



# Temporary Stream Crossing Options

## Forest Management Practices Fact Sheet Crossing Options Series #1

### Introduction

Timber harvesting and hauling equipment can damage water quality by stirring up sediment and harming fish and other aquatic organisms when crossing streams. However, operators can use special stream crossing options to minimize the impact. Many of these options are temporary and can be reused at another crossing.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

### Where Used

Temporary stream crossing options are used in forests with streams.

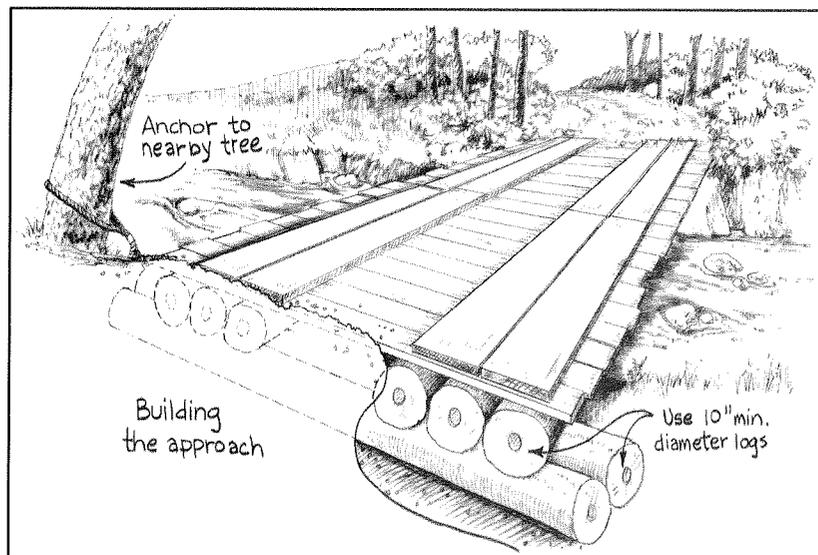
### Application

Survey the area and plan the harvest to minimize the number of stream crossings. Then determine which stream crossing option to use for each crossing. Generally, avoid crossing streams when fish are spawning, incubating eggs, or migrating. Some states require permits for crossing both permanent and intermittent streams. Check with the appropriate regulatory or natural resource agency.

Many stream crossing options work best with a proper foundation. Logs, railroad ties, or similar abutments help level the structure. They also minimize stream bank disturbance and make removal easier. PVC or HDPE pipe bundle crossings and some fords work best with a porous fabric mat called geotextile under them. Geotextiles support the option and separate it from the soil, making removal easier.

### Options

A *ford* is a crossing in which vehicles drive directly through the stream. Use fords only when crossing infrequently or for short periods. Clean rock on top of geotextile can strengthen the ford and the approaches leading up to it.



Log stringer bridge

A *culvert* is a pipe or other round or oblong object that diverts water under the crossing. Culverts work well in streams with well-defined, deep channels. Operators can install and remove them quickly. Culverts are very portable.

An *ice bridge* consists of packed snow that is iced over with water. It is useful on streams with low water flow. Operators may need to pack and ice the structure for several days to build a strong structure.

A *timber bridge* is built from logs, railroad ties, demolition materials, or lumber. To build, cable the materials together and nail over them with lumber. This gives the structure stability, strength, and allows it to control sediment from passing vehicles. A *solid-sawn stringer* is similar in construction. A *panel bridge* is built using stress-laminated, glued-laminated, dowel-laminated, or nail-laminated materials. Firmly anchor timber bridges at one end—it should be able to swing away during flooding. Install curbs or guardrails on bridges designed for truck traffic to help the driver position the vehicles safely. Most timber bridges are temporary and reusable.

*Railroad cars, truck flatbeds, steel bridges, and prestressed concrete panels* are commercial options that are often used to span wider streams. Operators generally can reuse them again.

A *PVC or HDPE pipe bundle crossing* consists of pipes cabled together with galvanized steel to form mats. Place the mats on top of geotextile. Use wood mats, wood panels or pallets, or other materials on top of the pipe bundles to increase traction. Securely anchor pipe bundles so they don't move downstream.

**Maintenance**

Keep culverts and pipe bundles clear of debris. Re-ice bridges as needed. Check bridges and pipe bundle strength and wear during and between uses.

**Costs**

<u>Option</u>	<u>Cost</u>
Fords	Low
Culverts	Low
Ice bridges	Low
Timber bridges	Low - Medium
Pipe bundles	Low - Medium
Other options	Medium - High

**Related Fact Sheets in This Series**

*Fords* (FS-7002); *Culverts* (FS-7003); *Ice Bridges* (FS-7004); *Timber Bridges* (FS-7005); *Railroad Car, Steel, and Prestressed Concrete Bridges* (FS-7006); and *PVC or HDPE Pipe Bundle Crossings* (FS-7007).

**Cooperators**

University of Minnesota Extension Service, Minnesota Department of Natural Resources, Minnesota Logger Education Program, Michigan Department of Natural Resources, Michigan State University Extension, USDA Forest Service, and Wisconsin Department of Natural Resources.



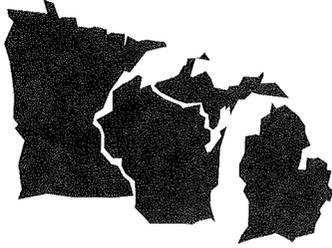
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# Fords

## Forest Management Practices Fact Sheet Crossing Options Series #2

### Introduction

Timber harvesting and hauling equipment can damage water quality and habitat when crossing streams. Fords can cost-effectively minimize environmental impact.

*Fords* are stream crossings in which vehicles enter and drive across the stream. They may be suitable for low levels of traffic when the water flow is low. The streambed must be able to support the weight of traffic. Local authorities may let operators remove weak soils and replace them with a woven geotextile covered with stable fill materials such as gravel. In some states, operators need a permit to build a ford crossing.

### Where Used

Fords are used in streams with low flow. The streambed should contain rock or coarse gravel capable of supporting equipment.

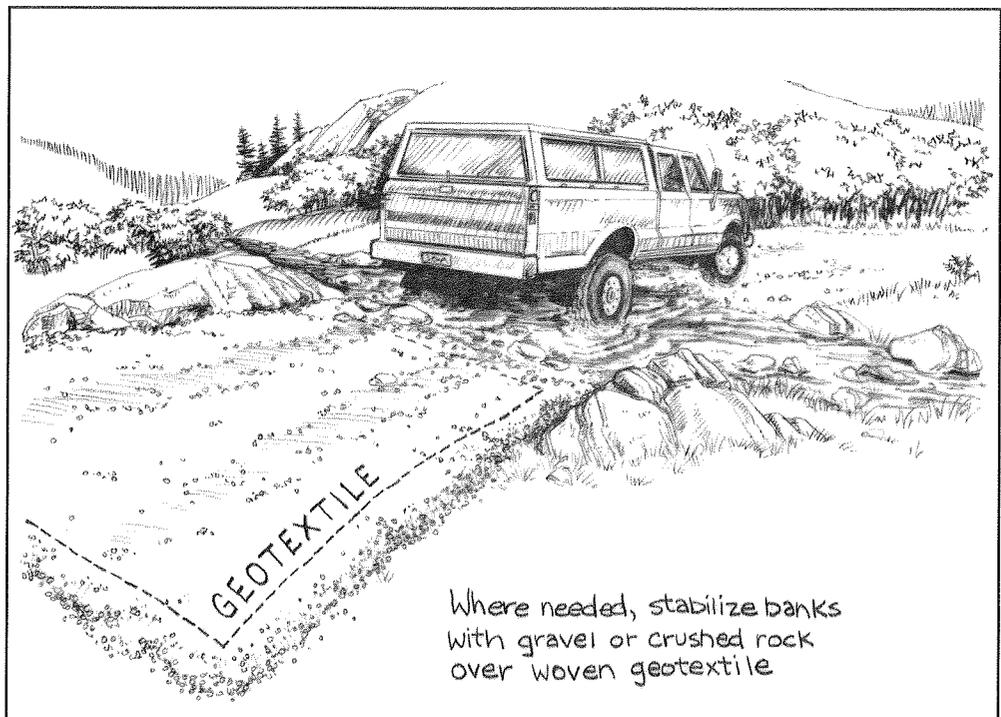
Place the ford where the stream is straight. Choose an area where the banks are less than 4 feet high with a natural, gentle slope. The finished graded slope from road to stream level should not exceed 5:1 (horizontal to vertical).

