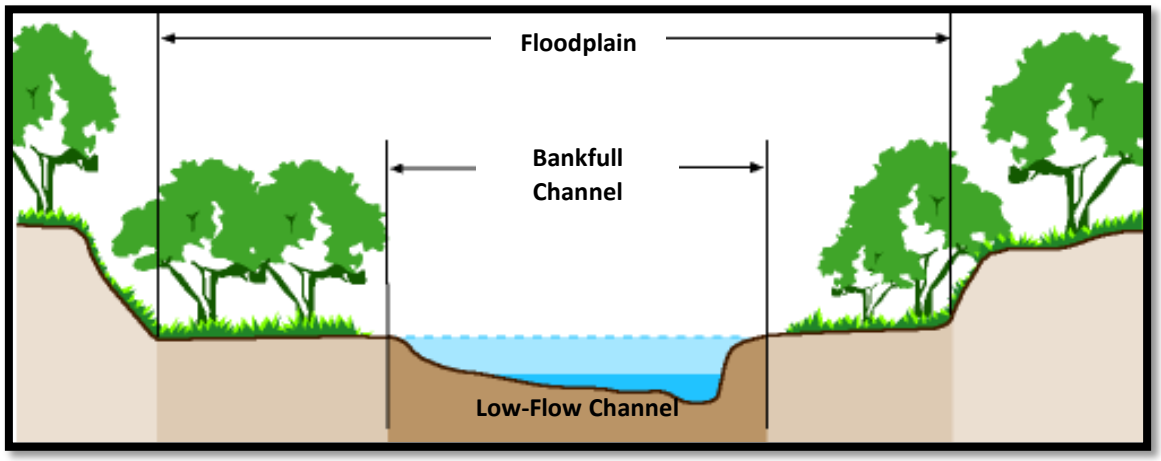
Technical Bulletin

# Bankfull Width Determination

7/2022

Center for Dirt and Gravel Road Studies

**BANKFULL FLOW (STAGE OR ELEVATION) –** This flow stage is determined by the elevation point at which the stream accesses the floodplain. This point is typically indicated by deposits of sand or silt at the active scour mark, a break in stream bank slope, perennial vegetation limit, rock discoloration, and root hair exposure. The bankfull flow is also known as the channel-forming or dominant discharge, which is the flow that transports the most sediment over time and is the most effective in shaping and maintaining the natural stream channel. The bankfull flow roughly corresponds to a 1.5-2 year recurrence interval. The **BANKFULL CHANNEL WIDTH** is the width of the channel at the bankfull flow elevation.




**Bankfull Width:** The average width of the channel at the bankfull elevation. (image credit USFS)

## Finding the Natural Channel of a Stream:

Because streams vary widely in composition, slope, and human-made impacts, it is impossible to create a set of "instructions" for determining bankfull that will work on every channel. The goal when determining bankfull flow is to find an area that represents natural channel conditions either upstream or downstream of the crossing. This sometimes means moving further upstream or downstream away from the structure, or skipping sections of stream that are unnaturally widened or constricted. **Be flexible and think logically in choosing your bankfull measurement stream section in order to get the best representation of the natural channel.**

## Procedure for Determining Bankfull Width Near a Road / Stream Crossing Structure:

**Location:** Start at a location away from the influence of any culvert or bridge, since they often impact channel width. To do this, roughly estimate bankfull channel width, then go at least 5 times that distance away from the structure. Looking upstream is preferred, but downstream reaches can be used if necessary *(see locations to avoid below).* **Be sure to notify landowners and receive permission before entering private property.**

**Determine Bankfull:** Because the bankfull flow does the greatest amount of work forming the channel, the bankfull stage is identifiable in the field. Using the indicators listed below, begin by looking up in the floodplain and then work down toward the stream. Using both sides of the channel, find the elevation of the best bankfull indicators and mark those locations, using flags if necessary. Stretch a measuring tape across the stream at your bankfull mark(s), noting that the tape should be level, to measure the bankfull channel width. Continue moving upstream or downstream, taking successive measurements that are at least 1/2 bankfull width apart (for example, if the first bankfull measurement is 16 feet, move at least 8 feet away before taking another measurement). Collect at least 5 measurements and average them together. More than 5 bankfull measurements can be used to obtain a better average if needed. This is only a general guide; note the "locations to avoid" section that follows.

