9. Wetland Crossings

Well-designed crossings allow wildlife unrestricted access to a watershed, maintain natural conditions without becoming barriers to fish, and help protect roads and property from the damaging effects of floods. If it is determined that a wetland cannot be avoided and must be crossed to access an upland area, it is essential to design an appropriate crossing that minimizes adverse effects.

If not properly designed and constructed, wetland crossings can fragment linear habitat corridors, disturb or block fish and wildlife passage, alter ecosystem processes and aquatic communities, flood roads and property, and compromise water quality. Problems are often encountered when crossings are undersized, perched, or result in water depths that are too shallow. The following negative consequences commonly result from poor design, improper structure selection, or careless construction:

- Water velocities increase in undersized crossings, thus degrading fish and wildlife habitat while also possibly weakening the integrity of a structure
- High water velocities scour and erode natural substrates, thus degrading habitat;
- Water can pond upstream of undersized culverts which can cause changes to the existing habitat while also leading to property flooding and road and stream erosion;
- Undersized crossings may also become blocked with debris and be time-consuming and costly to regularly maintain;
- Perching of a crossing outlet leaves the structure above the natural bottom and thereby acts as a barrier; and
- Water depths that are too shallow for fish and wildlife movement may occur, especially during seasonal low flows.

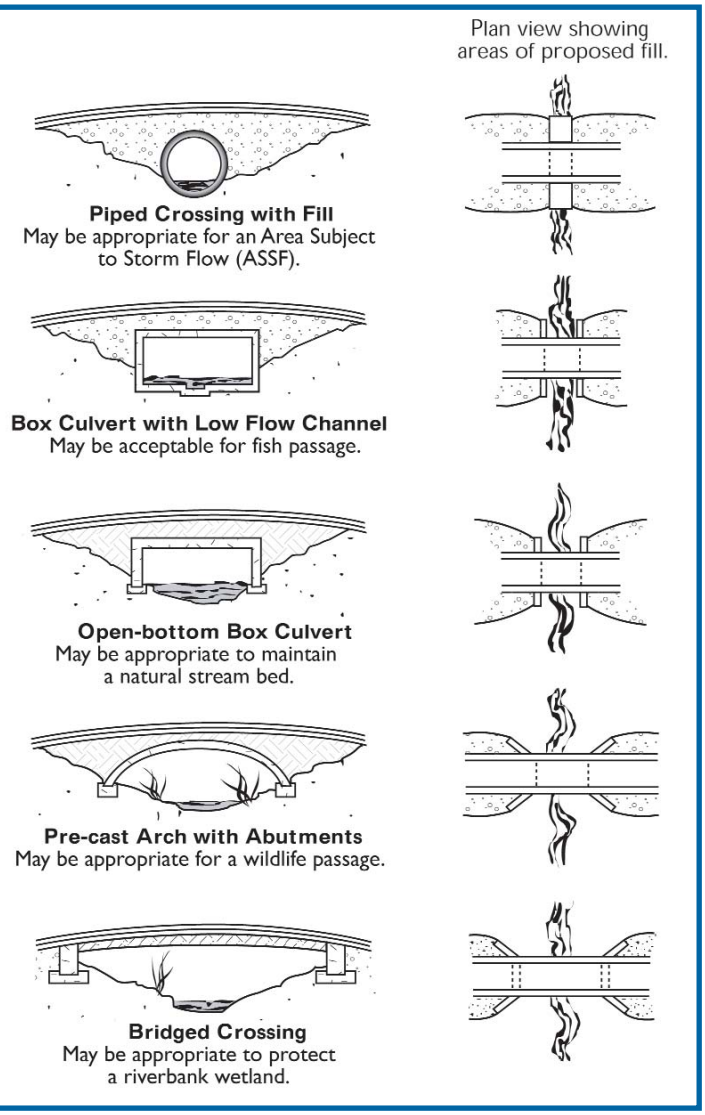
Best Practices for All Types of Crossings

- Avoid crossing open bodies of water, rivers, streams or other wetlands if possible.
- Where crossings are unavoidable, design them to traverse a narrow section of wetland.
- Use or upgrade existing paths, cart paths, roads, or other authorized disturbed areas so as to avoid previously undisturbed locations.
- Design a crossing that keeps disturbance to a minimum and spans as much of the wetland and perimeter or riverbank, floodplain, and floodway wetland as possible.
- Avoid disturbance to streambeds, wetland soils, and other vegetation.
- Avoid fragmenting wetland wildlife habitat by building away from wildlife travel corridors.
- Avoid crossing through or bisecting a wetland wildlife breeding area.
- Minimize light and noise disturbance on roadways by installing plantings to act as a buffer on the sides of roadways.