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

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**Geotextile is a fabric mat that allows water to drain through it. It supports material placed on top of it and makes removal of that material easier.**

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## Application

Do not build or use a ford during fish spawning, incubation, or migration. Check with the appropriate regulatory agency in your state to see if fords are acceptable and if permits are required.

When building a ford:

- ▶ Maintain the natural level of the streambed to let fish pass over the crossing.
- ▶ Keep vehicles constructing and using the ford in good condition to minimize water pollution.
- ▶ Obtain permission to replace weak soils. Use rock or coarse gravel and place on top of geotextile to strengthen and stabilize the streambed.
- ▶ Where necessary, stabilize banks and approaches by placing at least 12 inches of clean material such as gravel or crushed rock over a woven geotextile. Use temporary options such as wood mats, wood panels or pallets, and expanded metal grating to stabilize approaches.
- ▶ Install lead-off ditches or water bars on roads approaching streams to divert water into vegetation away from the stream.
- ▶ Reseed bank cuts right away to keep them from eroding into the stream.
- ▶ Remove any temporary surfacing materials used on the approaches when the ford is no longer being used.

## Advantages

Fords require little maintenance. Operators can install them relatively quickly in most cases.

## Disadvantages

Operators can't use fords in many streams because of local regulations. They also may not meet site criteria. They can only be used during low flow. Vehicles can stir up sediment or cause soil to enter the stream while using fords. Operators can't build or use fords while fish are spawning, incubating, or migrating.

## Maintenance

Very little maintenance is required.

## Related Fact Sheets in This Series

*Temporary Stream Crossing Options* (FS-7001); *Culverts* (FS-7003); *Ice Bridges* (FS-7004); *Timber Bridges* (FS-7005); *Railroad Car, Steel, and Prestressed Concrete Bridges* (FS-7006); and *PVC or HDPE Pipe Bundle Crossings* (FS-7007).

## Cooperators

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# Culverts

## Forest Management Practices Fact Sheet Crossing Options Series #3

### Introduction

Harvesting or other forestry operations can damage stream habitat and water quality. Operators who need to move vehicles and equipment across streams must consider how they can do so and still protect streams.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

### Where Used

Culverts are made from metal, concrete, polyethylene pipes, or wood boxes. An operator sets a culvert in the crossing and the stream flows through it. Workers can use a bulldozer, backhoe, or excavator to install or remove a culvert.

### Application

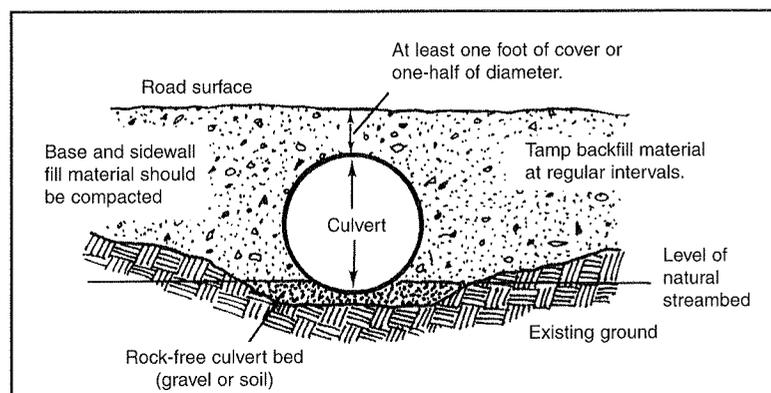
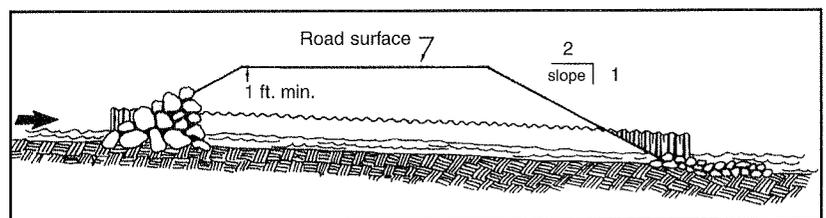
Culverts are used in streams with well-defined, deep channels without a lot of woody debris. Culverts need to be large enough to handle peak flows.

Do not install or remove culverts during fish spawning, incubation, or migration. Check with the appropriate regulatory or natural resource agency in your state to see if permits are required. You may be able to buy used culverts from highway departments or road-building companies. Consult local water-permitting authorities or county highway engineers when sizing and installing culverts.

When installing culverts:

- ▶ If possible, install and remove culverts when the streambed is dry. In a flowing stream channel, use sediment basins, a temporary diversion channel, or a pump to divert water away during installation and removal.

*Install culverts so there is no change in the natural stream bottom elevation.*



*Installation of culverts.*

(Adapted from Montana Department of State Lands, 1992.)

- ▶ Dig a channel at least twice the width of the culvert. Follow the natural slope and course of the streambed.
- ▶ Use a single large-diameter culvert rather than several small culverts. It's easier to maintain tight seals around one culvert than around more.
- ▶ Size the culvert so that each end extends about 2 feet beyond the side slopes of the fill.
- ▶ Install the culvert on compacted granular material. Set it into the streambed and cover the inside with streambed gravel.
- ▶ Pack fill firmly by hand around the sides and lower portion of the culvert.
- ▶ Cover the top of the culvert with fill to a depth recommended by your local BMP guidelines. Often, this depth is one-half the pipe diameter or 12 inches, whichever is greater.
- ▶ Make sure the side slope does not exceed 2:1 (horizontal to vertical).
- ▶ Riprap the culvert's inlet and outlet to protect against erosion.
- ▶ Revegetate bank cuts immediately. This will keep them from eroding into the stream.
- ▶ Remove temporary culverts as soon as you are done using them. Remove when the channel is dry or during low flow to minimize movement of sediment downstream. Restore the stream channel to its natural shape to the extent possible.

**Advantages**

Culverts are very portable and are usually readily available locally. Operators can install and remove them quickly.

**Disadvantages**

Culverts cannot be used in some areas because of local regulations. Operators may need technical assistance to correctly size culverts for each crossing. If sized or installed incorrectly, they can damage the stream. Relatively large quantities of sediment can enter the stream during installation and removal.

**Maintenance**

Keep culverts free of debris that can cause clogging.

**Related Fact Sheets in This Series**

*Temporary Stream Crossing Options (FS-7001); Fords (FS-7002); Ice Bridges (FS-7004); Timber Bridges (FS-7005); Railroad Car, Steel, and Prestressed Concrete Bridges (FS-7006); and PVC or HDPE Pipe Bundle Crossings (FS-7007).*

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# Ice Bridges

## Forest Management Practices Fact Sheet Crossing Options Series #4

### Introduction

During harvesting or other forest management operations, it is sometimes necessary to move equipment across streams. Ice bridges can provide acceptable temporary access across streams during winter.

*Ice bridges* are made by pushing and packing snow into streams and applying water to freeze the structures solid so vehicles can drive across. Use is limited to winter under continuous freezing conditions. Operators may need permits before an ice bridge crossing can be built.

### Where Used

Ice bridges are for temporary use in streams with low flow rates, thick ice, or dry channels during winter. They may not be appropriate on streams with large or high-velocity spring flows.

