River and Stream Continuity Project

DRAFT
Instruction Guide for the 5/14/12 Field Data Form: Road–Stream Crossing Inventory

Developed by the

River and Stream Continuity Partnership

Including:
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For more information go to: **www.streamcontinuity.org**.

OVERVIEW

The River and Stream Continuity Project is a program that trains volunteers and technicians to inventory river and stream road crossings (culverts, bridges, etc.). This information will be used to help determine if crossings are barriers to fish and wildlife movement, and cause habitat fragmentation. Barriers that are identified can then be prioritized for remediation.

These instructions provide additional explanations for the questions on the Road–Stream Crossing Inventory Field Data Form. Remember that the data form is for the entire river or stream crossing, which might include multiple culverts or multiple cell bridges. With the exception of dimensions, answer each question for the crossing as a whole. It is not necessary that every cell of a multiple cell bridge crossing span the channel. Look instead to determine whether, for example, the combination of cells collectively spans the stream channel.

It can be difficult to determine how best to evaluate multiple culvert/cell crossings. Please use the following as a guide for these inherently confusing situations.

1. When the multiple culverts/cells are similar in material, size and elevation use the best case for answering questions on page one of the crossing form. For example if a crossing has two similar sized culverts and where only one of the culverts contains substrate that is comparable to that found in the natural stream channel and the other does not, then answer "comparable" to question #12 (Crossing substrate).
2. When the culverts/cells are significantly different in either material, size, elevation or other characteristics then focus the review on the structure that carries most of the stream flow.
3. When the culverts/cells are significantly different but no single structure carries the majority of the stream flow then focus the review on the "best case" structure considering the full range of characteristics on the data form. If it is not clear which structure is the "best case" structure then consult with the survey coordinator.

Please be sure to answer every question.

SHADED BOXES

The Survey Coordinator will provide the necessary information for these boxes. These include "Coordinator," "Crossing ID#," Stream/River," "Road," "Town" and "Flow condition" as well as information related to entering and reviewing data in the Crossings Database. *Do not enter data in these boxes*.

Survey teams in the field they may encounter unmapped crossings or be unclear as to whether or not the crossing they are assessing is one of the crossings depicted on the map. A crossing may exist on the map that does not exist in the field (in this case the "No crossing" option should be checked on line 3 of the field data form). Survey teams also may encounter unmapped crossings because either the road or the stream was unmapped or due to errors in the GIS analysis that generated the crossings. In some cases the crossing on the map may just be a little off.

When an unmapped crossing is encountered in the field survey teams should write "Unmapped crossing #__" (providing a unique number for each unmapped crossing) at the top of the field data form. Later the Survey Coordinator will forward the record to the National Coordinators for assignment of a crossing code.

BASIC INFORMATION

GPS Coordinates (lat/long) – Use of a GPS (Global Positioning System) unit is required.

- Map Datum: It is best to use datum WGS84 but NAD 83 (North American Datum 1983) or NAD 83 Conus are acceptable as well.
- Location Format: Use projection Latitude-Longitude decimal-degrees (hddd.ddddd or dd.ddd) with 6 decimals if possible.
- If coordinates are collected in decimal degrees then check the "Decimal degrees" check box and enter coordinates in the spaces provided.
- If coordinates are collected in degrees, minutes and seconds then check the "Degrees, minutes, seconds" check box and enter coordinates in the spaces provided.
- Make sure that you are standing on the road above the culvert when taking the GPS point.

Date – Date that the crossing was evaluated.

Location – Provide enough information about the exact location of the crossing so that another person using your data sheet will be confident that they are at the same crossing that you evaluated. For example "between telephone poles # 162 and 163" or "right across from the Depot Restaurant."

Observer – Your name.

Photo IDs – If you took digital photos record the ID numbers from your camera. Enter "none" if you did not take photos.

Digital photographs are an extremely useful tool to use in assessing potential barriers to aquatic organism passage. When taking photos, be sure to use the date/time stamp to code each photo if possible, and record the ID number from the camera of each photo in the appropriate blank on the form. It is important to set the camera to record in low to medium resolution so that the photos do not take up too much space when downloaded for storage. Ideally, to minimize storage space required, but still allow a reasonable image, each photo would be between 100 and 500 kilobytes in size when downloaded.

You can take and submit to the survey coordinator as many photographs as it takes to thoroughly document the site. Only two photographs from each site can be uploaded to the database. Please ensure that you have one good photo of the inlet taken from upstream of the crossing and another of the outlet taken from downstream of the crossing.

