

**The Bureau of Land Management AIM National Aquatic Monitoring Framework Draft Field
Protocol for Non-wadeable Lotic Systems**

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1.0 Introduction

This protocol is designed for use in non-wadeable rivers and streams. This protocol should only be used if there is no possible way to safely sample reach using the wadeable protocol (five or more transects must be wadeable), as the data produced is less precise than the data that can be gathered following the AIM National Aquatic Monitoring Framework (NAMF) field protocol for wadeable systems (TR 1735-2).

This protocol requires the use of boats and boating equipment designed and intended for use in swift water such as multi-chambered inflatable rafts and kayaks. Teams attempting to implement this protocol should have a minimum on one individual who is skilled and comfortable safely navigating swift moving water in such watercraft. All team members should be given a swift water oriented safety briefing before setting out onto the water and should be equipped with know how to use the proper safety equipment for such endeavors including personal floatation devices.

1.1 How to use this protocol

This protocol is intended to be used in conjunction with the AIM-NAMF field protocol for wadeable systems (TR 1735-2) and should not be considered as a stand-alone document. TR 1735-2 covers the critical concepts referenced in this protocol in detail, and users of this protocol are expected to be familiar with these critical concepts, as well as the field methods described in TR 1735-2. It is strongly recommended that anyone using this protocol be thoroughly trained in the field methods described in TR 1735-2 prior to using this protocol. Because of these expectations, this protocol does not describe methods which are described in TR 1735-2 in detail.

1.2 Key differences between the AIM-NAMF wadeable and non-wadeable protocols

- Implementing this protocol requires a minimum of three people rather than two.
- All data at non-wadeable reaches are collected in one pass down the river, since going back upstream is often not an option.
- The order of the transects is reversed - A is at the upstream end of the reach and K is at the downstream end of the reach (Figure 1).
- There are no intermediate transect measurements taken when using the non-wadeable protocol.
- Some transect data is only collected one side of the river, rather than both.

- Bank cover is not recorded by cover category.
- Substrate measurements are estimated for the littoral zone, and are not measured along a cross-section.
- Wetted and bankfull widths are measured using a laser rangefinder rather than a tape measure.
- Bankfull and incision heights are often measured using a stadia rod and a hand level, rather than depth rods.
- Pools are not measured.
- Thalweg depth profile is always measured and is not considered a contingent indicator for non-wadeable reaches.
- Riparian plots are larger (20 m x 10 m; Figure 2) than at wadeable reaches and begin where the perennial vegetation begins or at bankfull, rather than where bed-meets-bank.
- Instream habitat complexity (fish cover) is only measured 10 m out into the channel instead of across the entire channel.
- Slope is not measured on non-wadeable systems

2.0 Pre-Sampling Tasks

The non-wadeable protocol requires more pre-sampling work than the wadeable protocol (TR 1735-2). Sampling reaches must be set-up using Google Earth and therefore this work should be done in an office environment. Additionally, thought and effort needs to be put into identifying the best locations to launch the boat(s) (i.e. put-in) and to take the boat(s) out of the water (i.e. take-out). Because sampling requires floating down the river or stream from one point to another, the best mode of shuttling a vehicle from the put-in location to the take-out location also need to be determined. These tasks are most effectively completed in an office environment where the field crew will have access to aerial imagery, internet, and phone service.

2.1 Reach Layout

The length of a sample reach is 40 times the average wetted width near the point coordinates. Wetted width is estimated by using aerial imagery and the measuring tool in Google Earth. The distance between transects is a 1/10 of the reach length and transect locations are also determined using the measuring tool in Google Earth. NAMC will provide each project lead with a spreadsheet template to use during the Google Earth reach set-up exercises.

Point coordinates may be moved if a large portion of the reach will be unsampleable due to rapids or the presence of steep canyon walls that will prohibit the crew from pulling over to the side of the river at the identified transect locations. Point coordinates should be moved the minimum distance required to allow the field crew to sample the reach. The maximum distance that the point coordinates may be moved is 4km.

