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ENVIRONMENTAL MONITORING AND ASSESSMENT PROGRAM-SURFACE WATERS:

WESTERN PILOT STUDY
FIELD OPERATIONS MANUAL FOR
WADEABLE STREAMS

Edited by

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SECTION 4
INITIAL SITE PROCEDURES

by
Alan T. Herlihy[1]

When a field team first arrives at a stream site, they must first confirm they are at the correct site. Then they determine if the stream meets certain criteria for sampling and data collection activities to occur. They must decide whether the stream is unduly influenced by rain events which could affect the representativeness of field data and samples. Certain conditions at the time of the visit may warrant the collection of only a subset of field measurements and samples. Finally, if it is determined that the stream is to be sampled, the team lays out a defined reach of the stream within which all subsequent sampling and measurement activities are conducted.

Table 4-1 summarizes modifications to procedures from those published previously for EMAP-SW by Herlihy (1998), and from EMAP-WP field activities in 2000. Modifications from Herlihy 91998) include providing guidance for sampling streams that are partially wadeable (Section 4.3.2), and for wide streams with braided channels (Section 4.3.3). Changes from EMAP-WP 2000 activities include not collecting any field data at stream sites having completely dry reaches, and modifying the field data form for use with streams that are either determined to be non-target before a field visit, or that are non-target when visited.

4.1 SITE VERIFICATION ACTIVITIES

4.1.1 Locating the Index Site

Stream sampling points were chosen from the “blue line” stream network represented on 1:100,000- scale USGS maps, following a systematic randomized selection process developed for EMAP stream sampling. Sample sites were then marked with an "X" on finer-resolution 1:24,000-scale USGS maps. This spot is referred to as the “index site”

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TABLE 4-1. SUMMARY OF CHANGES IN INITIAL SITE PROCEDURES FOR THE WESTERN PILOT STUDY

Changes from Herlihy (1998)
4. Developed guidance for sampling streams that are partially wadeable.
5. Developed guidance for how to sample streams that have braided channels..
Changes from Year 2000 Western Pilot Study Activities
1. Field data are non longer collected at sites where the entire sampling reach is dry when visited. They are now classified as non-sampleable
2. The field data form has been revised to deal more clearly with sites that are either determined to be non-target before a field visit or at the time of the visit, ncluding those that are temporarily inaccessible and can be visited again in a future year.
3. Site coordinates can be recorded in DMS or decimal degree format to accomodate different types of GPS units or other data recording requirements of EMAP-WP participants..

or "**X-site**". The latitude/longitude of the X-site will be listed on a stream information sheet that is part of the dossier compiled for each stream (see Section 3).

Complete a verification form for each stream visited (regardless of whether you end up sampling it), following the procedures described in Table 4-2. While traveling from a base location to a site, record a detailed description of the route taken on page 1 of the Verification Form (Figure 4-1). This information will allow others to find the site again in the future. Upon reaching the X-site for a stream, confirm its location and that the team is at the correct stream. Use all available means to accomplish this, and record the information on page 1 of the Verification Form (Figure 4-1).

4.1.2 Determining the Sampling Status of a Stream

Not all chosen stream sites will turn out to be streams. On the basis of previous synoptic surveys, it was found that the maps are far from perfect representations of the stream network. A significant part of EMAP is the estimation of the actual extent of stream length in the area. After the stream and location of the X-site are confirmed, evaluate the stream reach surrounding the X-site and classify the stream into one of three major sampling status categories (Table 4-2). The primary distinction between "Sampleable" and

TABLE 4-2. SITE VERIFICATION PROCEDURES

1. Find the stream location in the field corresponding to the "X" marked on a 7.5" topographic map (X-site) that is provided with the dossier for each site. Record the routes taken and other directions on the Verification Form so that someone can visit the same location in the future.

2. If available, use a GPS receiver to confirm the latitude and longitude at the X-site against the coordinates provided in the dossier for the site. Record these on the Verification Form.