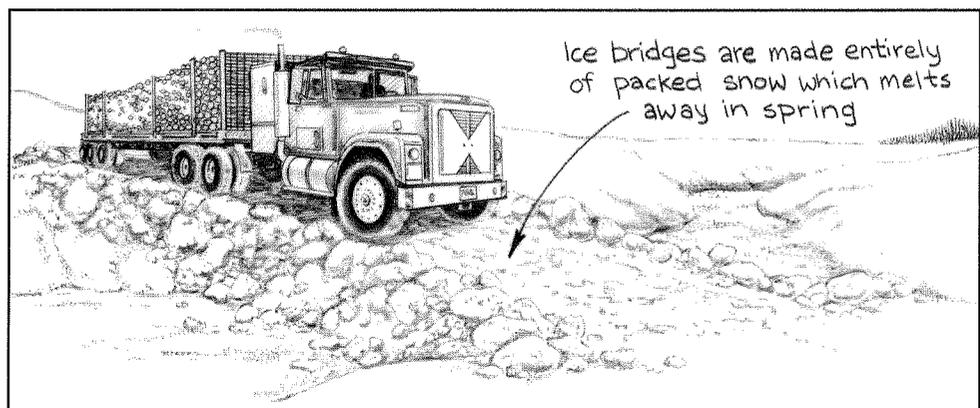
### Application

Before beginning, check with the appropriate regulatory or natural resource agency in your state to see if permits are required.

When constructing an ice bridge:

- ▶ Choose a period with night temperatures below 0° F.
- ▶ Choose a site that has low flow, is completely frozen or dry, or has a layer of ice on top of the flowing water. Approaches should be level or nearly level.
- ▶ Push snow that is free of dirt and debris into the channel and pack it down. Add water to ice the structure. Don't add brush or other vegetation to the ice bridge. This will weaken the structure. It can also dam the stream when the bridge melts.
- ▶ Let the surface freeze, then repeat the process until the crossing reaches the desired thickness and width. The bridge should be thick enough to permit a level approach. The ice also must be thick enough to support the weight and speed of anticipated traffic (see Table 1).

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**Table 1.** Minimum ice thickness required to support a given load above a flowing river or stream or on a lake (Haynes and Carey 1996).<sup>1</sup>

Vehicle class <sup>2</sup> (tons)	Minimum ice thickness (inches)	Minimum distance between vehicles <sup>3</sup> (feet)
0.1	2	17
1	4	34
2	6	48
3	7	58
4	8	67
5	9	75
10	13	106
20	18	149
30	22	183
40	26	211

<sup>1</sup> Information in this table assumes clear, sound ice. White, bubble-filled ice should be twice as thick as clear ice. If the air temperature has been above freezing for at least 6 of the previous 24 hours, multiply the vehicle class by 1.3 to obtain a much larger minimum thickness. If the air temperature stays above freezing for 24 hours or more, the ice begins to lose strength and the table no longer represents safe conditions. It is recommended that operators drive below 15 miles per hour.

<sup>2</sup> Vehicle class equals the total weight of the vehicle plus its load in tons (2,000 lbs), not the vehicle's load capacity.

<sup>3</sup> At thicknesses greater than the minimum ice thickness, the spacing between vehicles can be reduced on sound ice.

Source: Haynes, F. D., and K. L. Carey. 1996. Safe loads on ice sheets. U.S. Army Cold Regions Research and Engineering Laboratory, Ice Engineering Number 13. 4 p.

**Advantages**

Ice bridges are easy to build and don't need to be removed at the end of an operation.

**Disadvantages**

There are many conditions where ice bridges won't work. The bridge must be inspected often, since weather and water flow can affect its strength.

**Maintenance**

Inspect ice bridges often. Look for problems such as water dammed above the bridge or openings in the ice near the bridge. In high-risk areas, you may need to cut a hole through the ice above or below the bridge often during each day to determine its thickness and condition.

**Related Fact Sheets in This Series**

*Temporary Stream Crossing Options* (FS-7001); *Fords* (FS-7002); *Culverts* (FS-7003); *Timber Bridges* (FS-7005); *Railroad Car, Steel, and Prestressed Concrete Bridges* (FS-7006); and *PVC or HDPE Pipe Bundle Crossings* (FS-7007).

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# Timber Bridges

## Forest Management Practices Fact Sheet Crossing Options Series #5

### Introduction

**T**imber bridges can help protect water quality and stream habitat during forestry operations.

There are three basic types of temporary timber bridges. *Log stringer bridges* are built from trees felled in the area. *Solid-sawn stringer bridges* are made from new lumber, railroad ties, or large timbers removed from buildings that are being torn down. *Panel bridges* are constructed from stress-laminated, glued-laminated, dowel-laminated, or nail-laminated lumber. A licensed engineer can help operators design a safe, appropriate timber bridge.

### Where Used

### Application

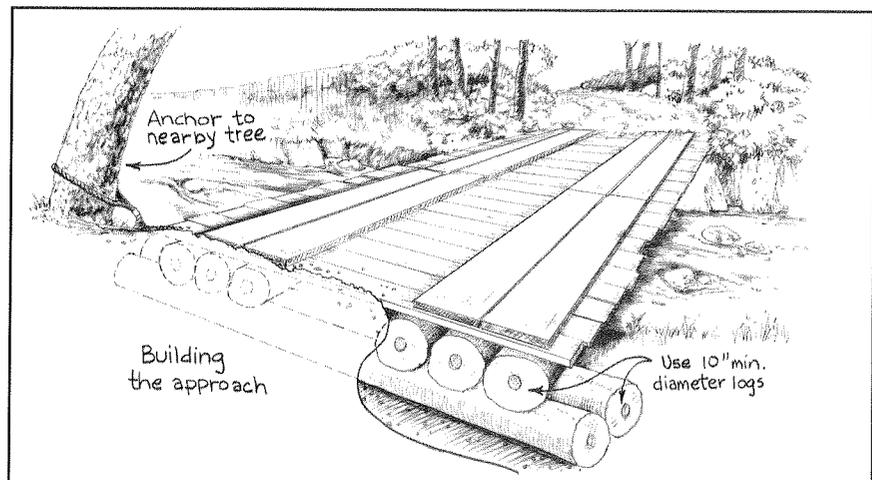
Timber bridges can be placed over small streams or channels with firm, stable banks.

Check with the appropriate regulatory agency in your state to see if permits are required to build timber bridges.

When building and installing a log stringer bridge:

- ▶ Use logs from a high-strength species (e.g., oak or pine) that are rot-free. They should be at least 10 inches in diameter on the small end.
- ▶ Cut logs at least 6 feet longer than the width to be spanned (e.g., use logs 18 feet long for a 12-foot-wide stream). Use at least six logs, more if using aspen, basswood, or other low-strength species.
- ▶ Place abutment material (e.g., one or more logs or railroad ties) on each bank parallel to the stream flow. This helps level the structure, minimizes stream bank disturbance, and makes removal easier.
- ▶ For each wheel path, place at least three logs on the abutments. Tie together the logs in each wheel path with three cables and clamps.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.



Log stringer bridge

- ▶ Nail lumber between the two wheel paths to stabilize the bridge and to catch debris that may drop off passing vehicles.
- ▶ Build approach ramps. Stabilize them as needed using wood mats, wood panels or pallets, expanded metal grating, or other materials.
- ▶ Anchor one end of the bridge with a cable to a nearby upstream tree or other fixed object. Add guardrails or curbs to the bridge if you will be using trucks to haul loads.
- ▶ After you finish construction, immediately revegetate the banks and any disturbed areas. This will prevent soil from eroding into streams.

When building and installing a solid-sawn stringer bridge:

- ▶ Follow directions for building and installing a log stringer bridge, substituting lumber from a high-strength species. The lumber must be at least 8 inches thick and 8 inches wide.

When installing a panel bridge:

- ▶ Follow directions for installing a log stringer bridge, using stress-laminated, glued-laminated, dowel-laminated, or nail-laminated panel sections centered in each wheel path. Place panels side by side with lumber covering any gaps between them.

