TEXAS A&M FOREST SERVICE

W. Goodrich Jones State Forest

Best Management Practices Virtual Demonstration Tour

Demonstrations of Commonly Implemented Texas Forestry BMPs for Water Quality Protection

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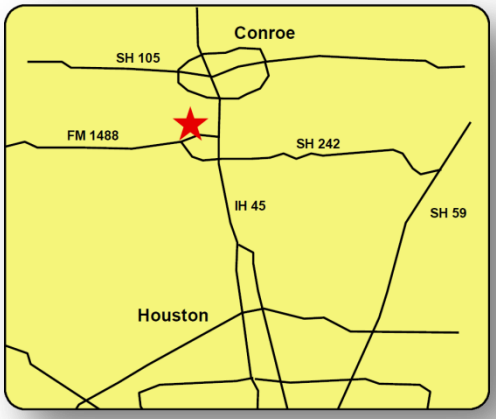

Welcome to the W. Goodrich Jones State Forest Best Management Practices virtual demonstration tour. Best Management Practices, or BMPs, are recommended conservation practices implemented before, during, and after forest management activities to protect water quality from nonpoint source (NPS) pollution.

Clean water is essential for people and wildlife to survive. Streams and other water systems supply communities with the resources they need to meet the water demands of their citizens. This includes water to drink, wash clothes, and water their gardens. Maintaining the forest's ability to produce clean water is the primary goal of BMPs.

In Texas, implementing BMPs to protect water quality during forest operations is achieved through a voluntary, education based approach. This is different from other parts of the country where forest activities are strictly controlled by mandatory regulations. In order to avoid that situation here in Texas, we must continue to demonstrate that the forest sector is committed to voluntarily implementing BMPs to protect our water quality.

Since the mid-1990s, Texas A&M Forest Service has been maintaining Best Management Practices demonstration areas on the W. Goodrich Jones State Forest located in Conroe, approximately 1.5 miles west of Interstate 45 on FM 1488 in Montgomery County. The purpose of these demonstration areas is to give loggers, forest landowners, and other interested members of the general public a chance to see how properly implemented BMPs can be used to protect our waterways during all types of forest operations. The forest is open year round to the general public during daylight hours. Additional information about the State Forest is available at the Texas A&M Forest Service Conroe District Office.

For more information on Forestry BMPs or to obtain a copy of the Texas Forestry BMP handbook please visit our web site at http://tfsweb.tamu.edu/water or contact the Texas A&M Forest Service Water Resources office.