3. Use all available means to insure that you are at the correct stream as marked on the map, including: 1:24,000 USGS map orienteering, topographic landmarks, county road maps, local contacts, etc.

4. Scan the stream channel upstream and downstream **from the X-site**, decide if the site is sampleable and mark the appropriate box on the verification form. Assign one of the following sampling status categories to the stream. Record the category on the Verification Form.

Sampleable Categories

Boatable: The site can be sampled by boat following non-wadeable river protocols
Partial Boatable/ Wadeable: Over half the reach cannot be safely sampled by wadeable protocols AND the reach is inaccessible to boat sampling due to barriers or water velocity/depth. Sample using modified procedures.
Wadeable: The stream can be sampled with wadeable stream protocols, continuous water flow and > 50% of the sample reach is wadeable.
Interrupted: The flow of water is not continual, but there is water in the sample reach (e.g. isolated pools). Sample using modified procedures. Record as Wadeable Interrupted or Boatable Interrupted.
Altered Channel: There is a stream at the location marked with the X-site on the map, but the stream channel does not appear the way it is drawn on the map. An example would be a channel rerouting following a flood event that cut off a loop of the stream. Establish a new X-site at the same relative position in the altered channel. Make careful notes and sketches of the changes on the Verification Form.

Non-Sampleable Categories

Dry Channel: A discernible stream channel is present but there is no water in the sample reach. If determined in the field, record on the field form as "Dry-Visited"; if site was determined to be dry from some other source and not field verified, record as "Dry-Not visited".
Wetland (No definable stream channel): There is standing water present, but no definable stream channel. In cases of wetlands surrounding a stream channel, define the site as Target but restrict sampling to the stream channel.
Map Error: No water body or stream channel is present at the coordinates provided for the X-site.
Impounded stream: The stream is submerged under a lake or pond due to man-made or natural (e.g., beaver dam) impoundments. If the impounded stream, however, is still wadeable, record the stream as Altered and sample.
NON-SAMPLEABLE-TEMPORARY: A site that should be sampled but wasn't because the crew did not have the right equipment. Examples are a boatable river visited by a wadeable stream crew without rafts (or vice versa).

No Access to Site Categories

Access Permission Denied: You are denied access to the site by the landowners.
Permanently Inaccessible: Site is unlikely to be sampled by anyone due to physical barriers that prevent access to the site (e.g., cliffs).
Temporarily Inaccessible: Site cannot be reached at the present time due to barriers that may not be present at some future date (e.g. forest fire, high water, road temporarily closed)

5. Do not sample non-target or "Non-sampleable" or "No Access" sites. Place an "X" in the "NO" box for "Did you sample this site?" and check the appropriate box in the "NON-SAMPLEABLE" or "NO ACCESS" section of the Verification Form; provide detailed explanation in comments section.

STREAM VERIFICATION FORM - STREAMS/RIVERS

Reviewed by (initial): DP

SITE NAME: PILOT CREEK DATE: 07/01/2001 VISIT: 0 (1) 2 3

SITE ID: WXXP99-9999 TEAM: XX-1

STREAM/RIVER VERIFICATION INFORMATION

Stream/River Verified by (X all that apply): ☒ GPS ☐ Local Contact ☐ Signs ☐ Roads ☒ Topo. Map
☐ Other (Describe Here): ☐ Not Verified (Explain in Comments)

Coordinates		Latitude North	Longitude West	Type of GPS Fix	Are GPS Coordinates w/i 10 Sec. of map?
MAP	Degrees, Minutes, and Seconds OR Decimal Degrees	38 10 25	114 25 10	☐ 2D ☒ 3D	☒ Yes ☐ No
GPS	Degrees, Minutes, and Seconds OR Decimal Degrees	38 10 26	114 25 15		

DID YOU SAMPLE THIS SITE?