### **Advantages**

Operators can find materials for timber bridges at the site or purchase them locally or through commercial outlets. Little site preparation is needed. Structural characteristics are known and engineering specifications may be available for lumber or panels. Operators can remove and reuse timber bridges several times. Local water regulators generally favor timber bridges.

### **Disadvantages**

Timber bridges may pose a safety hazard if operators don't get help from a licensed engineer or accurately assess the strength of logs and other construction materials. Logs, railroad ties, and demolition materials can have rot, knots, and other problems that affect strength. If operators don't use proper abutments, timber bridges may freeze into the ground during the winter. Surfaces may wear quickly during skidding operations.

### **Maintenance**

Inspect timber bridges during and between uses to check for signs of wear or weakness.

### **Related Fact Sheets in This Series**

*Temporary Stream Crossing Options* (FS-7001); *Fords* (FS-7002); *Culverts* (FS-7003); *Ice Bridges* (FS-7004); *Railroad Car, Steel, and Prestressed Concrete Bridges* (FS-7006); and *PVC or HDPE Pipe Bundle Crossings* (FS-7007).

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# Railroad Car, Steel, and Prestressed Concrete Bridges

## Forest Management Practices Fact Sheet Crossing Options Series #6

### Introduction

Operators often cross streams during harvesting or other forestry operations. This fact sheet describes several types of temporary bridges that can help protect streams from damage during crossing. They include: *used railroad cars* (flatcars and boxcars) and *truck flatbeds*; *portable hinged bridges*, which can be folded for easier transport; *modular steel bridges*, made of interlocking panels; and *prestressed concrete panels*.

### Where Used

Use these bridge types on streams with firm, stable banks. The maximum span distance should not exceed engineering specifications (if available). Where specifications are not available, the distance to be spanned should be at least 4 feet less than the length of the bridge.

### Application

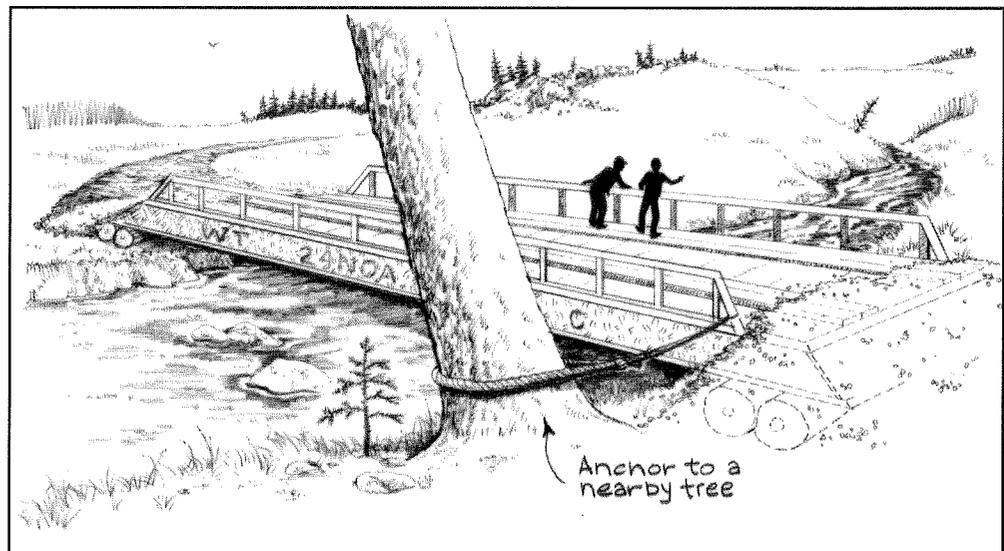
Check with the appropriate regulatory or natural resource agency in your state to see if permits are required.

Buy used railroad cars, truck flatbeds, and steel bridges through commercial sources. Railroad cars and truck flatbeds come in a limited range of lengths, generally 85 feet for railroad cars and 60 feet for truck flatbeds. Purchase new prestressed concrete panels from vendors or used panels from highway departments.

When installing these bridges:

- Place abutments (e.g., one or more logs or railroad ties) on each bank parallel to the stream flow.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.



Steel bridge

- ▶ Place the railroad car, truck flatbed, steel bridge, or concrete panel on top of the abutments. (You may need two railroad cars or flatbeds side by side for machinery that is wider than about 12 feet.) Nail or bolt the sections together for added stability and to catch debris that may drop off passing vehicles.
- ▶ Build approach ramps. Use wood mats, wood panels or pallets, corduroy, or other materials to protect the approaches if the soil is weak.
- ▶ Attach one end of a cable to the bridge and the other to a tree or other fixed object upstream. This will anchor the structure, especially when the stream flow is heavy.
- ▶ Add guardrails or curbs to the bridge if it is to be used for truck hauling.
- ▶ Revegetate all bank cuts or disturbed areas immediately to prevent soil from entering the stream.

### **Advantages**

Operators can use these options to span wider streams than many other types of bridges. They also wear well. Local regulators generally favor bridge crossings because they minimally impact water quality and fish habitat.

### **Disadvantages**

These options are heavy and may be difficult to transport to the site. Without proper abutments, they may freeze into the ground in winter. Used railroad cars, truck flatbeds, and steel bridges are expensive to purchase and install. Used railroad cars and truck flatbeds may need reinforcement before they can be used as bridges. You may need dozers or special equipment such as cranes to install used railroad cars, long or heavy steel bridges, or prestressed concrete panels.

### **Maintenance**

Periodically inspect bridges during and between uses to determine strength and stability.

### **Related Fact Sheets in This Series**

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# PVC or HDPE Pipe Bundle Crossings

## Forest Management Practices Fact Sheet Crossing Options Series #7

### Introduction

Water quality and stream habitat can be harmed during forestry operations. Operators should plan for and use stream crossing techniques that minimize damage.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

PVC (polyvinyl chloride) or HDPE (high-density polyethylene) pipes can be used to build temporary stream crossings. Pipes are cabled together to form mats and then layered on top of geotextile set into the streambed. (Geotextile is a fabric mat that lets water drain through it while supporting any material placed on top of it.) Operators can place wood mats, wood panels, or other materials over the pipes to add stability and traction. Water flows through the pipes while vehicles travel over them. HDPE pipes are recommended over PVC pipes because they tolerate cold better and do not need protection from sunlight.

### Where Used

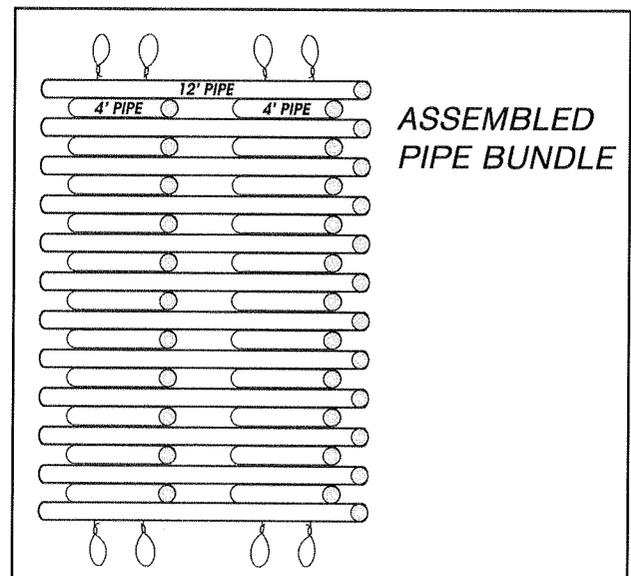
Operators use PVC or HDPE pipe bundle crossings on small streams with enclosing banks (a U-shaped profile) that are less than 10 feet wide and 4 feet deep. The channel should be straight with slow-moving water. Don't use pipe bundles on streams with lots of woody debris that might clog pipes. Use pipe bundles in flashy streams only when combined with appropriately sized culverts.

### Application

Don't install or use pipe bundles during fish spawning, incubation, or migration. Check with the appropriate regulatory agency in your state to see if permits are required.