**Be flexible and think logically in choosing the best indicators for your bankfull measurement locations.**

**<u>Field Indicators of Bankfull Flow</u>:** *(listed in order from most to lease reliable indicators)*

**1. Change in Bank Slope:** Bankfull flows are often associated with "benches" or the top of the stream bank, unless the stream is entrenched or has been altered in the past.

**2. Depositional Features:** The top of features such as point bars and mid-channel bars are often indicators of the bankfull flow elevation. Use these elevations to look for additional clues on each bank at the same elevation.

**3. Changes in Particle Size:** Streams drop sediment when they start accessing their floodplain. A Change in particle size along a stream bank (from gravelly, to silty or sandy) often indicates bankfull elevation.

**4. Vegetation Changes:** Although not as reliable, changes in vegetation can indicate bankfull elevation.

**5. Scour Features:** Erosion and scour lines can be used if other features cannot be located.


**<u>Locations to Avoid in Determining Bankfull Flow</u>:** *(if possible)*

**Logjams or Fallen Trees:** These structures tend to increase the bankfull width in their immediate vicinity.

**Human-made Impacts:** Avoid locations with wall, weirs, dams, rip-rap, pipes, etc.

**Bedrock Outcroppings:** Bedrock can hide indicators of bankfull flow and alter channel width.

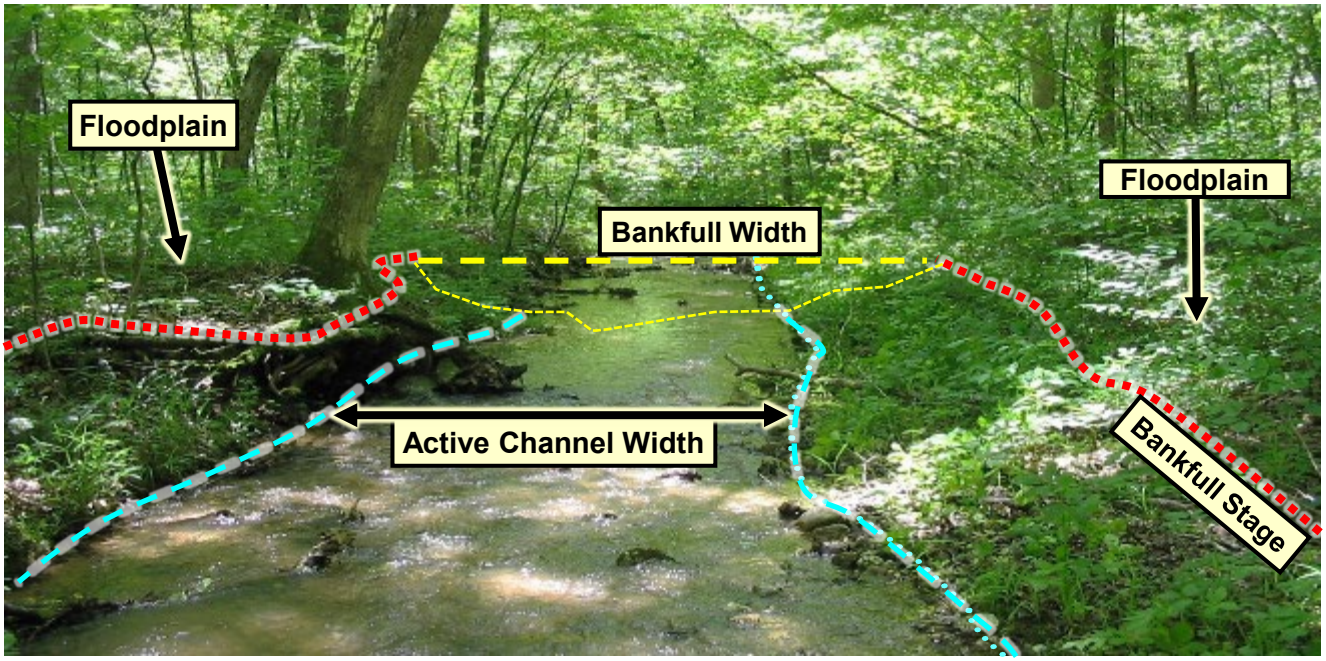
**Braided Channels:** Measure upstream or downstream of any braided channels, if at all possible.

