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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM-SURFACE WATERS:

FIELD OPERATIONS AND METHODS FOR MEASURING THE ECOLOGICAL CONDITION OF WADEABLE STREAMS

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SECTION 2
OVERVIEW OF FIELD OPERATIONS

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This section presents a general overview of the activities a 4-person field team conducts during a typical one-day sampling visit to a stream site. General guidelines for recording data and using standardized field data forms and sample labels are also presented. Finally, safety and health considerations and guidelines related to field operations are provided.

2.1 DAILY OPERATIONAL SCENARIO

The field team is divided into two groups, termed the "Geomorphs" and the "Biomorphs," that reflect their initial responsibilities more than their expertise. The geomorphs are primarily responsible for conducting the intensive physical habitat characterization. The biomorphs are primarily responsible for collecting biological samples. Table 2-1 provides the estimated time required to conduct various field activities. Figure 2-1 presents the general sequence of activities conducted at each stream reach.

Upon arrival at a stream site, the geomorphs are responsible for verifying and documenting the site location, determining the length of stream reach to be sampled, and establishing the required transects (Section 4). The biomorphs collect samples and field measurements for water chemistry (Section 5) and determine stream discharge (Section 6). The biomorphs also collect sediment for the sediment metabolism determination (Section 9)

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TABLE 2-1. ESTIMATED TIMES AND DIVISION OF LABOR FOR FIELD ACTIVITIES

Activity	Group	Est. Time Required
Site verification and establishing sampling reach and transects	Geomorphs (2 persons)	2 hours
Water chemistry sampling and stream discharge determination	Biomorphs (2 persons)	1 hour
Collecting and processing benthos, periphyton and sediment metabolism samples	Biomorphs (2 persons)	3.5 hours
Intensive physical habitat characterization	Geomorphs (2 pesons)	2 to 3 hours
Aquatic vertebrate sampling and processing	Geomorphs and Biomorphs (4 persons)	2 to 5 hours
Rapid habitat assessment Visual stream assessment	Biomorphs (2 persons)	0.5 hours
Sample tracking and packing	Geomorphs (2 persons)	1 hour
SUMMARY	28 to 32 person-hours	7 to 8 hours per team

and sediment toxicity testing (Section 10), and collect periphyton and benthos samples (Sections 8 and 11, respectively). The geomorphs conduct the intensive physical habitat characterization (Section 7). Both groups are involved with collecting aquatic vertebrates (Section 12) and preparing samples for fish tissue contaminants (Section 13). Finally, the biomorphs conduct a habitat characterization based on the Rapid Bioassessment Protocols (RBP; Plafkin et al., 1989) and a visual stream assessment (Section 14), while the geomorphs prepare samples for transport and shipment (Section 3).

2.2 GUIDELINES FOR RECORDING DATA AND INFORMATION

During the one-day visit to a stream, a field team is required to obtain and record a substantial amount of data and other information for all of the various ecological indicators described in Section 1.3. In addition, all the associated information for each sample collected must be recorded on labels and field data forms to ensure accurate tracking and subsequent linkage of other data with the results of sample analyses.

It is imperative that field and sample information be recorded accurately, consistently, and legibly. Measurement data that cannot be accurately interpreted by others