2.1.1 Estimating Wetted Width

Methods:

1. Using Google Earth, locate the point coordinates for the site.

2. Zoom in on the point coordinates, and use the ruler/path tool to determine the average wetted width of the channel based on 5 “typical” wetted widths. To do this, first measure the wetted width at the point coordinates and then take four more measurements (two upstream and two downstream) within a distance of approximately 5 channel widths of the point coordinates.
3. Enter the wetted widths into the reach calculator spreadsheet which contains a formula that will multiply average wetted width by 40 to determine reach length. Note: the maximum reach length is 4km, if your wetted width is 200 m or greater set up a 4 km reach.

2.1.2 Determining Transect Locations (“Setting up the Reach”)

Once the average wetted width and reach length have been calculated, the reach calculator spreadsheet will display the distance between transects (reach length/10). Measure out transect locations and record GPS coordinates for each transect.

While transects extend across the river, the field crew will only pull over on one side of the river at each transect. The side of the river that will be visited first (the A transect) is identified at random by flipping a coin or some other random means.

Methods:

1. Place a pin on the Google Earth image in the location that most closely corresponds to the thalweg and the point coordinates, and label this pin Transect F.
2. Obtain the distance between transects based on the reach length.
3. From the F transect, use the ruler/path tool to measure the distance to the nearest transect along the thalweg. Make sure to measure all of the bends of the river/stream; do not artificially straighten out the line of measurement.
4. Drop a pin on the thalweg at the transect location and name the pin with the appropriate transect letter. For boatable sites remember that A is the upstream most transect and K is the downstream most transect.
5. Repeat steps 2 and 3 until all transects (A-K) have been identified.
6. Randomly determine which bank will be sampled first (Transect A) by flipping a coin (heads for right bank, tails for left bank). Note that right and left are identified when facing downstream.
7. From the A transect pin move the cursor, perpendicular to the thalweg, to the randomly identified bank and record the GPS coordinates displayed on the bottom right corner of your Google Earth screen for that location.
8. Work your way downstream repeating step 7 for each transect, keeping the next two transects on the same randomly chosen side so that the first three transects will be on the randomly selected side of the river. From here, the next two transects should be place on the opposite side of the river, and then switch back to the randomly chosen side for the next two. Alternate placing two transects on one side of the river and then the other until you reach Transect K. For example if you randomly chose the right side A-C would be on the right, D and E on the left, F and G on the right, H and I on the left, J and K on the right.

If an island splits the channel at a transect, sample and assign bank GPS coordinates within the channel that has the most flow (you may have to “estimate” which channel has the most flow using channel widths from google earth)

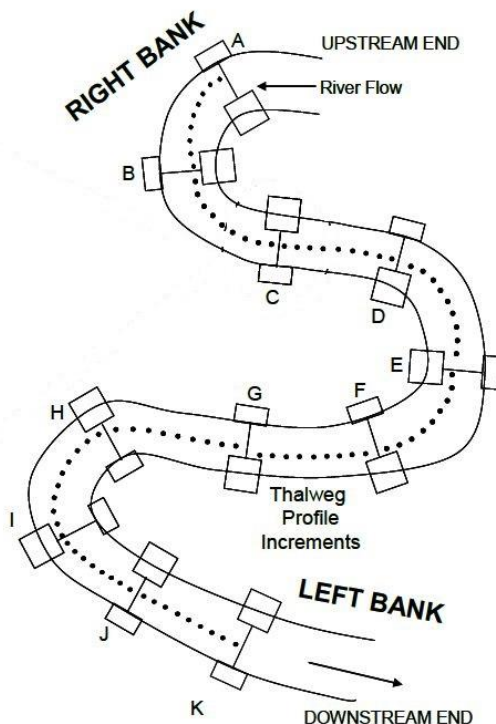


Figure 1. Non-Wadeable reach set-up.

3.0 Water Quality

YSI and nutrient grab samples are collected at Transect A (top of reach) as near to mid-channel as possible, in flowing water.

3.1 pH, Specific Conductance, Temperature

These parameters are all measured with an YSI. Before departing for the field site, make sure the YSI has been properly calibrated within the last 7 days. Avoid contacting the stream bottom with the YSI, as the instrument is delicate

Methods:

1. Lower the probe into the water to a depth of 0.5 m below the water surface. If water depth is < 1 m, take measurements at mid-depth.
2. Navigate between screens, record the pH, specific conductance (μS), and temperature ($^{\circ}\text{C}$).
 - a. For specific conductance, make sure to navigate to the screen where the temperature ($^{\circ}\text{C}$) is flashing in the lower right corner. This indicates the YSI is correcting for temperature (i.e. measuring specific conductance and not conductivity).