☒ YES If YES, check one below

SAMPLEABLE (Choose method used)
- ☒ Wadeable - Continuous water, greater than 50% wadeable
- ☐ Boatable
- ☐ Partial - Sampled by wading (Explain in comments)
- ☐ Partial - Sampled by boat (Explain in comments)
- ☐ Wadeable Interrupted - Not continuous water along reach
- ☐ Boatable Interrupted - Not continuous water along reach
- ☐ Altered - Stream/River Present but not as on Map

☐ NO If NO, check one below

NON-SAMPLEABLE-PERMANENT
- ☐ Dry - Visited
- ☐ Dry - Not visited
- ☐ Wetland (No Definable Channel)
- ☐ Map Error - No evidence channel/waterbody ever present
- ☐ Impounded (Underneath Lake or Pond)
- ☐ Other (explain in comments)

NON-SAMPLEABLE-TEMPORARY
- ☐ Not boatable - Need a different crew
- ☐ Not wadeable - Need a different crew
- ☐ Other (Explain in comments)

NO ACCESS
- ☐ Access Permission Denied
- ☐ Permanently Inaccessible (Unable/Unsafe to Reach Site)
- ☐ Temporarily Inaccessible-Fire, etc. (Explain in comments)

GENERAL COMMENTS:

DIRECTIONS TO STREAM/RIVER SITE: From Barnesville, go East on County Road 996 ~5 miles to Smithtown Road. Turn South and travel 0.6 miles to gravel road on left. Turn onto gravel road and drive 0.5 miles to house on right side of road. Owner will unlock gate to road leading to stream near the X-site location.

Record information used to define length of reach, and sketch general features of reach on reverse side.

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Figure 4-1. Verification Form (page 1).

"Non-Sampleable" streams is based on the presence of a defined stream channel and water content.

Record the site class and pertinent site verification information on the Verification Form (Figure 4-1). If the site is non-sampleable or inaccessible, the site visit is completed, and no further sampling activities are conducted.

4.1.3 Sampling During or After Rain Events

Avoid sampling during high flow rainstorm events. For one, it is often unsafe to be in the water during such times. In addition, biological and chemical conditions during episodes are often quite different from those during baseflow. On the other hand, sampling cannot be restricted to only strict baseflow conditions. It would be next to impossible to define "strict baseflow" with any certainty at an unstudied site. Such a restriction would also greatly shorten the index period when sampling activities can be conducted. Thus, some compromise is necessary regarding whether to sample a given stream because of storm events. To a great extent, this decision is based on the judgment of the field team. Some guidelines to help make this decision are presented in Table 4-3. The major indicator of the influence of storm events will be the condition of the stream itself. If a field team decides a site is unduly influenced by a storm event, do not sample the site that day. Notify the field coordinator or other central contact person to reschedule the stream for another visit.

4.1.4 Site Photographs

Taking site photographs is an optional activity, but should be considered if the site has unusual natural or man-made features associated with it. If you do take any photographs at a stream, start the sequence with one photograph of an 8.5 × 11 inch piece of paper with the stream ID, stream name, and date printed in large letters. After the photo of the stream ID information, take at least two photographs at the X-site, one in the upstream direction and one downstream. Take any additional photos you find interesting after these first three pictures. For pictures of aquatic vertebrates (see Section 12) or other small objects, place the paper with the stream ID and date in each snapshot.

