Resolve Beaver Conflicts with an Ounce of Prevention

by Chuck Hulsey, Regional Wildlife Biologist

Introduction

Beavers are large, semi-aquatic furbearers with an important ecological, economic, and historical role in North America. Westward expansion of human settlement in the early 1800s was fueled by fur trapping. Beaver continue to be an important furbearer and are unique among wildlife in their ability to alter wetland habitats. Impounding water provides them with protection from harsh environmental conditions and predation. In doing so they create and maintain habitats important to a variety of fish, amphibians, reptiles, birds, and mammals. Many people value these wetland habitats and the wildlife inhabiting them. But this lifestyle frequently comes into conflict with the function of water passages on roads, farm land, forest management, and waterfront homes and camps. This document covers ways to use cost-effective measures to deter or even prevent the most common conflicts with beaver.

Know the Adversary

Maine has a robust beaver population supported by an abundance of streams, rivers, lakes, and ponds. Add to that a landscape that is largely rural or remote, and 90% forested. Equipped with large incisor teeth, powerful jaws, a prominent tail, and feet built for both work and swimming, North America's largest rodent is nature's logger and engineer. The saying "busy as a beaver" is not an exaggeration. Except for the winter months, they are on the job 24/7, take no vacations and observe no holidays. Every adult and "teenager" in the family has a job.

Take-home message*: Every spring sub-adult beaver disperse from the home colony to find unoccupied habitat or a potential mate.*

Photo by Chuck Hulsey, MDIFW

The Step-Down Approach to Human-Wildlife Conflict Resolution

Maine Department of Inland Fisheries and Wildlife resolves wildlife conflicts through the following step-down approach for applying the best course of action:

1) Education and Extension

2) Prevention *(site modification)*

3) Use of Hunting and Trapping Regulations

4) Live-Capture/Relocation

5) Lethal Removal (outside the trapping season)

Step 1 has very limited application because most beaver problems do not include altering human actions, for example bringing in bird feeders before bears exit their dens in the spring. The focus on this document is the application of ***Step 2 – Prevention***. But first a very brief discussion of Steps 3, 4, 5.

Beaver Removal vs. Site Modification

Removing beaver from problem locations has both pros and cons. Taking beaver during regulated trapping seasons has good conservation value and no associated cost because the fur is sold and utilized. Alternatively, live-trap and relocation have good conservation value, and for some property managers there is a positive public relations value. Some property owners want a resolution that does not cause harm to beaver. Lethal removal is the last choice, reserved when other options are not possible.

Long-term resolution may not be realized with Steps 3, 4, and 5 if high quality habitat exists and beavers are abundant in the drainage. The words of Benjamin Franklin, *"An ounce of prevention is worth a pound of cure"* is a good fit for resolving many of the conflicts with beaver.

Beaver captured in a Hancock live-trap at a problem site and relocated to suitable habitat.

Photo by Chuck Hulsey, MDIFW

Use of Site Modification – Should I or Shouldn't I?

The objectives of site modification are to resolve a current problem, minimize or eliminate future conflicts, and maintain quality wetland wildlife habitat.

Sites and situations are all different. Here are four key site-specific factors to evaluate:

- Is there a ***history*** of problems? Remember, every spring sub-adults will be dispersing to find unoccupied habitat or a mate. Site modification is often the most cost-effective action for chronic problems because it addresses both the beaver of the moment as well as future beaver that will likely be attracted to the site.

  Alternatively, removing beaver and clearing debris from a culvert might be effective for first-time problems.

  Assessing Past Use: Presence of standing dead trees, remnants of old dams, old stumps, piles of old previously cleared debris show the history of use, sometimes going back decades. Wetland size and shape (natural bottlenecks are good beaver dam sites) are indications of expected future use.

- What is the quality of the ***habitat?*** The presence and abundance of deciduous trees and shrubs greater than two inches in diameter are indicators of quality habitat. Aspen and birch are highly preferred foods. Red maple and alders are desirable foods. Roots of emergent aquatic plants like water lilies are often eaten. Presence of these foods supports the use of site modification over removal.

