

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

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1.0 Introduction

The lotic AIM protocol for non-wadeable rivers is a modified version of the EPA’s Field Operations Manual for Non-Wadeable Rivers and the AIM protocol for wadeable lotic systems. The protocol is to be used in the absence of a formal BLM lotic AIM protocol for non-wadeable rivers and should only be used if there is no possible way to safely sample reaches using the wadeable lotic protocol (five or more transects must be wadeable). Given the difficulty of working in large rivers, the resulting data from the non-wadeable protocol is less precise than data gathered following the AIM field protocol for wadeable lotic systems.

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 of 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 Key differences between the lotic wadeable and non-wadeable protocols

- Implementing this protocol requires a minimum of three people rather than two.
- Reach set up is done in the office.
- 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, because of the need to float from up to downstream (Figure 1).
- There are no intermediate transects for boatable reaches.
- Some transect data is only collected on one side of the river, rather than both (e.g., human influence).
- Bank cover is not recorded by cover category (e.g., boulders, bedrock, perennial vegetation).
- Substrate measurements are estimated for the littoral zone and thalweg, 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 bench heights are often measured using a stadia rod and a hand level, rather than depth rods.
- Pools are not measured; they are calculated from the thalweg depth profile.
- Thalweg depth profile is always measured for non-wadeable reaches.
- Riparian plots are larger (20 m x 10 m; Figure 2) than for wadeable reaches and begin at the bankfull elevation or the start of perennial vegetation, whichever comes first.
- Slope is not measured on non-wadeable systems

2.0 How to Use this Protocol

The non-wadeable protocol is intended to be used in conjunction with the AIM field protocol for wadeable lotic systems (TR 1735-2) and should not be considered a stand-alone document. TR 1735-2 covers the critical concepts referenced in this protocol in detail (e.g., scour line, bankfull width, bench height), and users are expected to be thoroughly trained on these critical concepts, as well as the field methods described in TR 1735-2. Because of these expectations, this protocol does not describe methods which are described in TR 1735-2 in detail. Where applicable, numbered sections in this protocol correspond to the numbered sections found in 1735-2 Version 2.

Lastly, the non-wadeable protocol does not distinguish between core and contingent indicators except for turbidity. All non-wadeable reaches will include the core indicators plus thalweg, bank angle, and total nitrogen and total phosphorus. Please consult the webmap (points layer and turbidity column) to see if turbidity should be collected at a reach. Be sure to select these indicators (thalweg, bank angle, total nitrogen and total phosphorus) on the “Add/Remove Contingent Indicators” page of SARA prior to reaching the “Verification” page for data collection. On the verification page, crews should select “Sampled-Boatable” as the site status. Quantitative riparian vegetation estimates are currently collected in the Multiple Indicator Monitoring (MIM) application by a separate crew; please contact the National AIM Team for coordination.

3.0 Office Evaluation

The non-wadeable protocol requires more pre-sampling work than the wadeable protocol. 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 from one point to another, the best means 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.

4.0 Reach Setup, Monumenting, and Initial Assessment

Overview: Office evaluation is very different in the boating protocol as compared to the wadeable protocol. Much more effort is expended before the field season in order to delineate reaches and identify transect locations. Reach length is determined from wetted width, which is measured from imagery. Transects are then distributed up and down river from the F transect based on determined reach length. A single bank (left or right) is randomly assigned at each transect and is physically visited by the crew (i.e., data collection bank). This information is recorded using a standardized method for use in the field during current sampling year, as well as for reference for future sampling events.

The length of a sample reach is 40 times the average wetted width. If average wetted width is ≥ 100 m the reach length is set at 4 km (maximum allowable reach length), minimum reach length is 150m. Wetted width is estimated by using aerial imagery and the measuring tool in Google Earth, WebMap, or ArcMap. The distance between transects is 1/10 of the reach length and transect locations are also determined using a digital measuring. The crew lead uses the [Excel spreadsheet template](#) (available in the Teams Boating Channel) to document transect locations during the reach set up office evaluation process.