4.2 LAYING OUT THE SAMPLING REACH

Unlike chemistry, which can be measured at a point, most of the biological and habitat structure measures require sampling a certain length of a stream to get a represen

TABLE 4-3. GUIDELINES TO DETERMINE THE INFLUENCE OF RAIN EVENTS

- If it is running at bank full discharge or the water seems much more turbid than typical for the class of stream do not sample it that day.
- Do not sample if it is unsafe to wade in the majority of the stream reach.
- Keep an eye on the weather reports and rainfall patterns. Do not sample a stream during periods of prolonged heavy rains.
- If the stream seems to be close to normal summer flows, and does not seem to be unduly influenced by storm events, go ahead and sample it, even if it has recently rained or is raining.

tative picture of the ecological community. Previous EMAP pilot studies have suggested that a length of 40 times the channel width is necessary to collect at least 90% of the fish species occurring in the stream reach. Thus, a support reach that is 40 channel widths long around the X-site is required to characterize the community and habitat associated with the sampling point. Establish the sampling reach about the X-site using the procedures described in Table 4-4. Scout the sampling reach to make sure it is clear of obstacles that would prohibit sampling and data collection activities. Record the channel width used to determine the reach length, and the sampling reach length upstream and downstream of the X-site on page 2 of the Verification Form as shown in Figure 4-2. Figure 4-3 illustrates the principal features of the established sampling reach, including the location of 11 cross-section transects used for physical habitat characterization (Section 7), and specific sampling points on each cross-section transect for later collection of periphyton samples (Section 8) and benthic macroinvertebrate samples (Section 11).

There are some conditions that may require adjusting the reach about the X-site (i.e., the X-site no longer is located at the midpoint of the reach) to avoid features we do not wish to sample across. Do not proceed upstream into a lower order stream or downstream into a higher order stream when laying out the stream reach (order is based on 1:100,000 scale maps). If such a confluence is reached, note the distance and flag the confluence as the endpoint of the reach. Make up for the loss of reach length by moving ("sliding") the other end of the reach an equivalent distance away from the X-site. Similarly, if you run into a lake, reservoir, or pond while laying out the reach, stop, flag the lake/stream confluence as the reach end, and make up for the loss of reach length by moving the other end of the reach an equivalent distance from the X-site. Do not “slide” the reach so that the X-site falls outside of the reach boundaries. Also, do not “slide” a reach to avoid man-made obstacles

TABLE 4-4. LAYING OUT THE SAMPLING REACH

1. Use a surveyor's rod or tape measure to determine the wetted width of the channel at five places considered to be of "typical" width within approximately 5 channel widths upstream and downstream from the X-site. Average the five readings together and round to the nearest 1 m. If the average width is less than 4 m, use 150 m as a minimum sample reach length. Record this width on page 2 of the Verification Form.

   For dry or intermittent channels, estimate the width based on the unvegetated width of the channel.

2. Check the condition of the stream upstream and downstream of the X-site by having one team member go upstream and one downstream. Each person proceeds until they can see the stream to a distance of 20 times the average channel width (equal to one-half the sampling reach length) determined in Step 1 from the X-site.

   For example, if the reach length is determined to be 150 m, each person would proceed 75 m from the X-site to lay out the reach boundaries.

3. Determine if the reach needs to be adjusted about the X-site due to confluences with higher order streams (downstream), lower order streams (upstream), or lakes, reservoirs, or ponds.

   If such a confluence is reached, note the distance and flag the confluence as the endpoint of the reach. Move the other endpoint of the reach an equivalent distance away from the X-site.

   NOTE: Do not slide the reach to avoid man-made obstacles such as bridges, culverts, rip-rap, or channelization.

4. Starting back at the X-site (or the new midpoint of the reach if it had to be adjusted as described in Step 3), measure a distance of 20 channel widths down one side of the stream using a tape measure. Be careful not to "cut corners". Enter the channel to make measurements only when necessary to avoid disturbing the stream channel prior to sampling activities. This endpoint is the downstream end of the reach, and is flagged as transect “A”.

5. Using the tape measure, measure 1/10 (4 channel widths in big streams or 15 m in small streams) of the required stream length upstream from the start point (transect A). Flag this spot as the next cross-section or transect (transect B). For transect B, roll the dice to determine if it is a left (L), center (C), or right (R) sampling point for collecting periphyton and benthic macroinvertebrate samples. A roll of 1 or 2 indicates L, 3 or 4 indicates C, and 5 or 6 indicates R (or use a digital wristwatch and glance at the last digit (1-3=L, 4-6=C, 7-9=R). Mark L, C, or R on the transect flagging.