  Alternatively, a predominance of conifer species is an indicator of low or poor-quality habitat. Occupying sub-optimal habitat occurs primarily when dispersing beaver have limited food, space, or experience. Removal of beaver from such sites is usually effective. Dispersing younger beaver often occupy sub-optimal habitat.

- What is the ***hydrology*** of the site? Brooks, streams, and rivers are travel ways for dispersing beaver. Occupied ponds and lakes are often population sources. Assess the connectivity of a problem site to these hydrological features. Google Earth on a smart phone is great for this. High connectivity supports the use of site modification.

  Alternatively, problems associated with waterbodies having little or no connectivity, such as farm or fish ponds can be resolved via regulated trapping or live-trap and relocation.

- What is the nature of the '***highway'*** with a problem? The value and use of a road can be an influential factor for the action and level of investment. High-purpose critical roads can warrant site modification. Alternatively, seasonal, low-use roads or trails may not.

Assessing these four characteristics associated with a problem site will help determine the most effective course of action to resolve a conflict with beaver, today and in the future. Successful site modification maintains a water level that both the beaver and humans can live with.

Site modification serves four purposes:

1. Deny access to culverts, undersides of small bridges, or residential trees.

2. Encourage dam placement where you want it, well outside and in front of the upstream side of the culvert/bridge.

3. Maintain normal water flows using a water leveling device placed through dams or exclosures, or to keep water off land where it would cause property damage.

4. Maintain quality wetlands for wildlife

Protecting Ornamental and Shade Trees

Deciduous trees within 100 feet of a waterfront home or camp may be highly susceptible to beaver. It is extremely rare for beaver to take conifers (evergreens). Loosely wrapping vulnerable trees with light grade fence like chicken wire, as shown below, is low-cost and highly effective. Leaving room for 10 years of diameter tree growth will approximate the life of light gauge wire. Height should be four feet, starting snugly at ground level. To save time and realize other benefits, trees of poorer form can be left unprotected if their crowns (canopy) are crowding a better tree. A minimum of six feet between the crowns of trees provides good spacing. This strategy benefits seasonal camp/home who might not be present if dispersing beaver arrive before or after their stay.

The wrapped birch tree on the left deterred the beaver while the unprotected tree was lost.

Photo by Chuck Hulsey, MDIFW

Road Culverts

What do humans see when looking at a road and culvert in a wet area? A way to get across. What does a beaver see? Answer: a big dam with a leak to fix.

Excluding beaver from the entrance or interior of a culvert/bridge is priority one because beavers are hard-wired to impound water and to repair leaks. Termed *'Site Modification'*, the actual structures are commonly called *'beaver deceivers'*. They have been used in Maine for about 50 years and come in many forms and complexity. Cost to construct ranges from a few hundred dollars to over a thousand(s) per site. A physical barrier to exclude wildlife is commonly the best solution for resolving human/wildlife conflicts.

Tip: *Consider modifying unoccupied chronic sites before it becomes a problem again. A new beaver arrival will adapt easier to a structure in place vs. a resident beaver whose environment undergoes a sudden change.*

Photo by Chuck Hulsey, MDIFW

Small Bridges

The following is by Joe Wiley, retired MDIFW and Maine Public Lands Wildlife Biologist.

Several factors should be considered when replacing or repairing a stream crossing. Chronic beaver conflicts can be the result of poor or incorrect structure design or placement.

The size of the opening required for bridges and culverts is calculated using an engineering formula. It uses watershed size, slope, soil type, and other factors to determine the proper opening size. The standard is to design for a 25-year storm event. Maine has storms which sometimes exceed this standard, resulting in flooding of roads. When replacing bridges and culverts, using a 50-year storm event factor in the design will significantly increase the opening size.

For crossing perennial streams, a box culvert that maintains the natural stream bottom is recommended. The design should incorporate the Maine Forest Service standard that the structure width be 1.2 times the full stream bank width. This design has many advantages:

- Abutments can be placed anytime with no equipment in the water;
- One-lane traffic can be maintained during replacement;
- Passage of fish, invertebrates, mammals, and amphibians is maintained;
- Attractions affecting where beavers build dams are significantly reduced, which are: a less constricted stream channel and a reduction in the sound of falling water.