- Consider using pre-cast bridges, especially for long spans, that allow installation to be completed with minimal contact with the wetland.
- Design and construct wildlife crossings that attempt to preserve existing light conditions and maintain soil moisture levels similar to existing natural conditions.
- Maintain existing elevations, or consider installing retaining walls to reduce disturbance and side slope fill.
- Restore stream channels to natural conditions if disturbance of the channel is unavoidable.
- Avoid impounding water up-gradient of the crossing.
- Maintain existing side slope grades, as much as possible, to minimize fill and any wetland loss.
- Minimize the extent of fill needed on top of a crossing structure by limiting the increase of the road grade as it approaches the crossing point.

Crossing Structure Selection

A number of different structures can be used to cross wetlands, including rivers and streams. Each project and wetland to be crossed is different, and a structure that may be appropriate in one situation may not be sufficient for another.



This illustration was modified from a State of Connecticut manual on site design practices (Callahan et al. 1992). It depicts various crossing options, from the most constraining for fish and wildlife to the least constraining.

Arch culverts and bridge spans or open-bottom culverts are clearly preferred for maintaining wetland continuity and protecting existing habitat conditions and quality.

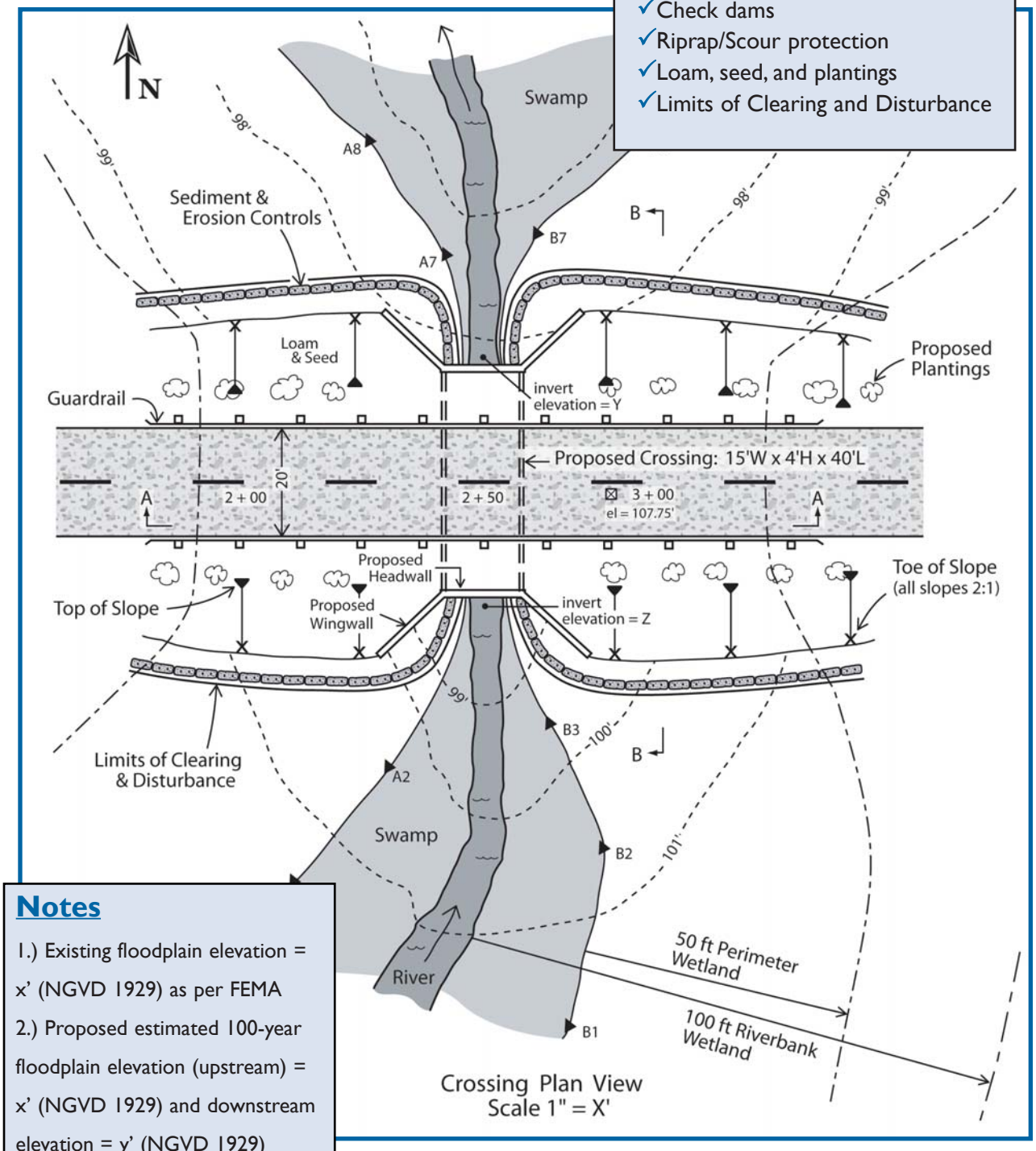
Example 29

Example 30: Detailed Labeling Required for Crossings

In addition to the labels required on a full site plan, all plan details included in a wetland application submittal must be completely labeled, as in the example below. Other views, such as a cross section or profile view, may need additional labels for elevations and dimensions.