A simple way to know which photos were taken at a particular site is to use a black marker to write the date, crossing ID # and inlet/outlet on a dry-erase board or an 8 ½"X11" paper (waterproof if available). The white board should be strategically placed in the photo to make it legible and to not block key features of the crossings. This will make the photo readily identifiable with the appropriate crossing # and will denote whether the image is of the outlet or inlet of the structure. Some people have noted that white dry-erase boards and white paper reflect so much light that they are often "washed out" in the photos and the codes written on the board impossible to read. Use of a small blackboard and chalk may be preferable depending on light conditions.

ROAD /RAILWAY CHARACTERISTICS

Road surface - Check "Paved," "Unpaved" or "Railroad."

Road type – Check the most appropriate box for the type of road at the crossing location.

1-Lane road – Check this option for one-lane roads and smaller, including cart paths, bike baths, trails, and abandoned rail beds. If the road is greater than 18 feet wide it should be considered a 2-lane road.

2-Lane road – Use this option for typical roads – with or without shoulders/breakdown lanes – that have two travel lanes. Include in this category unpaved roads that are of comparable width to paved, two-lane roads.

Multilane road – This category includes roadways with three or more travel lanes but not divided highways.

Divided highway – Include any divided highway with a total of four or more travel lanes (e.g. two lanes eastbound + two lanes westbound). Any multi-lane (>2 lanes) roadway with a median, vegetated island, Jersey barriers, or guardrails should be considered a divided highway. When travel lanes are separated by a median you can get two crossings (e.g. one for eastbound and one for west bound traffic). Where you have a divided highway but no median you often get a single crossing. In both cases, the road type should be "divided highway."

Railroad – Use this category for rail beds with railroad tracks regardless of how many sets of tracks may be involved. Use "1-Lane road" for abandoned rail beds and rail trails.

Buried Stream – Use this category for a segment of stream that has been buried within a pipe extending well beyond the road crossing itself.

CROSSING / STREAM CHARACTERISTICS – Assess the following for the entire crossing

Crossing type – If a crossing exists at an assessment location check the most appropriate choice among "Ford," "Bridge," "Open bottom arch," "Single culvert" and "Multiple culverts" to identify the crossing type (for additional information see descriptions in the glossary). For an open-bottom box culvert check "Bridge." If there is no crossing at the assessment location check either "Removed" if there was once a structure there that had has since been removed or "No crossing" if it appears that there was never a crossing at that location. If you choose the "No crossing" option then it is not necessary for you to fill out the remainder of the data form.

Condition of crossing – Check the appropriate box: "New," "Excellent," "Fair" or "Poor."

Does the stream at the crossing support fish? – Check "Yes" if you see fish or believe that the stream segment at the crossing supports fish. Also check "Yes" if you think that the stream both above and below the crossing supports fish. Check "Not likely" if you think that it is almost certain that the stream segment does not support fish (including fish just passing through). Otherwise check "Don't know."

Is the stream flowing? – Check "Yes" if stream is flowing in the channel upstream and downstream of the crossing. To answer "yes" water in the channel must be moving (even if very slow) and consistent. Puddled areas separated by dry land and rocks does not constitute flow.

Crossing span: Natural streams are variable in width. In selecting the appropriate category consider the average conditions in the natural stream channel outside the influence of the crossing itself.

Bankfull is amount of water that just fills the stream channel and where additional water would result in a rapid widening of the stream or overflow into the floodplain. Indicators of bankfull width include[1]:

- Abrupt transition from bank to floodplain. The change from a vertical bank to a horizontal surface is the best identifier of the floodplain and bankfull stage, especially in low-gradient meandering streams.
- Top of point bars. The point bar consists of channel material deposited on the inside of meander bends. Set the top elevation of point bars as the lowest possible bankfull stage.
- Bank undercuts. Maximum heights of bank undercuts are useful indicators in steep channels lacking floodplains.
- Changes in bank material. Changes in soil particle size may indicate the operation of different processes. Changes in slope may also be associated with a change in particle size.
- Change in vegetation. Look for the low limit of perennial vegetation on the bank, or a sharp break in the density or type of vegetation.

Check the appropriate description from the list below.

Severe constriction: The crossing is half as wide, or narrower, than the bankfull width of the natural stream.

Mild constriction: The crossing is narrower than bankfull width in the natural channel upstream and downstream of the crossing but not enough to qualify as a severe constriction.