**Tributaries/Springs:** Measure bankfull between road crossing and any incoming flows that may increase width.

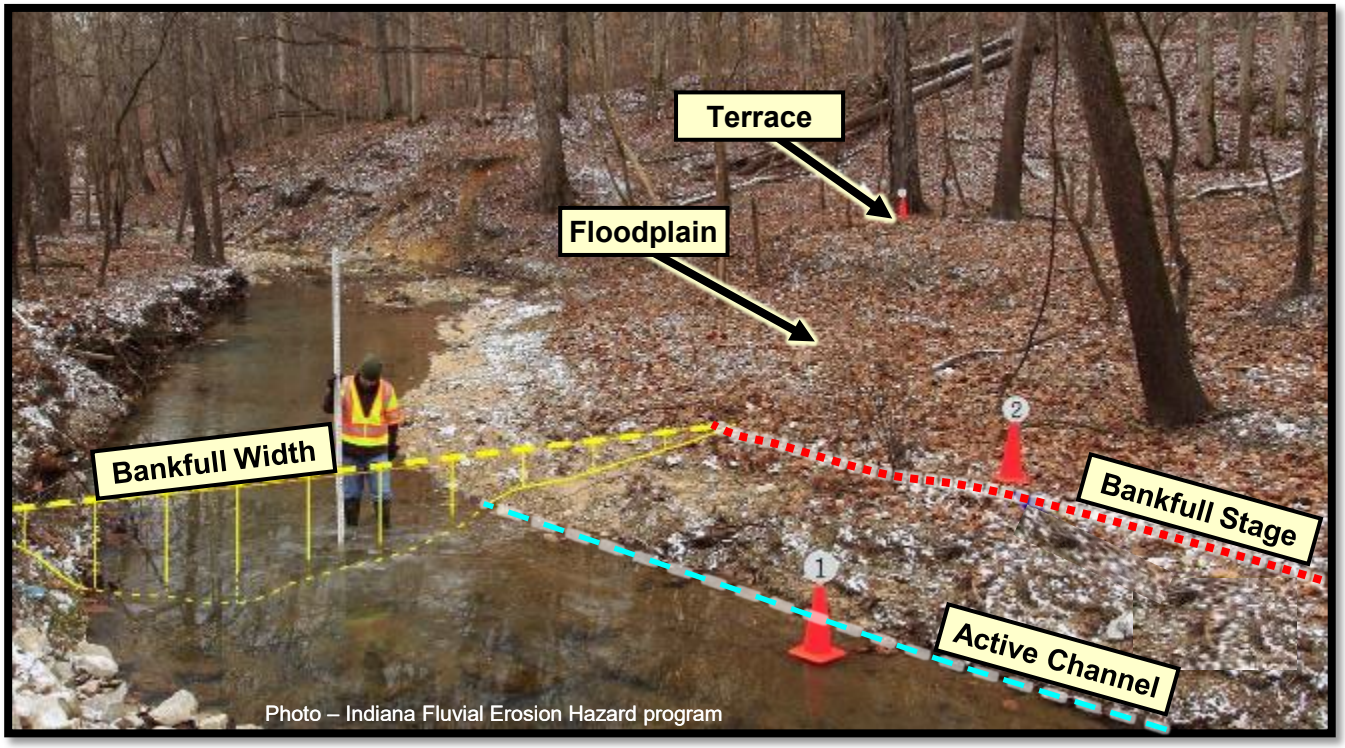
**Hard Meander Bends:** Hard bends make it difficult to find good indicators, since the stream is moving laterally.

**<u>Additional Bankfull Determination Tips</u>:**

- Bankfull flows will be level across the channel, so ensure the tape is level when measuring bankfull widths. If you find strong indicators on one bank, you can stretch your tape level across the stream to get the width.
- When looking for bankfull indicators, think logically about a 1.5-2 year recurrence interval. Does it make sense that the points you are measuring as bankfull will see flow with that frequency?
- When changes in bank slope are strong field indicators, cross sections collected in the same reach can be used to verify bankfull width by comparing the location of slope changes from the cross section with those in the field.
- On entrenched streams, or streams with historically high sediment impacts (legacy sediments), bankfull elevation is often below the elevation of the "top of stream bank" due to many years of human-made impacts.
- Note that tree roots and other vegetation can exist below the bankfull elevation, especially in dry years.
- Measuring bankfull is often easier during Spring and Fall when vegetation is dormant.
- As long as there are no major tributaries, channel splits, or changes in stream type, you can go as far as needed upstream and downstream of the crossing to find "natural" spots to take bankfull measurements.
- **<u>Be flexible</u> in your measurement locations to find the best representation of the natural channel.**



