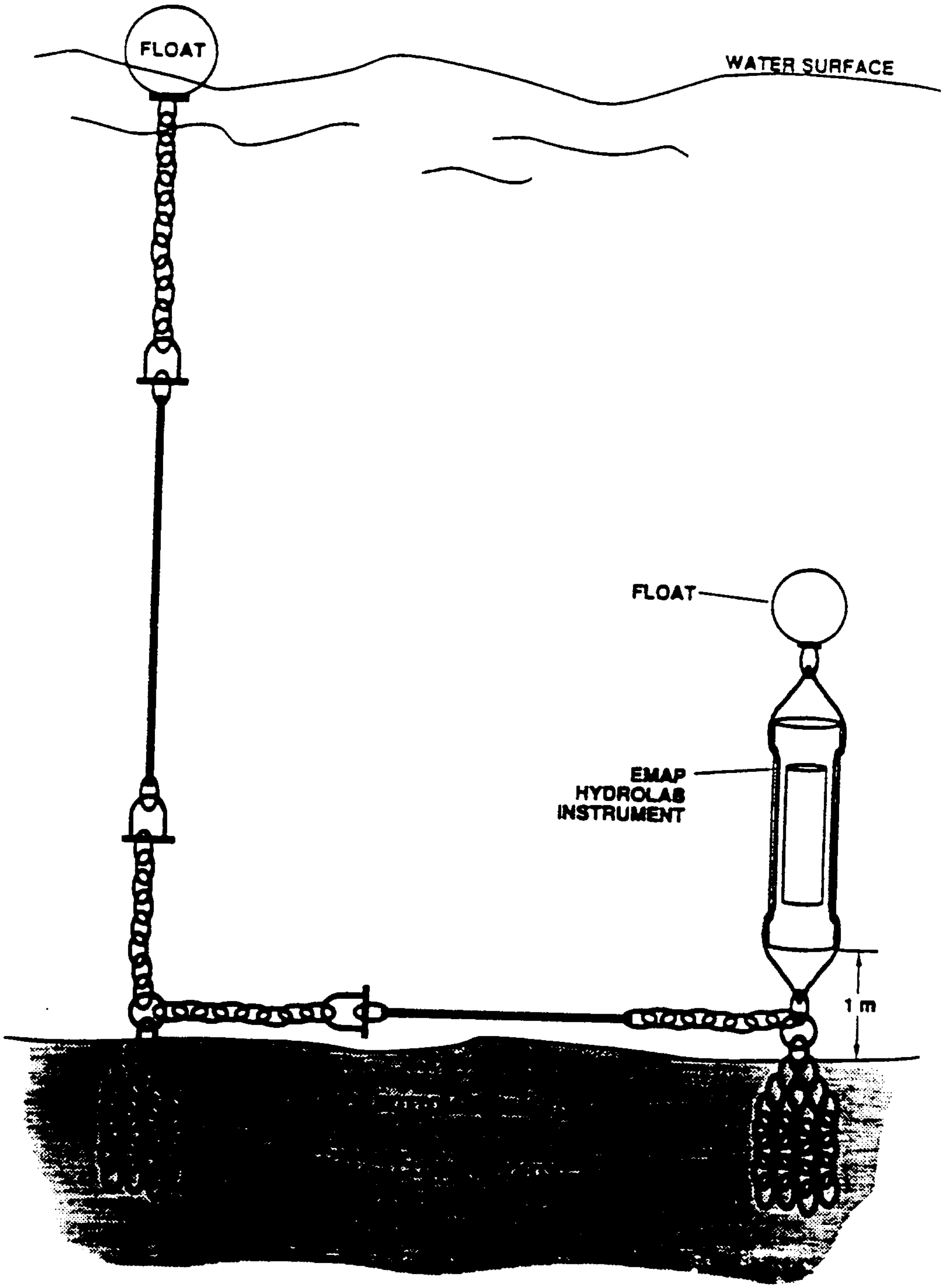


Figure 13.1. The DataSonde mooring system (from Holland, 1991).

are lined up with the **WIDE** pin and the cap is firmly pushed down. The cap is then "burped" by applying pressure to the top of the cap and then working down the cap to the bottom. The user should hear a snap as air trapped under the cap is expelled.

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

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

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

13.5.4 Retrieval

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

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

3. Anchor the boat.

4. Remove the DataSonde from the protective cover.

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

6. Examine the probes for evidence of damage or fouling. Note any evidence of this in the computer.

7. Back at the dock, connect the DataSonde to the on-board computer and transfer the data using the supplied software.

8. Perform a QC check.

13.5.5 Servicing Units

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

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

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

13.5.6 Safety Considerations

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

13.5.7 Quality Assurance

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

Both batteries and the DO probe's Low-Flow membrane must be replaced between deployments. Calibration of the DO probe must be performed no earlier than

12 hours after the installation of a new membrane. This allows adequate time for the membrane to "relax." Calibrating the probe before the membrane has had time to relax can result in collection of inaccurate data.

13.5.8 Contingency Plans

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

2. At least two calibrated DataSondes should be carried on-board whenever a station is visited. This allows for one back-up instrument in case one fails. Units that fail to operate properly should be returned to the FOC for repair immediately.