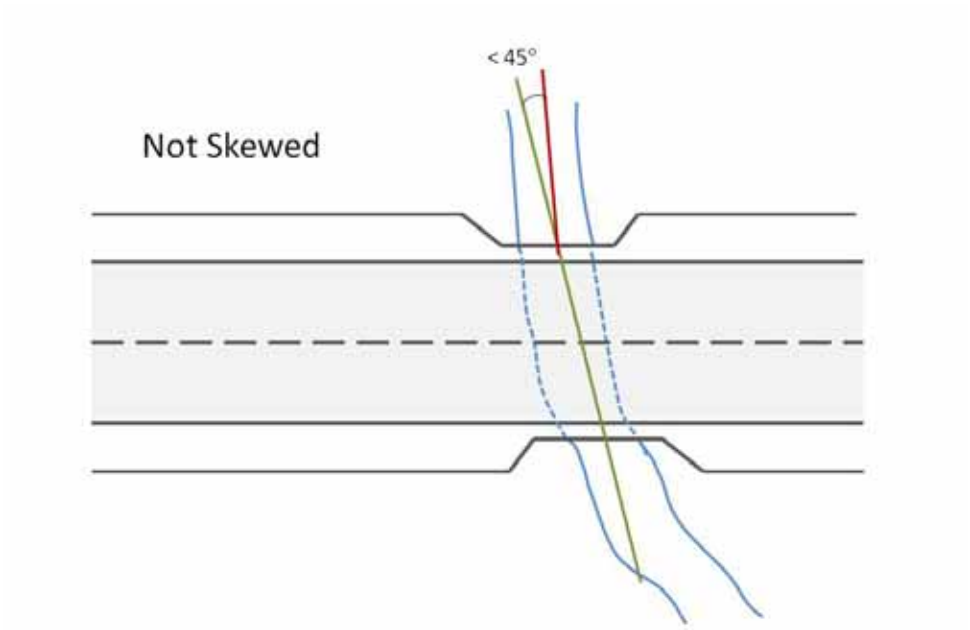
Spans bank to bank: Choose this option if the crossing spans the bankfull width of the channel, but does not include the banks of the stream.

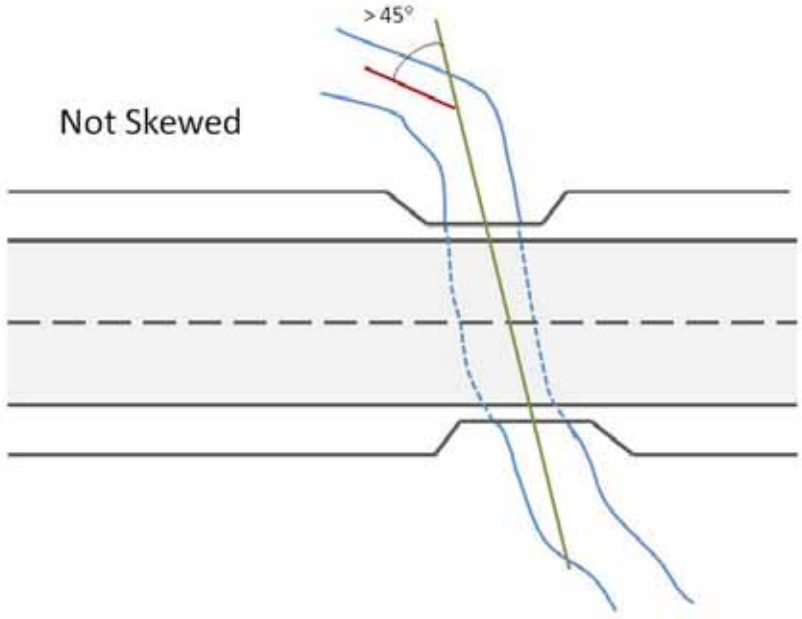
Spans channel and banks: Choose this option if the crossing structure spans the bankfull channel width and one or more of the banks with sufficient headroom to allow dry passage for some wildlife.