Crossing Labels

- ✓Existing and proposed contours
- ✓Spot elevations
- ✓Floodplain information
- ✓Cross section locations
- ✓Surface course
- ✓Invert elevations
- ✓Structure dimensions
- ✓Toe of Slope
- ✓Check dams
- ✓Riprap/Scour protection
- ✓Loam, seed, and plantings
- ✓Limits of Clearing and Disturbance



Notes

1.) Existing floodplain elevation = x' (NGVD 1929) as per FEMA

2.) Proposed estimated 100-year floodplain elevation (upstream) = x' (NGVD 1929) and downstream elevation = y' (NGVD 1929)

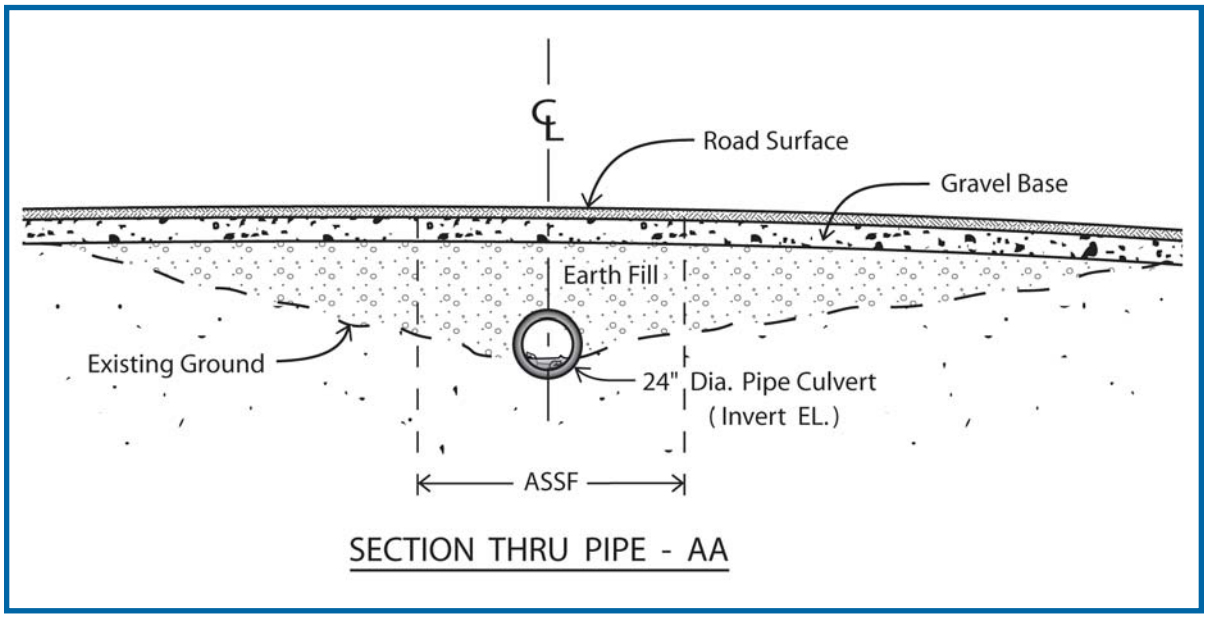
Example 30

Overtopping

Each of the following three examples, as well as the wildlife crossings, carries the potential for "overtopping" during severe rain periods. Consider the quantity of flow involved, such as in a 100-year storm event. If the profile of the road is gentle, creating a broad, shallow weir, flow will overtop in a broad shallow depth. This will minimize potential for washout of the road surface and may be less dangerous in a major flood event.

Example 31: Piped Culvert Crossing

Driveway construction that traverses a wetland is one of the most common types of proposed crossings. The proposed driveway in this example skirts the edge of a piece of property to cross a wetland in a narrow section, in order to reach a large upland area on the southern end of the property. A proposed pipe culvert channels the water from an Area Subject to Storm Flowage (ASSF) underneath the new driveway crossing. A culvert of this type is sufficient for this crossing because the area is not consistently wet.