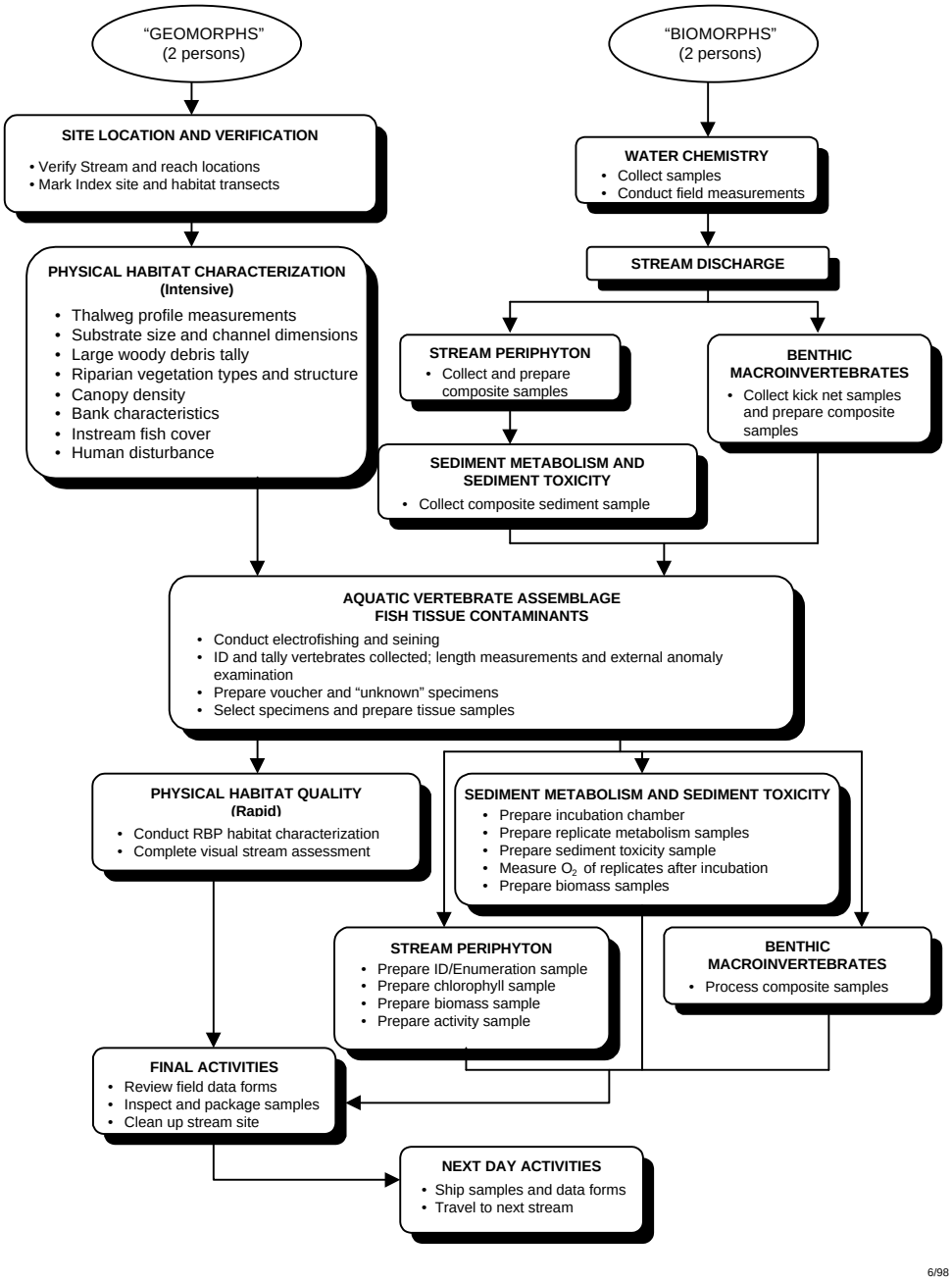

Figure 2-1. General sequence of stream sampling activities (modified from Chaloud and Peck, 1994).

besides the field teams, and/or samples with incorrect or illegible information associated with them, are lost to the program. The cost of a sampling visit coupled with the short index period severely limits the ability to re-sample a stream because the initial information recorded was inaccurate or illegible. Some guidelines to assist field personnel with recording information are presented in Table 2-2. Examples of completed data forms and labels are presented in the sections describing field sampling and measurement procedures for different indicators, and a complete set of blank field data forms are included as Appendix C.

2.3 SAFETY AND HEALTH

Collection and analysis of samples (e.g., benthic invertebrates, fish, periphyton, sediment) can involve significant risks to personal safety and health (drowning, electrical shock, pathogens, etc.). While safety is often not considered an integral part of field sampling routines, personnel must be aware of unsafe working conditions, hazards connected with the operation of sampling gear, boats, and other risks (Berry et al., 1983). Personnel safety and health are of the highest priority for all investigative activities and must be emphasized in safety and health plans for field, laboratory, and materials handling operations. Preventive safety measures and emergency actions must be emphasized. Management should assign health and safety responsibilities and establish a program for training in safety, accident reporting, and medical and first aid treatment. Safety documents and standard operating procedures (SOPs) containing necessary and specific safety precautions should be available to all field personnel. Additional sources of information regarding field and laboratory safety related to biomonitoring studies include Berry et al. (1983), U.S. EPA (1986) and Ohio EPA (1990).

2.3.1 General Considerations

Important considerations related to field safety are presented in Table 2-3. It is the responsibility of the group safety officer or project leader to ensure that the necessary safety courses are taken by all field personnel and that all safety policies and procedures are followed. Sources of information regarding safety-related training include the American Red Cross (1989), the National Institute for Occupational Safety and Health (1981), U.S. Coast Guard (1987) and Ohio EPA (1990).