3.2 Nutrient Grab Samples

Methods:

1. Obtain a pair of surgical gloves and place them on both hands.
2. Obtain a 50 ml centrifuge vial (new or acid washed) and rinse it with stream water five times. Be careful not to overly disturb the stream bottom; increasing suspended solids.
3. After rinsing, fill the vial with 30-35 mL of stream water. Note the time the sample was collected in the comment field.
4. Fill out water quality label with the full site code and the date and secure the label to the outside of the vial with packing tape.
5. Immediately after collecting and labeling, place the sample on ice/dry ice. If in the field without ice, keep the vial at ambient temperature by suspending it in the water column.
 - a. For each water quality sample, record the number of hours it was <75% frozen for each day after collection on the datasheet in the cooler.
 - b. At the end of the trip and before data submission, go back into each site in the app and record the total number of hours it was <75% frozen.

4.0 Transect-based Measurements (PHAB, Canopy Cover, and Visual Assessments)

After the reach has been set up and put-in and take out locations have been identified, the field sampling can be performed. Before putting in on the river, make sure to enter the GPS coordinates for the appropriate bank of each transect into a hand-held GPS unit.

After launch, set the GPS to navigate to Transect A and pay attention to how quickly you are moving down the river so that you don't accidentally float past the first transect. It is the responsibility of the person reading the GPS to relay the distance to the next GPS coordinate to the person steering the boat. Depending on how swiftly the current is moving, the person steering the boat will need to know that the GPS coordinates are approaching some distance between 80 and 20 meters in advance so that they will have enough time to maneuver the boat to shore.

4.1 Channel Dimensions

At each transect, measure/estimate the indicators below from the appropriate bank.

4.1.1 Wetted and Bankfull Widths

Methods:

1. Stand at the wetted edge and use the laser rangefinder to measure the width of the wetted channel, including the width of any mid-channel bars or islands.
2. If there is a mid-channel bar present, measure the distance to both banks of the bar (as best you can) and subtract these values from each other to obtain the width of the bar and record the width of the bar.
 - a. If any islands exist, measure them as though they were bars, but flag the measurements and indicate in the comments that the "bar" is an island.
 - b. If you are unable to see across full width of river because an island separates a side channel, record width of main channel, flag observation, and note in comments that width pertains only to main channel.

3. Repeat steps 1 and 2 while standing at the bankfull width location, but this time sight the bankfull location on the opposite bank.

4.1.2. Incision and Bankfull Heights

Bankfull and incision heights are often very far away from the wetted edge on large river systems and therefore can be difficult to measure using depth rods. Additionally, since incision is only measured on one side of the river, the incised surface is often on the opposite side of the river from the rest of the plot. For these reasons, bankfull and incision heights are often measured using a hand level and stadia rod, rather than two depth rods. Therefore, the hand level and stadia rod method is described here, however, whenever height measurements can be reasonably collected using depth rods, this method is preferred.

Methods:

1. Examine both banks and identify the bankfull elevation
2. Position your body so that your eye is approximately level with the bankfull elevation
3. Have another person hold the stadia rod vertically on the transect, with its base planted at the water's edge
4. Use your hand level to sight the bankfull elevation and then while keeping the level balanced slowly turn your head or body so that you can now sight the stadia rod.
5. Record the bankfull height.
6. Examine the banks to identify the incised surface, keeping in mind that incision height should be measured off the lowest of the surfaces among the two banks. If the incised surfaces seem to be the same height, measure the surface above the bank on which you are standing as this measurement will be more accurate.
7. Re-position your body so that your eye is approximately level with the incised surface.
8. Repeat steps 3 and 4.
9. Record the incision height.

4.1.3 Bank angle (Contingent Indicator)

Bank angle is estimated (not measured) at each transect between wetted channel margin up to 5 m into the bankfull channel margin.

Methods:

1. Visually estimate the bank angle of the bank on which you are standing or viewing and determine which category best describes the angle of the bank:
 - a. V = vertical/near vertical/undercut ($>75^\circ$ or undercut)
 - b. S = steep ($30-75^\circ$)
 - c. G = gradual ($5-30^\circ$)
 - d. F = flat ($<5^\circ$)

4.2 Bank Stability and Cover

Determine if the transect is in an erosional or depositional area, and evaluate bank stability and cover.