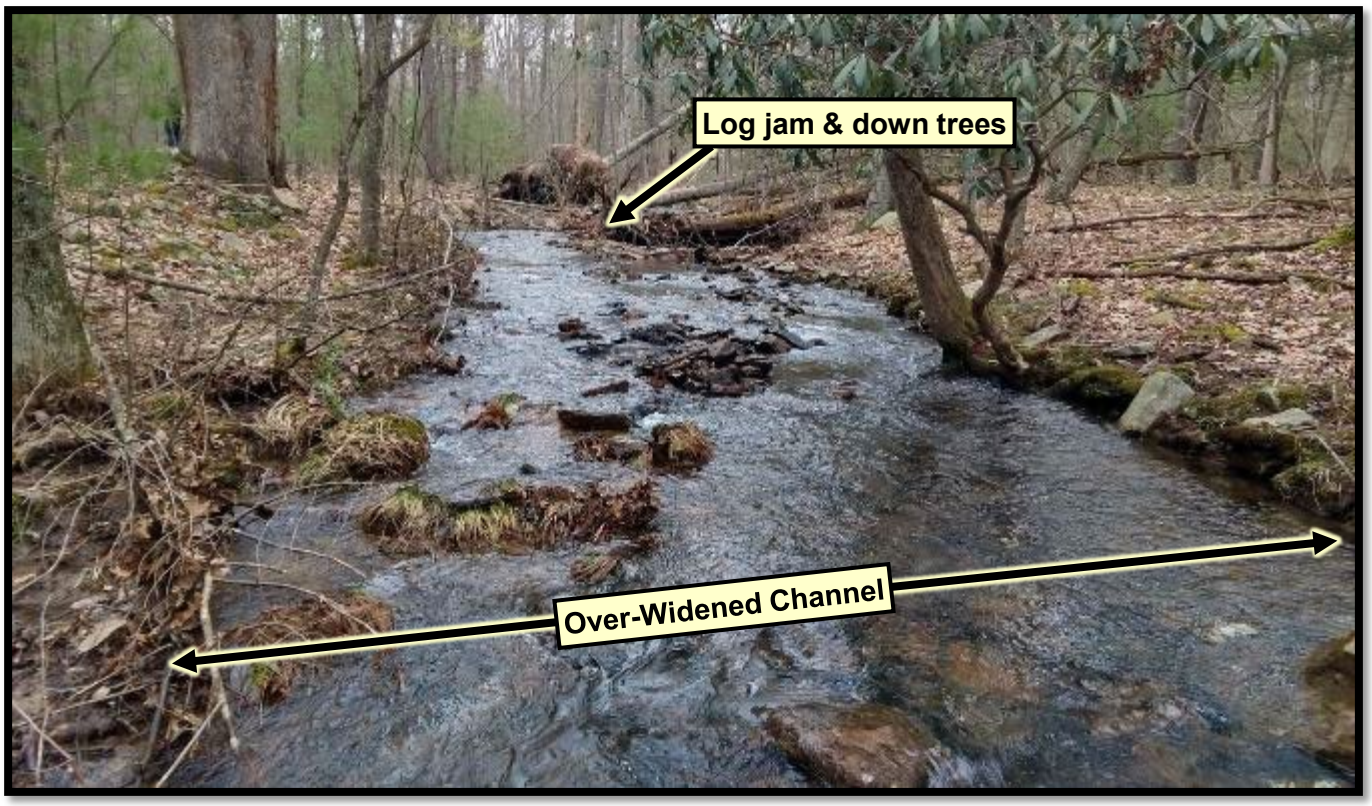

This photo shows a typical forested stream in the summer. Bankfull width is significantly wider than the stream bed width. Bankfull indicators are obscured by vegetation on the right side of the photo and complicated by roots and vegetation growth on the left side of the photo.