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. Like the wadeable protocol, the point coordinates can also be moved to maximize the number of transects on BLM land or to avoid the sample reach spanning two stream size categories. Point coordinates should be moved the minimum distance required to allow the field crew to sample the reach and the original point coordinates must be contained within the new reach after it is moved. Reaches that have been sampled in the past should never be moved unless the reach extends into a different size class category (e.g., LS to RV) or in cases where the reach can be moved to ensure the maximum number of transects are located on BLM managed land. If revisit reaches are moved for these purposes you must keep the previously sampled portion of the reach within the new reach, but it is best to consult with the BLM project lead for such instances.

4.1 Estimating Wetted Width

Methods:

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

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. Next, 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. Maximum reach length is 4 km and minimum reach length is 150 m.
4. If a transect has a mid-channel bar or island, use the following guidelines:
 - a. Estimate whether islands/bars are typical of this reach (>40% of reach length has these features.)
 - b. If a mid-channel feature has vegetation that can be seen on imagery, consider it an island and subtract its width from wetted width.
 - c. If a feature has no vegetation, consider it a bar and do not modify the wetted width estimate.

4.2 Setting up the Reach

Overview: Each transect location is identified with coordinates, and the data collection bank is noted.

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 where measurements will be taken (i.e., data collection bank). Only a subset of field measurements will be estimated for the opposing bank. The data collection bank 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 aerial imagery in the location that most closely corresponds to the thalweg and the point coordinates, and label this pin Transect F.
2. The zoom scale bar should be approximately the same width as the wetted width (i.e., if river width is 115 m, the scale bar should read 115 m). Additionally, use a flat field view, rather than a view with tilt.
3. Obtain the distance between transects based on the reach length.
4. 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; do not artificially straighten out the line of measurement.
5. 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 most upstream transect and K is the most downstream transect.
6. Repeat steps 2 and 3 until all transects (A-K) have been identified.

7. Randomly determine the data collection bank for transect A by flipping a coin (heads for right bank, tails for left bank). Note that right and left are identified when facing downstream.
8. From the A transect pin move the cursor, perpendicular to the thalweg, to the data collection bank and record the GPS coordinates displayed on the bottom right corner of your Google Earth screen for that location.
9. Work your way downstream repeating step 7 for each transect, keeping the next two data collection banks on the same randomly chosen side so that the first three transects are sampled on the same side of the river. From here, the next two data collection banks should be placed on the opposite side of the river, and then switch back to the originally randomly chosen side for the next two. Alternate placing data collection banks and associated 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 to start, 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.
 - a. No transect measurements should be taken on the banks of islands. Therefore, if an island is encountered, measurements should be taken on the outer most banks of the river. In some instances, this might require one to switch the side of the data collection bank for measurements. Additionally, dangerous obstacles can also cause access issue to a specific bank. If these situations occur subsequent data collection banks should be switched in an effort to balance the number of banks sampled on the right and left side of the river (i.e., roughly a 6 to 5 split). Note such instances when setting up the reach and assign bank GPS coordinates accordingly. If a bank access issue occurs in the field, do not attempt to change all transects, just move your problematic transect to the opposite bank.
 - b. Every reasonable effort must be made to navigate to the exact location of the data collection bank. Each data collection bank and associated transect should be analyzed as follows:
 - i. Is the data collection bank impossible to access in any reasonable way? If so, can the location of the data collection bank be accessed by landing the boat up or downstream and then approached on foot?
 - ii. If the data collection bank cannot be safely accessed, assess whether the opposite bank can be safely approached?
 - iii. If neither the left or right banks can be safely accessed, consider whether the transect can be moved up or downstream to enable sampling. Do not move the transect more than one-third the distance of transect spacing.
10. After the reach has been set up make sure to enter the GPS coordinates for the data collection bank of each transect into a hand-held GPS unit for use in the field.
11. Throughout this process, make careful note of long riffles paralleling the downstream orientation of the valley bottom. You will need to identify and be ready for flood-prone width measurements at a representative riffle.