Guidance for identifying erosional and depositional areas:

Depositional (D) streambanks are primarily comprised of sediment that has been deposited by the stream. Deposited sediments can be sand, silt, clay, or gravel deposited above the scour line (i.e., lower extent of the bank stability and cover plot). Depositional banks are often recognizable as **point bars** at or stream deposited sediments located above the scour line. Point bars are typically convex-shaped mounds of substrate that are typically found adjacent to the stream channel on the inside bend of **meanders** at or below bankfull.

Erosional (E) streambanks are actively losing soil or sediment into the stream channel. Erosional banks typically occur on the outside bends of stream meanders and along straight reaches. Some examples of erosional banks are **cut banks** and undercut banks.

4.2.1 Bank Cover

Determine if the bank is greater than or less than 50% covered (covered vs. uncovered).

Methods:

1. Examine the bank stability plot area.
 - a. The plot extends up the bank from the scour line to the first flat depositional feature at or above bankfull.
 - b. The plot extends parallel to the stream 25 cm up- and downstream of the transect flag (50 cm wide total).
2. Determine if the bank is at least 50% covered by the following:
 - Perennial vegetation (including roots that are holding the soil in place). Note: moss does not count as perennial vegetation.
 - Cobbles that are 15 cm or larger
 - Bedrock
 - Anchored large woody debris with a diameter > 10 cm
3. Record the bank as covered (more than 50%) or uncovered (less than 50%).

4.2.2 Bank Stability

Methods:

Determine if the plot contains any obvious erosional features (subsequently described) that span at least 1/4 (13 cm) of the plot width. If multiple erosional features are present, record the single most prominent feature.

Absent (A): None of the erosional features subsequently described are present.

Fracture (F): An obvious crack on the top of a bank that has not yet separated from the bank into a block or blocks.

Slump (S): A portion of a streambank that has obviously slipped down resulting in a block of soil/sod that is completely separated from the bank.

Slough (SL): Soil or sod has gradually eroded from the bank and accumulated near the base of the bank. Sloughing typically occurs on banks that are less than vertical and void of herbaceous or grassy vegetation.

Eroding (E): Banks that are bare and nearly vertical (between 80 and 90 degrees). Eroding banks are usually located on the outside curves of meander bends in the stream.

4.3 Riparian Canopy Cover

For non-wadeable systems, canopy cover is only measured on one side of the river. On the side that of the river that is sampled, four canopy measurements are taken.

Methods:

1. Position your body above where bed-meets-bank and hold the densiometer 0.3 m (1 ft.) above surface of the water or shore (if possible, use a depth rod to assist)
2. At channel margin, count the number of grid intersection points within the “V” that are covered by either a tree, leaf, high branch, or the bank
3. Take 1 reading facing each of the following directions: upstream (UP), downstream (DOWN), left bank (LEFT), and right bank (RIGHT). Right and left banks are defined facing downstream.
4. Record values (0-17)

4.4 Channel constraint

Channel constraint consists of three measurements: distance to riparian vegetation, identification of constraining features, and whether or not you can see over the bank.

Methods:

1. Estimate and record the distance (m) from the wetted edge to where the riparian vegetation plot begins, which is where perennial vegetation begins or at bankfull margin, whichever is closest to wetted edge. If no riparian vegetation exists, estimate the distance to where you first see upland vegetation and note that no riparian vegetation was present in the comments section.
2. Assign one of the following constraint categories to the river at each transect:
 - a. Channel is constrained (i.e. the river occurs in a tight valley or gorge and there is little room for channel movement)
 - b. Channel is in broad valley but constrained by its own incision (i.e. the river has down cut so far that the channel couldn't possibly move very far outside of its current location)
 - c. Channel is in narrow valley but not very constrained (i.e. the river is connected with its floodplain and channel movement is possible, but it cannot move very far)
 - d. Channel is unconstrained in broad valley (i.e. the channel has lots of room to move around)
3. Record whether or not you could readily see over the bank on the side that you are working.

4.5 Littoral Plot Survey: Substrate and Large Wood

The littoral plot is 20 m x 10 m and extends 10 m both upstream and downstream from the transect, and 10 m out into the river towards the thalweg (Figure 2).