6. Proceed upstream with the tape measure and flag the positions of 9 additional transects (labeled “C” through “J” as you move upstream) at intervals equal to 1/10 of the reach length. Assign sampling spots to each transect in order as L, C, R after the first random selection.

   For example, if the sampling spot assigned to transect “B” was C, transect “C” is assigned R, transect “D” is L, transect “E” is C, etc.

STREAM VERIFICATION FORM - STREAMS/RIVERS (cont.) Reviewed by (initial): DP

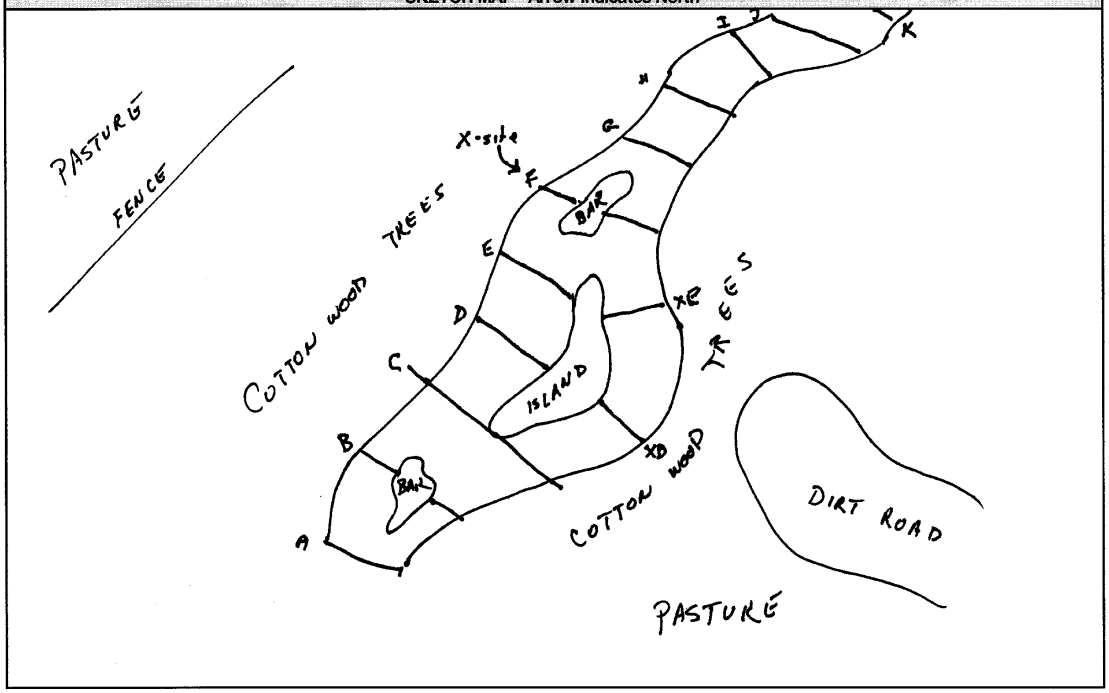
SITE NAME: PILOT CREEK DATE: 07/01/2001 VISIT: 0 (1) 2 3

SITE ID: WXXP99- TEAM: XX-1

STREAM/RIVER REACH DETERMINATION

Channel Width Used to Define Reach (m)	DISTANCE (m) FROM X-SITE		Comment
	Upstream Length	Downstream Length	
3	75	75	

SKETCH MAP - Arrow Indicates North



PERSONNEL Team Number: XX-1

NAME	DUTIES Biomorph	Geomorph	Forms
J. SHMOE	☒	☐	☐
G. WHIZ	☒	☐	☐
E. MAPPER	☐	☒	☒
S. TREAM	☐	☒	☐
	☐	☐	☐

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Figure 4-2. Verification Form (page 2).