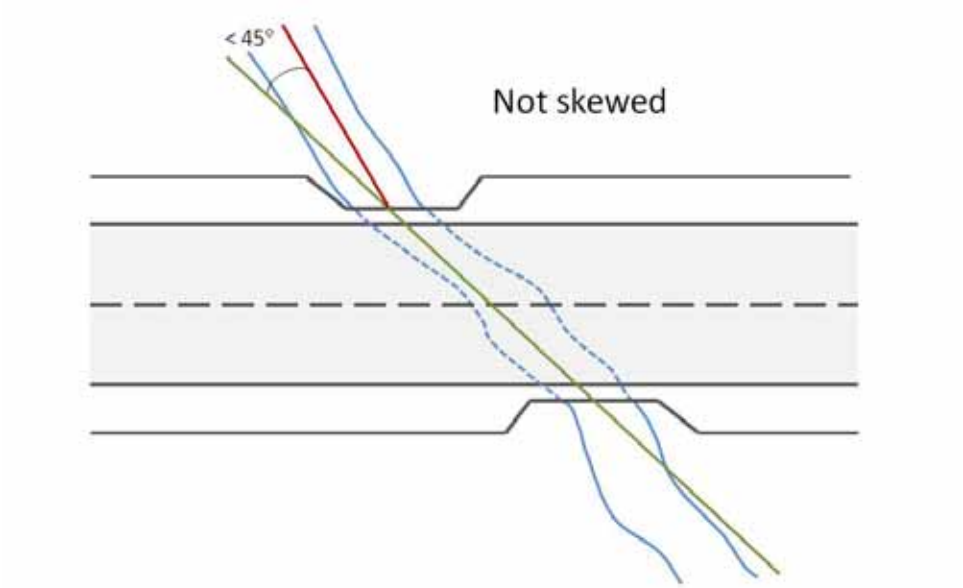
Tailwater scour pool: These are pools created downstream as a result of high flows exiting the crossing. Use as a reference natural pools occurring in a portion of the stream that is outside the influence of the crossing structure and not otherwise altered. A scour pool is considered to exist when its size (a combination of length, width and depth) is larger than pools found in the natural stream. Check “Large” if the width or depth of the pool is twice that of pools in the natural stream channel or more. Otherwise, check either “Small” if a smaller pool exists or “None” if there is no scour pool.

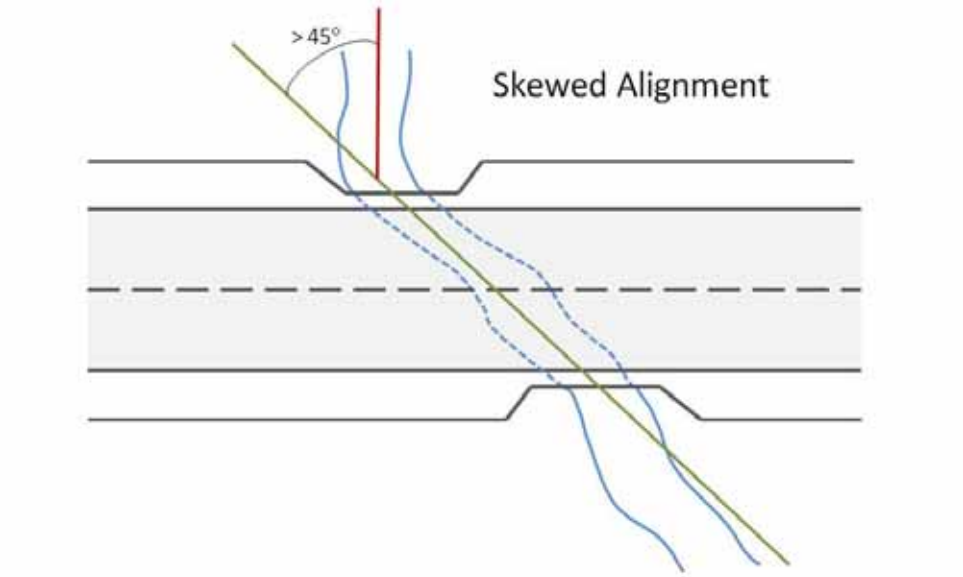
[1] Adapted from Georgia Adopt-A-Stream “Visual Stream Survey” manual. Georgia Department of Natural Resources, 2002.

Crossing alignment matches stream? – Assess crossing alignment at the structure inlet. Use as reference a line connecting the center of the channel where it enters the structure and the center of the channel as it exits the structure. If within 30 feet upstream of the structure the channel deviates from this line by 45 degrees or more check “Yes (flow aligned).” If the channel deviates by less than 45 degrees check “No (skewed).”









CULVERT/BRIDGE CELL CHARACTERISTICS – Assess the following for each structure that makes up the crossing

Crossing embedded?: An embedded culvert is a culvert that is installed in such a way that the bottom of the structure is below the stream bed and there is substrate in the culvert. Indicate on the data form whether or not the culvert is embedded and the degree that the culvert is embedded.