Culverts can be problematic when not installed properly, undersized, or not located deep enough. They typically need to be replaced every 15 to 20 years. Best management practices recommend they be oversized and imbedded in the stream bottom at a depth of one-third their opening diameter. The elevation is set so it does not create upstream ponding. When locating a crossing involving a stream-fed wetland, locating the structure at the head of the wetland and above the inlet (vs below and at the outlet) will significantly reduce the chance of creating conflicts with beaver.

A more cost-effective beaver resistant approach is to use large pre-cast concrete blocks to construct a box culvert crossing. These are readily available in Maine and can used on nearly any site. Initial cost is roughly one-third more than standard methods, but the service life is 50-80 years.

This crossing is constructed with commercially available modular concrete blocks. It is greater than full bank width and retains the natural substrate. Photo by Chuck Hulsey, MDIFW

Dams Not Associated with Culverts or Bridges

Impoundments created by dams usually occur on wetland soils not suitable for development. At times though, water reaches places where it can cause property damage. Examples would be wells, septic, fields, basements, lawns, or timber species not suited to survive with water over the roots. In Maine, white pine is a classic example of the latter.

A water leveler placed through a dam to get the desired relief can be more challenging to install vs culverts because work can't be done from a road. Water levelers work best when the water is lowered only a little, but low enough not to flow where it cannot be tolerated. Chances for long-term relief increase when more water column is left for the beaver. Every site is different, but in many instances lowering the water one foot will remove water for a significant lateral distance. All the water leveling devices shown in this document can be used with natural dams. However, installation of a single pipe is the easiest to pass through a dam.

Topography and wetland size are factors to consider. On large wetlands beavers will sometimes build another dam nearby, affecting the effectiveness of the dam with a leveler.

The upstream end of the leveler can be placed in a sunken cage made from livestock panel fencing. To extend the life of the cage, use epoxy coated wire mesh as shown in the right image. If holes are drilled in the water leveler it does not to be level. Tip: The farther the cage is from the dam the harder it is for beaver to determine the origin of the leak. With a plastic culvert use a minimum of one 20-footer. Photos by Ben Nugent, USDA-Wildlife Services

Barriers = Exclosures

***"Fences make good neighbors" - Robert* Frost**

Exclosure devices come in all shapes, sizes, and cost. Simple, effective fences can be made with channel post (used for highway stop signs) or T-posts (for fencing), and heavy gauge wire. T-posts can be driven by hand, while channel posts are strong enough to be driven by hand or backhoe.

Never install a simple fence directly against the face of the culvert or bridge or make it too small. It is best to maximize the length of the fence, and hence the surface area of a dam built against the fence. This allows water from large rain events to be slowed, then flow over a dam before reaching the passage.

Wildlife Biologist Ben Nugent of the USDA-Wildlife Service uses the terms "deceiver shape" and "diversion shape" to describe exclosures based on their intended purpose. A deceiver style is intended to discourage beaver from building a dam. This might occur where there is little elevation difference between a tolerable water level and a road surface. A fence for this purpose would be shaped like a diamond or a trapezoid, with the point facing upstream.

This diamond shape exclosure is meant to "deceive" beaver and discourage the building of a dam.

Photo by Ben Nugent, USDA-Wildlife Services

Beaver are hard-wired to build *perpendicular* to the waterflow, so having a large percentage of the exclosure perimeter aligned parallel to the water course is meant to "deceive" them. This design was developed by wildlife biologist Skip Lyle.

Photo by Chuck Hulsey, MDIFW

What did the salmon think when it swam into a concrete wall…..” dam”!

We expect, and often desire, that beavers rebuild their dam following our maintenance work. Half the battle of achieving damage management is choosing where we want it and properly siting a fence. A commonly used “diversion shape” is a half-circle fence with the arc facing upstream, with the diameter length parallel to the road. This provides high strength because it is like an arch lying flat. The starting and ending points on the shore should be located on either side of a culvert. The distance from the sides of the passage should be proportional to the diameter of the passage. And the distance away from the front of the passage also proportional to the diameter of the passage. Exceeding these dimensions is not an issue.