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

13.6 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. The descent of the sampler can be watched on the depth finder.

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 13.2). Grabs containing no sediments, partially filled grabs, or grabs with shelly substrates or grossly slumped surfaces are unacceptable. Grabs completely filled to the top, where the sediment is in direct contact with the hinged top, are also unacceptable. It may take several attempts using different amounts of weight to obtain the first acceptable sample. The more weight added, the deeper the bite of the grab. In very soft muds, pads may be needed to prevent the sampler from sinking in the mud. If pads are used, the rate of descent near the bottom should be slowed even further to reduce the bow wave.

6. Drain overlying water from the grab.

7. Enter notes on the condition of the sample into the computer. 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.

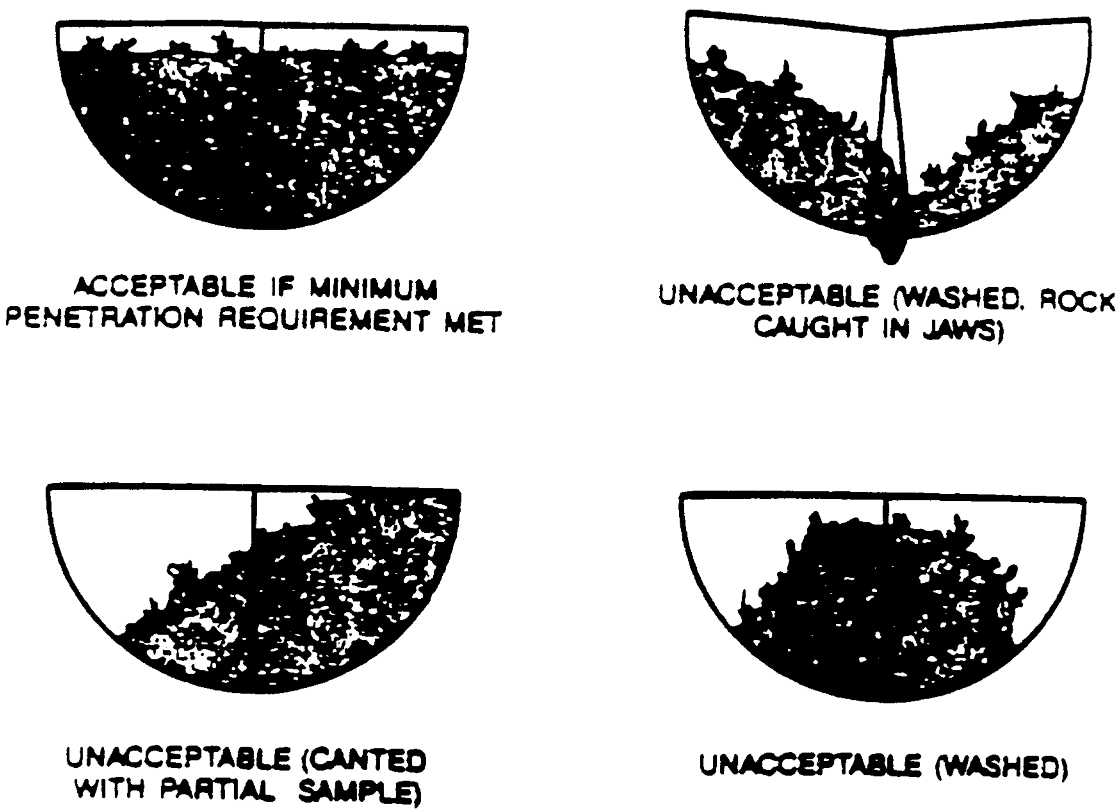


Figure 13.2. Quality assurance criteria for obtaining grab samples. Only those samples meeting QA criteria are retained. Those not meeting these criteria are discarded.

13.8.1 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 ≥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. Measure the depth to the black layer of sediment within the core and record in the RPD (Redox Potential Discontinuity) field in the computer. 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, 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.

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 that 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. Fill the jar with seawater to the 700 ml mark, add 100 ml of a 500 g/l Magnesium Chloride solution to the sample, gently invert the jar to mix the contents, and set aside in the shade for approximately 30 minutes. This "relaxes" the organisms, thereby reducing damage when the preservative is added. A recipe for making up the $MgCl_2$ is included in Table 13.1.

8. 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 13.1. After 30 minutes in the relaxant, 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 the two 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 13.1. Directions for mixing stock solutions of $MgCl_2$ and formalin.

Chemical	Quantity per liter	Volume Desired	Total Quantity
<u>Magnesium chloride stock</u>			
$MgCl_2$	500 g	6 ℓ	3 Kg (one box)
<u>100% formalin stock (stained and buffered)</u>			
Rose Bengal stain	3 g	8 ℓ	25 g (one bottle)
Borax	200 g	8 ℓ	1.6 Kg (ca. 3.5 lbs)
100% formalin	n.a.	8 ℓ	two gallons

13.8.2 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. These samples are processed as follows:

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

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 Kynar-coated spoon is 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. Remove the top two cm of sediment using the Kynar-coated spoon. Place the sediment removed in a Teflon pan and place the pan in a cooler on ice (NOT dry ice). The sample must be stored at 4°C, NOT FROZEN.