Methods:

1. Using a stadia rod or depth rod, measure and record water depth (cm) at 5 haphazardly chosen locations. If the water is too deep to wade, reach out over the four sides and off of the back of the boat to take measurements.
2. Visually observe and record the dominant and secondary substrate particle sizes of the riverbed within littoral plot. If can't see bottom, "feel" the bottom with a depth rod or stadia rod and use your best judgement to determine substrate size. Bin the substrate into the following size classes:
 - a. Bedrock (Smooth) – Larger than a car
 - b. Bedrock (Rough) – Larger than a car
 - c. Large Boulders (1000-4000 mm) – Meter stick to car
 - d. Small Boulders (250-1000 mm) – Basketball to meter stick
 - e. Cobbles (64-250 mm) – Tennis ball to basketball
 - f. Coarse Gravel (16-64 mm) – Marble to tennis ball
 - g. Fine Gravel (2-16 mm) – Ladybug to marble
 - h. Sand (0.06-2 mm) – Gritty up to ladybug
 - i. Silt/Clay/Muck – Not gritty
 - j. Hardpan – Firm consolidated fine substrate
 - k. Wood (any size)
 - l. Other (provide comment)
3. Visually observe and record the dominant and secondary substrate particle size class (see above) from the water's edge to 1m from the wetted edge.
4. Tally all qualifying, large wood debris (small end diameter *30 cm*; length *5 m*) for which the large end occurs within plot and all the way to bankfull margin even if that area is outside of the plot. Tally large wood in the following size classes:
 - a. Diameter based on large end
 - i. 0.3-0.6 m
 - ii. 0.6-0.8 m
 - iii. 0.8-1.0 m
 - iv. > 1.0 m
 - b. Length on the portion that has diameter >30 cm
 - i. 5-15 m
 - ii. 15-30 m
 - iii. > 30 m

Note: If the piece is not cylindrical, visually estimate what the diameter would be for a piece of wood with circular cross-section that would have the same volume

 - c. Within the bankfull channel, make separate tallies for wood that is wet (entirely or partially) and wood that is dry.
 - d. *Though not recorded, make notes of large debris dams and/or accumulations that occur outside the plot*

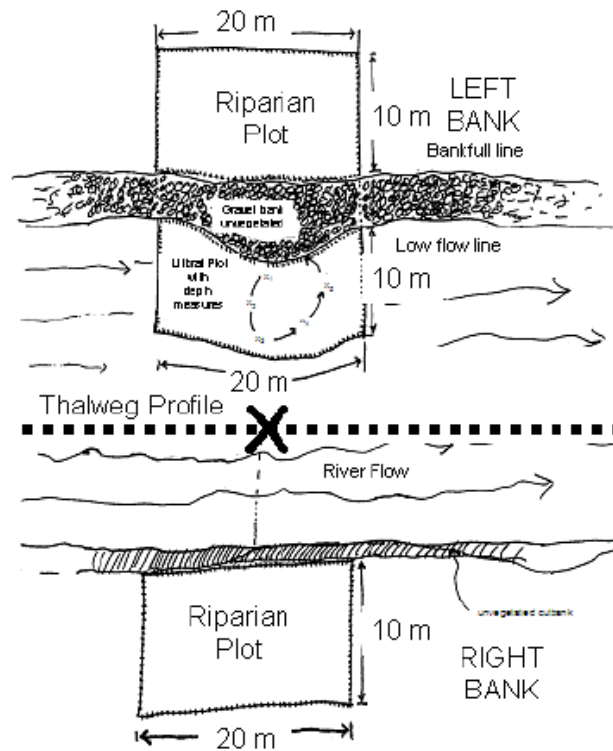


Figure 2. Riparian and instream habitat plots showing a gravel bar on the shoreline.

4.6 Macroinvertebrates

The default method for benthic macroinvertebrate sampling in non-wadeable systems is the reach-wide method using a kick net.

Methods:

1. Identify the dominant habitat type using (i.e. sand, coarse gravel, boulders, macrophytes, etc.).
2. In an area of dominant habitat within the littoral plot, kick your feet to disturb the substrate and use the kick net to “sweep” through 1 linear meter of the water.
3. Process the sample once all transects have been sampled.