- If the culvert is not buried and generally lacks substrate, then check “Not embedded”.
- If the culvert is partially buried and contains substrate for half or more of its length, check “Partially embedded.”
- If the culvert is buried for its entire length, check “Fully embedded”.
- If the structure has no bottom (bridge, open bottom arch, etc.) or is a ford then check “No bottom.”

Crossing substrate: Record whether the substrate in the crossing is "Inappropriate," "Contrasting," "Comparable," or absent ("None").

- If the culvert is not fully embedded check "None." If a culvert is only partially embedded then the substrate should be considered "none."
    - Check "None (smooth)" if the structure bottom lacks corrugations or other roughened conditions
    - Check "None (rough/corrugated)" if the structure bottom is corrugated (e.g. metal or plastic pipe), contains some substrate (but not enough to be considered fully embedded) or is otherwise roughened.
- Large riprap and broken slabs of concrete are examples of substrates that are "Inappropriate" for river and stream continuity.
- Check "Contrasting" if the substrate is not wholly inappropriate, but contrasts with the substrate in the natural stream channel. For example, if the crossing's predominant substrate is boulders and large cobble on a stream where the natural stream bottom is predominantly mud/muck.
- Check "Comparable" if the substrate in the crossing is similar to that found in the natural stream channel.

Internal features: Check the appropriate box(es) if any of the following features are present within the crossing structure. If no such features are present check "none."

- Slip lined – Slip lining is when a small liner pipe is inserted into a larger culvert and sealed in place as a way of repairing a crossing without having to replace the structure.
- Baffles/sills – These are low structures that run roughly perpendicular to the flow of water to either reduce velocity or trap/hold sediment. Typically a series of baffles or sills are used within a structure.
- Weirs – Are substantial structures that typically run perpendicular to the flow to back water up (increase depth), reduce velocity or confine low flows to create a channel. One or more weirs might be present within a structure.
- Support structures – Include any internal supports that intercept or interfere with the flow of water.

Physical barriers to fish and wildlife passage: This includes any durable structure that physically blocks fish or wildlife movement. Do not include temporary barriers such as debris or sediment accumulations that are not likely to persist for a number of years. If physical barriers exist at a crossing indicate whether the barrier effect is:

- "Severe" (essentially blocking all fish and wildlife passage),
- "Moderate" (blocking passage for some species or individuals but not others) or
- "Minor" (blocking passage for only a few species or individuals or for only a small proportion of the year) and describe them on the data form.
- Otherwise check "None."

Is there a clear line of sight through the structure? – Look through the structure if you can see clear through the structure to the other side and check "yes." Otherwise check "no."

Does the structure provide dry passage suitable for use by terrestrial wildlife? – Check "yes" if at the time of the assessment the structure provides dry passage with sufficient headroom for semi-aquatic and terrestrial wildlife (e.g. along banks or within the stream channel). Otherwise check

"no." If "yes" is checked then also record the maximum structure height in the portion of the structure that offers dry passage.

Comments – Add anything you feel may not have been included, but is important for describing the crossing.

Water depth matches stream? – To evaluate water depth use as a reference a portion of the natural stream channel that is outside the influence of the crossing structure and not otherwise altered. Depth is considered comparable if water depths in the crossing are similar to the depths upstream and downstream in the natural stream channel. Comparable means that the depth in the crossing falls within the range of depths naturally occurring in that reach of the stream and for comparable distances. For example a crossing that has water depths that are similar to those found in deeper pool sections of the stream but that extend for longer distances along the stream than do the pools would not be considered comparable. After evaluating the crossing relative to the natural stream check the most appropriate option among "Yes (comparable)," "No (deeper)," "No (shallower)" or "Dry."

Water velocity matches stream? – To evaluate water velocity use as a reference a portion of the natural stream channel that is outside the influence of the crossing structure and not otherwise altered. Velocity is considered comparable if water velocities in the crossing are similar to the velocities in the nature stream channel upstream and downstream of the crossing. Comparable means that the velocities in the crossing fall within the range of velocities naturally occurring in that reach of the stream and for comparable distances. For example a crossing that has water velocities that are similar to those found in riffle sections of the stream but that extend for longer distances along the stream than do the riffles would not be considered comparable. After evaluating the crossing relative to the natural stream check the most appropriate option among "Yes (comparable)," "No (slower)," "No (faster)" or "Dry."