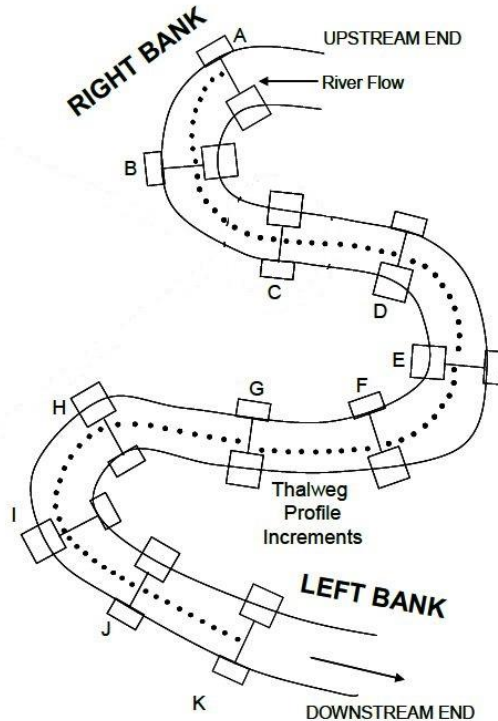


Figure 1. Non-Wadeable reach set-up. Data collection occurs at 11 transects (A through K) and along the thalweg (dotted line). At each transect, the boat is landed and measurements are taken at one bank (i.e., data collection bank – large boxes or plots in the figure at each transect) and estimated for the other (smaller boxes or plots).

At the end of this Office Evaluation Process, the following products should be completed and uploaded to the Boating Teams Channel for each Reach:

1. KMZ of Reach Set up
2. Completed Reach Set Up Template, with KMZ image screen capture pasted into spreadsheet
3. Put in / Take out notes, as well as comments about directions, access, contacts, etc. This information also needs to be copied into the Office Webmap following the Office Evaluation process outlined in the Evaluation and Design Management Protocol.

4.3 Monumenting or Relocating Sample Reaches

The only difference between the wadeable and non-wadeable protocol for Monumenting is that the A transect should be monumented in the field following section 4.2.1 and not the F transect.

4.4 Assessment before launching

Before launching the boat or upon arriving at the A transect, the crew should identify the following critical concepts (review in 1735-2.2 section 2.2): Scour line, Bankfull, the presence of benches (active: floodplains or inactive: terraces), and thalweg. Time should also be spent inventorying priority native woody and noxious vegetation from the state species lists.

After launch, set the GPS to navigate to Transect A and pay attention to how quickly you are moving down 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. Each member of crew must have specific tasks prepared to execute (e.g., GPS navigation, thalweg depth and substrate measurements, data recording). Rivers can move quickly and missed opportunities can rarely be reversed. If a put-in is very close to transect A, the crew should be ready to begin sampling when they start heading down river.

5.0 Water Quality

The only difference between the wadeable and non-wadeable protocol for water quality is that measurements are taken at the A transect and not the F transect. At the A transect, water quality can be collected from the bank so long as there is moving water – do not collect water quality samples from backwaters.

6.0 Benthic Macroinvertebrates (BMIs)

Overview: The default method for benthic macroinvertebrate sampling in non-wadeable systems is the reachwide method using a kick net. This means that BMIs will be collected within plots located at each of the 11 transects. For this method, you must specify the date collected, sampled habitat (reachwide), and total number of sample jars.

Methods:

1. At each of the 11 transects a single kick net sample is collected from the littoral plot. 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 from the wetted (Figure 2).
2. If a transect cannot be accessed, use the following:

- a. Collect two spatially separated subsamples at the next transect
 - b. If the K transect is unreachable, collect the 11th subsample at the next accessible location.
3. Visually delineate the 20 x 10 m littoral plot.
4. Identify the dominant habitat type within the littoral plot (e.g., sand, coarse gravel, boulders, macrophytes, etc.). Do not sample within 0.5 of the wetted edge to avoid edge effects.
5. In an area of dominant habitat within the littoral plot sample as follows based on whether you can wade in the plot and whether current exists:
 - a. No current:
 - i. Wadeable: use your feet or hands to disturb the substrate for one meter upstream of the net while pushing water into net or moving the net through the water to capture invertebrates
 - ii. Unwadeable: use the kicknet to disturb the substrate and then sweep the kick net through 1 linear meter of water.
 - b. Current present:
 - i. Wadeable: use the kicknet as you would in a wadeable system and disturb an area of substrate for 1 meter upstream of the kicknet with your feet
 - ii. Unwadeable: use the kicknet to disturb the substrate by poking at the stream bottom against the current for a length of one meter
 - c. Each time you take a sample with the kicknet empty it into a sealable bin or bucket. Accumulate the contents of each kicknet into this container over the entire reach. Be careful not to spill the contents while traveling from transect to transect. At the end of your reach processing into a single sample following section 5.1.