4. Repeat this procedure, compositing the sediment in the same Teflon pan until a sufficient quantity of sediment has been collected for all samples.

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

6. Using the Kynar-coated 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.

7. Using a plastic spoon, fill the 125 ml plastic AVS jar to the rim. No air should be allowed to remain as it could result in the oxidation of the sample. Record the sample number and refrigerate at 4°C.

8. At station per crew, three additional 250 cc chemistry and AVS samples are also collected for duplicate analyses (1) and for analysis by a referee laboratory (2). These samples are collected from the same composite as per the directions in Step 6. The FC will notify the crew at which stations this sample needs to be collected. In addition, one glass sample jar should be left open on the deck whenever the chemistry sample is exposed. This will serve as a blank.

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

10. Using the Kynar-coated spoon, fill the two liter plastic container for toxicity testing with sediment (minimum volume required is 1500cc). 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.

13.8.3 Safety Considerations

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

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

13.8.4 Quality Assurance

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

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

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

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

4. At selected sites, "blanks" for chemistry will be obtained. Leave an empty glass chemistry jar open 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 sample does not become contaminated. This requires great care in extracting the sample, homogenizing it, and placing it in the proper container. If it is raining when the sample is collected, all activities should be conducted under a tarp to prevent contamination of the sample by rain water.

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.

13.8.5 Contingency Plans

It is recognized that at certain stations, the sediment type will prevent the collection of sediment samples. If a single "acceptable" grab sample cannot be obtained after five attempts, or if $\geq$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.

13.9 Fish Trawls

After all required sediments are collected, one or more trawls are made to collect fish for species composition and relative abundance, tissue chemistry, and for pathological examination.

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

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

The cod-end is the rear portion of the trawl net which serves as a collecting bag for all that is captured by the trawl. To ensure capture of small organisms, a cod-end liner of very small mesh is often used.

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

At BSS and LTT stations the first trawl is performed in this standardized fashion, i.e. the "large" net towed for 10 minutes at the prescribed speed. A minimum of five individuals of one target species must be collected for chemical analysis. If these are not obtained in the first trawl, additional trawls will be necessary. These need not be performed in a standardized fashion as species composition will not be determined. At least 1½ hours should be spent on trawling activities if needed to obtain these fish. If the first trawl is unsuccessful as a standardized trawl, target species for chemistry can still be saved.

At Index stations, the crew only need obtain at least one individual of one of target species collected for chemistry at the associated BSS/LTT (for which all five individuals were collected). Again the crew should spend up to 1½ hours to obtain the sample. If unsuccessful at obtaining at least one fish from a target species for which all five individuals were captured at the BSS, they should save all individuals from any other target species that was saved for chemistry at the BSS. Note that ALL (up to five) individuals of all target species collected for chemistry at the BSS should be saved and processed for chemistry at the Index site.

13.9.1 Trawl Preparation

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

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

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

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

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

13.9.2 Net Deployment

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

2. The boom should be positioned out over the starboard gunnel with a enough incline for the doors to clear the rail. Lead the bridles through the snatch block on the boom, raise the doors with the winch, and bring them to rest on the gunnel (starboard door forward, port door aft). Circle the boat slowly to starboard. When the starboard side is down current, deploy the float and safety line attached to the cod-end. Flake the net into the water from the cod-end to the wings. Check to make sure that the legs of the net are not twisted before continuing deployment. Pay out wire until the doors are well behind the engines. Swing the boom to the centerline then lower the boom, releasing tension on the snatch block (the wire should now be on the goalpost assembly). Head slowly into the current (e.g., 1 knot) and continue to pay out wire until appropriate warp length is obtained (consult Table 13.2 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.

Table 13.2. Amount of Winch Wire to be Used for Trawling and Dredging

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

13.9.3 Trawling

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

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

3. During the trawl tow, the Crew Chief should monitor the depthfinder for potential obstructions or sudden changes in depth. If a hazard is identified or a hang up occurs, the net should be retrieved and another tow attempted approximately 100 m from the initial trawl track. If three unsuccessful attempts are made, or 1.5 hours effort is expended, trawling operations should be aborted. If a successful 10 minute trawl cannot be accomplished, fish can still be collected from a shorter trawl for chemistry.

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.

13.9.4 Net Retrieval

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

2. Haul back the wire until approximately 10 meters of the bridle is still out. Throttle back and raise the boom so the wire clears the goal post assembly. Turn the boat slightly to starboard and move the boom over the starboard side (the boom should be controlled by the vangs during this process). Take in wire until the doors are at the block. Remove the splitting strap attached to the port door, and run the line through a second block on the boom and through the capstan head. Switch the hydraulic power to the capstan, and retrieve the cod-end of the net, being careful to not foul the props. With the cod-end on deck, drag the remainder of the net over the gunnels from the extension to the wings. When the entire net is on deck, lower the doors to the deck and secure them. If the net is nearly empty, both the doors and the net can be hauled in by hand. If the net is full and cannot be split and brought in, retrieve the cod-end float and pull the line in with the capstan until the cod-end can be tripped and dumped.

