



## Culvert Designs that Restrict Movement of Fish and other Aquatics

There are three common culvert design flaws that create migration barriers for fish and other aquatic species:

- Perched culverts with excess drop at the outlet;
- Poorly-sized or installed culverts that create high water velocity, turbulence, and/or inadequate water depths within the culvert; and
- Debris accumulation at the culvert inlet.

**Perched Culverts:** A perched culvert's downstream end hangs above the level of the stream bottom, so that water leaving the culvert forms a waterfall at the culvert lip. Perching can occur when culverts are installed directly on the stream bottom, rather than being sunk into the bed, or from years of channel scour caused by an undersized culvert.



**Poorly-sized or Installed Culverts:** Undersized culverts restrict natural stream flows, particularly during floods. Water exits the structure at a high velocity, causing channel and bank erosion. Overly-wide culverts spread a stream's flow out over a wide area, so water depths are too shallow for many fish and other aquatic organisms to swim or move through.



**Multiple Pipe Culverts:** Culverts designed with two or more widely-spaced pipes to move a stream's flow are prone to clogging, which may inhibit the movement of animals through the crossing and increase water velocity in the remaining pipes. Clogging can cause flooding into roadside ditches, resulting in problems for roadways and hazardous conditions for motorists. Clogged entries sometimes cause water to scour the channel banks, causing bank erosion and often increased maintenance costs. Many multiple pipe culverts are undersized to carry normal or flood flows.



## Aquatic-Passage Friendly Culvert Designs

In general, bridges have less impact than culverts on aquatic species movement, because they typically do not constrict a stream channel to as great a degree as culverts and usually allow for vertical movement of the streambed. Bottomless culverts may be a good alternative for fish passage where foundation conditions allow their construction and width criteria can be met. All culverts should be designed to meet appropriate hydraulic capacity and structural integrity criteria.

Several methods exist for designing culverts for fish passage, including methods that focus on hydraulic design and stream simulation. The recommendations below borrow from, but do not replace, these more rigorous culvert design protocols.

The Fish and Wildlife Service recommends that culverts designed to facilitate movement of aquatic species should:

- Have a width equal to or slightly greater than the average streambed width
- Be installed at a relatively flat gradient
- Be countersunk (embedded) below the channel bed at least 20% of the culvert's diameter or rise
- Provide adequate flood capacity with extra culverts at bankfull elevation or in the floodplain.





These bottomless or embedded culverts were sized so they are wide enough to carry baseflows without altering stream depth (i.e., width equal to or slightly greater than the average channel width).



The culvert is installed at a relatively flat gradient to allow substrate to colonize the culvert's interior and maintain natural flow velocity.

Culverts, set at bankfull elevation (top) or with baffles constructed at bankfull height carry flood waters but do not overwiden the channel at baseflow.