6.1 Sample Preservation

Same as wadeable protocol.

7.0 Physical Habitat and Canopy Cover

7.1 Channel Widths

Methods:

Measure (or estimate) the bankfull and wetted widths along each transect from the data collection bank.

7.1.1 Wetted 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.

- a. 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.
 - i. If any islands exist, measure the island as if it were a bar, but flag the measurements and indicate in the comments that an island was present and not a bar.
 - ii. If you are unable to see across the full width of the river because an island obstructs your view, do not record a value and flag the cell as not collected. Measurements can be taken of the visible main channel only, but the value should be recorded in the comments section. If measurements cannot be taken at 5 or more transects because of island obstructions, use estimates of wetted width from google earth and flag the measurements as estimated.
2. Record the measurement in **meters** rounded to the nearest 0.01 m.

Note: in rare instances transects located on large meander bends and oriented perpendicular to the thalweg will not intersect the bank the opposite side of the river (Figure 2). If this occurs, the transect location should be moved up or downstream so that the transect intersects the opposite bank while located perpendicular to the thalweg. No matter the circumstance, transects should not be moved more than one-third the distance of transect spacing. If measurements still cannot be taken after attempting to move the transect, do not take the measurements.

7.1.2 Bankfull Widths

Methods:

1. Identify bankfull using the guidance in Section 2.2.1.
2. Use a laser range finder to measure bankfull width from the location of bankfull on the data collection bank to the opposite bank of the river. If a transect intersects an island, the bankfull width is measured to the opposite bank of the river; the island is ignored for this measurement.
3. If measurements cannot be taken at 5 or more transects because of island obstructions, use estimates of bankfull width from google earth and flag the measurements as estimates.
4. Record the measurement in meters rounded to the nearest 0.01 m.
5. If the bankfull elevation cannot be identified for an individual transect, then use the average bankfull elevation measured throughout the reach for measuring bankfull width.

Note: See note for wetted width and large meander bends above. The same logic should be applied to bankfull width.

7.2 Floodplain Connectivity

Overview: Bankfull and bench 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 bench height is only measured on one side of the river, the bench surface is often on the opposite side of the river from the rest of the plot. For these reasons, bankfull and bench 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. Hand levels are not waterproof and easily broken, because this method depends on using this, a spare should be taken with you and kept in a waterproof case.

Besides differences in the equipment and procedures used to take measurements, all other methods are similar to the wadeable protocol.

Bankfull and bench height methods:

1. Follow all guidance in 7.2 except for the following:
 - a. Position your body so that your eye is approximately level with the bankfull elevation.
 - b. Have another person hold the stadia rod vertically on the transect, with its base planted at the water's edge.
 - c. Use the hand level to sight the bankfull elevation and then, while keeping the level at the same height, slowly turn your head or body so that you can now sight the stadia rod. Alternatively one can sight the bankfull or bench height from the boat while the stadia rod is held at the water surface.
 - d. Record the bankfull height.
 - e. Repeat steps a – e for bench height using the guidance in Section 2.2.2 to identify bench heights.
 - f. If the lower of the two benches is on the opposite side of the river than the data collection bank, have one person hold the stadia rod at the water's surface, the other person should try to use the hand level to sight across the river to the bench height, position your body so your eye is level (hand level is level) with the bench height, and then focus in on the stadia rod to determine the bench height.