Arc-shape exclosure with channel post and concrete reinforcement wire. The leveler is made from a piece of salvage plastic culvert, with the end blocked and a slot on the underside to receive water. **NOTE**: Leave a gap on one side, between the first post and the shore if turtle passage is a concern.

Photo by Chuck Hulsey, MDIFW

Make the fence length about 4X the width of the culvert or about 2X the width of the bridge. This will create the necessary surface area should a dam be rebuilt. ***Added benefit:*** *A dam against the fence structure can prevent blockage from flowing debris during large rain events.*

For maximum strength, if channel posts are used the spacing should average two feet apart. Fencing of a heavier gauge will last longer in acidic water associated with beaver flowages in Maine. This is important if beaver do not build a dam. If a dam is rebuilt, the fencing will have served its purpose and deterioration over time is not an issue.

This exclosure has been working for 30 years despite the fencing having long since deteriorated. This is because beaver constructed a dam against the fence when it was installed. The culvert opening is clear and out of view, 20 feet left of the fence.

The upper image shows the site as it remained for about 20 years. The lower image is the site in 2020 with new beaver activity. This culvert remains unplugged and requires no maintenance associated with beaver.

Photos by Chuck Hulsey, MDIFW

A recommended material for fencing is concrete reinforcement wire which comes in 5-foot by 10-foot sheets. This material is available with epoxy coating for longer life and is preferred. Another good material is heavy gauge, welded wire live-stock fencing called 'Handy-Panel'. It comes in 50-inch by 8-foot, or 12-foot lengths. The large squares provide fish and small wildlife an opportunity for passage.

Exclosures constructed as a square, triangle, or trapezoid (narrow side or point at upstream end) are connected to the sides of the culvert entrance. When constructed with Handy-Panel livestock fence or heavy gauge concrete wire, incorporating a top and a bottom will make the structure strong enough to use T-Posts. Named for their cross-section shape, they are less costly than channel posts, come in a variety of lengths, and are readily available. T-Posts are

green with white tops and can be placed by hand, most easily with a fence post pounder. A cage type exclosure can be constructed on land making installment easier.

Beavers may attempt to go under a fence not constructed with a top and bottom. To prevent this, make a 90-degree bend in the bottom end of the fence so 18 to 24 inches of the fence is flat on the bottom. Place rocks on this apron to prevent access from underwater. Applying the fence vertically makes it easier to conform to the contour of the channel and the curve of the exclosure. Observe how beaver react to the change. Should they need to recreate the impoundment they will immediately build a new dam on upstream side of the fence. If their reaction isn't immediate, place temporary fencing across the downstream end of the culvert and across the roadside section structure to dissuade beaver from going around the exclusion device.

In situations where there isn't high-quality habitat upstream or down, beavers may not build against a fence. This occurs when plugging an open culvert is more of an opportunity, than a real need to impound water. This is quite common. An easy way to assess this is to use Google Earth to view the satellite imagery of the location.

Water Levelers

An exclosure may require a device to facilitate water flow through a dam built against the structure. A device may be needed if the water level resulting from a dam (against exclusion device) is higher than desired. Commonly called *"water levelers"* their function is to create a leak in the dam. It is installed at an elevation through the exclosure that leaves beaver enough water but does not cause problems on adjoining property. Finding a balance is important to success. Using a transit level to set the desirable elevation difference between the leveler and where water cannot be tolerated is sometimes worth the extra effort.

A water-leveler is not needed when there is sufficient difference in height between normal water flow (with a fence/dam) and the adjoining property that must remain dry. A general rule of thumb is to use a leveler if there is less than a four-foot difference between these elevations.

Water levelers come in many forms. Here are a four:

1. **Three-sided wooden box culverts**: Made with rough-sawn, 12" wide by 16-foot boards. The fourth side of the box is all wire mesh and that side faces the water. Extend the wire over both ends of the device to prevent beaver from plugging. Place to maximize the amount of the device on the upstream side of the dam. Support the upstream end with posts with cross bars both top and bottom to prevent getting out of level. This design will conduct significant water flow along its whole length. Most appropriate for very small flowages.