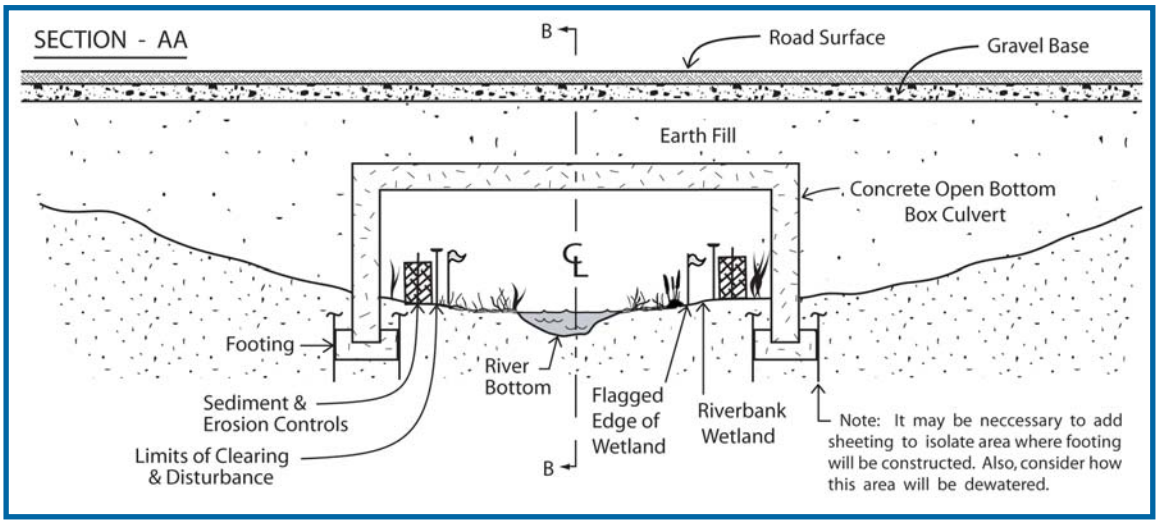
Example 31

How wetland impacts were minimized:

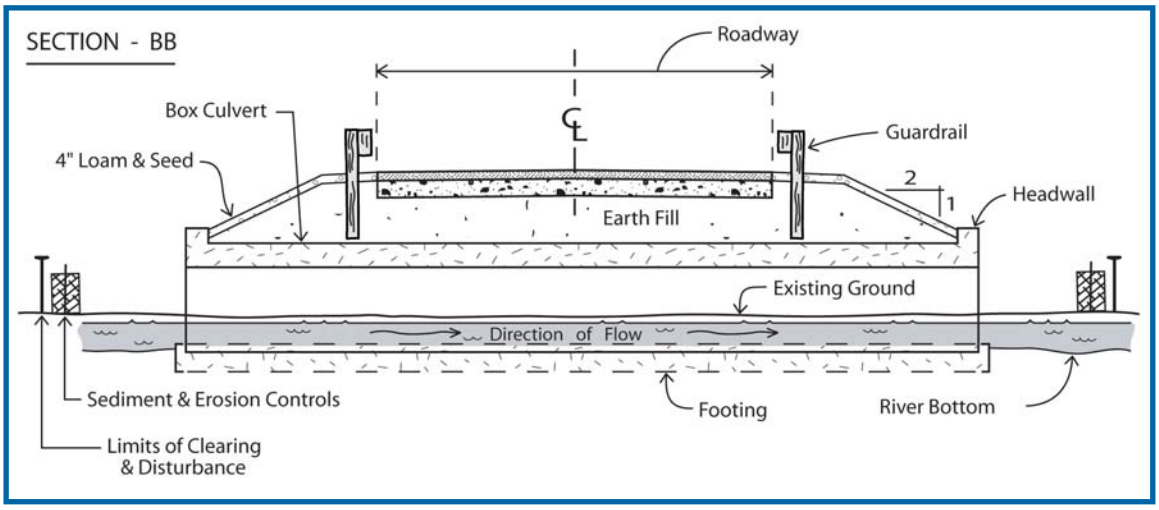
- ✓ The crossing traverses a narrow part of the Area Subject to Storm Flowage.
- ✓ The driveway is fairly narrow, so that no more wetland is disturbed than necessary.
- ✓ The earth fill over the culvert is kept to a minimum and is sufficient to satisfy the structural capacity of the pipe.
- ✓ The buffer plantings on either side of the driveway help prevent sedimentation of the wetland and erosion of the slope.
- ✓ Narrow Limits of Clearing and Disturbance are maintained.

Example 32: Open-Bottom Box Culvert Crossing

A subdivision roadway is a common type of wetland crossing. The roadway in this example skirts several properties to reach the upland north of the River and Swamp, thus placing the new subdivision more than 200 feet from the wetland area to be crossed. This example illustrates an open-bottom box culvert used to cross the River and Swamp. While acceptable, the best type of crossing design would span a greater portion of upland on either side of the River and Swamp and require less fill. A different type of structure might be necessary to accomplish such a design.



