

U.S. Fish and Wildlife Service, Caribbean Ecological Services Field Office, Culvert Design and Construction Guidance

Many culvert permits are issued under the Nation Wide Permit Program. To qualify for NWP authorization, the permittee must comply with various general conditions, as appropriate, in addition to any regional or case-specific conditions imposed by the division engineer or district engineer.

US Army Corps of Engineers (COE) Nation Wide Permit General Condition #2, Aquatic Life Movement states: No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the water body, including those species that normally migrate through the area. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

The Service encourages the use of bottomless culverts or single span bridges in lieu of either single or multiple pipes or culverts with bottoms, particularly in streams that support native fish species. The bottomless culvert and span bridge structures require little long term maintenance, allow for full passage of low and bankfull flows, do not adversely impact the stream bed and allow for the free movement of aquatic fauna.

However, if bottomless culverts or a single span bridge are not feasible due to cost or engineering constraints, box or round culverts placed in streams must be installed to maintain low flow conditions and avoid impacts to stream bed and bank. This will allow for passage of native stream fauna and comply with the above referenced NWP general condition. We recommend the following design and construction criteria be used to maintain good habitat in the streams:

- 1) Culvert alignment should follow the natural curvature of the stream. Culvert outlet should discharge into the center of the exiting channel and should not be directed at an opposing bank.
- 2) Culverts should be designed to approximate the total stream width and/or carry bankfull flow. Bankfull flow is defined as the flow that fills the active channel to the top of its banks, just prior to overtopping and flooding. It is usually estimated as the 1.5-2 year flow. It is this flow that maintains the stream channel and will also maintain the culverts free from excess sedimentation.
- 3) Abutments should not intrude into the active stream channel. Abutments intruding into the active stream channel only serve as focal points for erosion. Abutments should be firmly anchored into the stream bank.
- 4) All culverts and footings must be countersunk (buried into the stream bed). Culverts should be countersunk at the invert a minimum of 10% of the culvert height (can be 10%-20% of culvert height). This will align the culvert with the slope of the stream. Calculations of culvert capacity should take this construction feature into consideration (see illustration1). Natural stream bed material will form the bottom of the countersunk culvert. This material does not impede flow and does not have to be “cleaned” out.

- 5) In the case of multiple pipe designs such as triple box culverts, only one culvert should be designed to carry bankfull flows, it may be necessary to have additional culverts to carry flood flows (see illustration 2). The remaining culverts should be elevated or have a restriction or baffle at the inlet openings to impede low flows from entering the culvert. This will maintain the main culvert active throughout the year and free of excess sedimentation.
- 6) If the terrain is steep, placement of a culvert may allow for unacceptably fast flows that can cause excessive scour at the outlet. In this situation a plunge pool and, large stone baffles should be placed at the outlet to smooth the transition from the culvert to the stream bed and minimize scour.
- 7) If the construction is occurring on bedrock then the requirement for countersinking need not apply, however, additional baffling may be needed to reduce flows at the outlet.
- 8) The use of gabion structures or reno mattresses as bank, inlet or outlet protection should be minimized since this is not a permanent structure and is subject to failing causing additional problems at a later date and requiring additional stream impacts.

Following the above culvert design criteria will assure compliance with the COE Aquatic Life Movement NWP general condition and help preserve and maintain the native stream fauna of Puerto Rico and the US Virgin Islands.

For additional information regarding the information contained in this document, you may contact Felix Lopez, ecologist, US Fish and Wildlife Service, Caribbean Ecological Service Field Office, felix_lopez@fws.gov, 787-510-5208.

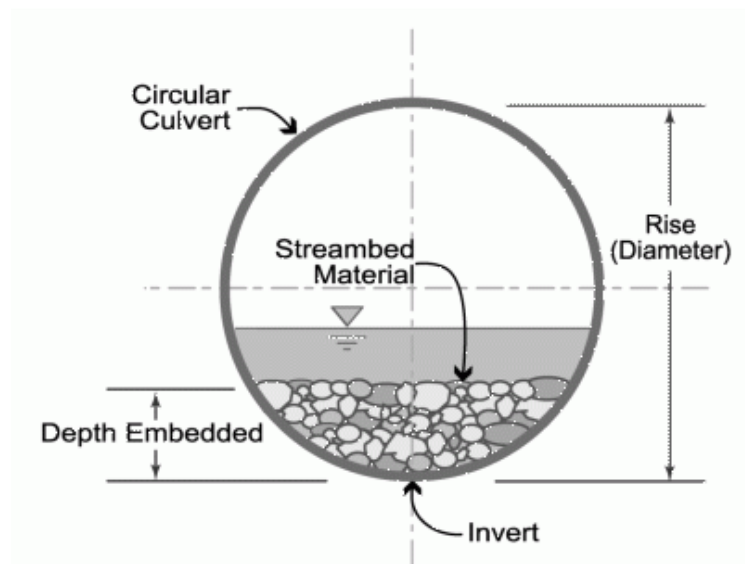


Illustration 1. Typical cross section of a countersunk culvert.

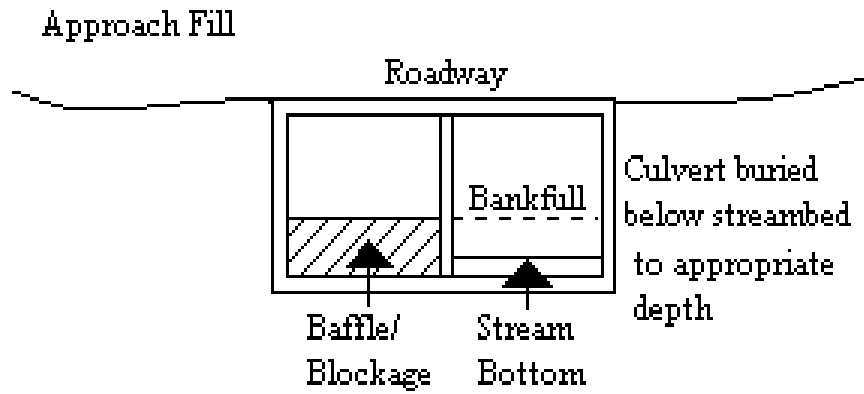


Illustration 2. One Culvert carrying bankfull flows, second culvert blocked and will become active when bankfull flows are exceeded.



Illustration 2a. Using elevated equalizer culverts to capture excess flows once bankfull flow is exceeded.