5.0 Visual Estimates

5.1 Riparian Vegetation Estimates

In non-wadeable reaches, vegetative plot sizes are 20 m long (i.e. 10 m upstream and downstream of the transect) x 10 m wide (Figure 2). Plots begin at the lowest extent of perennial vegetation or at the bankfull margin, whichever is closest to wetted edge. On steeply-sloping channel margins, estimate plot dimensions as if they were projected down from aerial view.

Vegetative complexity and riparian cover is estimated on both banks, even though only one bank of the river is visited. At times, determining the difference between riparian and non-riparian vegetation as well as native and non-native vegetation will not be possible. In this case, do not attempt to make these estimates, and flag these data as not collected.

Vegetative complexity and riparian cover is estimated. Vegetative complexity and riparian cover is estimated for three vertical strata: canopy, understory, and ground cover within the 20 m x 10 m plot. Aerial cover is an estimate of the amount of shadow that would be cast by a particular category of vegetation if the sun were directly over the plot area.

Aerial cover estimates are based on five cover classes:

- a. 0 = absent: zero cover
- b. 1 = sparse: < 10%
- c. 2 = moderate: 10-40%
- d. 3 = heavy: 40-75%
- e. 4 = very heavy: > 75%

Methods:

1. Stand on the shore or in the boat, and visualize the 20 m x 10 m plot. If you cannot see the full depth of the plot (e.g., 10 m into the riparian zone), base estimates on the vegetation that you can see from where you stand.
2. Within the plot area, conceptually divide the riparian vegetation into three layers:
 - a. Canopy (> 5 m high)
 - b. Understory (0.5 to 5 m high)
 - c. Ground cover (< 0.5 m high)
3. Categorize the dominant woody vegetation type for the canopy and understory layers as one of the following:
 - a. Deciduous
 - b. Coniferous (e.g., juniper, cedar, pine, fir)
 - c. Broadleaf evergreen (e.g., sagebrush, rhododendron, manzanita)
 - d. Mixed - more than 10% of the aerial coverage is made up of more than one of the three previous categories
 - e. No canopy
4. Considering each layer independently, determine which cover class most accurately represents the percent aerial cover provided by each of the following vegetation types. Include standing dead trees as cover and both riparian and non-riparian species.
 - a. Canopy (> 5 m high)
 - Large trees - greater than 1 ft (0.3 m) diameter at breast height
 - Small trees - less than 1 ft (0.3 m) diameter at breast height
 - d. Understory (0.5 to 5 m high)
 - Trees, shrubs, and saplings
 - Non-woody herbs, forbs, and grasses
 - b. Ground cover (< 0.5 m high)
 - Trees, shrubs, and saplings

- Non-woody herbs, forbs, and grasses
 - Bare ground or duff
5. Again, considering each layer independently, record the percent aerial cover of the plot provided by riparian vegetation only (i.e., facultative wetland or obligate wetland) for:
 - a. Canopy (> 5 m high): consider only the percent aerial cover of woody riparian vegetation.
 - b. Understory (0.5 to 5 m high): consider only the percent aerial cover of woody riparian vegetation.
 - c. Ground cover (< 0.5 m high): consider the percent aerial cover of both woody and non-woody (including sedges and rushes, but excluding grasses) riparian species combined.
 6. For all layers combined, record the presence or absence of the following types of vegetation:
 - a. Nonnative woody (e.g., Russian olive, salt cedar)
 - b. Native woody
 - c. Nonnative herbaceous (e.g., Canada thistle)
 - d. Native herbaceous
 - e. Sedges and rushes
 7. Repeat steps 1-6 for the opposite bank, and continue repeating steps 1-6 until all measurements are collected along all main transects.