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

13.9.4 Criteria for Voiding Tows

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

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

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

3. The cod-end is not tied shut.

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

5. The net is filled with mud or debris.

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

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

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

NOTE: Although the tow may be invalid as a standardized tow, target species should still be saved for chemistry.

13.9.5 Sample Processing - Fish Species Composition and Abundance

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

2. All species considered to be rare, threatened, or endangered (Table 13.3) should be processed immediately and released alive. At the discretion of the Chief Scientist, photographs may be taken to document the catch.

Table 13.3. 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

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

4. 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. As fish are measured, they are examined for evidence of gross pathology (Section 13.9.7) and processed for chemistry (Section 13.9.6). If it is estimated that more than 30 individuals of a species were caught, a subsampling procedure should be used to measure between 30-50 individuals. Subsampling will be accomplished by randomly selecting fish from the buckets. All data are entered onto data sheets and later into the computer.

5. Enter data on the fish data sheets. Common names are acceptable on data sheets only. All data are entered into the computer in the mobile laboratory, at which time only scientific names are accepted (most are already listed in the computer).

6. All fish not measured for length (i.e. those subsampled) are counted, either by direct count or weight-counts. When extremely large catches of schooling fish such as bay anchovy or 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.

7. 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.

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

13.9.6 Processing of Fish for Chemical Analysis of Muscle

1. For taxa designated as target species (Table 13.4), measure, gut, and retain five individuals within the desired size range for future chemical analysis. Individuals are randomly selected from all those collected until five of the appropriate size have been selected. If no individuals in the primary size range were collected, individuals from the secondary size range closest to the primary size range should be selected. If only individuals outside the desired size range are obtained, those that are closest to the preferred size range are selected. As chemistry takes

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

SPECIES	PRIMARY RANGE (mm)	SECONDARY RANGE (mm)
Channel Catfish	200-300	300-400
Atlantic Croaker	200-300	100-270
Bluefish	175-225	125-175
Scup	150-200	100-150
Summer Flounder	350-450	65-350*
Spot	150-250	70-150
White Catfish	200-300	300-400
Weakfish	300-400	45-300*
Winter Flounder	300-400	55-300*
White Perch	150-250	70-150

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

priority over saving fish for histopathology, any of the first five fish from each target species (in the appropriate size range) showing evidence of pathology are processed for chemistry, not histopathology.

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

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

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

4. To assign a sample number, choose the next number in the series for that event designated as a fish chemistry sample (see Data Base Management section - Section 17). Fish bar codes are supplied in duplicate. Place one bar code on the pack of the data sheet and number the box to correspond with the number on the front of the sheet. Place the twin bar code on a plastic tag and affix to the fish by placing the twist-tie through the mouth and out the operculum.

5. The treatment of fish saved for chemical analysis is dependent on the size of the fish. For fish smaller than 30 cm, gut the fish, wrap it in aluminum foil (with the tag exposed), place all fish of that species in a single zip-lock bag, and place it in a cooler on DRY ICE.

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

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

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

9. Repeat trawling (standardized methods not required) for up to 1½ hours if needed to obtain five individuals of at least one target species. Fish collected in these trawls are processed for chemistry only, however, those fish saved for chemistry are examined for gross external pathology.

NOTE: Target species collected in the secondary size range should be saved until sampling is completed in case five within the primary range are not collected. If an insufficient number in the primary size range are not collected in 1½ hours, then some of those in the secondary range can be processed to bring the number to five.

The portion of the fish used for chemical analysis is mid-fish above the lateral line. Great care must be exercised to assure that the knife does not penetrate below the skin in this area.

13.9.7 Processing of Fish for Gross External Pathological Analyses

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

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

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

3. Record the sample number on the data sheet for subsequent entry into the computer.

13.9.8 Safety Considerations

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

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

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

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

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

13.9.9 Quality Assurance

In order for the net to "fish" properly, the proper amount of winch cable must be let out. Consult Table 13.2 for the proper scope. Care must also be taken to assure that fish are not lost from the net during retrieval.

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

In an attempt to determine the "true" percentage error associated with species identification and the determination of pathological conditions, individuals of each species collected will be preserved in 10% formalin and returned to ERL-N or VERSAR for verification of identification. All fish collected in the Chesapeake Bay and tributaries should be shipped to Versar, and all others to ERL-N.

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

13.9.10 Contingency Plans

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

13.9.11 Collection Permits

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

SECTION 14
PACKAGING AND SHIPPING SAMPLES

After samples are collected, proper packaging and shipping procedures are critical steps in assuring the integrity of the samples. Failure to follow these procedures could result in the loss of valuable data. Each type of sample requires different handling as described below. Packaging and shipping are performed 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.

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 outside of the box. The shipment data sheet should also be completed and sent to the Field Operations Center along with the next shipment of data sheets. Samples that are "hand-carried" require the same paperwork (less the airbill) and tracking as those shipped by commercial carrier.