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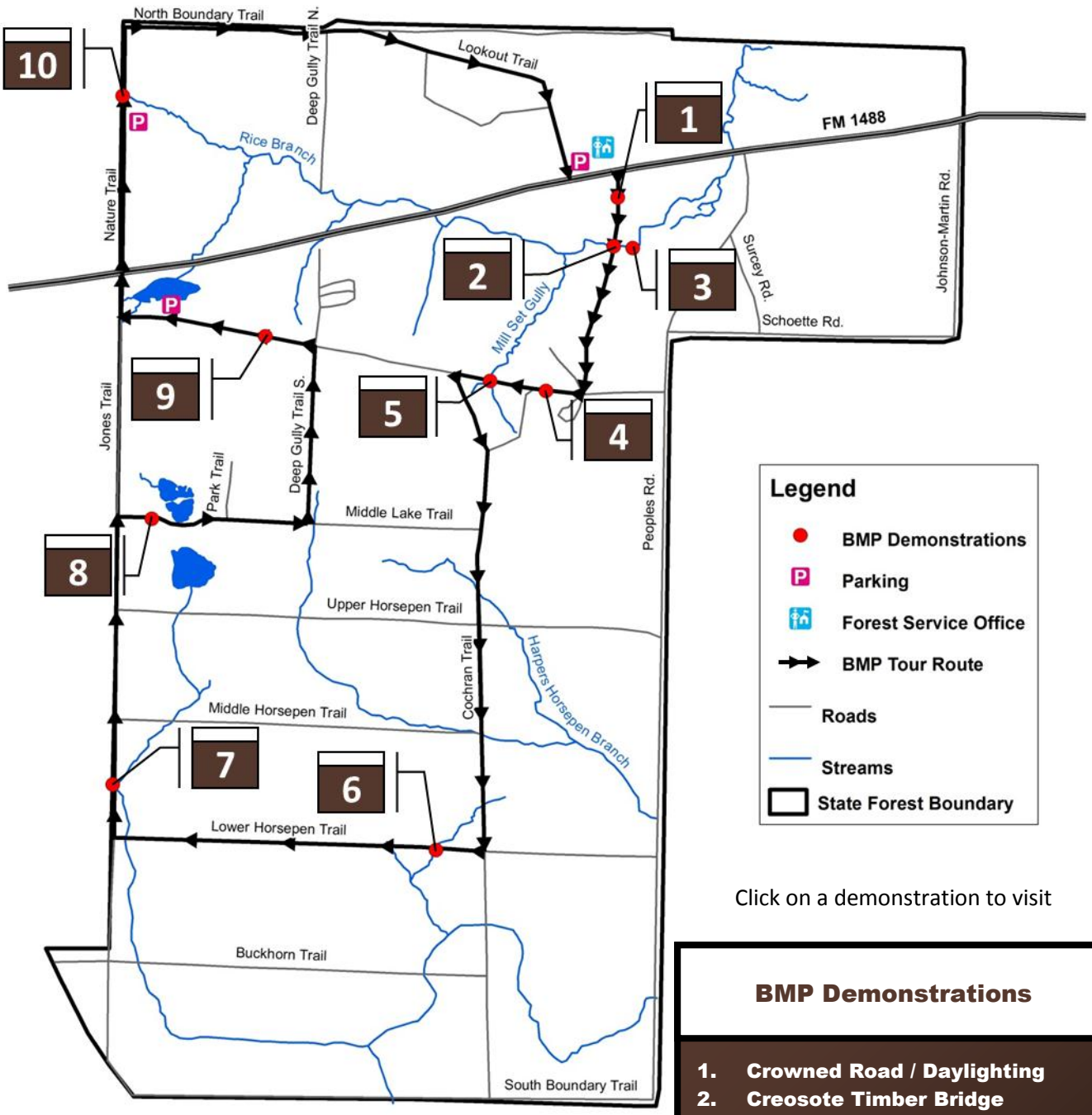
Click on a demonstration to visit



Click on a demonstration to visit

BMP Demonstrations

1. **Crowned Road / Daylighting**
2. **Creosote Timber Bridge**
3. **Streamside Management Zone**
4. **Wing Ditch**
5. **Bridgemat Crossing**
6. **Geoweb Low Water Crossing**
7. **Road Stabilization – Seeding**
8. **Road Stabilization – Rock**
9. **18” Steel Culvert**
10. **Flat Car Bridge**

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Stop #1 – Crowned Road with Ditches and Daylighting

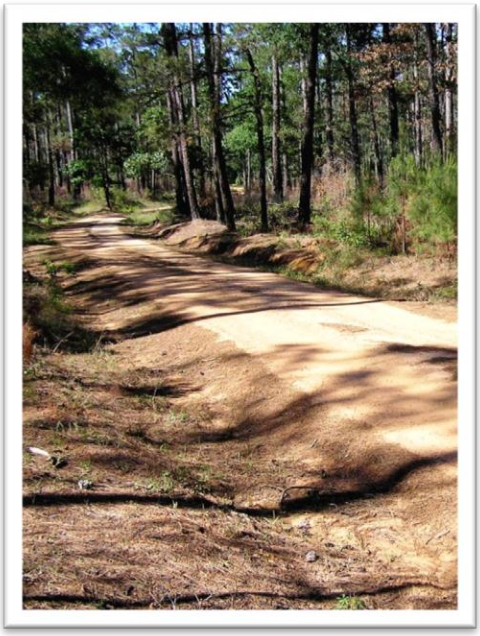
Purpose

- **Promotes Drainage**
- **Prevents Road Surface Erosion**
- **Increases Wet-Weather Access**

A well designed road system is essential for providing reliable access to forest land. Roads are not only necessary for the majority of forest management activities but also for many recreational uses as well. However, forest roads have the potential to adversely impact the quality of local water resources. Most forest roads are unpaved and provide large areas of exposed sediments that can erode and wash into nearby streams, ponds, rivers, wetlands and other water bodies. This action, called sedimentation, can degrade water quality and harm aquatic life. Therefore, it is important to always follow all applicable recommendations and guidelines related to forest roads listed in the Texas Forestry Best Management Practices handbook when constructing or maintaining the roads on your forest.