When installing a pipe bundle crossing:

- ▶ Wash pipe bundles away from the stream before using to remove soil that could contaminate the water.
- ▶ Place geotextile on the stream bottom. Layer the bundles to the top of the stream bank. Tuck cable loop ends under the bundles so vehicles don't catch them and damage the crossing.
- ▶ Cover bundles with geotextile. Add surfacing materials such as wood mats, wood panels or pallets, or other materials for stability and traction.



- ▶ Use wood mats or pallets, corduroy, or other materials to protect approaches if the soil is weak.
- ▶ Securely anchor the pipe bundles to a nearby fixed object upstream.
- ▶ Revegetate all bank cuts immediately to keep soil from eroding into the stream. Check the crossing frequently to make sure that it doesn't become plugged.

#### To construct a 12-foot-wide pipe bundle:

Use 20-foot lengths of 4-inch-diameter Schedule 40 PVC or SDR11 HDPE. Saw pipes into 12-foot lengths; saw the remaining 8-foot sections in half. Drill four 1/4-inch holes completely through the 12-foot long pipes at locations 2 feet and 4 feet from either end. Drill two holes completely through each 4-foot section 1 foot from each end.

Alternate one 12-foot long section with one row made of two 4-foot wide sections placed 2 feet from each other.

String 3/16-inch galvanized steel cable through all sections. Make loops at the end of each cable, extending beyond the last pipe, and secured with 3/16-inch cable clamps. Each cabled section should be loose so pipes can conform to the stream channel.

### Advantages

Operators can purchase PVC construction materials from hardware or plumbing supply stores. Construction, transport, installation, and removal is easy. Operators can easily replace broken pipes.

### Disadvantages

Operators must cover pipes for traction. Sunlight can harm PVC pipes. HDPE pipes are only available through a national distributor. Pipes can become plugged.

### Maintenance

Check pipes periodically during use for clogging. Clean soil from pipes between uses at a location away from the stream. Inspect pipes for breakage between uses. Remove broken pieces by disconnecting the cable clamps and sliding off to replace broken sections.

### Related Fact Sheets in This Series

*Temporary Stream Crossing Options* (FS-7001); *Fords* (FS-7002); *Culverts* (FS-7003); *Ice Bridges* (FS-7004); *Timber Bridges* (FS-7005); and *Railroad Car, Steel, and Prestressed Concrete Bridges* (FS-7006).

### Cooperators

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# Temporary Wetland Crossing Options

## Forest Management Practices Fact Sheet Crossing Options Series #8

### Introduction

Operators crossing wetlands with vehicles and other logging equipment may harm water quality, alter the water flow, and damage habitat. To protect wetlands, the best strategy is to go around them. If this isn't possible, use temporary crossing options to minimize impacts.

### Where Used

Operators build wetland crossings on roads used to reach forest management areas. The surface should be flat (maximum grade 4 percent) and free of stumps and other high spots. Operators should size options to meet anticipated loads, soil strength, and installation equipment. Because skidding can cause movement and increased wear of a temporary wetland crossing option, limit the use of the options to hauling and forwarding. You can also use some of the options to help stabilize approaches to stream crossings.

### Application

Most options work best with a nonwoven geotextile under them. Geotextiles prevent material from mixing with the soil below it, yet allow water to flow through. They also help distribute a load over a broad area and make an option easier to remove. A nonwoven fabric is less slippery than a woven one, reducing movement of the option during use.

On very weak soils that have a low bearing strength (e.g., muck or peat), you may need to make options longer and wider than on other soils to spread the weight over a larger area.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.



Corduroy Crossing

## Options

*Wood mats* are made from logs or sawn hardwood. Cable together individual pieces to make a single-layer crossing.

*Wood panels* and *pallets* are stronger, larger versions of shipping pallets. They are reversible for easier repair.

*Expanded metal grating* is made from nongalvanized steel. It is light and inexpensive, and provides good traction. Build crossings by placing grating sections in the wheel path.

*PVC* or *HDPE pipe mats* are constructed by cabling together pipes to form mats of varying lengths. *PVC* or *HDPE plastic roads* are similar to pipe mats, except that the pipes are interconnected using PVC. Build transition mats/panels into the design to ease transition between firm soil and the mat.

*Bridge decks* consist of the decking of a timber bridge and are available commercially. They are best used to cross small wetlands.

*Tire mats* are constructed by interconnecting tire sidewalls. Modify lengths and widths to fit the soils and situation.

*Pole rail crossings* can be built on-site from straight hardwood poles cut from local trees. Lay them parallel to the direction of travel below each wheel. Use pole rails only with skidders that have wide, high-flotation, or dual tires.

*Corduroy crossings* are built from residues such as brush or slash; small, low-value logs; or mill slabs. Corduroy spreads a load over the length of the log or slab, increasing the load-bearing area.

## Advantages

Operators can build some of the crossing options (corduroy, pole rail) inexpensively from on-site materials. Build other options (wood mats, wood panels and pallets, and expanded metal grating) inexpensively from purchased materials. Once constructed, operators can rapidly install most options. Because most options are reusable, operators can spread costs over many uses.

## Disadvantages

Some of these options (bridge decks, tire mats) are expensive. Some are limited to certain wetland soils or conditions.

## Maintenance

Maintenance needs vary. Check options for strength and wear both during and between uses. Remove and replace worn or broken pieces.

## Related Fact Sheets in This Series

*Wood Mats* (FS-7009); *Wood Panels and Pallets* (FS-7010); *Expanded Metal Grating* (FS-7011); *PVC or HDPE Pipe Mats and Plastic Roads* (FS-7012); *Bridge Decks, Tire Mats, and Pole Rails* (FS-7013); *Corduroy Crossings* (FS-7014); *Low-Ground-Pressure Equipment* (FS-7015); and *Equipment With Central Tire Inflation* (FS-7016).

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# Wood Mats

## Forest Management Practices Fact Sheet Crossing Options Series #9

### Introduction

Loggers sometimes need to cross wetlands with vehicles and other heavy equipment. This can damage wetland soils, aquatic habitat, and hydrology. Temporary crossings can minimize these impacts.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

*Wood mats* provide surfaces that protect wetlands during hauling or forwarding operations. They are made from sawn hardwoods or round logs that are cabled together and placed on top of nonwoven geotextile.

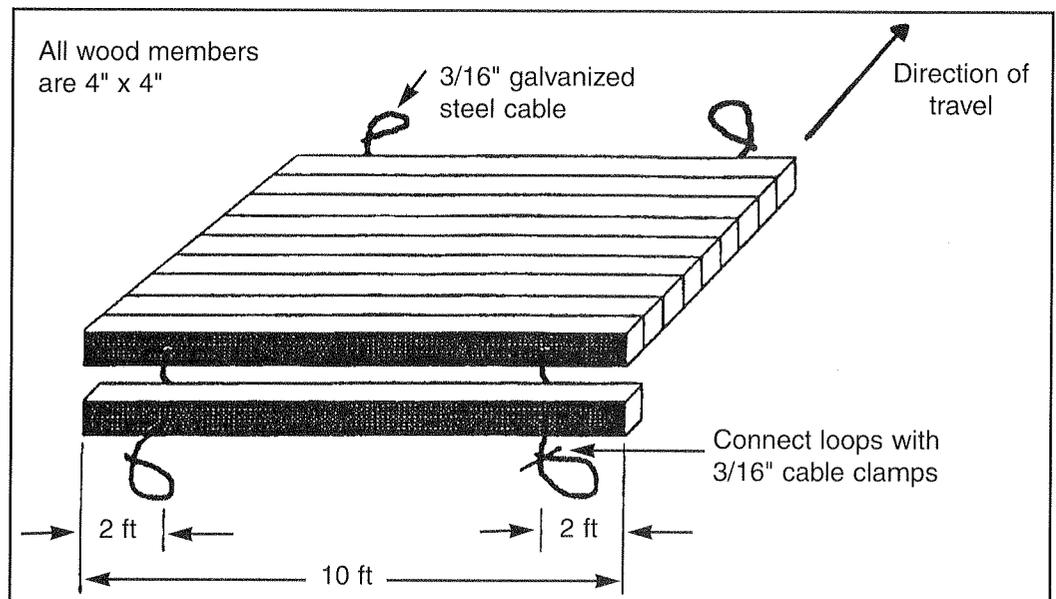
### Where Used

Use wood mats on wetland soils or existing road beds. The surface should be flat (maximum grade 4 percent) and free of high spots (e.g., stumps and large rocks). Because skidding will move and abrade the mat, this option is best limited to hauling and forwarding. Mats can help stabilize approaches to stream crossings.