14.1 Proper Packaging Methods

Proper packaging of samples is critical in assuring they arrive at the receiving laboratory in good condition. During the 1990 Demonstration Project many samples arrived in an unacceptable condition, primarily because of improper packaging. 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 pieced 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.

Each team carries coolers with dry ice and blue ice to keep samples frozen or cool prior to shipment. Blue ice blocks are frozen by placing them on the dry ice. A general rule of thumb supplied by the shipping box supplier is to use at least 20-25 pounds of dry ice for shipments between 20 and 100 pounds ASSUMING THE SAMPLES ARE ALREADY FROZEN. An additional 30 pounds per 100 pounds of fish would be required to freeze samples if they are not 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. During 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 carefully.

Proper storage and shipment conditions are summarized in Table 14.1. Federal Express requires a Dangerous Materials waybill for all shipments of dry ice and formalin.

Table 14.1. 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 DAILY EXCEPT ON WEEKENDS
SEDIMENT CHEMISTRY	REFRIGERATED	* SHIP DAILY EXCEPT ON WEEKENDS
SEDIMENT AVS	REFRIGERATED	* SHIP DAILY EXCEPT ON WEEKENDS
SEDIMENT TOXICITY	REFRIGERATED	* SHIP DAILY EXCEPT ON WEEKENDS
SUSPENDED SOLIDS	REFRIGERATED	* SHIP DAILY EXCEPT ON WEEKENDS
FISH CHEMISTRY	FROZEN	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 daily, or at least as frequently as logistically possible. Samples MUST be shipped at least twice during a six-day shift.

14.2 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 being for protection rather than thermal regulation. As described above, a computer printout of the sample numbers included in this shipment is enclosed in the box. To assure blind processing of the samples, no additional information is provided to the analytical laboratory.

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

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

14.3 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 to prevent the metal tips from piercing one of the other bags.

Whenever possible, grain size samples should be shipped on the day following their collection. At a minimum, they should be shipped twice during a six-day shift. Whirl Packs should be placed into an insulated box 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 Lab.
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Darryl Keith

14.4 Sediment Chemistry Samples

Following collection, sediment samples for 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. The lids of sample bottles should be tightened as necessary, then bottles wrapped in bubble wrap to protect them from breakage. 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 chemistry 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) 569-7155
Attention: Maryan Pennington

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

14.5 Sediment AVS samples

Sediment AVS 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. The lids of sample bottles should be tightened as necessary, and the bottles then be placed in an insulated box with an appropriate amount of blue ice.

All sediment AVS samples must be shipped Federal Express Next Day Service to:

EMAP Sample Processing
U.S. EPA Research Containment Facility
26 West Martin Luther King Drive
Cincinnati, OH 45268
(513) 569-7155
Attention: Maryan Pennington

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

14.6 Sediment Toxicity Samples

Sediment samples collected for sediment toxicity testing must be kept refrigerated (4°C), NOT FROZEN. Sediment toxicity samples should be shipped on the day following collection. Samples collected on weekends can be shipped on the following Monday, providing they are properly stored in the mobile lab. To prepare the samples for shipment, the lids are tightened and taped. Containers are then placed, 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: Glen Thursby

14.7 Fish Chemistry Samples

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

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

EMAP Sample Processing
Texas A & M University / GERG
833 Graham Road
College Station, TX 77845
(409) 690-0095
Attention: James Brooks

14.8 Fish Histopathology Samples

Fish samples retained for histopathological examination are kept preserved in Dietrich's fixative. It is therefore not necessary to ship fish samples daily, 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 Appendix E. 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 is available from the Agent picking up the shipment.

14.9 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. Most samples are shipped to:

EMAP Sample Processing
U.S. EPA Environmental Research Laboratory
27 Tarzwell Drive
Narragansett, RI 02882
(401) 782-3000
ATTN: Jill Schoenherr

Samples collected in the Chesapeake Bay are to be shipped to:

EMAP Sample Processing
Versar Inc.
9200 Rumsey Road
Columbia, MD
(301) 964-9200
ATTN: Willie Burton

14.10 Total Suspended Solids Samples

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 container lids are taped, and the samples placed in a small, insulated box along with blue ice and shipped Federal Express Next Day Service to:

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

14.11 Field Computer Diskettes

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, the mailers placed in a U.S. Mail Express envelope, and the envelope dropped in an Express Mailbox at any Post office. The outside of the envelope should be clearly marked COMPUTER DISKETTES - DO NOT BEND, X-RAY, OR EXPOSE TO MAGNETIC FIELDS.

Diskettes 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 15
CONTINGENCY PLANS

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

15.1 Adverse Weather Conditions

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

Because of the sampling schedule, careful planning by the Crew Chief is critical. Predictions of inclement weather may necessitate the premature removal of Hydrolabs to assure the crew completes their cluster prior to the end of their shift. Likewise, deployments may be delayed, or samples obtained on the second, rather than first visit to a station 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.

15.2 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.

4. Index stations MUST be located in depositional environments. All Index stations are located in small estuaries. If one is inaccessible, or grab samples show the bottom to be inappropriate (anything but mud), the Chief Scientist should relocate the station to an appropriate site anywhere within the small estuarine system. Again, care must be exercised to assure the station is not located near the end of an outfall pipe, or in any other location that could be considered inappropriate for that system.