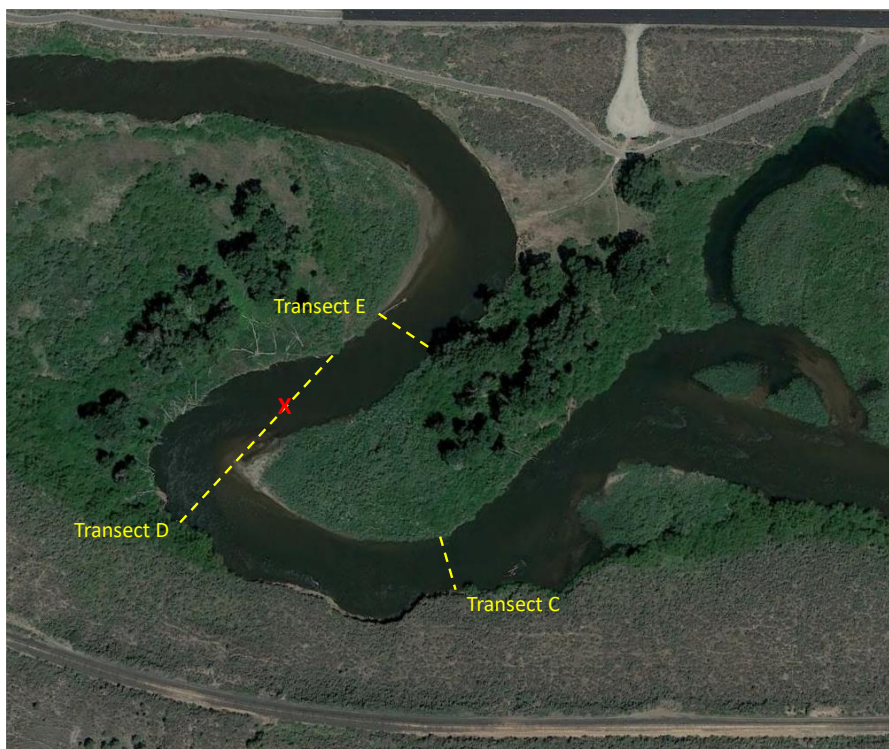


Figure 2. Example of rare instance in which a transect located on a meander bend and oriented perpendicular to the thalweg does not intersect the wetted edge or bankfull elevation on the opposite bank. In this example transect D should either be moved slightly up or downstream to avoid this issue or not be measured for wetted and/or bankfull width if the transect cannot be moved within the allowable distance.

7.3 Bank Stability and Cover

Overview: Bank stability and cover methods for non-wadeable systems are identical to the wadeable protocol except that measurements are taken on the bank where the boat is located (data collection bank) and estimated for the other side of the river. The use of binoculars greatly assists with estimates on the opposite side of the river. The app notes which bank was measured versus estimated for analysis. Furthermore, individual cover categories are not assessed, simply whether the bank is covered or not.

7.4 Riparian Canopy Cover

Overview: For non-wadeable systems, canopy cover is only measured in four locations per transect on one side of the river – the data collection bank.

Methods:

1. Position your body at the scour line and hold the densiometer 0.3 m (1 ft.) above the scour line location (if possible, use a depth rod to assist). If the water surface is above the elevation of the scour line, hold the densiometer 0.3 m above the water surface.
2. Count the number of grid intersection points within the “V” that are covered by any form of vegetation or object that creates shade such as a canyon wall or bridge.

3. Take 1 reading facing each of the following directions: upstream (UP), downstream (DOWN), left bank (LEFT), and right bank (RIGHT).
4. Record values (0-17)

7.5 Littoral Streambed Particle Sizes and Depths

Overview: Streambed particle measurements significantly differ for non-wadeable systems. Particles are measured within littoral plots associated with each of the 11 transects for both the entire littoral plots and the shoreline. 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 from the wetted edge (Figure 3).