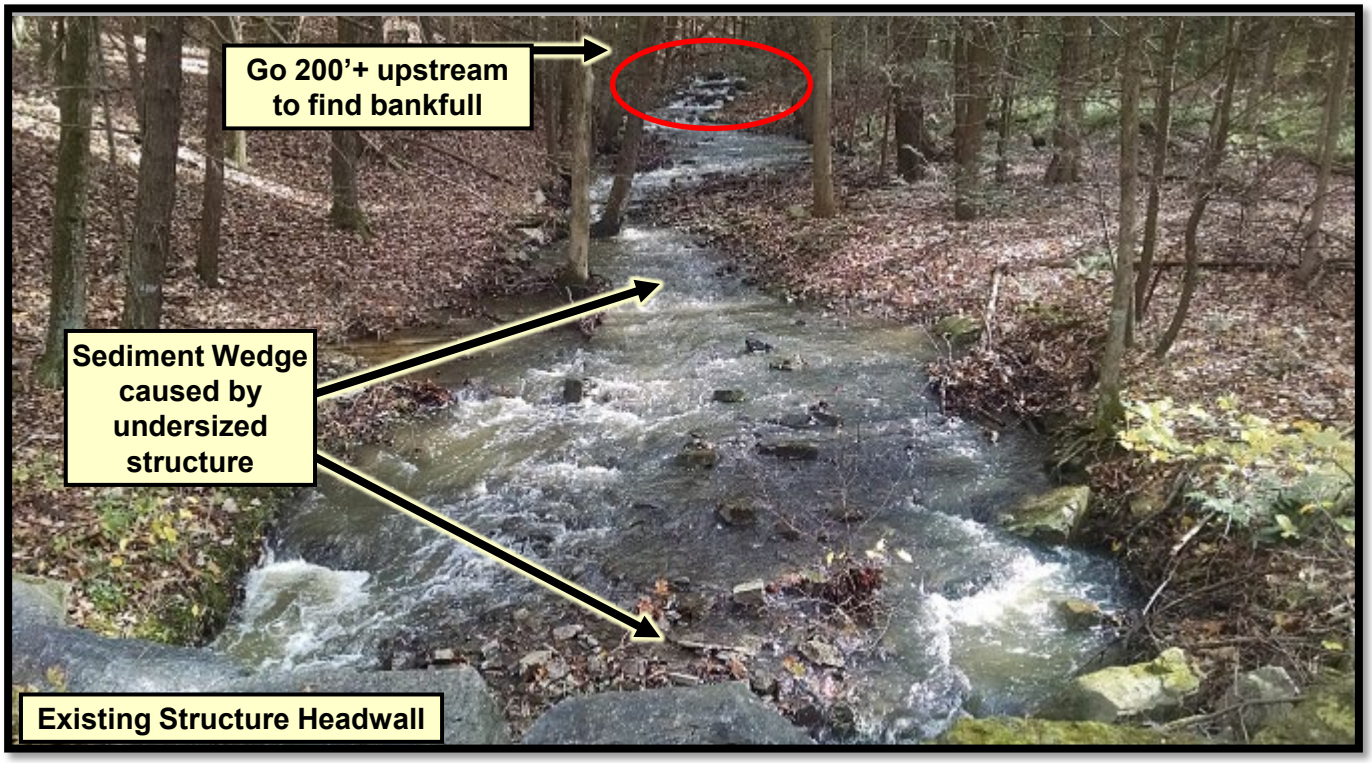

This photo shows a typical forested stream in the winter. Bankfull indicators such as changes in slope, depositional features, and changes in particle size are more obvious due to lack of vegetation.


Entrenched channels are often found in agricultural settings and in high gradient channels. When measuring entrenched channels, the bankfull width and channel width are often the same.