15.3 Equipment Failure

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

In the event that 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 the spare boat to the crew before sampling begins on the following day.

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

SECTION 16
MAINTENANCE

The importance of proper maintenance of all gear cannot be understated. Failure of any piece of major equipment 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 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 to the FC.

16.1 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. Maintenance of the bar code readers is discussed in Appendix M.

No maintenance is required other than properly exercising the Ni-Cd batteries. Ni-Cd batteries need to be exercised properly to prevent them from loosing their ability to maintain a charge. Once during a shift, the crew member working in the mobile lab will disconnect his/her computer from external power (supplied by the laboratory's battery) and run it off of the computer's Ni-Cd battery until the battery goes completely dead. If the battery is properly charged, this should take two to two and one-half hours. Once the low battery light starts flashing, the operator should save whatever he/she is working on to avoid losing data. After the battery is completely dead, it can be recharged from the truck's battery and later in the hotel room. Complete charging takes approximately 18 hours.

16.2 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.

16.3 Hydrolab DataSonde 3 Data Logger

Probes are checked and cleaned with a brush and detergent, the DO membrane and the batteries replaced, and the unit calibrated following each deployment. QC checks are also performed prior to deployment and immediately following retrieval. All information regarding maintenance is recorded in the equipment log in the computer.

16.4 Boats, Motors and Vehicles

Maintenance on these items are described in Tables 16.1 and 16.2.

Table 16.1. Vehicle maintenance schedule

SERVICE	INTERVAL
Oil Change	
ONAN	After first 20 hrs. then every 50 hours.
BRIGGS	50 hrs.
TRUCK	3,000 miles or 3 months
LAB	3,000 miles or 3 months
155 GEARCASE	100 hrs.
Spark Plug Change	
ONAN	100 hrs.
BRIGGS	100 hrs.
155	50 hrs.
25	First 20 hrs. then 100 hrs
Fuel Filter Chg.	
ONAN	200 hrs
BRIGGS	100 hrs
155	Both filters 100 hrs.

(continued)

Table 16.1. continued.

SERVICE	INTERVAL
Check Tire Pressure and Lugs	
TRUCK	Before change-over
TRAILER	Before change-over
LAB	Before change-over
Check OIL	
ONAN	Daily
BRIGGS	Daily
155	Daily
TRUCK	At gas fill-up
SEASTAR	Before change-over
PULLMASTER	(hyd. oil) Before change-over
Check Trans Fluid	
TRUCK	At gas fill-up
LAB	Before change-over

(continued)

Table 16.1. continued.

SERVICE	INTERVAL
Fresh Rinse	
BRIGGS	Daily
PULLMASTER	Daily
155	Daily
TRAILER	Daily
25	Daily when exposed
Grease Hubs and Actuator	Before change-over
Clean Air Filter	
ONAN	50 hrs.
BRIGGS	100 hrs.
Spray with anti-corrosion spray	
BRIGGS	(Before change-over
PULLMASTER	after fresh
155	rinse)

(continued)

Table 16.1. continued.

SERVICE	INTERVAL
Check 155 tilt tubes for salt deposits	Before change-over
Grease cylinder studs on tilt	When free of grease
Inspect bow of vessel for cracks	Before change-over
Inject tuner cleaner	50 hrs.
Fuel conditioner for vessel gas	Every fill-up

Table 16.2. Maintenance Supply Specifications

ONAN LUBE OIL -- 10 W 40 High Detergent CC or CD Service

BRIGGS LUBE OIL -- 10 W 40 or 10 W 30 High Detergent

TRUCK and LAB LUBE OIL -- 10 W 30

LOWER UNIT OIL -- OMC High Viscosity Gearcase Lube

STEERING UNIT (SEASTAR) OIL -- Seastar Hydraulic Oil

TWO CYCLE OUTBOARD OIL -- OMC Outboard Lubricant

FUEL CONDITIONER -- OMC 2 + 4 Fuel Conditioner

OUTBOARD MOTOR GREASE -- OMC Triple Guard Grease

TRAILER WHEEL GREASE -- OMC Wheel Bearing Grease or High Speed Bearing Grease

INJECTOR TUNER -- OMC Tuner

POWER TILT-TRIM FLUID -- OMC Power Tilt-Trim Fluid

155 SPARK PLUGS -- Champion 77JC4 (Torque 18 - 20 ft. lbs.)

25 SPARK PLUGS -- Champion L78V or QL16V (Torque 17 - 20 ft. lbs.)

ONAN SPARK PLUGS -- NGK BPR6HS or equivalent

BRIGGS SPARK PLUGS -- Champion J19LM

TRUCK TIRE PRESSURE -- 80 psi.

TRAILER TIRE PRESSURE -- 100 psi.

LAB TIRE PRESSURE -- 65 psi.

SECTION 17
FIELD DATA BASE MANAGEMENT

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

Experience gained during the 1990 Demonstration Project demonstrated that the field computers were capable of withstanding the rigors of boat operations. In 1991 the use of the computer system is 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 K). 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.