2. **Light duty perforated drainage pipes**: These come in 10-foot sections with diameters of four or six inches. They are easily connected for 20-foot lengths to maximize the amount in the impoundment. Length makes it more challenging for beavers to foil. The number of pipes depends on the size of the impoundment, waterflow, upstream hydrology, etc. Support the upstream end with posts and cross support top and bottom. Spreading the pipes apart makes it more difficult for beavers to foil. This system may require maintenance due to freeze and thaw of water surface. Most appropriate for smaller flowages. These are shown in the following image.

Photo by Chuck Hulsey, MDIFW

3. **Small-diameter plastic culverts**: Use like the perforated drainage pipes. Block the upstream end. Cut a long, narrow slot in the upstream end, wrap with light-duty fencing and place the slot towards the water. The intake capacity of the slot should exceed the opening of this culvert by 25%. This method affords high flow capacity and less support structure than needed with multiple perforated drainage pipes. These move water from upstream and through the inside of the exclosure.

Culvert being modified to use either as a water leveler or culvert extension. Intake end is blocked with a heavy rubber livestock dish. They are available in many sizes.

The area of the water intake slot should be 1.25 times diameter of the culvert.

Slot faces the bottom of the impoundment.

Photo by Chuck Hulsey, MDIFW

This water leveler was constructed using a slightly damaged culvert and salvage chain link fence. The total cost of material was $20 for the livestock dish. Time to construct was 30 minutes. The slot opening was calculated using the formula for determining the area of a circle in square inches. Pi (3.14) multiplied by the radius of the circle squared. It is a 12-inch culvert. So, for square inches it is 3.14 X 6 X 6 = 113 square inches.

Add 25% to increase the capacity slightly. So, multiply 113 X 1.25 = 141 square inches.

141 square inches will be the area of the long narrow slot shown in this image.

At 4 inches wide, the length of the slot is 35 inches., round up to three feet.

Tip: *Some sites may need more water column below the water leveler or culvert extension intake. Where increased water depth is desired, digging an inverted, bell-shape hole can create more. Generally, this is allowed if excavated material is not put back in the wetland and if it is done to maintain wetland wildlife values.*

Large diameter plastic road culverts can be used to transfer water from an upstream fenced cage to the inside of the exclosure at the culvert. In the example below, both ends are left open and small vent holes created along the plastic culvert leveler allows the upstream end to be lower than the downstream end. An advantage of this design is the continual draw of rising water levels. Passage through the exclosure at the road culvert is determined by the desired water level should beaver construct a dam. Appropriate for medium to larger flowages. See image below.

Exclosures are constructed with livestock panel fencing. Both were built on dry ground nearby. The white-tipped T-Posts were put in place with a light, hand-held fencepost pounder. Photo by Chuck Hulsey, MDIFW

4. **Culvert extension**. Either add to an existing road culvert or use longer culverts with initial installation or replacements. Modify the longer upstream end the same as described in using 'Small Diameter Plastic Culverts' culverts as levelers. This has a significant advantage of requiring no exclosure device. Appropriate for small and medium size flowages.

The culvert below is on a heavily used four- season recreational trail. It was added to existing culvert to extend upstream into the impoundment. The end was blocked to deny beaver access. There is a long slot cut in the bottom which is wrapped with wire to prevent debris from entering. Photo by Chuck Hulsey, MDIFW

The Secret to Success

Beavers will do what it takes to have water to survive. When provided enough they tend to leave beaver deceivers alone, often forever. The cost savings are significant when the requirements of both beaver and human can be met.

Advice to consider: ***"Approach plugged culverts as a water problem and not a beaver problem"*** -Jim Dorso, former Wildlife Technician with MDIFW who was the first to start using site modification in Maine on a broad scale.