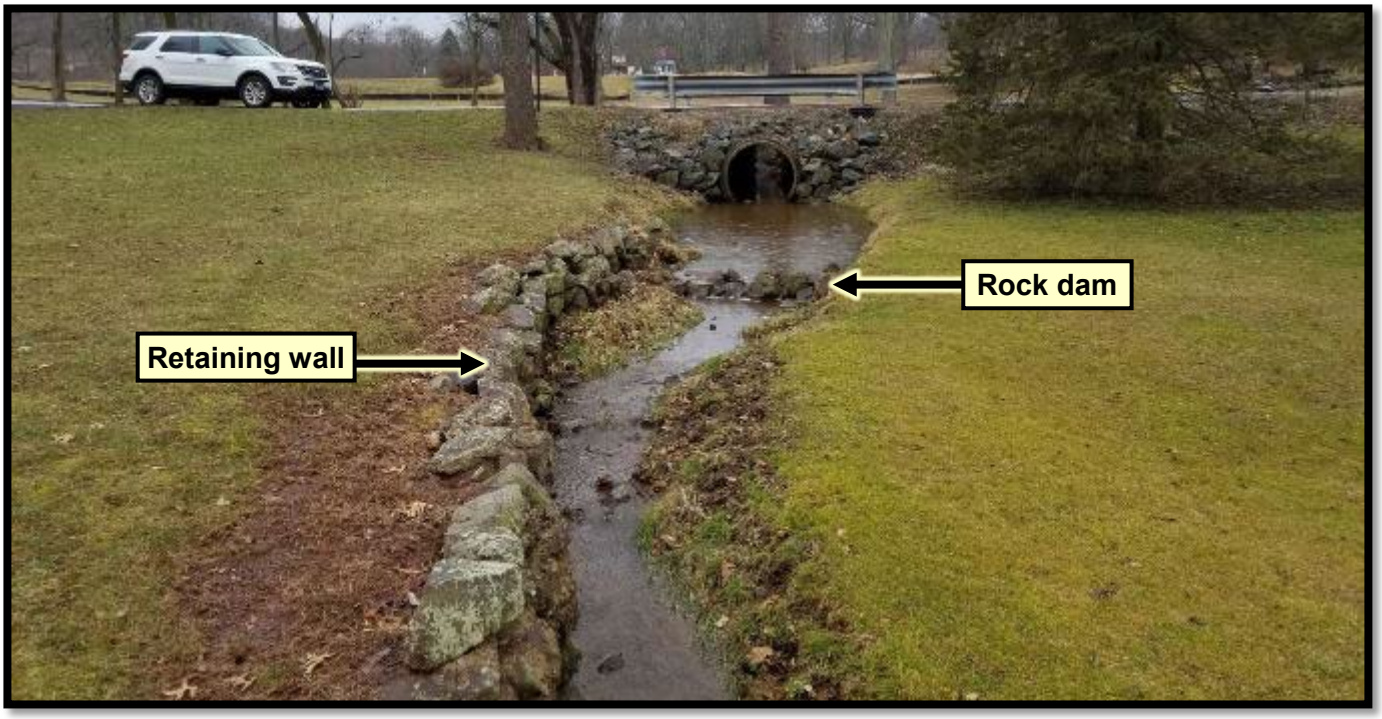

Additional water sources such as tributaries, springs, or tile drains add additional flow and change the bankfull width. If additional water enters above the crossing, then measurements should be taken downstream of the crossing. If additional water enters below the crossing, then measurements should be taken upstream of the crossing. Bankfull measurements of tributaries cannot simply be “added” to get an accurate bankfull width of the combined channel.