Example 32a



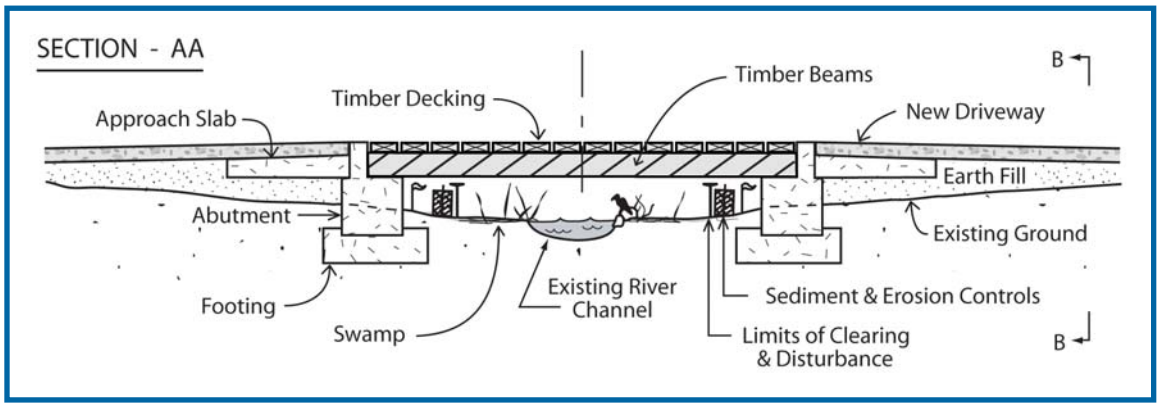
Example 32b

How wetland impacts were minimized:

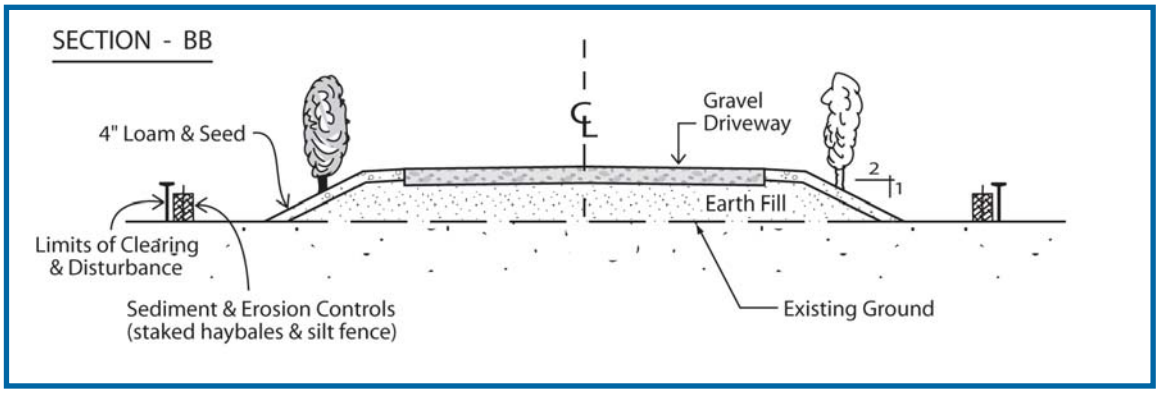
- ✓ The open-bottom culvert allows the Stream to flow freely in the natural streambed.
- ✓ Plantings along the edge of the road buffer the wetlands from noise and light.
- ✓ Narrow Limits of Clearing and Disturbance were maintained.
- ✓ Sediment and erosion controls were used to enclose and isolate the construction zone to prevent sediment from flowing downstream.
- ✓ Upon completion of the project the adjacent Riverbank Wetland was returned to its previous condition.

Example 33: Timber Bridge Crossing

This is an example of a residential driveway that crosses a River and Swamp to reach an upland area. This proposed design uses a timber bridge to cross the wetland complex. This crossing could be improved with a wider span that would also breach some of the upland on either side.



Example 33a



Example 33b

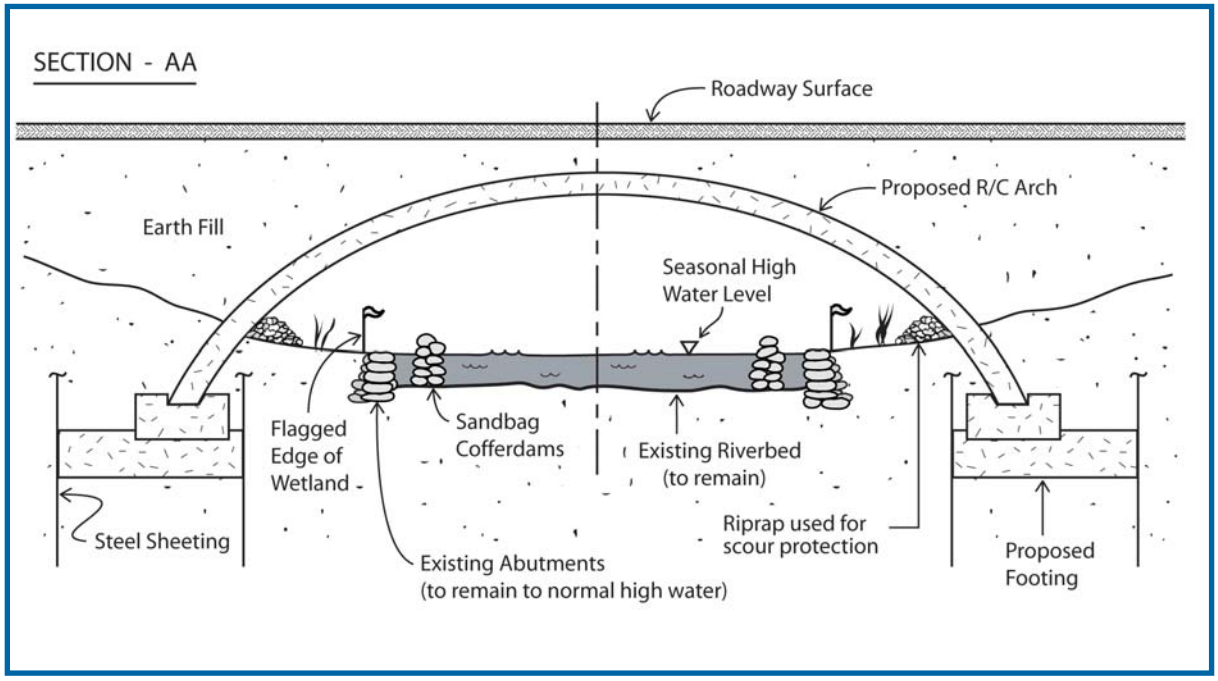
How wetland impacts were minimized:

