DNR Indiana Department of Natural Resources

Stream Crossings

Overview of Regulations

- Typically, a proposed stream crossing requires prior approval for construction under the Indiana Flood Control Act from the DNR, Division of Water. However, if the proposed stream crossing can meet all the following conditions, then a permit is not required:
    - The project site has an upstream drainage area of 5 square miles or less
    - Located in a rural area (not in an incorporated city or town, or in the extraterritorial jurisdiction of an incorporated city or town)
    - Not in a floodway mapped on a Flood Insurance Rate Map, as published by the Federal Emergency Management Agency (FEMA). The Indiana Floodplain Information Portal (INFIP) provides floodplain information for public use.
    - Used for an agricultural or residential application. A residential application is defined for an access road to a single residence.
    - Must not adversely affect the efficiency or capacity of the floodway, cause a safety hazard, or result in detrimental effects to fish, wildlife or botanical resources. A definition of each of these requirements can be found in the floodplain management rules at 312 IAC 10-2-3, 312 IAC 10-2-40 and 312 IAC 10-2-39.
- If the installation of a stream crossing assumed as exempt from the Flood Control Act is challenged, it will be the responsibility of the property owner to demonstrate to the DNR that the crossing meets the three components for approval under the Flood Control Act listed in the final bullet point above. This likely will require computer modeling to show the impact of the crossing.

Permits from other agencies

- Although a Flood Control Act permit from the Division of Water may not be needed for the construction of a stream crossing meeting the criteria listed above, the exemption does not alleviate the property owner's responsibility of obtaining other permits, approvals, easements etc. as required by other local, state or federal agencies.
- If the crossing is on a legal drain that is maintained by the county surveyor and the drainage board under Indiana Drainage Codes, then the local drainage board / county surveyor should be contacted prior to construction.

Best engineering practice for stream crossings

- Hydraulic modeling is strongly encouraged to check the capacity of a stream crossing even if it is not submitted to the Division of Water for review.
- Stream crossing installed must not cause a rise of more than 0.14 ft within the floodway.
- Culvert capacity can be manually calculated using nomographs from FHWA Publication HDS#5 "Hydraulic Design of Highway Culverts" available online.

General best management practices for stream crossings

- Proper stream crossing design should be chosen depending on the purpose and intended type of traffic and the number of crossings should be kept to a minimum. The stream crossing should be such that it does not create or accelerate stream instability.
- A wrong choice of stream crossing method can result in major damage to the immediate site as well as downstream areas.
- Crossings that span the entire channel width (a minimum of 1.2 times the ordinary high-water mark width) are preferred.
- Table 1 can be used as a guidance for choosing proper stream crossing structures.

Table 1: Choices of stream crossing and their potential impacts.

	Preferred choices		**Acceptable choice**	**Not Recommended**	
	1st	2nd			
Crossing Type	**Bridge** Note: avoid piers when possible	**Three sided/ bottomless culvert** Note: need to be appropriately sized & installed	**Box or pipe culvert** Note: need to be appropriately sized & installed	**Multiple culverts or culverts with multiple openings**	**Dirt crossing or Ford or Low water crossing**
Stream impacts	Least disturbance to stream and banks	Only minimal disturbance to stream bottom.	Considerable disturbance to stream and banks.	Can have significant impacts on Stream and banks	Severe impacts to stream, banks, and erosion issues
Aquatic organism passage	Allows minimal obstruction to aquatic organism passage	Allows minimal obstruction to aquatic organism passage	Must be sufficiently sumped to avoid obstructing aquatic organism passage.	Cause significant aquatic organism passage issues	Allows passage, but disturbs streambed and aquatic organism use of the stream
Debris/Ice jam issues	Best for this issue especially if no piers used.	Good for this issue if sized properly.	Can cause issues with this, especially during higher flows.	Accumulates debris and become blocked	No issues with debris. Potential for dirt to be washed away

Location of stream crossing

- Stream crossings should be installed perpendicular to the stream channel at a location where streambed is straight and uniform as practicable. (See Fig. 1)
- Stream crossings should be constructed where they will cause the least amount of disturbance to the channel and surrounding vegetation. Good locations generally include straight sections as opposed to bends and shallow areas rather than deep pools. (See Fig. 1)

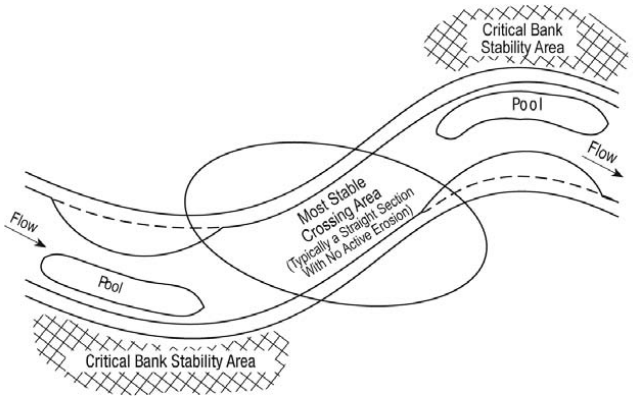


Fig.1: Stable location for stream crossing[1]