Crossing Slope matches stream? – To evaluate crossing slope use as a reference a portion of the natural stream channel that is outside the influence of the crossing structure and not otherwise altered. Slope is considered comparable if the crossing slope is similar to the slopes found in the nature stream channel upstream and downstream of the crossing. Comparable means that the crossing slope falls within the range of slopes naturally occurring in that reach of the stream and for comparable distances. For example a crossing that has a slope that is similar to that found in short, high-gradient sections of the stream but that extend for longer distances than found in the natural stream would not be considered comparable. After evaluating the crossing relative to the natural stream check the most appropriate option among "Yes (comparable)," "No (flatter)" or "No (steeper)."

Length of stream through crossing (ft.) Measure the crossing from inlet to outlet by walking through the structure if it is large enough and safe to do so. If walking through culvert is not possible, then hold measuring tape at inlet and let current carry it to the outlet where someone else catches it and measure the length. Another option is to estimate length by measuring distance from inlet to outlet on the road above the structure.

Upstream/Downstream Crossing Type – Choose the most appropriate choice from #1-9 or Ford that describes the type of crossing. Record crossing type separately for upstream and downstream portions of the structure. If you have a partially embedded culvert you will have a different culvert type at one end (e.g. round culvert) compared to the other (e.g. embedded round culvert) and will need to record different dimensions.

1.-Open Bottom Arch will look like a pipe culvert on the top half, but you will not see a bottom half. Instead for the bottom, it has metal footings that are sunk into concrete below the stream channel. For recording dimensions a stone arch bridge should be considered an open bottom arch.

2.-Bridge with abutments will have sides at right angles, but no bottom structure.

3.-Bridge with side slopes will have angled sides, and no bottom structure.

4.-Bridge with side slopes and abutments will have both sloping sides as well as sides at right angles to give the bridge height over the stream.

5.-Round Culvert will be a circular pipe. If the culvert typically contains a significant amount of water then choose "Round Culvert Embedded or with Persistent Water" instead.

6. Elliptical Culvert will have a wider, squashed look than a round pipe culvert. If the culvert typically contains a significant amount of water then choose "Elliptical Culvert Embedded or with Persistent Water" instead.

7. Box Culvert will usually be made of concrete.

8. Round Culvert Embedded or with Persistent Water Use this option for a round culvert where the bottom has been buried below the stream channel or for a round culvert that typically contains significant amounts of water, even if not truly embedded.

9. Elliptical Culvert Embedded or with Persistent Water Also known as a "pipe arch" use this option for an elliptical culvert where the bottom has been buried below the stream channel or for an elliptical culvert that typically contains significant amounts of water, even if not truly embedded.

Ford is a shallow water crossing directly across the streambed, often with logs, stone, or gravel to protect or stabilize the bottom. These are rare, and are mostly found on roads that are not frequently used.

Upstream /Downstream dimensions (ft.) Provide the measurements shown in the appropriate diagram for the crossing type. **(If measurements cannot be taken, please estimate and write EST. after estimated measurement.)**

A. Measure interior width of crossing at its widest point above the water line at the time of the assessment.

B. Measure height from underside of crossing to:

- Water surface or top of bank whichever is higher for bridges, open-bottom arches, and embedded culverts
- Water surface for box culverts and culverts with persistent water
- Structure bottom for non-embedded culverts lacking persistent flow

C. Measure width of actual stream channel (wetted width) through crossing structure if natural bottom exists (i.e. bridges or embedded culverts).

D. Measure height of vertical abutments from underside of bridge to where sides start sloping.

If the opening of the culvert is completely submerged under water then check "Submerged."

Inlet/Outlet Water Depth: Measure (if possible/safe) or estimate the water depth at the deepest point where the stream enters and exits the structure (at edge of structure).

Inlet drop: Where water level drops suddenly at the crossing inlet, causing changes in water speed and turbulence. In addition to the higher velocities and turbulence, these jumps can be physical barriers to fish and other aquatic animals when they are swimming upstream and are unable to swim out of the culvert. Only measure if it is safe to access the pipe, otherwise estimate the drop and check the appropriate box. Measure or estimate the distance that water has to drop to enter the culvert (e.g. from the top of the water in the stream just above the inlet to the top of the water

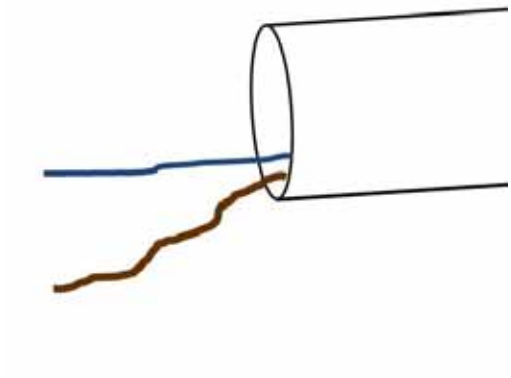
in the culvert at the inlet) and record the measurement (in inches). If there is no inlet drop then check "None."