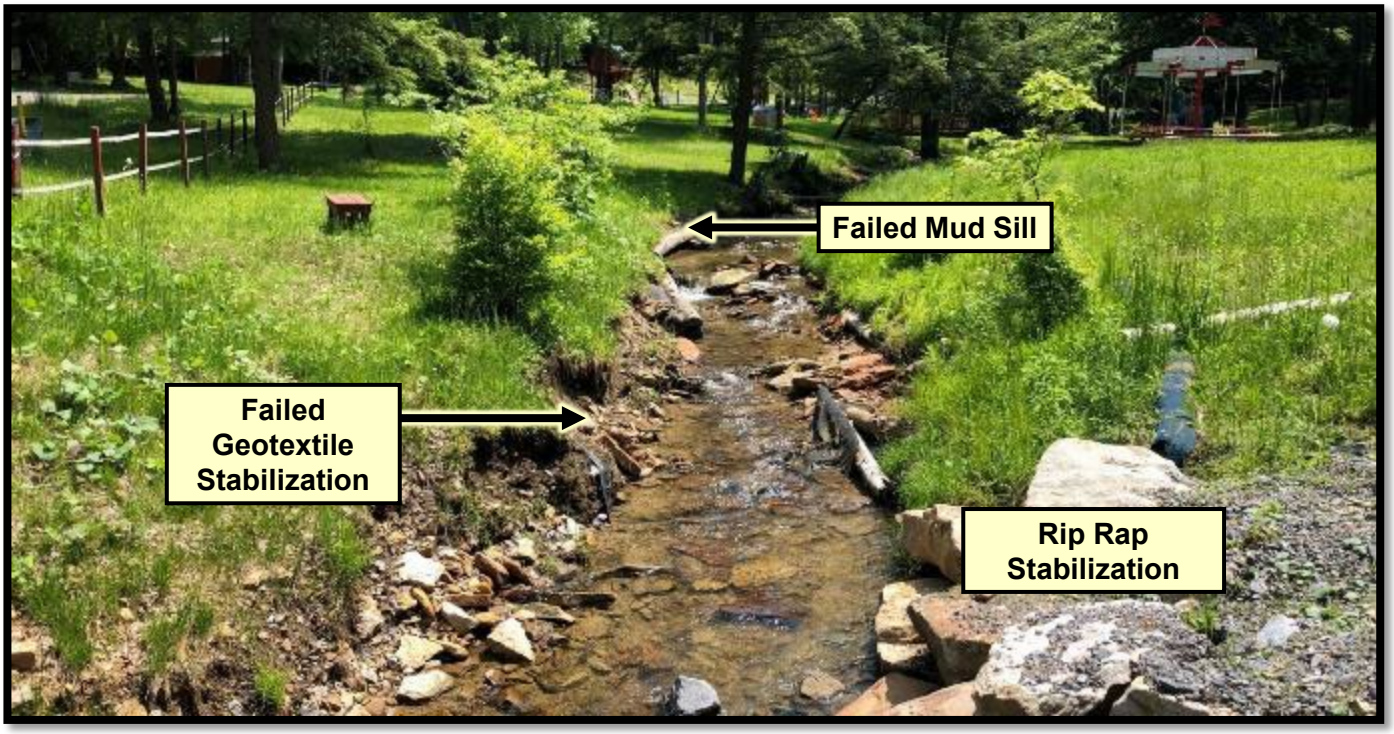

This photo shows a stream section with **locations to avoid when measuring bankfull**. In the foreground, the channel is over-widened and there is noticeable vegetation in the stream. Upstream there is a log jam and downed trees impacting the stream channel. Remember to be flexible when locating the best representation of the natural channel.




This photo shows a sediment wedge that has formed upstream of an undersized structure, causing over-widening of the channel. The impacts from the undersized structure extend approximately 150 feet upstream, and this section should be avoided when measuring bankfull. The red oval shows where the natural channel begins.



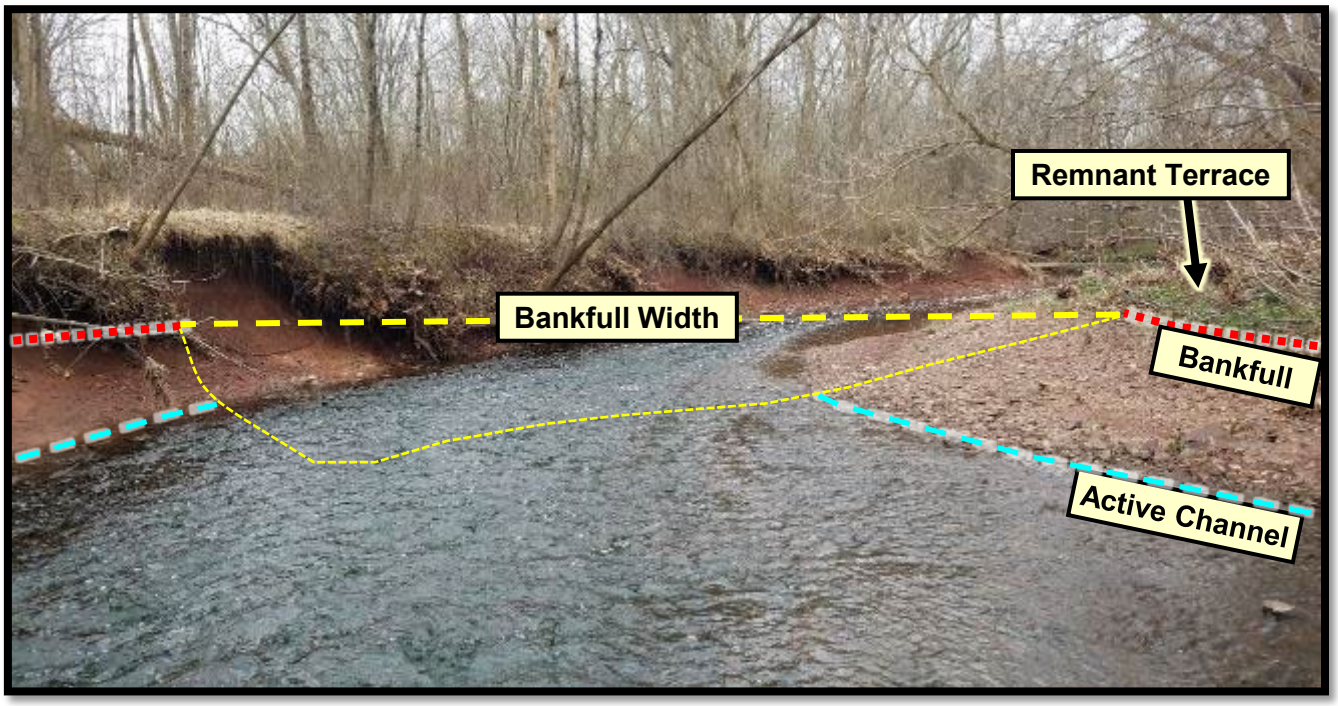

Urban settings pose unique challenges due to human channel modifications. In areas with significant disturbance near the structure, it is necessary to start looking for bankfull indicators more than 5 bankfull widths away from the crossing.