- Approaches to the crossing should be constructed at a 90-degree angle to the stream crossing and higher than the elevations of the crossing. Stabilize the approaches with aggregate materials. (See Fig. 2)

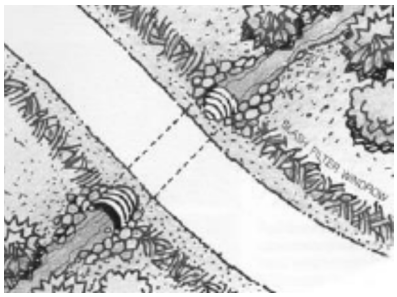
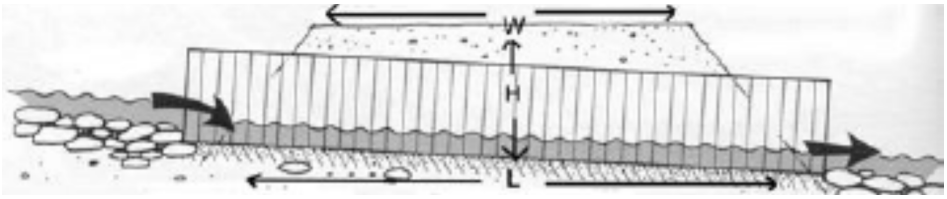


Fig.2: Approach roads to stream crossing

Construction practices of stream crossings

- Fill materials must be minimized to avoid adverse effect on flood levels.
- Stream depth, channel width, and water velocities in the crossing structure during low-flow conditions must approximate those in the natural stream channel.
- The alignment of culvert must fit the natural stream channel (Refer slope in Table 2). It should not be set at an angle to the channel as that can cause bank erosion and can develop debris problems.
- The length of culvert needed will depend on the desired width of the road top, the height of the culvert, and the average depth of the road fill over the culvert. A minimum of 1 foot of culvert should extend beyond the toe of the road fill on each end.



Determining Length of Culvert: L = W + 2H + 2 (for 1:1 side slope);
L = W + 3H + 2 (for 1 1/2 :1 side slope)

- The size of culvert required depends on the size of the drainage above the culvert site, average stream width, depth, and gradient (slope) at the crossing site, amount of debris loading anticipated, and the permanence of the crossing. Culvert diameter shall be at least three times the depth of normal stream flow at the point of the stream crossing. If the crossing must be placed in deep, slow-moving pools, the culvert diameter may be reduced to twice the depth of normal stream flow.
- The crossing span of culvert span should be 1.2 times the stream channel's bankfull width.
- The culvert openness ratio (culvert cross-sectional area divided by culvert length) should be greater than or equal to 0.82 to ensure that the culvert is wide and high relative to its length

[1] https://dam.assets.ohio.gov/image/upload/epa.ohio.gov/Portals/35/storm/technical_assistance/CH5_3-3-14.pdf

- If box and pipe culverts are used, the culvert bottoms should be sumped a minimum of 6 inches (or 20% of the culvert height or diameter, whichever is greater up to a maximum of 2 ft.) below the stream bed elevation. The Table 2 below can be used as a guide.

Table 2: Sump dimensions

Structure Diameter or Span, *S* (ft)	Sump Required for Stream Bed of Sand (in.)	Sump Required for Stream Bed of Other Soil (in.)	Sump Required for Stream Bed of Rock or Till (in.)
<4	6	3	3
4≤*S*<12	12	6	3
12≤*S*<20	18	12	3

- All culverts should be of adequate size to carry the normal water flow anticipated during heavy rains. The water height should be no higher than the top of the culvert's inlet and the culvert is large enough to pass debris.
- Improper culvert placement can restrict flows, increase the risk of plugging, cause undercutting of the culvert, and form a barrier to fish migration.
- Culvert crossings should be properly backfilled to prevent from washing out with clean, non-erosive and non-toxic stone, rock or aggregate fill.
- Cover the top of culverts with fill to a depth of one-third of the pipe diameter or at least 12 inches, whichever is greater, to prevent crushing. There should be no frozen soil in the fill material, as it reduces the ability to compact. Tamping fill material in layers (lifts) throughout the entire backfill process is important. Compact fill material firmly around culverts, particularly on the bottom half to prevent water seepage around culvert. (See Fig. 3)