Outlet Drop: When water drops off or cascades down from the outlet, usually into a receiving pool. This may be due to the original design/construction or subsequent erosion of material at the downstream end of crossing. Outlet drops create barriers to the upstream movement of fish and other aquatic animals that are unable to jump up over the drop. Only measure if it is safe to access the pipe, otherwise estimate the two drop characteristics. Record the measurements (in inches) and check the appropriate boxes (measured or estimated).

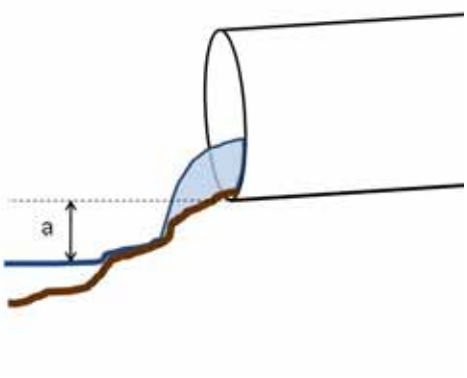
a. Culvert bottom to water surface – Measure or estimate the distance from the bottom of the culvert to the water surface in the first pool large enough to provide resting habitat for fish swimming upstream. If there is no outlet drop then check "None."

b. Culvert bottom to stream bed – Measure or estimate the distance from the bottom of the culvert to the bottom of the channel in the stream bed directly below the outlet. If there is no outlet drop then check "None."

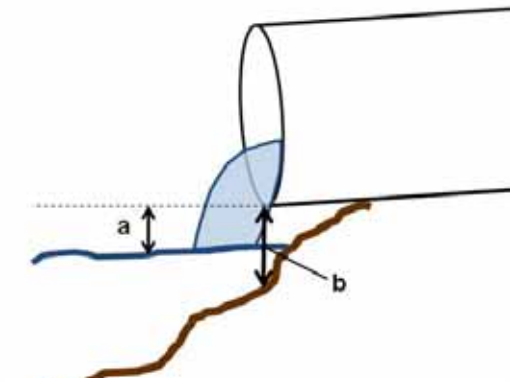
c. If there is an outlet drop, check "cascade" if the water tumbles over rocks, logs, or other debris; or "freefall", if the water falls directly into the pool below. Use "freefall onto cascade" for a combination of characteristics (see illustrations below). If there is no outlet drop then check "No drop."



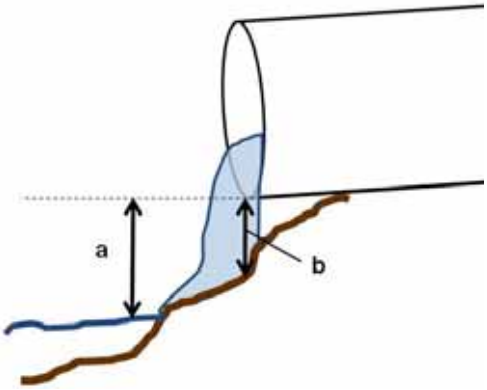
No Outlet Drop



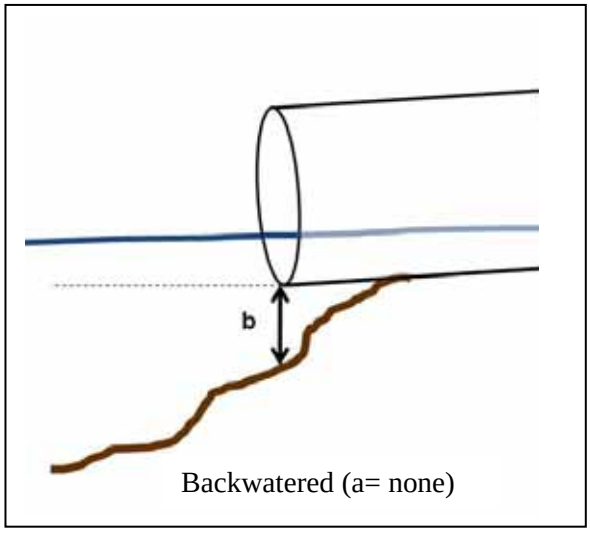
Cascade (b=none)



Freefall (a<b)



Freefall onto Cascade (a>b)



Armored Streambed at Outlet: This includes concrete aprons, plastic aprons, riprap or other structures added to the *streambed* at the crossing outlet to facilitate flow and prevent erosion. This does not include wing walls, retaining walls, or armored stream banks. Indicate on the data form whether tailwater armoring at the outlet of the crossing is "extensive", "not extensive" or absent ("none"). Armoring is considered extensive if it covers the entire width of the channel at the outlet and extends downstream for a length equal to or greater than half the bankfull width of the natural stream.