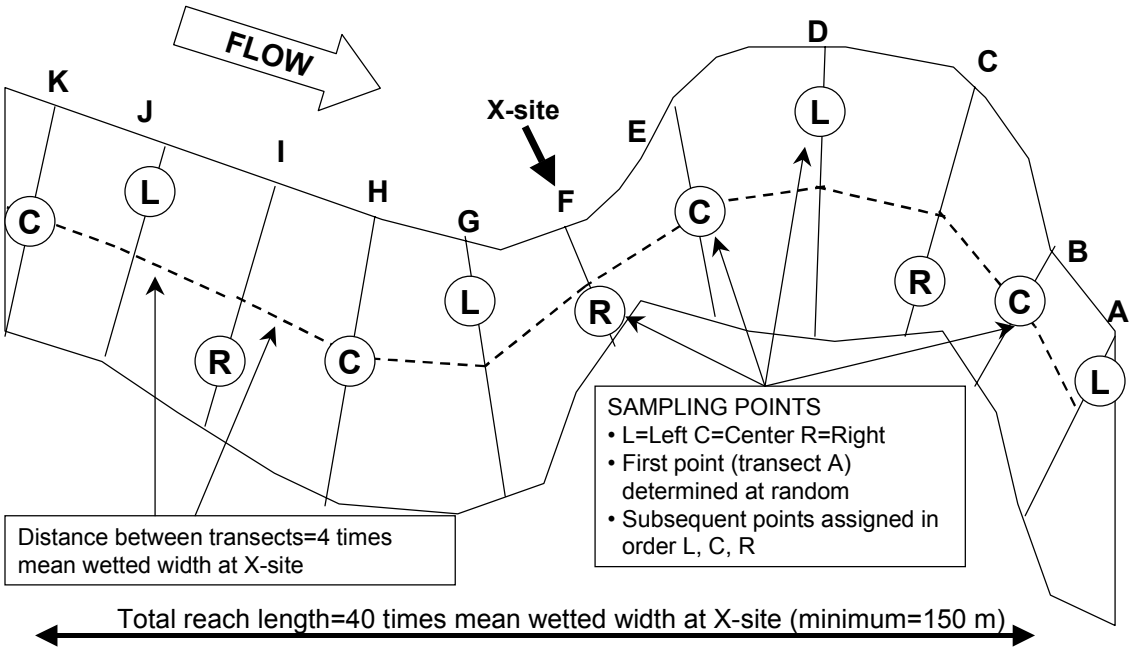

Figure 4-3. Sampling reach features.

such as bridges, culverts, rip-rap, or channelization. These represent features and effects that EMAP is attempting to study.

Before leaving the stream, complete a rough sketch map of the stream reach you sampled on the page 2 of the Verification Form (Figure 4-2). In addition to any other interesting features that should be marked on the map, note any landmarks/directions that can be used to find the X-site for future visits.

4.3 MODIFYING SAMPLE PROTOCOLS FOR HIGH OR LOW FLOWS

4.3.1 Dry and Intermittent Streams

The full complement of field data and samples cannot be collected from streams that are categorized as “Interrupted” (Table 4-1). Note that no data should be collected from streams that are completely “Dry” as defined in Table 4-1. Interrupted streams will have some cross-sections with biological and habitat measurements and some with none. Modified procedures for interrupted streams are presented in Table 4-5. Samples and measurements for water chemistry (Section 5) should be collected at the X-site (even if the reach has been adjusted by “sliding” it). If the X-site is dry and there is water elsewhere in the sample reach, the sample and chemical measurements are taken from a location having water with a surface area greater than 1 m^2 and a depth greater than 10 cm.