To learn more about beaver site modification contact your nearest MDIFW Regional Wildlife Biologist, the MDIFW Furbearer Biologist, or the USDA Wildlife Service in Augusta. *Shown below are MDIFW Regional Wildlife Biologists Chuck Hulsey (L), Scott Lindsay (C), and USDA Wildlife Service's Wildlife Biologist Ben Nugent (R) at site modification training they conducted in western Maine in 2019. Photographer unknown.*

For more information contact:

Maine Department of Inland Fisheries and Wildlife: **mefishwildlife.com or (207) 287-8000**

USDA-Wildlife Services: **(207) 629-5181**

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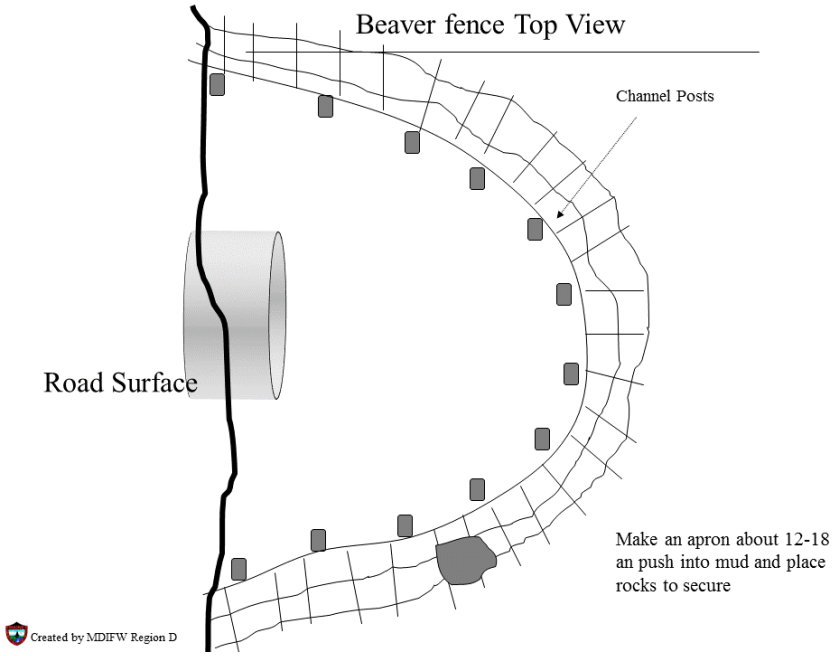
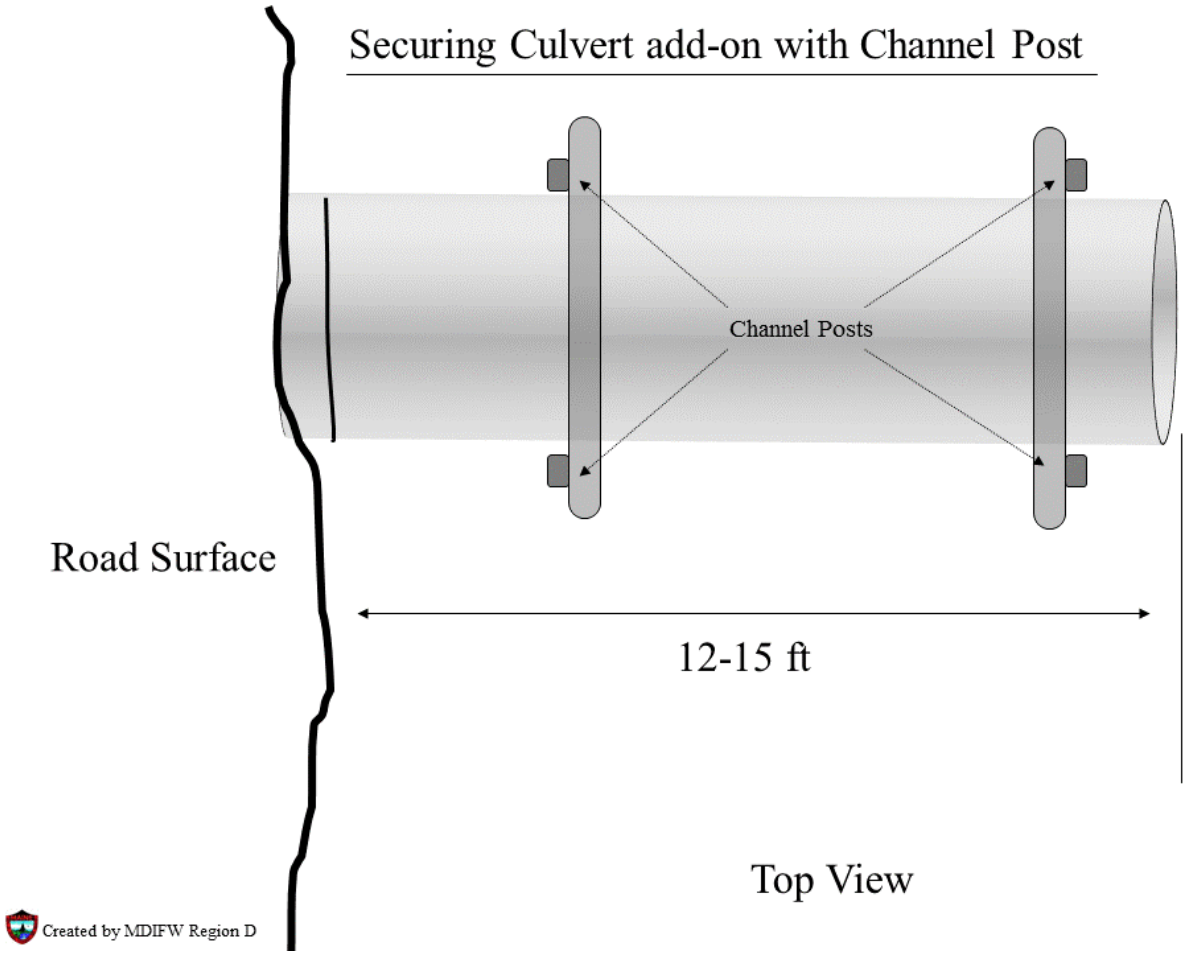
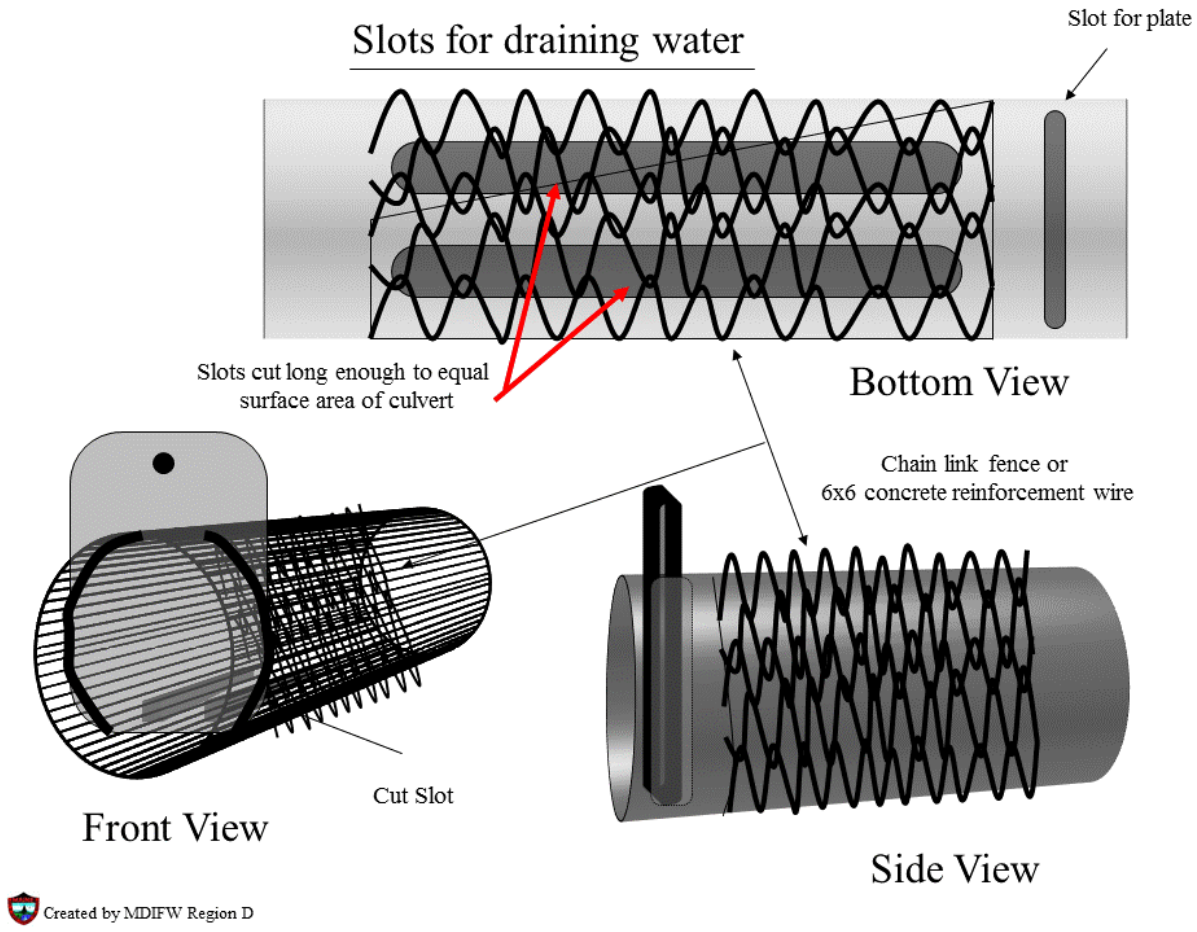
Design Graphics by Robert Cordes, Special Projects Wildlife Biologist