17.1 Events Numbering

Unique event numbers (Table 17.1) have been assigned to each station class (including extras), to quality assurance/quality control (QA/QC) sediment chemistry samples, and to crew training (dry run) events. An event is defined as: 1) Two visits to a BSS, BSS/ITE, or BSS/LTT station, or 2) One visit to an IND or LTS station. All event numbers for the VA91 sampling season consist of four digits beginning with a "1" and followed by three digits ranging from "000" to "255". An additional event number (1300) was assigned to BSS/ITE station reference histopathology fish since the number of samples collected is not predictable.

Table 17.1. Event Numbers.

Station Class	Event Number Range
Chemistry QA/QC Duplicates	1000-1009
BSS, BSS/ITE, BSS/LTT	1010-1145
Reference Lab Duplicates Set 1	1146-1155
Reference Lab Duplicates Set 2	1156-1165
LTS	1166-1183
IND	1184-1225
Crew Training (Dry Runs)	1226-1255
BSS/ITE Reference Pathology Fish	1300

Sediment QA/QC samples will be collected at approximately 5% of the VA91 stations. The station numbers for QA/QC sampling are not pre-determined--crews will be notified the night before a QA sampling event. Crews will be supplied in the beginning of the sampling season with envelopes containing barcode labels for the QA/QC sample events. A blind numbering scheme consisting of three dummy events per QA/QC station has been developed for these QA sample collections. The purpose of this scheme is to prevent the laboratory performing the chemical analyses from knowing that they are analyzing duplicate samples from the same station. Event numbers for QA/QC samples were assigned as close as possible to the real event numbers of the EMAP samples to avoid alerting the chemistry labs of the presence of QA/QC samples.

The QA/QC sampling scheme involves the collection of one duplicate each of the sediment chemistry and sediment AVS samples per dummy event (total of six QA/QC samples). The SAMPLEIDs for the duplicate chemistry and chemistry AVS samples collected for one of the dummy events will end in the same three digits as the samples collected for the real event--"010" and "011". These four sediment samples, which appear to be from two different stations since they have two different event numbers, plus the QA blank bottle (assigned the SAMPLEID ending in "012" in the real event sample number sequence) will be sent to the laboratory performing the routine sediment chemistry analyses. The four duplicate sediment chemistry and AVS samples collected for the other two dummy events will be sent to the reference laboratory for analysis. The SAMPLEIDs for the reference laboratory samples will end in "013" and "014".

17.2 SAMPLEIDs and Sample Numbers

All samples collected are assigned a unique SAMPLEID. With the exception of shipment SAMPLEIDs and equipment numbers, SAMPLEIDs always consist of seven digits beginning with the four-digit event number followed by a three-digit sample number. Each sample type to be collected is associated with a specific three-digit sample number (see Table 17.2). Sample numbers were assigned primarily to samples which are collected at all station classes and which must be tracked physically. SAMPLEIDs for these physical samples are barcoded to facilitate data entry by the field crews and reduce the possibility of data transcription errors. Crews will be provided with three barcode readers and envelopes containing all of the barcodes for an event.

Sample numbers were also assigned to activities which have data associated with them. These activities include CTD casts and Hydrolab deployments, which generally have large amounts of water quality data associated with them, and fish trawls, which may have data for a large number of individual fish. CTD casts have been assigned two sample numbers per event, since one CTD cast is performed at each of the two visits to BSS, BSS/LTT, and BSS/ITE stations. Hydrolab deployments have been assigned one sample number per event--this number will refer to both deployment and retrieval activities. Two fish trawl sample numbers have been assigned per event: one for the standard fish trawl for species composition, chemistry, and pathology fish, and another for additional chemistry fish. These trawl sample numbers will be used to link data for individual fish to a specific trawl.

Sample numbers have been pre-assigned to each of five fish collected plus a composite for five target species. The sample numbers for individual fish will end in the digits 1, 2, 3, 4, and 5 in the range of 020 through 070. Sample numbers in this range ending in the digits 6-9 will be extras for any additional fish collected and saved (pathology fish, for example). All of these fish may not be collected at a station; since barcodes will be applied to each fish, it was necessary to order a sufficient quantity of barcodes to label chemistry fish collected during a "typical" event. Duplicates of these barcodes were also ordered for application to the back of fish pathology data sheets.

Chemical analysis will be performed on a composite of tissue samples from the five individual chemistry fish of a species. Therefore, it is necessary to assign a composite number to allow the tracking of the results from these composites and to allow the tracing of the composite results to individual fish. The chemistry composite number for a species will be assigned the sample number ending with the digit 0 in the same tens digit range as the individual fish. For example, the sample numbers for individual chemistry fish of the first target species collected would be 021-025, and the composite number for these fish would be 020.

Research samples collected during the VA91 sampling season will be tracked using EMAP SAMPLEIDs. Sample numbers in the range 071-099 have been assigned to research samples collected during an event, but no barcodes will be applied to these samples. The nature of these samples will vary and cannot be determined at this time.

Shipment SAMPLEIDs are the only SAMPLEIDs which do not consist of seven digits. The range assigned to shipment SAMPLEIDs is from 810000 through 820999.