### Application

Wood mats consist of cants, sawn dense hardwoods (usually oak), or round logs cabled together. When building and installing a wood mat:

- ▶ Use cants or logs at least 10 feet long, 4 inches by 4 inches. Use longer cants or logs for weak soils. Cants can be purchased at sawmills or lumber supply stores.
- ▶ Drill 1/4-inch holes through each cant or log about 1 to 2 feet from each end. String the cants or logs close together with a 3/16-inch galvanized steel cable.



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**Geotextile is a fabric mat that allows water to drain through it. It supports material placed on top of it and makes removal of that material easier.**

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- ▶ Make loops at the end of each cable for ease of transport. Secure loops with 3/16-inch cable clamps. Tuck loops under the mats during installation and use so that they don't get caught by vehicles.
- ▶ If needed for stability or to reduce movement, connect mats using quick links or other heavy-duty connectors.
- ▶ Install mats on top of nonwoven geotextile that covers the crossing area. On a haul road, smooth out high spots and fill ruts to protect the geotextile fabric and the mats. Do not disturb the root mat of any vegetation because it provides additional support.
- ▶ Use the size of wood mat needed to meet anticipated loads, soil strength, and installation equipment. Use larger mats on very weak soils with low bearing strength (e.g., muck or peat) to spread the weight over a larger area.
- ▶ If vehicles need more traction, use expanded metal grating on top of the mats.

### **Advantages**

Wood mats can be built on site or locally using readily available materials. They are easy to install, remove, and repair.

### **Disadvantages**

Wood mats can't be used in areas with rocks or other firm high spots. The surface may not have adequate traction under wet conditions unless an additional tractive surface is applied.

### **Maintenance**

Inspect wood mats during and between uses to make sure no sections are broken. Repair broken pieces by disconnecting the cable clamps and sliding off and replacing broken sections.

### **Related Fact Sheets in This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Panels and Pallets (FS-7010); Expanded Metal Grating (FS-7011); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Corduroy Crossings (FS-7014); Low-Ground-Pressure Equipment (FS-7015); and Equipment With Central Tire Inflation (FS-7016).*

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# Wood Panels and Pallets

## Forest Management Practices Fact Sheet Crossing Options Series #10

### Introduction

When operators use heavy machinery to carry out forest management activities, they may need to cross wetlands. This can damage the soils, aquatic habitat, and hydrology of a wetland. *Wood panels* and *pallets* can be assembled in the field or off-site and placed over a wetland to protect it. Operators can then move machinery over the wetland on top of these temporary surfaces.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

### Where Used

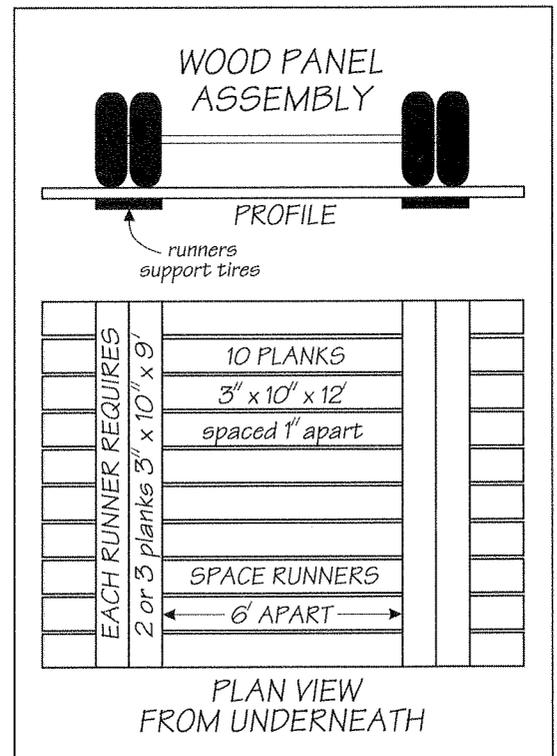
Wood panels and pallets work well on most wetland soils that are flat (less than 4 percent grade). The area should be free of large rocks and other high spots. Because skidding will move and abrade wood panels and pallets, it's best to use them in conjunction with hauling and forwarding.

### Application

Wood panels are built from dense hardwood (usually oak) lumber planking nailed together to form a two-layer crossing. Wood pallets are available commercially. They are three-layered and made from dense hardwood planks that are nailed together. In some wood pallets, top and bottom pieces are interconnected similar to a traditional pallet. In others, top and bottom pieces are separate and interlock during installation to prevent sideways movement. Install each option over a nonwoven geotextile.

When building a wood panel:

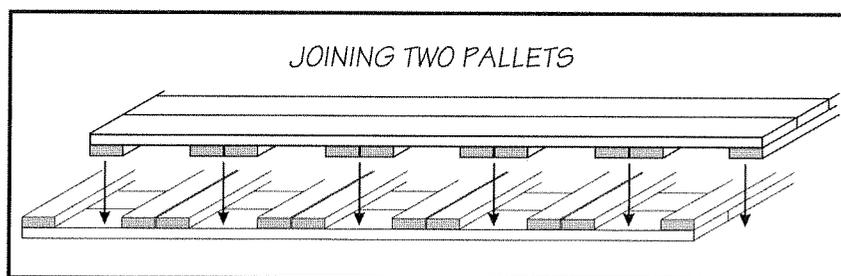
- ▶ Use 3-inch thick by 10-inch wide by 12-foot long lumber for planks. Align planks parallel to each other.
- ▶ Nail 2 or 3 boards, each measuring 3 inches x 10 inches by 9 feet, perpendicular to the planks (use ring-shank or spiral spikes). These are runners.
- ▶ Leave a 1-inch gap between the planks to allow water to run through. Use an air gun or countersunk bolts to reduce nail withdrawal during use.
- ▶ Add eye hooks and looped cables or other materials to the wood panel. This facilitates lifting and interconnection once they are installed.



When installing wood panels and pallets:

- ▶ Smooth out high spots and fill ruts. Leave roots and vegetation mats in place to add stability.
- ▶ Cover the entire crossing area with nonwoven geotextile.
- ▶ Minimize spacing between panels or pallets. Connect with quick links or other heavy-duty connectors for extra stability. (Some wood pallets are designed to interconnect during installation.)
- ▶ If additional traction is needed, use expanded metal grating or similar materials on top of the wood panels or pallets.
- ▶ Size wood panels and pallets to meet anticipated loads, soil strength, and installation equipment. You may need additional size on very weak soils with low bearing strength (e.g., muck or peat) to spread the weight over a larger area.

**Geotextile is a fabric mat that allows water to drain through it. It supports material placed on top of it and makes removal of that material easier.**



### Advantages

Operators can build wood panels on-site. They can buy wood pallets locally. Both options are relatively inexpensive and are easy to install, maintain, and remove.

### Disadvantages

Operators can't use either option in areas with rocks or other firm high spots. You may need a forklift to install and remove pallets. Under slippery conditions, you may need to use an additional tractive surface.

### Maintenance

Inspect wood panels and pallets during and between uses, replacing broken pieces and loosened or missing nails.