Data for the physical habitat indicator (Section 7) are collected along the entire sample reach from interrupted streams, regardless of the amount of water present at the transects. Depth measurements along the deepest part of the channel (the “thalweg”) are obtained along the entire sampling reach providing a record of the "water" status of the stream for future comparisons (e.g., the percent of length with intermittent pools or no water). Other measurements associated with characterizing riparian condition, substrate type, etc. are useful to help infer conditions in the stream when water is flowing.

4.3.2 Partial Boatable/Wadeable Sites

Some sites are too deep or swift to safely wade or float the majority or all of the sample reach yet they are also impossible to sample by boat or wading due to shallowness, barriers or current velocity. In these reaches, it will be impossible to do all of either the wadeable or non-wadeable sample protocols. In these sites, keeping safety in mind, the crews should try to do as much of the indicator sampling as they can. It will be impossible to do thalweg depth profiles and flow measurements but it should be possible to do the various assessments that don’t require getting in the water (stream/river assessment, RBP form, riparian condition). It is also usually possible to collect a water sample for chemistry and perhaps to do the transect sampling near the bank for benthos and periphyton. The amount of sampling that can actually be done will be dependent on observed conditions. Be sure to only sample what can be done **safely**. Be sure to make detailed comments on the Verification Form describing what the conditions were like and how much sampling could actually be done. Use the sketch map on the back of the Verification Form to indicate

TABLE 4-5. MODIFICATIONS FOR INTERUPTED STREAMS

Water Chemistry

- If the X-site is dry but there is flowing water or a pool of water having a surface area greater than 1 m^2 and a depth greater than 10 cm somewhere along the defined sampling reach, take the water sample and water chemistry measurements at the pool or flowing water location that is nearest to the X-site. Note that the sample wasn't collected at the X-site and where on the reach the sample was collected on the field data form.

- Do not collect a water sample if there is no acceptable location within the sampling reach. Record a "K" flag for the chemistry sample on the sample collection form and explain why the sample was not collected in the comments section of the form.

Physical Habitat Characterization, Periphyton, Sediment, and Benthic Macroinvertebrates

- Obtain a complete thalweg profile for the entire reach. At points where channel is dry, record depth as 0 cm and wetted width as 0 m.

- At each of the transects (cross sections), sample the stream depending on flow status:

  DRY CHANNEL: No surface water anywhere in cross section;
  Collect all physical habitat data. Use the unvegetated area of the channel to determine the channel width and the subsequent location of substrate sampling points. Record the wetted width as 0 m. Record substrate data at the sampling points located in the unvegetated, but dry, channel. Do not collect macroinvertebrates, sediment or periphyton from this transect.

  DAMP CHANNEL: No flowing water at transect, only puddles of water < 10 cm deep;
  Collect all physical habitat data.
  Collect periphyton samples from the wet spots; these are great places for algae.
  Do not collect a benthic macroinvertebrate or sediment sample.

  WATER PRESENT: Transect has flow or pools > 10 cm deep;
  Collect all data and measurements for physical habitat, periphyton, sediment, and benthic macroinvertebrate indicators, using standard procedures.

- If at the end of sampling, there were more than 2 transects Dry or Damp so that there are missing macroinvertebrate or periphyton transects in the composite (< 10 transects in composite), then take additional samples from other places in the stream reach that had sufficient water. Preferably, these samples would be taken at the mid-point between transects but may be taken anywhere in streams with only a small amount of water. Try to get an equivalent amount of material as you would from an 11 transect composite. Make detailed notes on the sample collection form for how and where you did sample.

Aquatic Vertebrates

- In interrupted streams, sample any wet areas within the sampling reach that are potential habitat for aquatic vertebrates. **Do not sample downstream of Transect "A" or upstream of Transect "K", even if there appears to be good habitat present.**

problem areas and where samples were collected if you had to go off transect. If barriers to the site prohibit physically reaching the X-site, then the site is not a Sampleable site but should be coded as "No Access - Inaccessible" on the Verification Form.