Hydrolab and CTD units will have EMAP barcodes applied to them for data tracking purposes. Whenever a barcode number is required on a data sheet or in a computer program for these equipment, use this EMAP barcode number. The range of these numbers is 802497-802536 for the 40 Hydrolab units and 802537, 648222-648224 for the four CTD units.

Table 17.2. Sample Numbers

Sample Number	Description	Barcode Used?	Stations Collected
000	DISKETTE	YES	ALL
001	SUSP SOLIDS	YES	ALL
002	GRAB 1-GRAIN SIZE	YES	ALL
003	GRAB 1-BENTHOS	YES	ALL
004	GRAB 2-GRAIN SIZE	YES	ALL
005	GRAB 2-BENTHOS	YES	ALL
006	GRAB 3-GRAIN SIZE	YES	ALL
007	GRAB 3-BENTHOS	YES	ALL
008	SEDIMENT TOXICITY	YES	ALL
009	SEDIMENT GRAIN SIZE	YES	ALL
010	SEDIMENT CHEMISTRY	YES	ALL
011	SEDIMENT AVS	YES	ALL
012	QA/QC BLANK (OR EXTRA)	YES	QA/QC
010	SEDIMENT CHEMISTRY DUPLICATE	YES	QA/QC
013	SED CHEM REF LAB DUPLICATE 1	YES	QA/QC
013	SED CHEM REF LAB DUPLICATE 2	YES	QA/QC
011	SEDIMENT AVS DUPLICATE	YES	QA/QC
014	SED AVS REF LAB DUPLICATE 1	YES	QA/QC
014	SED AVS REF LAB DUPLICATE 2	YES	QA/QC
015-019	EXTRA	YES	
020	FISH CHEM SPEC. 1 COMPOSITE	YES, w/ DUPLICATE	ALL BUT LTS
021-025	FISH CHEM SPEC. 1 FISH 1-5	YES, w/ DUPLICATES	ALL BUT LTS
026-029	EXTRA	YES, w/ DUPLICATES	
030	FISH CHEM SPEC. 2 COMPOSITE	YES, w/ DUPLICATE	ALL BUT LTS
031-035	FISH CHEM SPEC. 2 FISH 1-5	YES, w/ DUPLICATES	ALL BUT LTS
036-039	EXTRA	YES, w/ DUPLICATES	
040	FISH CHEM SPEC. 3 COMPOSITE	YES, w/ DUPLICATE	BSS, ITE
041-045	FISH CHEM SPEC. 3 FISH 1-5	YES, w/ DUPLICATES	BSS, ITE
046-049	EXTRA	YES, w/ DUPLICATES	

TABLE 17.2, continued.

Sample Number	Description	Barcode Used?	Stations Collected
050	EXTRA, OR FISH CHEM SPEC. 4 COMP.	YES, w/ DUPLICATE	BSS, ITE
051-055	FISH CHEM SPEC. 4 OR PATH0L. FISH	YES, w/ DUPLICATE	BSS, ITE
056-059	EXTRA	YES, w/ DUPLICATES	
060	EXTRA, OR FISH CHEM SPEC. 5 COMP.	YES, w/ DUPLICATE	BSS, ITE
061-065	FISH CHEM SPEC. 5 OR PATHOL. FISH	YES, w/ DUPLICATE	BSS, ITE
066	CTD CAST DAY 1	NO	ALL
067	CTD CAST DAY 2	NO	BSS, ITE
068	HYDROLAB DEPLOYMENT	NO	BSS, ITE
069	FISH TRAWL 1 - STANDARD	NO	BSS, ITE
070	FISH TRAWL 2 - CHEMISTRY	NO	ALL BUT LTS
071-099	RESEARCH SAMPLES	NO	VARIES
1300000-1300999	ITE STATION REF. PATH. FISH	YES, w/ DUPLICATES	ITE
810000-820999	SHIPMENT	YES	
802497-802536	HYDROLAB UNITS	YES	
802537, 648222-648224	CTD UNITS	YES	

SECTION 18
QUALITY ASSURANCE

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

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

QA steps performed on field activities are:

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

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

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

4. Guidelines for packaging and shipping must be followed.

5. Fish will be saved and shipped to ERLN or Versar for identification by experts. The purpose of this is to attempt to determine the true percentage error in identifications.

SECTION 19
LOST GEAR

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

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

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

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

19.1 Recovery of a DataSonde Mooring

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

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

19.2 Recovery of a CTD

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

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

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

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

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

19.3 Recovery of a Grab Sampler

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.

SECTION 20
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.

20.1 Routine Garbage

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

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

20.2 Detergent Washes

Detergent is used in the 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.

20.3 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.

20.4 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 21
CONTACT PERSONNEL

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

In the event that the Field Coordinator is not available, the 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 COORDINATOR
MR. CHARLES STROBEL
1-(800)-732-2305 (FIELD OPERATIONS CENTER)
(401) 364-7457 (HOME)

PROJECT MANAGER
MR. STEVEN SCHIMMEL
1-(800)-732-2305 (FIELD OPERATIONS CENTER)
(401) 789-5269 (HOME)

SECTION 22
REFERENCES

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