Persons using sampling devices should become familiar with the hazards involved and establish appropriate safety practices prior to using them. Individuals involved in electrofishing must be trained by a person experienced in this method or by attending a

TABLE 2-2. GUIDELINES FOR RECORDING FIELD DATA AND OTHER INFORMATION

Activity	Guidelines
Field Measurements:	
Data Recording	Record measurement values and/or observations on data forms preprinted on water-resistant paper. Record information on forms using No. 2 pencil only. Erase mistakes completely and write the correct value whenever you can. If you must line out an incorrect value, place the correct value nearby so the data entry operator can easily find it. Headers on the second pages of all forms link the data. Fill in all headers of all pages or data will be lost (this is a good one to review at the end of the day). Record data and information so that all entries are obvious. Enter data completely in every field that you use. Follow the "comb" guidelines--print each number or letter in the individual space provided. Keep letters and numerals from overlapping. Record data to the number of decimal places provided on the forms. Illegible information is equivalent to no information. Print neatly, using block capital letters in alphabetical fields. Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.). Do not put lines through 7's, 0's, or Z's. Do not use slashes. Record information on each line, even if it has to be recorded repeatedly on a series of lines (e.g., fish species codes or physical habitat characteristics). Do not use "ditto marks" (") or a straight vertical line. When recording comments, print or write **legibly**. Make notations in comments field only. Avoid marginal notes, etc. Be concise, but avoid using abbreviations and/or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided on the form.
Data Qualifiers (Flags)	Use only defined flag codes and record on data form in appropriate field. K Measurement not attempted and/or not recorded. Q Failed quality control check; re-measurement not possible. U Suspect measurement; re-measurement not possible. F*n* Miscellaneous flags (*n*=1, 2, etc.) assigned by a field team during a particular sampling visit (also used for qualifying samples). Explain all flags in comments section on data form.
Review of Data Forms	Field team reviews data forms for accuracy, completeness, and legibility before leaving a stream. Data forms from all teams are reviewed for completeness, accuracy, and legibility before transfer to the information management staff.

(continued)

TABLE 2-2 (Continued)

Activity	Guidelines
Sample Collection and Tracking	
Sample Labels	Use adhesive labels with preprinted ID numbers and a standard recording format for each type of sample. Record information on labels using a fine-point indelible marker. Cover completed labels with clear tape.
Sample Collection Information	Record sample ID number from the label and associated collection information on sample collection form preprinted on water-resistant paper. Record information on field data forms using No. 2 pencil only (fine-point indelible fine-tipped markers can be used if necessary). Record collection information using correct format as provided on the collection form.
Sample Qualifiers (Flags)	Use only defined flag codes and record on sample collection form in appropriate field. K Sample not collected or lost before shipment; re-sampling not possible. U Suspect sample (e.g., possible contamination, does not meet minimum acceptability requirements, or collected using a nonstandard procedure) F*n* Miscellaneous flags (*n*=1, 2, etc.) assigned by a field team during a particular sampling visit (also used for field measurements). Explain all flags in comments section on sample collection form.
Review of Labels and Collection Forms	The field team compares information recorded on labels and sample collection form for accuracy before leaving a stream. The field team reviews labels and collection form for accuracy, completeness, and legibility before leaving a stream. Sample collection forms are reviewed for completeness, accuracy, and legibility before transfer to the information management staff.

If boats are used to access sampling sites, personnel must consider and prepare for hazards associated with the operation of motor vehicles, boats, winches, tools, and other incidental equipment. Boat operators should be familiar with U.S. Coast Guard rules and regulations for safe boating contained in a pamphlet, "Federal Requirements for Recreational Boats, " available from a local U.S. Coast Guard Director or Auxiliary or State Boating Official (U.S. Coast Guard, 1987). All boats with motors must have fire extinguishers, boat horns, life jackets or flotation cushions, and flares or communication devices.

A communications plan to address safety and emergency situations is essential. All field personnel need to be fully aware of all lines of communication. Field personnel should

TABLE 2-3. GENERAL HEALTH AND SAFETY CONSIDERATIONS

Training:
! First aid
! Cardiopulmonary resuscitation (CPR)
! Vehicle safety (e.g., operation of 4-wheel drive vehicles)
! Boating and water safety (if boats are required to access sites)
! Field safety (e.g., weather conditions, personal safety, orienteering, reconnaissance of sites prior to sampling
! Equipment design, operation, and maintenance
! Electrofishing safety
! Handling of chemicals and other hazardous materials
Communications
! Check-in schedule
! Sampling itinerary (vehicle used and its description, time of departure, travel route, estimated time of return)
! Contacts for police, ambulance, fire departments, search and rescue personnel
! Emergency services available near each sampling site and base location
Personal Safety
! Field clothing and other protective gear
! Medical and personal information (allergies, personal health conditions)
! Personal contacts (family, telephone numbers, etc.)
! Physical exams and immunizations

certified electrofishing training course. Reynolds (1983) and Ohio EPA (1990) provide additional information regarding electrofishing safety procedures and practices. have a daily check-in procedure for safety. An emergency communications plan should include contacts for police, ambulance, fire departments, and search and rescue personnel.