One way to prevent erosion on a road is to shape the surface in a way that promotes drainage. This road demonstrates a "crowned" surface in which the center of the road is higher than the shoulders. This allows water to quickly shed off the road surface and into the roadside ditches, preventing erosion. Crowning also keeps water from ponding on the road surface, which creates soft spots that result in vehicle ruts and wallows. The roadside ditches act as channels that collect the road surface water and carry it away from the road. Wing ditches are then used to carefully drain the roadside ditches onto the forest floor (see demonstration stop #4).

This road also demonstrates a practice known as "daylighting," in which some of the trees adjacent to the road are removed to increase the amount of sunlight and wind that reaches the road surface. This helps the road dry quickly after rain events, which allows for better wet-weather access. Daylighting also promotes the establishment of protective vegetative cover on road surfaces and shoulders to further increase stability.



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Stop #2 – Creosote Timber Bridge

Purpose

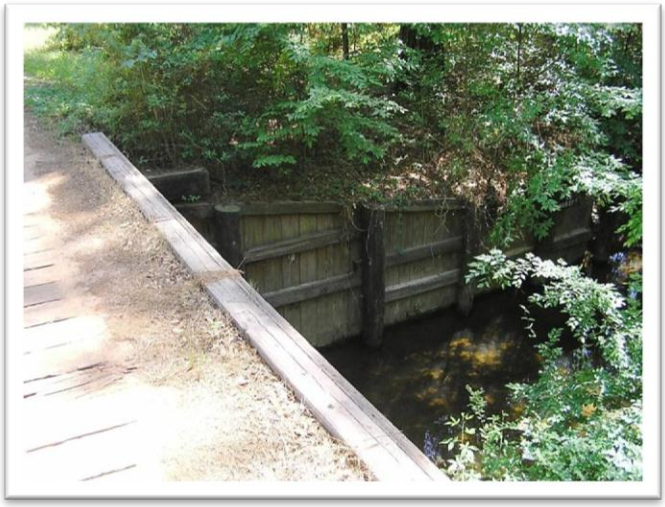
- **Handles Heavy Traffic**
- **Minimizes Sedimentation and Erosion**
- **Functions Under High Water Conditions**
- **Relatively Expensive**

Attaining access to forest land by road often requires crossing a stream. Stream crossings can be a major source of sediment and other nonpoint source pollution because of their proximity to water and the interaction of traffic with exposed dirt roads. Therefore, it is always best to avoid stream crossings whenever practical alternatives exist.

Properly implemented stream crossings enable traffic to traverse streams, drains, and ditches, when necessary, while protecting water quality. Bridges, like this creosote timber bridge installed on Rice Branch in 1992, are excellent options for creating permanent access across large streams. They require little maintenance and can handle heavy traffic. However, they are expensive to install.

Some things to keep in mind when installing a bridge:

- If possible, consider alternate road locations that avoid installing a stream crossing.
- Make crossings at right angles to the stream channel, and only in narrow straight sections to reduce the area disturbed by the crossing.
- Choose a site with stable approaches that will allow for adequate visibility, water diversion, and a relatively constant grade to the bridge. The bridge should maintain the grade of the approaches to avoid an abrupt rise or fall at the ends of the bridge.
- Install abutments that are parallel to the stream and imbedded into good foundation material.
- Get technical help in designing the bridge to handle your intended traffic.