### Related Fact Sheets in This Series

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Expanded Metal Grating (FS-7011); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Corduroy Crossings (FS-7014); Low-Ground-Pressure Equipment (FS-7015); and Equipment With Central Tire Inflation (FS-7016).*

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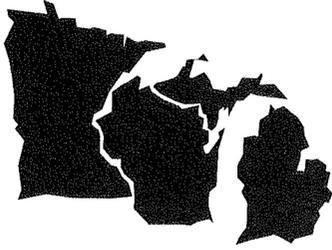
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# Expanded Metal Grating

## Forest Management Practices Fact Sheet Crossing Options Series #11

### Introduction

Wetlands need protection during logging and other forest management activities. Heavy equipment crossing wetlands can damage their habitat, soils, and hydrology. Many types of temporary crossings can be built to protect wetlands.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

Operators can build temporary crossings made from *expanded metal grating*. Expanded metal grating is a commercial product made from regular (not flattened) nongalvanized steel. The grating is placed on top of nonwoven geotextile.

### Where Used

Operators can use expanded metal grating crossings on shallow wetland or sandy soils. They also can be used on roads that don't have high spots (e.g., stumps or large rocks) where grades are less than 4 percent. Because skidding causes the grating to move, this option is best limited to hauling and forwarding.

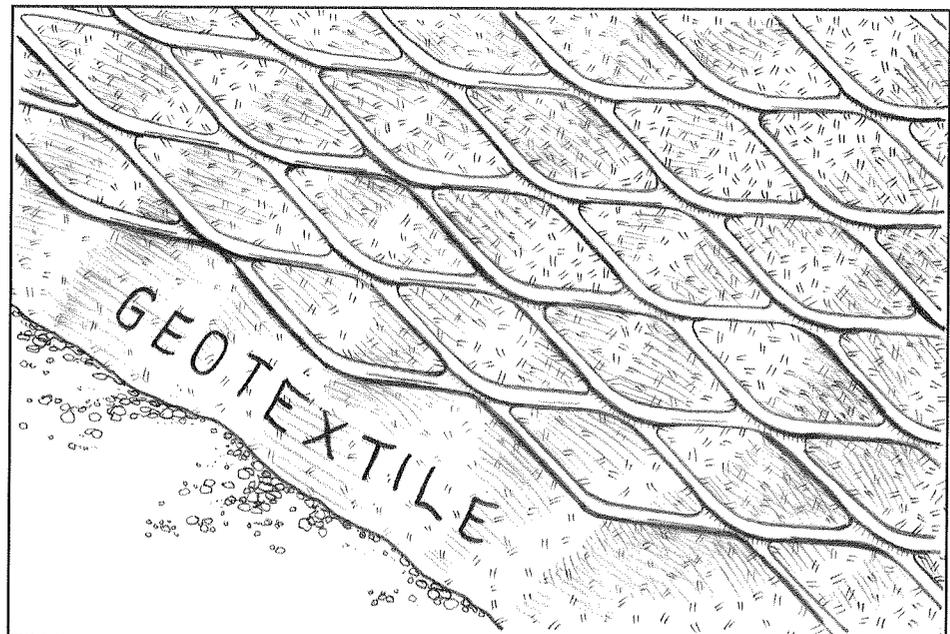
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**Geotextile is a fabric mat that allows water to drain through it. It supports material placed on top of it and makes removal of that material easier.**

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### Application

Expanded metal grating crossings are usually built in sections that are about 4 feet by 10 feet. Operators install crossings by hand-placing the grating sections in each wheel path.



Expanded metal grating on geotextile

When installing an expanded metal grating crossing:

- ▶ Size grating to meet expected loads, soil strength, and installation equipment. Use larger grating on very weak soils that have a low bearing strength (e.g., muck or peat). This spreads the weight over a larger area.
- ▶ Prepare the surface by smoothing out high spots and filling ruts. Do not disturb the root mat of any vegetation; it provides added support for the crossing. Cover the entire crossing area with nonwoven geotextile.
- ▶ Lay the grating in the wheel paths so that vehicles drive on the long part of the grating. Use quick links that are at least 3 inches by 3/8 inches or other heavy-duty links to join sections to the desired crossing length.

**Advantages**

Expanded metal grating is lightweight, durable, inexpensive, and provides some traction. Operators don't need special equipment to install the grating.

**Disadvantages**

Grating tends to bend to conform to any ruts that may develop. Equipment may be needed to remove grating if it becomes covered by soil.

**Maintenance**

Flip the grating occasionally to distribute wear. Remove and replace unusable bent sections.

**Related Fact Sheets in This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Wood Panels and Pallets (FS-7010); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Corduroy Crossings (FS-7014); Low-Ground-Pressure Equipment (FS-7015); and Equipment With Central Tire Inflation (FS-7016).*

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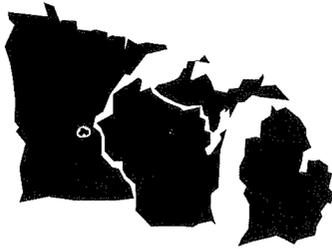
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# PVC or HDPE Pipe Mats and Plastic Roads

## Forest Management Practices Fact Sheet Crossing Options Series #12

### Introduction

Appropriate crossing options can protect wetlands during forest management activities. These options allow access while protecting soils, wetland hydrology, and aquatic habitat.

*PVC or HDPE pipe mat crossings* are built by cabling together PVC (polyvinyl chloride) or HDPE (high-density polyethylene) pipes to form mats. *PVC or HDPE pipe plastic road crossings* are built by linking together PVC or HDPE pipes using 1-inch PVC to form mats. The plastic road includes transition mats to ease the passage of tires up to and down from the crossing. Both options help protect wetland haul roads from rutting by distributing the load across the surface.

### Where Used

These crossings work well on most wetland soils. Haul roads should have slopes less than 4 percent without stumps or other high spots. The crossings work best with existing root or vegetation mats. Skidding will move the mats, so limit this option to hauling and forwarding.

### Application

When installing a pipe mat or plastic road:

- ▶ Smooth out high spots, fill ruts, and leave the root mat of any vegetation in place.
- ▶ Cover the entire crossing area with nonwoven geotextile. (Geotextile is a fabric mat that allows water drainage and provides support.) Place the mats on the geotextile. For a pipe mat crossing, build soil ramps up to and down from the crossing. Or, make ramps by interconnecting 2-, 3-, and 4-inch diameter pipes. The plastic road includes transition mats.
- ▶ Cover PVC with geotextile to prevent degradation by sunlight. HDPE doesn't need to be covered and will tolerate cold better than PVC. However, you may

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

#### To construct a 12-foot-wide pipe mat:

Use 20-foot lengths of 4-inch-diameter Schedule 40 PVC or SDR11 HDPE. Saw pipes into 12-foot lengths. Saw the remaining 8-foot sections in half. Drill four 1/4-inch holes completely through the 12-foot long pipes at locations 2 feet and 4 feet from either end. Drill two holes completely through each 4-foot section 1 foot from each end.

Alternate one 12-foot long section with one row made of two 4-foot wide sections placed 2 feet from each other.

String 3/16-inch galvanized steel cable through all sections. Make loops at the end of each cable, extending beyond the last pipe. Secure the loops with 3/16-inch cable clamps.

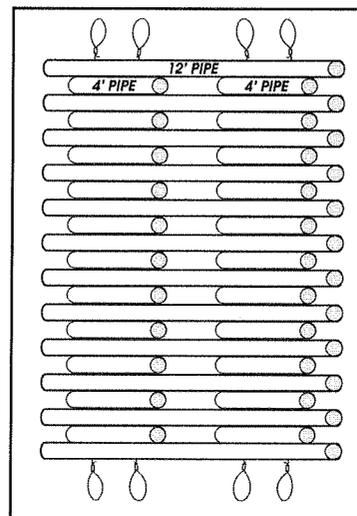
#### To construct a plastic road:

Detailed directions, including drawings, for constructing the plastic road are found in the following free publication:

Moll, J.E., and R. Hiramoto. 1996. *The Plastic Road*. USDA Forest Service, Technology and Development Program, Publication 9624 1206-SDTDC. 12p. (444 East Bonita Ave. San Dimas, CA 91173; 909-599-1267).

wish in either case to add another layer of geotextile. Cover that with materials such as expanded metal grating to add traction.