4.3.3 Braided Systems

Depending upon the geographic area and/or the time of the sampling visit, you may encounter a stream having "braided" channels, which are characterized by numerous sub-channels that are are generally small and short, often with no obvious dominant channel (See Section 7.6.1). If you encounter a braided stream, establish the sampling reach using the procedures presented in Table 4-6. Figuring the mean width of extensively braided systems for purposes of setting up the sample reach length is a bit of a challenge. For braided systems, calculate the mean width as the bankfull channel width as defined in the physical habitat protocol (Section 7). For relatively small streams (mean bankfull width # 15 m) the sampling reach is defined as 40 times the mean bankfull widths. For larger streams, (> 15 m), sum up the actual wetted width of all the braids and use that as the width for calculating the 40 channel width reach length. If that seems too short for the system in question, by all means set up a longer sample reach. Make detailed notes and sketches on the Verification Form (Figure 4-2) about what you did. It's important to remember that the purpose of the 40 channel width reach length is to sample enough stream to incorporate the variability in habitat types. Generally, the objective is to sample a long enough stretch of a stream to include 2 to 3 meander cycles (about 6 pool-riffle habitat sequences). In the case of braided systems, the objective of this protocol modification is to avoid sampling an excessively long stretch of stream. In a braided system where there is a 100 m wide active channel (giving a 4 km reach length based on the standard procedure) and only 10 m of wetted width (say five, 2 m wide braids), a 400 m long sample reach length is likely to be sufficient, especially if the system has fairly homogenous habitat throughout its length.

4.4 EQUIPMENT AND SUPPLIES

A list of the equipment and supplies required to conduct the stream verification and to lay out the sampling reach is presented in Figure 4-4. This checklist is similar to the checklist presented in Appendix A, which is used at the base location (Section 3) to ensure that all of the required equipment is brought to the stream. Use this checklist to ensure that equipment and supplies are organized and available at the stream site in order to conduct the activities efficiently.

TABLE 4-6. MODIFICATIONS FOR BRAIDED STREAMS

1. Estimate the mean width as the bankfull channel width as defined in the physical habitat protocol.

   1A. If the mean width is less than or equal to 15 m, set up a 40 channel width sample reach in the normal manner.

   1B. If more than 15 m, sum up the actual wetted width of all the braids and use that as the width for calculating the 40 channel width reach length. Remember the minimum reach length is always 150 m.

   1C. If the reach length determined in 1B seems too short for the system in question, set up a longer sample reach, taking into consideration the objective is to sample a long enough stretch of a stream to include at least 2 to 3 meander cycles (about 6 pool-riffle habitat sequences).

2. Make detailed notes and sketches on the Verification Form about what you did.

4.5 LITERATURE CITED

Herlihy, A.T. 1998. Initial site procedures. pp. 45-56 **IN**: J.M. Lazorchak, D.J. Klemm, and D.V. Peck (Eds.). *Environmental Monitoring and Assessment Program-Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams*. EPA/620/R-94/004F. U.S. Environmental Protection Agency, Washington, D.C.

EQUIPMENT AND SUPPLIES FOR INITIAL SITE ACTIVITIES

QTY.	Item	
1	Dossier of site and access information	
1	Topographic map with "X-site" marked	
1	Site information sheet with map coordinates and elevation of X-site	
1	GPS receiver and operating manual	
	Extra batteries for GPS receiver	
1	Verification Form	
	Soft lead (#2) pencils	
1	Surveyor's telescoping leveling rod	
1	50-m fiberglass measuring tape with reel	
2 rolls	Surveyor's flagging tape (2 colors)	
	Fine-tipped indelible markers to write on flagging	
1	Waterproof camera and film (or digital camera)	
1 copy	Field operations and methods manual	
1 set	Laminated sheets of procedure tables and/or quick reference guides for initial site activities	

Figure 4-4. Equipment and supplies checklist for initial site activities.

NOTES

NOTES