Methods:

1. Visually delineate the 20 x 10 m littoral plot
2. Using a stadia rod or depth rod, measure and record water depth (cm) at 5 haphazardly chosen locations within the littoral plot. 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.
3. Visually observe and record the dominant and secondary substrate particle sizes of the riverbed within littoral plot (referred to as "Bottom" in SARAH). If you cannot see the 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 (> 4000 mm and Smooth) – Larger than a car
 - b. Bedrock (> 4000 mm and 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)
4. Repeat step 3 but this time only assess the dominant and secondary substrate within the shoreline, which is defined as from the water's edge to 1 m from the wetted edge toward the thalweg.

7.6 Large Wood

Overview: Large wood measurements significantly differ for non-wadeable systems. Specifically, the location of measurements and the large wood qualifications differ.

Large wood qualification:

To qualify, each piece of large wood:

- Must have small end diameter ≥ 0.3 m (30 cm) in diameter for at least 5 m in length. If the diameter of the piece is < 30 cm at any point, visually cut the log, and do not use this portion for length estimates.
 - 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
- Must be either contained in the littoral plot and touching the water or dry and contained within the bankfull channel. For assessing whether the piece of wood is within the bankfull channel, imagine the stream is flowing at bankfull, and count any piece whose qualifying stem would be wet.
- Must be dead vegetation or standing dead vegetation. Dead limbs spanning bankfull that are connected to live trees are counted as large wood if they meet the qualifying size criteria, but only the dead portion is measured, not the whole tree. Dead limbs should be clearly dead (e.g., limbs devoid of leaves or needles, shedding or devoid of bark, with small branches broken off).

Special situations:

- If a qualifying piece of large wood extends outside the reach, (i.e., upstream of transect A and/or downstream of transect K), only measure the portion within the reach.
- If a forked piece of wood is encountered, measure only the qualifying stem or branch with the largest diameter.
- If a root mass with many stems is encountered, measure only the qualifying stem or branch with the largest diameter. Roots should not be measured or included.
- Cracked or broken pieces. Include the entire length when two pieces are still connected at any point. Treat them separately if they are no longer touching or connected.
- Large wood embedded in streambanks must have an exposed portion that meets the length and diameter requirements to qualify.

Note: Make notes of large debris dams and/or accumulations that occur outside the plot

Methods:

1. Visually delineate the 20 x 10 m littoral plot. 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 from wetted edge.
2. Tally all qualifying, large wood (small end diameter 30 cm; length 5 m) that occurs within the littoral plot. Tally large wood in the following size classes:

- a. Diameter based on large end
 - i. 0.3 to <0.6 m
 - ii. 0.6 to <0.8 m
 - iii. 0.8 to <1.0 m
 - iv. ≥ 1.0 m
- b. Length on the portion that has diameter >30 cm (measure the entire length even of the piece of wood extends outside of the plot so long as the diameter remains > 30 cm):
 - i. 5 to <15 m
 - ii. 15 to <30 m
 - iii. ≥ 30 m
3. Repeat step 2, but this time tally all qualifying large wood that is dry, but contained within the bankfull channel