Proper field clothing should be worn to prevent hypothermia, heat exhaustion, sun-stroke, drowning, or other dangers. Field personnel should be able to swim. Chest waders made of rubberized or neoprene material and suitable footwear must always be worn with a belt to prevent them from filling with water in case of a fall. The use of a life jacket is advisable at dangerous wading stations if one is not a strong swimmer because of the possibility of sliding into deep water.

Many hazards lie out of sight in the bottoms of lakes, rivers and streams. Broken glass or sharp pieces of metal embedded in the substrate can cause serious injury if care is not exercised when walking or working with the hands in such environments. Infectious agents and toxic substances that can be absorbed through the skin or inhaled may also be present in the water or sediment. Personnel who may be exposed to water known or suspected to contain human or animal wastes that carry causative agents or pathogens must be immunized against tetanus, hepatitis, typhoid fever, and polio. Biological wastes can also be a threat in the form of viruses, bacteria, rickettsia, fungi, or parasites.

Prior to a sampling trip, personnel should determine that all necessary equipment is in safe working condition. Good housekeeping practice should be followed in the field. These practices protect staff from injury, prevent or reduce exposure to hazardous or toxic substances, and prevent damage to equipment and subsequent down time and/or loss of valid data.

2.3.2 Safety Equipment and Facilities

Appropriate safety apparel such as waders, lab coats, gloves, safety glasses, etc. must be available and used when necessary. Bright colored caps (e.g., orange) must be available and worn during field activities. First aid kits, fire extinguishers, and blankets must be readily available in the field. A properly installed and operating fume hood must be provided in the laboratory for use when working with carcinogenic chemicals (e.g., formaldehyde, formalin) that may produce dangerous fumes. Cellular telephones or portable radios should be provided to field teams working in remote areas for use in case of an emergency. Facilities and supplies must be available for cleaning of exposed body parts that may have been contaminated by pollutants in the water. Soap and an adequate supply of clean water or ethyl alcohol, or equivalent, should be suitable for this purpose.

2.3.3 Safety Guidelines for Field Operations

General safety guidelines for field operations are presented in Table 2-4. Personnel participating in field activities on a regular or infrequent basis should be in sound physical condition and have a physical exam annually or in accordance with Regional, State, or organizational requirements. All surface waters and sediments should be considered potential health hazards due to toxic substances or pathogens. Persons must become familiar with the health hazards associated with using chemical fixing and/or preserving agents. Formaldehyde (or formalin) is highly allergenic, toxic, and dangerous to human

TABLE 2-4. GENERAL SAFETY GUIDELINES FOR FIELD OPERATIONS

- **!** Two persons (three to four persons for electrofishing) must be present during all sample collection activities, and no one should be left alone while in the field.
- **!** Exposure to stream water and sediments should be minimized as much as possible. Use gloves if necessary, and clean exposed body parts as soon as possible after contact.
- **!** All electrical equipment must bear the approval seal of Underwriters Laboratories and must be properly grounded to protect against electric shock.
- **!** Use heavy gloves when hands are used to agitate the substrate during collection of benthic macroinvertebrate samples and when turning over rocks during hand picking.
- **!** Use appropriate protective equipment (e.g., gloves, safety glasses) when handling and using hazardous chemicals
- **!** Persons working in areas where poisonous snakes may be encountered must check with the local Drug and Poison Control Center for recommendations on what should be done in case of a bite from a poisonous snake.

  If local advice is not available and medical assistance is more than an hour away, carry a snake bite kit and be familiar with its use.
- **!** Any person allergic to bee stings, other insect bites, or plants must take proper precautions and have any needed medications handy.
- **!** Field personnel should also protect themselves against the bite of deer or wood ticks because of the potential risk of acquiring pathogens that cause Rocky Mountain spotted fever and Lyme disease.
- **!** All field personnel should be familiar with the symptoms of hypothermia and know what to do in case symptoms occur. Hypothermia can kill a person at temperatures much above freezing (up to 10^{o}C or 50^{o}F) if he or she is exposed to wind or becomes wet.
- **!** Handle and dispose of chemical wastes properly. Do not dispose any chemicals in the field.

health (carcinogenic) if utilized improperly. Chemical wastes can cause various hazards due to flammability, explosiveness, toxicity, causticity, or chemical reactivity. All chemical wastes must be discarded according to standardized health and hazards procedures (e.g., National Institute for Occupational Safety and Health [1981]; U.S. EPA [1986]).

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