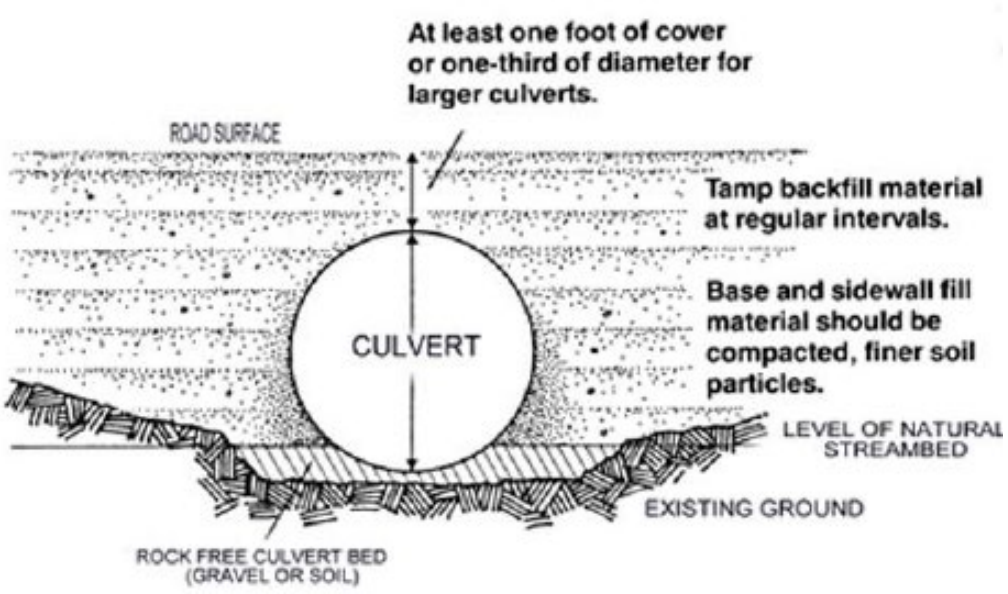


Fig. 3: Backfill of culvert[2]

- Both the culvert inlet and outlet should be armored with rock to protect these locations against erosion.
- The length of the bridge span should exceed the width of the stream at the crossing site in order to prevent any encroachment into the channel. The height of the bridge should be adequate to pass high water, debris, and ice jams.
- Abutments and wingwalls are recommended for all permanent bridge installations.
- Abutments should be positioned at or beyond the high-water mark of the channel, whenever possible, to prevent restriction of water flows.
- Abutments should be buried a minimum of 3 feet below ground surface. If placed on the stream bank, abutments

[2] https://co.mineral.mt.us/wp-content/uploads/2018/06/Stream-Crossing-Guide.pdf

should be buried at least 3 feet below the scour depth, to prevent undercutting.
- The bridge deck shall be properly anchored to resist floatation or dislodging during flood events.
- All disturbed areas and road fill should be reseeded immediately following completion of the culvert installation to prevent erosion and sedimentation of the stream.
- Crossings must maintain the natural stream substrate within the structure (natural stream substrate must be replaced in sumped box and pipe culverts up to the existing flowline).
- Equipment should be kept out of the stream bed.
- Construction debris and material not used as backfill shall be removed from the floodway.

Special Attention
- Construct crossing when stream is low. Installation should not be done in frozen ground.
- Avoid prolonged activity in salmonid streams during spawning periods (March 15-June 15 & July 15-Nov. 30).
- Avoid altering stream flow.
- Avoid filling wetlands.
- Culvert crossings should be routinely inspected to ensure the pipe is open, allowing proper flow of water and ensure the crossings are in safe, functional condition.
- Stream crossings shall not cause sudden changes in stream elevation, drops or waterfalls, which could create a barrier to migrating fish.
- The new/replacement/rehabilitated crossing structure, and any bank stabilization under or around the structure, must not create conditions that are less favorable for wildlife passage when compared to existing conditions.
- Close temporary crossings by removing culverts, poles, portable bridges, and other obstructions as soon as crossings are no longer needed.
- Upgrading wildlife passage for replacement/rehabilitated structures is recommended whenever possible to improve wildlife/vehicle safety. Please consult with the DNR Division of Fish & Wildlife for further guidance on wildlife passage.

Common Concerns
- Inadequate flow capacities of culvert, inadequate stabilization, inadequate compaction under or around culvert pipes results in failure of culverts.
- Debris not removed after a storm event results in clogging that may cause washout of the culvert and/or bridge.

References and Illustrations:

- Indiana Logging and Forestry Best Management Practices, 2022
- Culvert sump https://www.in.gov/idem/wetlands/information-about/section-401-water-quality-certification/terms-and-conditions-of-the-idem-regional-general-permit-notification-form/
- Ohio Technical assistance/CH5_3-3-14 https://dam.assets.ohio.gov/image/upload/epa.ohio.gov/Portals/35/storm/technical_assistance/CH5_3-3-14.pdf
- Montana Stream Crossing Guide, 2018 https://co.mineral.mt.us/wp-content/uploads/2018/06/Stream-Crossing-Guide.pdf