Standard fence with drainage pipes as water levelers



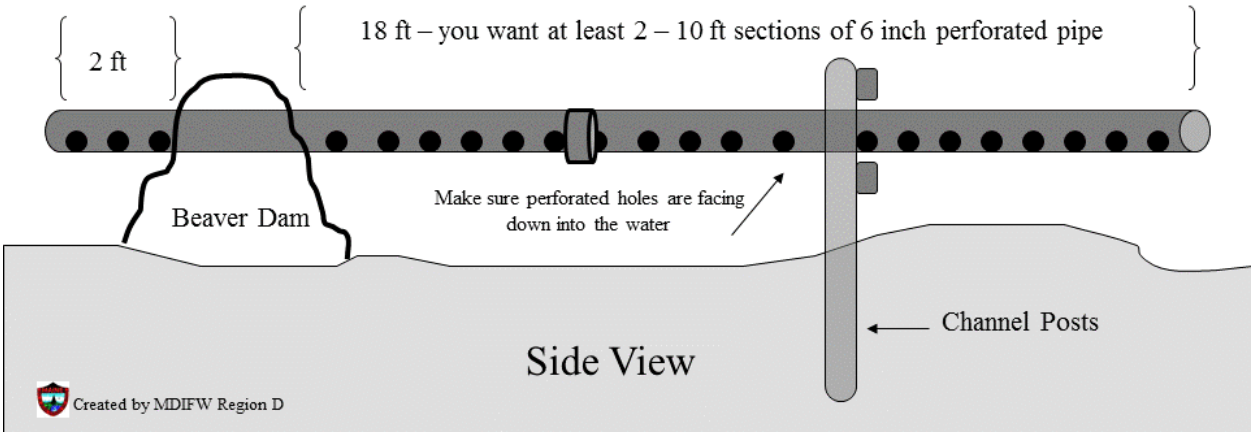

Securing Culvert add-on with Channel Post
Channel Posts
Road Surface
12-15 ft
Top View
Created by MDIFW Region D



NOTE: This same design can be used for smaller diameter culverts used as water levelers. Heavy-duty livestock dishes can also be used to block the upstream end of the leveler and are easier to install.

Piping through a Beaver Dam

leave the beaver as much
water as possible to solve the problem



Note: A single culvert can be used in place of multiple drainage pipe.