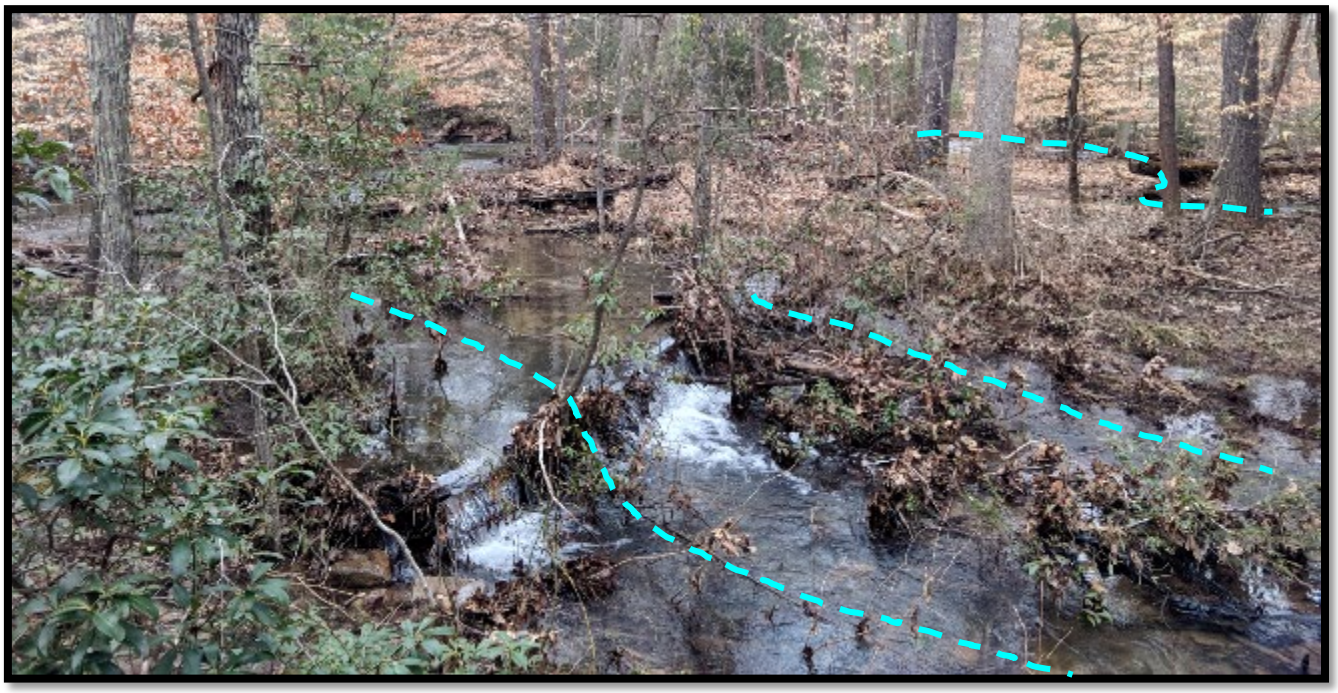

This creek flows through a park and shows impacts from channel modification and failed bank stabilization attempts due to channel downcutting. In areas with significant human-caused bank disturbance, it is necessary to start looking for bankfull indicators more than 5 bankfull widths away from the crossing.

In bedrock and boulder channels, bankfull indicators typically include scour lines on the rocks, fine sediment deposition, and potentially vegetation changes.

Some settings call for creative bankfull measurement. This small entrenched channel in an agricultural field has a bankfull width equal to the stream bed width of just over 1’.




This stream is aggressively adjusting both laterally and vertically. Bankfull elevation is at the top of the gravel point bar shown with the red line on the right, not at the more obvious grade break at the top of the grassy bench where the stream engages its floodplain. This elevation of the grade break is the top of a remnant terrace that is engaged at flows higher than bankfull. This is also a difficult place to measure bankfull due to being on a bend. Avoid measuring bankfull on meander bends like this if possible.



This stream has multiple braids of the main channel and is impacted by significant amounts of large woody debris. Bankfull measurements should not be taken in this section.