- ✓ A narrow section of the wetland was utilized for the crossing.
- ✓ The Limits of Clearing and Disturbance on either side of the driveway were kept narrow considering the grade change necessary to cross over the wetland.
- ✓ The bridge spans the entire Swamp and River to allow for the free flow of water for fish and adequate passage for wildlife.
- ✓ Plantings along the edge of the road buffer the wetland from noise and light.
- ✓ The driveway leading up to the bridge was constructed of gravel, a porous material, which promotes water infiltration, reduces runoff and provides groundwater recharge.
- ✓ Sediment and erosion controls were used to enclose and isolate the construction zone to prevent sediment from flowing downstream.
- ✓ Upon completion of the project the adjacent Riverbank Wetland was returned to its previous condition.

Note: DEM prohibits the use of creosote to treat wood used near wetland crossings. However, CCA is acceptable for treatment.

Example 34: Concrete Arch Crossing

This example depicts a road upgrade that accommodates increased travel and increased wetland protection through a wider span of the wetland. The existing bridge was removed and replaced with a reinforced concrete arch.



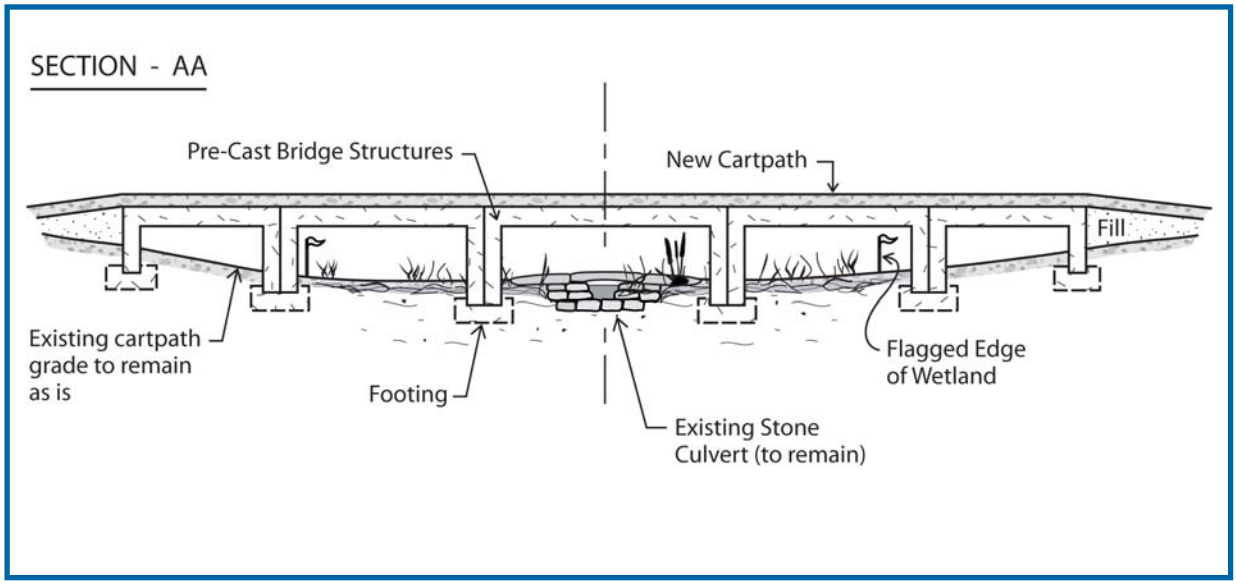
Example 34

How wetland impacts were minimized:

- ✓ The new bridge spans the entire River and a portion of the Riverbank Wetland will be restored on either side, allowing for the free flow of water and restoring a passage for wildlife.
- ✓ The Limits of Clearing and Disturbance on either side of the road are narrow.
- ✓ The arch was pre-cast and then installed from overhead, thus minimizing contact and disturbance to the wetland during installation.
- ✓ Retaining walls on either side of the road limit fill and reduce noise and light disturbance to the wetland.
- ✓ The temporary sandbag cofferdams helped to contain sediment during construction.