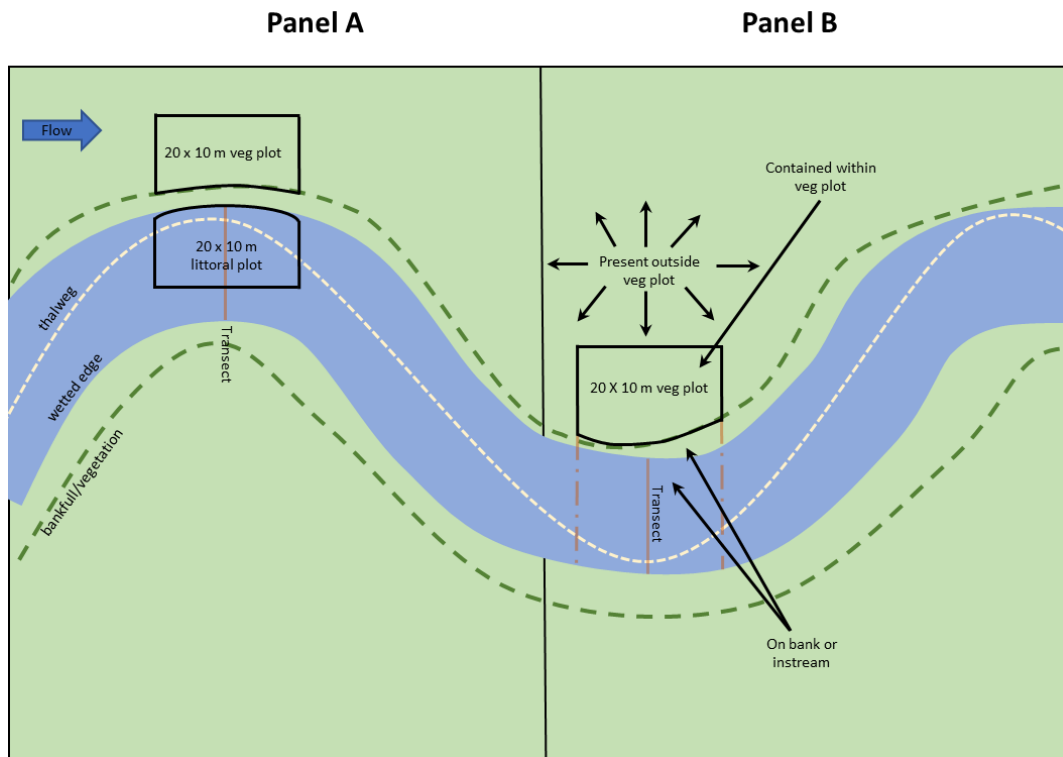


Figure 3. Location of vegetation, littoral, and human influence assessments. Panel A shows the littoral plot, which begins at wetted edge and extends 10 m into the wetted channel and 10 m up and downstream of the transect. Panel A also shows the vegetation plot, which begins at bankfull or the lowest extent of perennial vegetation, whichever is closest to the wetted edge. Panel B shows the three locations where human influences can be located: on bank or instream; contained within the 20 m x 10 m vegetation plot; or present outside of the vegetation plot.

7.9 Flood-Prone Width

Overview: For the non-wadeable protocol, flood-prone width is measured at representative riffles closest to transects A 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. Flood prone width can be measured below transect A and above B, if the riffle is representative and the thalweg can be relatively easily exited and re-entered.

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. Have one person hold the stadia rod at the bankfull depth and measure vertically on the stadia rod to the height of 1 x the maximum bankfull depth (since you are already standing at bankfull).
4. Have a second person walk to an elevation from which they are able to see and are standing level with the reading of the stadia rod at 1 x the maximum bankfull depth, while also able to see the opposite bank. Use the laser range finder to measure the flood prone width to the nearest 0.01 m. Before taking the reading one can use the hand level to ensure the measurement is taken at the proper elevation.
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.

7.11 Bank angle

Overview: Bank angle is estimated (not measured) at each transect between scour line and the bankfull elevation or 5 m, whichever is encountered first. Bank angle is only measured on one side of the river – the side randomly selected for sampling (data collection bank).

Methods:

1. Visually estimate the angle of the bank on which you are standing or viewing using the following categories:
 - a. V = vertical/near vertical/undercut ($>75^\circ$ or undercut)
 - b. S = steep ($30-75^\circ$)
 - c. G = gradual ($5-29^\circ$)
 - d. F = flat ($<5^\circ$)

7.12 Thalweg Depth Profile and Thalweg Substrate Estimates

Overview: 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. While collecting thalweg, the substrate type is also estimated from probes with the stadia rod.

Methods:

1. Determine the interval between thalweg depth measurements based on the distance between transects (distance between transects/10).
2. Before entering the sample reach, take a few “test depths” to obtain a general sense of the depth of the river.
3. Before leaving each transect, adjust the stadia rod to the appropriate height based on the depth of the river and be ready to take measurement!
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. Stadia rods do not float, be careful not to drop it completely.
 - b. Identify substrate type based on the sound that the rod makes when it contacts the substrate, a visual estimate, or *knowledge*. 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 woody 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 Riparian Vegetation

8.1 Priority Noxious (core) and Priority Native Woody Riparian (contingent) Vegetation

Overview:

The main differences between the wadeable and non-wadeable protocols for priority noxious and native woody vegetation are plot size and location, all other methods are identical. The area of a vegetation plot is 20 m x 10 m, centered on each main transect (i.e., 10 m upstream and 10 m downstream). Measurements are only taken within a single plot per transect (i.e., data collection bank) and the plot starts at the lowest extent of perennial vegetation or at the

bankfull margin, whichever is closest to wetted edge (Figure 3). On steeply-sloping channel margins, estimate plot dimensions as if they were projected down from aerial view.