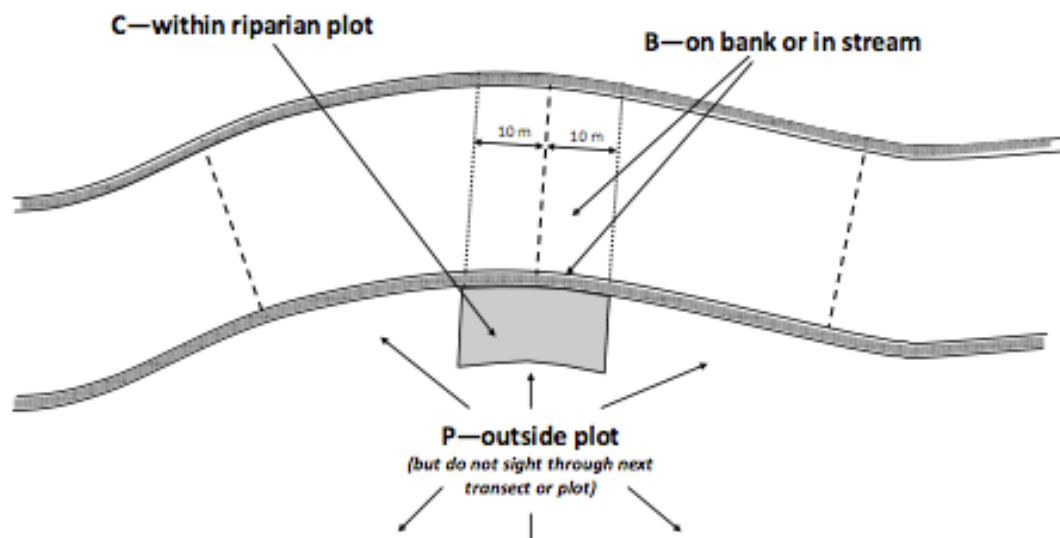


Figure 3. Locations of human influences relative to the riparian plot and transect in non-wadeable systems.

5.2 Human Influences

Note the presence of human influences within and outside of the same 20 m x 10 m plot that was used to assess vegetation (Figure 3).

Methods:

1. At each transect, visualize a 20 m X 10 m plot outlined in Figures 2 and 3.
2. Examine the channel and riparian plots, as well as the surrounding area, for the following human influences:
 - 1) walls, dikes, revetments, riprap, dams
 - 2) buildings
 - 3) cleared lots or pavement
 - 4) roads or railroads
 - 5) inlet or outlet pipes
 - 6) hydrologic alteration (irrigation withdrawals, etc.)
 - 7) landfills or trash
 - 8) parks or maintained lawns
 - 9) row crops
 - 10) pastures, rangeland, hay fields, or EVIDENCE of grazing
 - 11) grazing exclosures
 - 12) livestock grazing (animals are actually present or there are fresh feces on the bank)
 - 13) logging
 - 14) mining
 - 15) recreation
3. For each type of influence, record the appropriate location:

B = bank; present within the defined 10m stream segment or on the bank
C = close; present within the 10m x 20m riparian plot
P = present; present (i.e., "I can see it"), but outside the riparian plot
O = absent; not present
4. Do not include influences that cannot be seen from the cross-section transect or that have to site through another transect or its 10 m x 20 m riparian plot
5. Repeat for the other bank

5.3 Instream Habitat Complexity (Contingent Indicator)**Methods:**

1. Examine the littoral plot for the following features and types of cover:
 - a. filamentous algae
 - b. macrophytes
 - c. large woody debris
 - d. small woody debris
 - e. live trees, overhanging veg
 - f. undercut banks
 - g. boulders/ledges
 - h. artificial structures

2. For each cover type, estimate areal cover

6.0 Flood-Prone Width (covariate)

For the non-wadeable protocol, the flood-prone width is measured at transects B and K. No thalweg measurements will have been collected upon arrival at transect A, and a thalweg measurement is necessary to measure flood-prone width.

Methods:

1. Take the last thalweg depth measurement before arriving at the transect, provided that this measurement was truly taken in the thalweg. If the measurement was not taken in the thalweg, use the last measurement that truly was taken in the thalweg.
2. Add this depth measurement to the bankfull height measurement to calculate the maximum bankfull depth.
3. While one person holds a stadia or depth rod for reference at the bankfull elevation, another person walks to an elevation from which they will be able to see the bankfull depth on the stadia rod.
4. Next, the person who is now viewing the bankfull depth uses the hand level or depth rod to make sure that where they are level with the bankfull depth and measures the flood prone width to the nearest 0.1 m with the laser rangefinder. Depending on where the person taking the measurements is standing, two measurements may need to be taken and added together.
5. If the flood-prone width is greater than 3 times the bankfull width, stop measuring and record the value as 3 x bankfull width.