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Stop #3 – Streamside Management Zones

Purpose

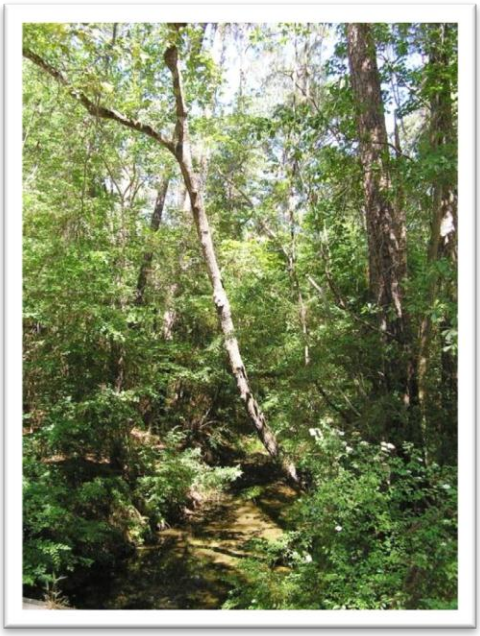
- **50 Foot Buffer Strip of Trees**
- **Filters Sediment From Runoff**
- **Provides Shade to Streams and Wildlife Habitat**

Streamside management zones, or SMZs, are perhaps the most essential and beneficial Best Management Practice for ensuring clean water. They are forested riparian buffers, at least 50 feet wide, purposefully maintained along both sides of intermittent and perennial streams. These areas receive special management attention because of their value in protecting water quality and the many other benefits they provide.

Functioning as a buffer from adjacent forestry activities, SMZs are very effective at preventing sediment and other forms of nonpoint source pollution from reaching the water bodies they protect. SMZs allow runoff to enter water bodies while filtering out pollutants by reducing the velocity of runoff water, trapping sediments from upslope areas, promoting infiltration, and ensuring bank stability. The trees provide important habitat for terrestrial species and supply woody debris that crates habitat for fish, other aquatic organisms, and terrestrial organisms. They also shade the stream from sunlight, maintaining cool water temperatures and sufficient oxygen levels for aquatic life. This SMZ on Rice Branch has filtered sediments from surface runoff and maintained cool water temperatures for over 15 years.

Thinning is allowed in SMZs, but site disturbing activities such as road construction, mechanical site preparation, and skidding are generally limited in order to maintain the shading, soil stabilization, and water filtering effects of the area. The following are important considerations for maintaining functional SMZs:

- 50 foot minimum width on each side of intermittent or perennial streams.
- Minimize ground disturbance within the SMZ.
- SMZs may be thinned, but 50% of the crown cover should be maintained.
- See the Texas Forestry BMP Handbook for more info.



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Stop #4 – Wing Ditch

Purpose

- **Prevents Road Ditches from Washing**
- **Easy to Construct and Maintain**
- **Runoff Should Not Discharge into a Stream**

Forest roads, when constructed improperly, have been found to contribute as much as 90 percent of the total in-stream sediment yield. In order to maintain good access and prevent erosion from your road system you need to ensure that your road surfaces are well drained. Wing ditches, like the ones below, are an important type of road drainage structure that collects runoff water from the road surface and roadside ditches and disperses it into stable areas of vegetation away from water bodies or other sensitive areas. Spreading and slowing down runoff allows it to drop any sediment it may be carrying. Constructing a series of wing ditches at regular intervals along a road helps to prevent erosion by reducing the volume of water carried down the road and within the roadside ditches and decreasing its erosive velocity by limiting the distance it can travel.

Some things to consider when locating and constructing wing ditches:

- A wing ditch should intersect the roadside ditch at the same depth to efficiently collect water, and should be outsloped 1 to 2% depending on the erodibility of the soils.
- On sloping roads, the wing ditch should be angled 30 to 45 degrees to the roadbed and be designed to follow the natural contour of the area.
- Construct wing ditches to be only as long as necessary to encourage the water to flow away from the road, and make a wide flat outlet that disperses the water over a broad area.
- The spacing of wing ditches will be determined by the topography of the area.
- Wing ditches should not feed directly into adjacent drainages, gullies or channels.