Example 35: **Multi-Span Bridge Crossing**

This driveway crossing was elevated above the existing grade of an old cartpath which leads to a small upland area near the rear of the property. By utilizing the existing crossing, the applicant avoided almost all other wetland impacts on a large piece of property. While not always typical for driveway crossings, this example does a great job of spanning the wetland.



Example 35

How wetland impacts were minimized:

- ✓ The driveway was built on an old cartpath where the vegetation had been previously disturbed.
- ✓ The existing crossing culvert remained in place to reduce disturbance to the wetland and to maintain existing hydrological conditions.
- ✓ All of the River and Swamp, and some of the Perimeter and Riverbank Wetland were spanned.
- ✓ The original tree canopy was maintained where possible, and there were a number of buffer plantings added surrounding the disturbed area.
- ✓ The pre-cast bridge structures were installed from overhead by crane, which limited the length of time the wetland area was disturbed.
- ✓ The driveway leading up to the bridge was constructed of gravel, a porous material, which promotes water infiltration, reduces runoff and provides groundwater recharge.
- ✓ Limits of Clearing and Disturbance were confined to within the existing cartpath corridor.

Construction Considerations

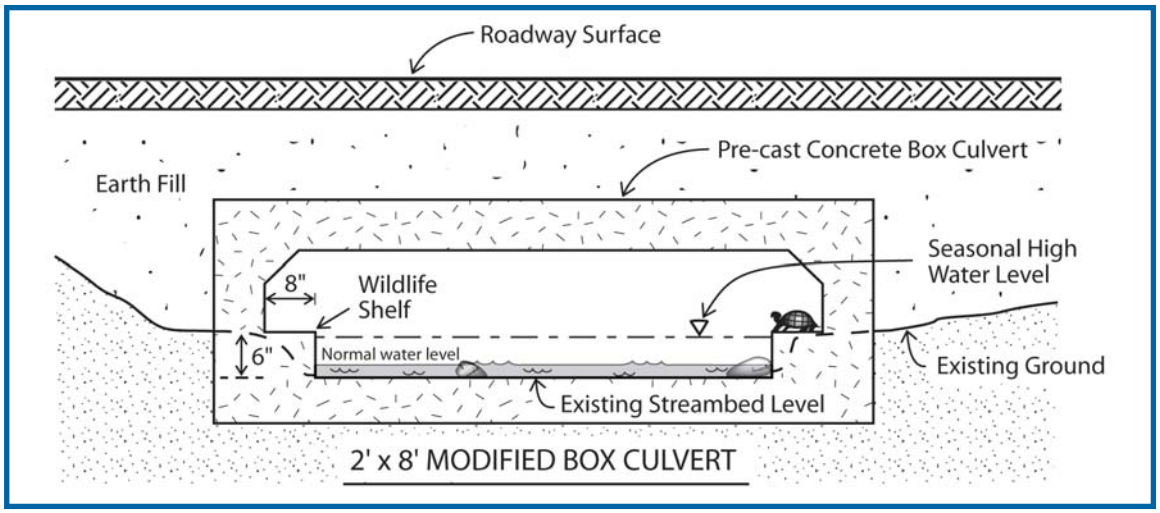
- Sequence and duration of project - Work within waterways should be limited to the low flow period of July 1 - October 31.
- Diversion of flow - In some crossing situations, river or stream flow may need to be diverted during construction. If unavoidable, plan ahead and include information on the plans about flow diversion to minimize impacts while considering the following issues:
    - Duration of the proposed construction;
    - Dewatering;
    - Quantity of flow; and
    - Design of the diversion device.

  To ensure minimization of wetland impacts, it is important to plan ahead and include information about flow diversion in a wetland application package.
- Phasing of work - Include information in the application if a project will be constructed in phases, and try to limit the amount of time wetlands will be impacted.
- Sediment and erosion controls for dewatering - All controls must be in place prior to beginning of work and must be maintained for the life of the project.

Wildlife Crossings

The following are two examples of wildlife crossing structures that could be used in conjunction with or alongside another wetland crossing. Wildlife crossing structures can be used when a wetland is being crossed, or when any wildlife habitat is being bisected. It is important to first research what types of wildlife live in the area and what paths they travel. This information helps determine where to locate a wildlife crossing and what type of structure is most suitable. It has been reported that if wildlife can see through to the other end of a crossing, they are more likely to use it. Please consider this when designing a wildlife crossing structure. It is also important to consider design elements, such as the volume of water during various storm events, that the wildlife crossing structure will need to accommodate.