Example:

- Max water depth = 250 cm
- Bankfull height (from water surface) = 165 cm
- Measure flood-prone width at a height of $2 \times (165 + 250) = 415$ cm
- Bankfull width = 25 m
- Max recorded flood-prone width is $4.15 \text{ m} \times 25 \text{ m} = 103.8 \text{ m}$

7.0 Thalweg Depth Profile and Substrate

In non-wadeable systems, thalweg depths are typically measured with a stadia rod while moving downstream in the boat. Begin collecting thalweg depth measurements at the transect that is furthest upstream (usually transect A) and continue collecting thalweg as you move downstream from transect to transect. The first thalweg depth measurement is supposed to be measured at each transect. Therefore, the person operating the boat will need to ferry out into the river to the best of their ability at each transect until the boat is in the thalweg. When attempting to reach the thalweg, float along the river course that is judged to be the *deepest*, but is also SAFE to navigate.

Methods:

1. Before entering the sample reach, take a few “test depths” to obtain a general sense of the depth of the river.
2. Determine the interval between thalweg depth measurements based on the distance between transects (distance between transects/10).
3. Before leaving each transect, adjust the stadia rod to the appropriate height based on the depth of the river.
4. Ferry the boat into thalweg and take the first measurement when the boat is perpendicular to the transect (or as close as possible).
5. Determine the location to take subsequent measurements using the GPS to estimate your position relative to the next transect.
6. While one person watches the distance to the next transect decrease, another person is poised with the stadia rod - ready to take a measurement.
7. When the thalweg station has nearly been reached, the person with the GPS shouts “now” and the stadia rod person takes the depth and substrate measurement.
 - a. Identify substrate type based on the sound that the rod makes when it contacts the substrate, a visual estimate, or *knowledge*.
 - b. Record the substrate as one of the following: Bedrock/hardpan, boulder, cobble, gravel, sand, silt/clay/muck, other
 - c. Also record the presence of any snags (submerged wood debris).
8. The person with the stadia rod shouts out the measurement and the data recorder records the depth measurements
9. Repeat for the remaining thalweg stations. Note that if the current is very swift, these measurements will be taken almost continuously.
10. While floating, also record the presence of any off-channel habitat (side channels or backwaters).

8.0 Equipment and Boat Decontamination

All equipment and gear must be cleaned and disinfected between sites to reduce the risk of transferring invasive species and pathogens. The following procedures will need to be performed at a decontamination station, self-wash car wash bay, or with a hose. Some states have well-established decontamination stations and the locations of these stations can be obtained by contacting the state invasive species program.

Methods:

1. Before leaving the river, use a scrub brush (attached to Surber net) to remove all visible mud / organic material from the boat, dry boxes, and sampling gear.
2. Decontaminate sampling gear per usual following the instructions in the wadeable protocol.
3. Drive the boat to the nearest state-run decontamination center or self-serve washing station.
4. Drive the boat into the wash bay.
5. Use a spray bottle and scrub brush to thoroughly coat and scrub the boat with Super HDQ, paying special attention the lacing on the floor.

6. Let the solution sit on the boat for 10 minutes. If the solution begins to dry, spray more chemical on the boat as the chemical must remain wet in order to be effective.
7. When the 10 minutes is over, thoroughly rinse the boat and sampling equipment. Note: you may need to keep re-applying the Super HDQ if it begins to dry on the boat. To reduce the chance of drying - perform this task in a shaded location if possible.

9.0 Review Data Forms and Labels

Upon return, field crew leader is responsible for reviewing all data forms and labels for accuracy, completeness, and legibility. Ensure written comments use no shorthand or abbreviations. Cross-check site codes on labels with those recorded on data forms and ensure that all of your sample jars are accounted for. It is best to conduct this after sampling each site.

10.0 Tips and Special Situations

Tips

1. If the current is swift, record thalweg depths on paper data sheets and transfer the data to SARAH at a later time – the app often won't load fast enough for all measurements to be recorded.
2. For safety, take thalweg measurements from the end of the boat that is facing upstream
3. If possible, bring along a mountain/road bike: shuttles can sometimes be completed using a bike to ride back up to the put-in.

Special Situations

1. If you cannot access the pre-determined side of the river at a given transect but the other side is accessible, the other side may be sampled.
2. If neither side of the river can be safely accessed at a transect, skip the transect.
3. *Slope* on small, non-wadeable systems: if feasible in terms of time and distance to the road measure slope using a stadia rod, level, and tripod. DO NOT EVER, float any of the slope gear down the river.