Methods:

1. Stand at the lowest extent of perennial vegetation or at the bankfull margin, whichever is closest to wetted edge, and visually establish the 20 m x 10 m vegetation plot. If you cannot see the full depth of the plot (e.g., distance of 10 m from the scour line), move from the scour line to obtain a better view. If you cannot safely view the plot, record as not collected.
2. Walk around the plot to assess the presence/absence of priority noxious species. Record each priority noxious species present.
 - a. For noxious aquatic species (riparian obligates), assess presence/absence in the 20 m x 10 m vegetation plot, but also extend the plot 10 m into the wetted channel (i.e., littoral plot).
 - b. For all identified noxious species, it is recommended to collect voucher specimens and/or photos for verification by local BLM field staff the first time a species is identified.
3. Walk around the vegetation plot to assess the presence/absence of priority native woody riparian species and sedges and rushes. Record each priority native woody riparian species present in the plot.
4. Repeat steps 1-3 for the opposite bank and continue repeating steps 1-3 until all measurements are collected along all main transects.
5. Plot assessments for the presence/absence of priority vegetation should be rapid and not take between one and two minutes to complete per plot unless time is needed to research and verify vegetation identifications.

9.0 Human Influence

Overview: Human influence is visually estimated identically to the 1735-2.2 protocol except for plot sizes and locations. Specifically, human influences can be (Figure 3):

- On the bank 10 m up or downstream of transect and from start of vegetation plot to river centerline (i.e., streambed in wadeable protocol)
- Contained within the 20 m x 10 m vegetation plot
- Present outside of the vegetation plot

10.0 Photos

Overview: Photo methods for non-wadeable systems generally matches the protocol for wadeable systems with a few small modifications that are noted below.

10.1 General Photo Methods

Do your best to place depth rods in as many photos as possible.

10.2 Reach Overview Photo Methods

Due to the large-scale of river both longitudinally and laterally, obtaining reach overview view photos will be impractical for the majority of non-wadeable reaches. Strive to obtain reach overview photos that contain several transects in a single photo or photos showing both left and right bank in a single photo taken from the thalweg while in the boat. Additionally, please up include your reach set up screenshot as a reach overview image.

10.3 Monument Photo Methods

Switch the location of monument photos from the F to the A transect.

The annotated aerial image is one of the most important monument photos to capture. This image is different than the reach set up screenshot.

Wadeability issues might prevent the taking of all monument photos (e.g., standing at A transect monument looking at A transect)

10.4 Critical Concept Photo Methods

No significant protocol differences

10.5 Bank Stability and Cover Photo Methods

No significant protocol differences

10.6 Flood-Prone Width Photo Methods

No significant protocol differences except that the vantage point for the photo. For non-wadeable systems it might not always be possible to capture both left and right banks in a single photo – do your best.

11.0 Equipment and Boat Decontamination

Overview:

All equipment and gear must be cleaned and disinfected between reaches to reduce the risk of transferring invasive species and pathogens. The following procedures 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 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. 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.
5. 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.
6. 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.

12.0 Channel constraint

Overview: Channel constraint observations are unique to the non-wadeable protocol and consist 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 perennial riparian vegetation begins. 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. Distance to vegetation is assessed via a 1.5 m belt transect – hold a depth rod parallel to the ground and walk from the wetted edge until perennial vegetation is encountered.
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 lateral 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.

Tips and Special Situations

Tips

1. Record thalweg depths on paper data sheets and transfer the data to SARAH at a later time – the app never loads fast enough for all measurements to be recorded.
2. For safety, take thalweg measurements from the end of the boat that is facing upstream.

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.