Example 36a: Modified Box Culvert



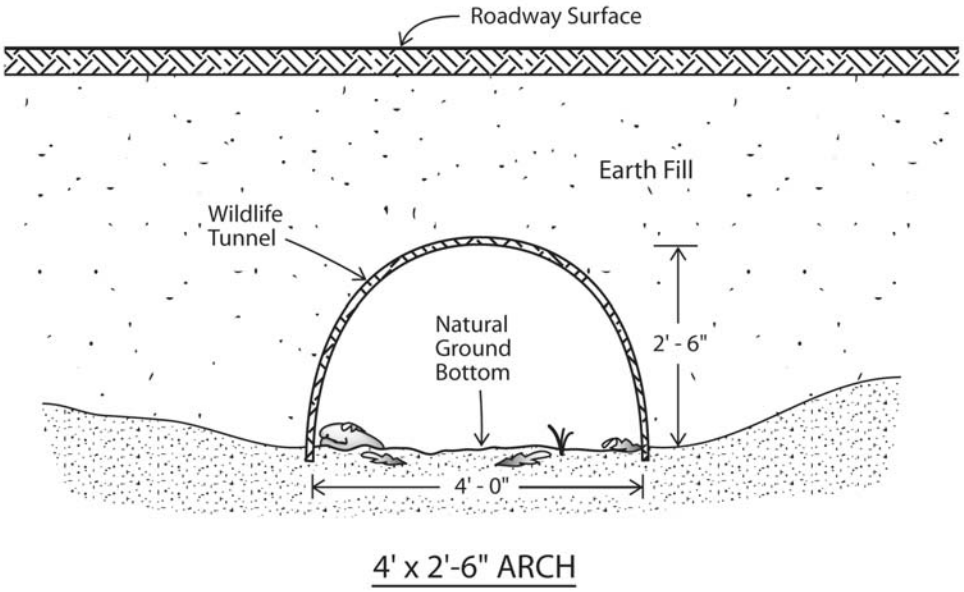
Example 36a

How impacts to wetland wildlife were minimized:

- ✓ This structure allows movement of water.
- ✓ There is a shelf for small amphibians (frogs, salamanders, etc.) to use for travel inside the structure.
- ✓ The shelf is level with the final soil grade, which allows small mammals easy access and use.
- ✓ The shelf adds little cost to the overall project when incorporated from the beginning.

While a modified box culvert with a shelf may need to be special ordered, they are available or can be built. The designer may consider adding concrete or stone blocks inside a standard culvert to build wildlife passage shelves.

Example 36b: **Polyethylene Arch**



Example 36b

How impacts to wetland wildlife were minimized:

- ✓ The arch was built alongside a wetland driveway culvert.
- ✓ A natural ground bottom allows easy travel for small and medium-sized animals.
- ✓ A larger tunnel allows more light to filter inside, which creates a more natural environment.

References

This list provides additional sources for information on wetland crossings. See Chapter 12 for complete citations arranged by author.

- *Ecological Considerations in the Design of River and Stream Crossings* by S.D. Jackson (2003)
- *Massachusetts Stream Crossings Handbook* by Massachusetts Riverways Program (2005)
- *Overview of Transportation Impacts on Wildlife Movement and Populations* by S.D. Jackson (2000)
- *Proposed Design for an Amphibian and Reptile Tunnel* by S.D. Jackson (1997)
- *Road Ecology, Science and Solutions* by R.T.T. Forman et al. (2003)
- *Strategy for Mitigating Highway Impacts on Wildlife* by S.D. Jackson and C.R. Griffin (2000)
- *Stream Crossing Guidelines* by Connecticut Department of Environmental Protection (2008)
- *Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings* by United States Forest Service (2008)

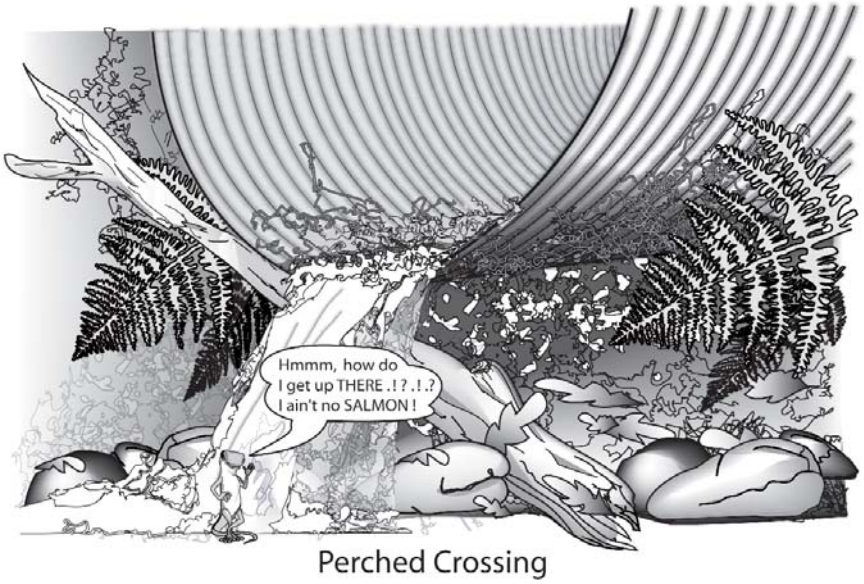


Illustration by Christopher Rowe, adapted from the Massachusetts Stream Crossings Handbook