MULTIPLE CULVERT OR BRIDGE CELL CROSSINGS

When inventorying multiple culverts or bridge cells, label left culvert/cell #1 and go in increasing order from left to right from downstream end (outlet) looking upstream. Record data for culvert/cell #1 on pages 1 and 2 of the data sheet. Use page #3 for additional culverts or cells.

Culvert or Bridge Cell #: Record the culvert/cell number.

Record Data: Follow the same instructions as above to complete data on page #3.

Glossary

→ **Bankfull Width –** Bankfull is amount of water that just fills the stream channel and where additional water would result in a rapid widening of the stream or overflow into the floodplain. Indicators of Bankfull width include:

- Abrupt transition from bank to floodplain. The change from a vertical bank to a horizontal surface is the best identifier of the floodplain and Bankfull stage, especially in low-gradient meandering streams.
- Top of pointbars. The pointbar consists of channel material deposited on the inside of meander bends. Set the top elevation of pointbars as the lowest possible Bankfull stage.
- Bank undercuts. Maximum heights of bank undercuts are useful indicators in steep channels lacking floodplains.
- Changes in bank material. Changes in soil particle size may indicate the operation of different processes. Changes in slope may also be associated with a change in particle size.
- Change in vegetation. Look for the low limit of perennial vegetation on the bank, or a sharp break in the density or type of vegetation.

→ **Bridge –** A crossing structure typically consisting of abutments and a deck spanning the stream.

→ **Culvert –** Round, elliptical or rectangular structures that are fully enclosed (contain a bottom) designed primarily for channeling water beneath a road, railroad or highway.

→ **Embedded Culvert** – A culvert that is installed in such a way that the bottom of the structure is below the stream bed and there is substrate in the culvert.

→ **Ford –** Modified or unmodified portions of a stream or river where vehicle drive through rather than over the streambed. Vented fords provide culverts to pass water during low flows while higher flows pass over the ford.

→ **Inlet drop** – Where water level drops suddenly at an inlet, causing changes in water speed and turbulence. In addition to the higher velocities and turbulence, these jumps can be physical barriers to fish and other aquatic animals when they are swimming upstream and are unable to swim out of the culvert.

→ **Open Bottom Arch –** An arched crossing structure that spans all or part of the stream bed, typically constructed on buried footings and without a bottom.

→ **Open Bottom Box Culvert** – A pre-cast box culvert with no bottom that spans all or part of the stream bed. Difficult to distinguish from a bridge.

→ **Openness ratio –** Equals cross-sectional area of the structure divided by crossing length when measured in meters. For a box culvert, openness = (height x width)/ length.

→ **Outlet drop** – An outlet drop occurs when water drops off or cascades down from the outlet, usually into a receiving pool. This may be due to the original culvert placement or erosion of material at the downstream end of culvert. Outlet drops are barriers to fish and other aquatic animals that can't jump to get up into the culvert.

→ **Physical barriers to fish and wildlife passage** – Any structure that physically blocks fish or wildlife movement as well as structures that would cause a culvert to become blocked. Beaver dams, debris jams, fences, sediment filling culvert, weirs, baffles, aprons, and gabions are examples of structures that might be or cause physical barriers. Weirs are short dams or fences in the stream that constrict water flow or fish movements. Baffles are structures within culverts that direct, constrict, or slow down water flow. Gabions are rectangular wire mesh baskets filled with rock that are used as retaining walls and erosion control structures.

→ **Pipe Arch –** A pipe that has been factory deformed from a circular shape such that the width (or span) is larger than the vertical dimension (or rise), and forms a continuous circumference pipe that is not bottomless.

→ **Tailwater armoring –** Concrete aprons, plastic aprons, riprap or other structures added to culvert outlets to facilitate flow and prevent erosion.

→ **Tailwater scour pool** – A pool created downstream from high flows exiting the culvert. The pool is wider than the stream channel and banks are eroded.