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Stop #5 – Bridgemat Crossing

Purpose

- **Temporary Access Across Waterways**
- **Easy to Install**
- **Reusable**
- **Higher Initial Cost**

When permanent road access to a site across a stream is not needed, an alternative to the permanent bridge installation is the use of a portable bridge for temporary stream crossings. Portable bridgemats (also referred to as dragline mats, skidder mats, bridge mats, skidder bridges, timber bridges, and portable glulam panel bridges) are a readily-available and proven method of crossing streams and ditches in a relatively 'low-impact' manner that contributes to the protection of water quality from nonpoint source pollution. They can provide a crossing without inhibiting stream flow or aquatic movement and can be installed without extensive soil backfill (unlike culverts and slash crossings). A portable bridge can be installed and used during logging operations, then removed after operations are finished and moved to another location. Although the initial cost of portable bridges might be greater than other stream crossing structures, the fact that they are reusable and easy to install significantly reduces their cost per use.

Bridgemats are available in a number of sizes and constructed from many different materials. This particular crossing was installed in 2012 and utilizes 3 timber bridgemats (4' x 16' x 8") made from several hardwood cants fastened together with threaded rods to create a stable crossing over this gully.

Here are a few things to keep in mind regarding bridgemats:

- If possible, consider alternate road locations that avoid installing a stream crossing.
- Locate bridgemat crossings where the channel is narrow and has firm level streambanks on either side. Ensure that the approaches are straight and that the bridge crosses perpendicular to the channel. Make sure that you allow for enough length so that the mats span the stream and maintain 4 – 6 feet of ground contact on either side of the stream bank to provide stability and support.
- Keep equipment out of the channel during installation and removal. Immediately remove bridgemats when no longer needed.

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Stop #6 – Geoweb Low Water Crossing

Purpose

- **No Culvert to Wash Out or Maintain**
- **Supports Heavy Traffic**
- **Minimizes Erosion and Siltation**

Low water crossings, or fords, are well suited for wide shallow streams where the banks are low and gentle sloping and provide natural approaches that do not require extensive excavation or shaping with a dozer. The approaches, stream banks, and stream bottom should be hard enough or sufficiently stabilized to minimize disturbances to the stream channel. Often rock is used to stabilize the approaches and stream bottom, but in some cases the rock can get washed downstream during periods of high flow.

Geoweb is a commercially available honeycomb-like confinement structure that can be used to securely hold rock materials for “hardening” a stream bottom for a low water crossing. Water is free to flow over the Geoweb, which prevents movement of the fill material and provides a firm base for traffic. Geoweb comes in four-, six-, and eight-inch depths and expands to approximately eight feet by twenty feet. While the appropriate size depends on soil type and other factors, a general recommendation is to use four-inch for light traffic, and eight-inch for heavy traffic (i.e., logging trucks and heavy machinery). A geo-textile fabric is usually recommended to be installed under the Geoweb, and two-inch filtered rock seems to work best as a fill material.

This Geoweb hardened ford crossing on this ephemeral drainage was installed in the mid-1990s and has provided excellent access while protecting water quality ever since. These types of crossings require very little maintenance. Today, there is not much to see as years of stream sediments have settled and deposited on top of the Geoweb material, further stabilizing the crossing.

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Stop #7 – Road Stabilization - Seeding

Purpose

- **Minimizes Erosion**
- **Mix Can Include Summer and Winter Grasses**
- **Fertilizer May be Necessary**
- **Inexpensive to Apply**

Vegetation is great for stabilizing soil and minimizing the chance for erosion where soil has been exposed, especially on forest roads and steep erodible slopes. Seeding quickly establishes ground cover that anchors the soil with roots, dissipates the impact force of raindrops, reduces the velocity of surface runoff, contributes organic matter to the soil which increases soil infiltration rates, and helps to prevent sediment and other pollutants from entering nearby surface waters. Seeding is especially appropriate for closing out temporary roads or to stabilize secondary roads that experience infrequent traffic. Seed selection should consider the local native species, intended planting season, soil type, availability of sunlight to the area, and the cost of seed.

- Consider reseeding any areas where the mineral soil has been disturbed.
- Broadcasted seed may need to be placed in contact with soil by dragging a chain, brush, or disk, or by firming with a roller.
- Consider mixing legumes with grasses for the best results.
- Fertilize with 600 pounds per acre of 13-13-13 or its equivalent, when necessary, but be careful not to allow any fertilizer to enter streams or other surface waters.
- Refer to the Texas Forestry Best Management Practices handbook for more information on revegetating disturbed areas. http://tfsweb.tamu.edu/water

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Stop #8 – Road Stabilization - Rock

Purpose

- **Crushed Concrete is Inexpensive**
- **Allows Road to be Used During Wet Conditions**
- **Supports Heavy Traffic**

While more expensive than seeding, armoring a road surface with rock is an excellent method of preventing erosion and improving access, especially for roads that remain wet for extended periods of time, experience heavy traffic, or are prone to erosion.

This section of road runs through a low area that naturally remains wet even during drier periods. It was reshaped and armored with rock in 2005 to improve access and reduce erosion. The road base was first graded, and then a geo-textile fabric was installed along the road corridor. This fabric allows water to drain through the road, prevents the rock from sinking into the ground, and dissipates tire pressure to provide a sturdy well-drained surface for vehicular traffic. Finally, 72 cubic yards of crushed concrete were spread and compacted to form the surface. The road surface was crowned to help shed water off the roadway and prevent pooling on the road. Crushed concrete is less expensive than limestone and granite and generally performs just as well.

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Stop #9 – 18" Steel Culvert

Purpose

- **Inexpensive and Readily Available**
- **Allows Water Flow and Fish Passage When Properly Sized**
- **Rock on Outfall Minimizes Erosion**
- **Minimal Impacts to Water Quality**

This culvert crossing was installed in the early 1990s. Culverts can serve as stream crossings or as a means of safely transmitting runoff across a road (under the road surface) in order to maintain the natural drainage patterns of the landscape. To avoid a costly blowout it is important that you carefully select the right size culvert based on the expected upstream drainage volume (see the Texas Forestry BMP handbook for more information on culvert sizing). Culverts are generally self-cleaning, but after periods of heavy rainfall debris can sometimes accumulate in the upstream opening. This can result in road washout or a blowout of the entire crossing. Periodic maintenance to remove debris and ensure free passage of water, especially after heavy rains, is therefore very important. Culverts generally serve as permanent crossing structures as removing and reusing them is costly and difficult to do without negatively impacting the channel or water quality.

A few things to keep in mind when installing culverts:

- Choose a culvert that has been sized to handle maximum stream flow.
- Locate culvert crossings only at straight sections of the stream channel.
- Make sure the inlet is placed level with the stream bed and not above it. The outlet should be 1-2% downgrade to prevent clogging. The inlet and outlet should be armored when necessary.
- Seat the culvert on firm ground (i.e., not fill material) at the bottom of the stream channel and compact the soil at least halfway up the side of the culvert.
- Allow about one foot of culvert to extend beyond the road fill both upstream and downstream.

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Stop #10 – Flat Car Bridge

Purpose

- **Handles Heavy Traffic**
- **Minimizes Sedimentation and Erosion**
- **Functions Under High Water Conditions**
- **Relatively Expensive but Durable**

This bridge represents a unique approach to establishing a permanent stream crossing. An old creosote timber bridge that stood in this location was badly damaged from high flood waters during Tropical Storm Allison in 2001, rendering it unusable for vehicular traffic. In 2005, the damaged bridge span was removed, leaving only the abutments. After evaluating several different bridge options, it was decided that a flat deck railcar would be used in conjunction with the old abutments to bridge the span and provide permanent access across the creek. The ends of the bridge were joined to the existing road surface using backfill.

While expensive, railroad flat cars can still be less costly than building timber bridges and can handle heavier vehicle traffic such as loaded log trucks or school buses. Also, since rail cars are made of steel they are not as susceptible to wood rot like many timber bridges are, especially after being installed for many years. Rail cars come in different lengths, and it is generally recommended that you select one that will extend approximately 10 to 15 feet past the bridge abutments to ensure that it can be securely tied in.