- Size the mat to meet anticipated loads, soil strength, and installation equipment. Use larger mats on very weak soils that have a low bearing strength (e.g., muck or peat).



**Assembled pipe mat**

**Advantages**

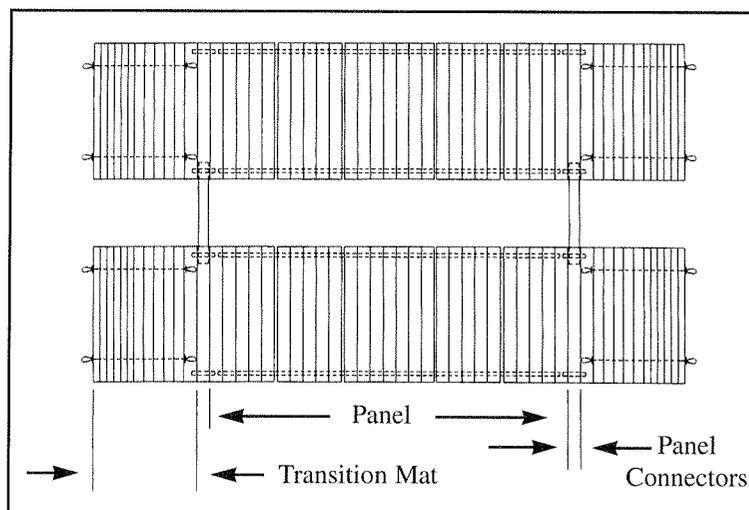
Pipe mat and plastic road sections are easy to transport, install, remove, and repair. Water can flow through the pipes instead of over the crossing. PVC materials can be bought locally.

**Disadvantages**

The surface of the mats can be slippery when wet, with little traction on grades. You may need to order HDPE pipes from a national distributor.

**Maintenance**

Inspect pipe mats and plastic road sections during and between uses for broken pieces. Repair by sliding off and replacing broken sections.



**Plastic road with transition mat**

Adapted from "The Plastic Road," USDA Forest Service, 1996.

**Related Fact Sheets in This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Wood Panels and Pallets (FS-7010); Expanded Metal Grating (FS-7011); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Corduroy Crossings (FS-7014); Low-Ground-Pressure Equipment (FS-7015); and Equipment With Central Tire Inflation (FS-7016).*

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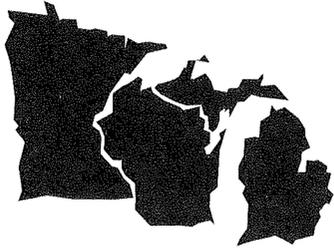
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# Bridge Decks, Tire Mats, and Pole Rails

## Forest Management Practices Fact Sheet Crossing Options Series #13

### Introduction

When vehicles cross wetlands during forest operations, they can damage soils, water quality, and hydrology. Temporary wetland crossings reduce this problem by providing a protective layer between the wetland and machinery.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

*Bridge decks, tire mats, and pole rails* can be used for temporary wetland crossings. Bridge decks are simply the decking of a timber bridge (e.g., prefabricated stress-laminated, glued-laminated, nail-laminated, or dowel-laminated panels). Tire mats may be purchased commercially or built by interconnecting tire sidewalls with corrosion-resistant fasteners. Some tire mat designs use double layers of sidewalls, while others use a layer of treads topped by sidewalls. Pole rails are made from straight hardwood trees laid in the direction of travel below each wheel.

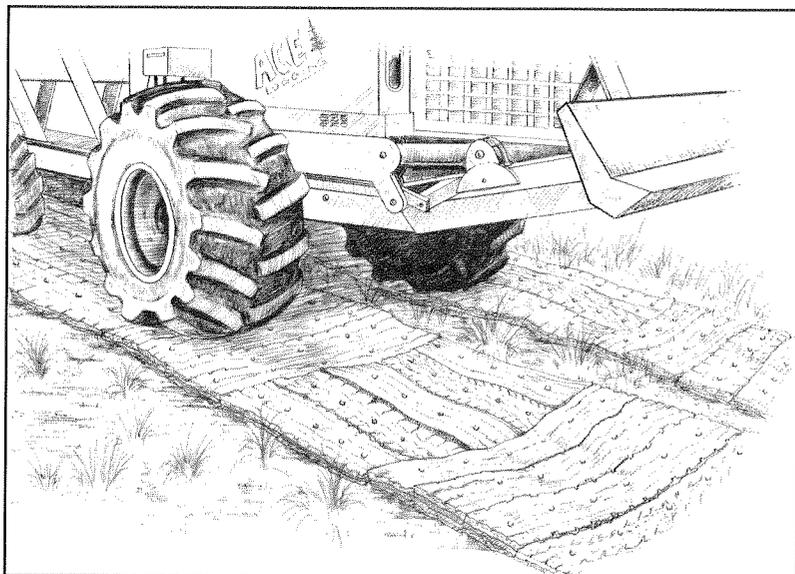
### Where Used

Bridge decks are suitable for most wetland soils. Tire mats are suitable for wet mineral soils. Either option can be used to cross wet areas on a haul road. Because skidding will move mats, these options are best limited to hauling and forwarding. Use pole rails on small, mineral-soil wetlands under skidders with wide, high-flotation, or dual tires. All options require relatively flat topography (less than 4 percent grade).

### Application

When installing a bridge deck crossing:

- Buy prefabricated stress-laminated, glued-laminated, nail-laminated, or dowel-laminated bridge panels from a commercial vendor.



Tire mat crossing

- ▶ Do not construct the crossing in an area with rocks or other firm high spots, since the bridge panels may break.
- ▶ Smooth out any high spots and fill ruts. Do not disturb the root mat of vegetation because it provides additional support for the crossing. Cover the crossing with nonwoven geotextile and lay the panels on top.

**Geotextile is a fabric mat that allows water to drain through it. It supports material placed on top of it and makes removal of that material easier.**

When installing a tire mat crossing:

- ▶ Purchase commercially available mats or construct mats from waste tires and corrosion-resistant fasteners. Size mats according to site needs.
- ▶ If you use a nonwoven geotextile below the tire mats, carefully place it with a loader.

When constructing a pole-rail crossing:

- ▶ Use hardwood poles harvested on-site that have a diameter of less than 10 inches. Use two or more if they are small in diameter.
- ▶ Place the poles parallel to each other below each wheel path on top of nonwoven geotextile with the larger end of the pole on the softer ground.
- ▶ Drive across the poles a few times without a load to secure them into the soil.
- ▶ Remove the poles when the crossing is no longer needed.

### **Advantages**

Bridge decks and pole rails are easy to install and remove. Bridge decks also can be used at stream crossings. Tire mats can last for many crossings, if properly cared for. Pole rails may be available on-site and are inexpensive.

### **Disadvantages**

Tire mats cannot support skidding, are heavy and hard to build, and may be difficult to install and remove. Tire mats must be installed and removed with care to avoid compressing the bolts that hold them together. Pole rails can't be used with conventional width tires.

### **Maintenance**

Tire mats need little maintenance.

### **Related Fact Sheets in This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Wood Panels and Pallets (FS-7010); Expanded Metal Grating (FS-7011); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Corduroy Crossings (FS-7014); Low-Ground-Pressure Equipment (FS-7015); and Equipment With Central Tire Inflation (FS-7016).*

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# Corduroy Crossings

## Forest Management Practices Fact Sheet Crossing Options Series #14

### Introduction

Harvesting and other forest management activities can harm wetlands. In areas with weak soils, vehicles can rut or disturb those soils, damage vegetation, and alter wetland hydrology. Properly planned and constructed crossings can protect wetlands.

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

One way to protect wetlands is with *corduroy crossings*. With this option, brush, slash, small logs and other woody materials (such as mill slabs) are laid across the wetland. This spreads the load weight over a larger surface.

### Where Used

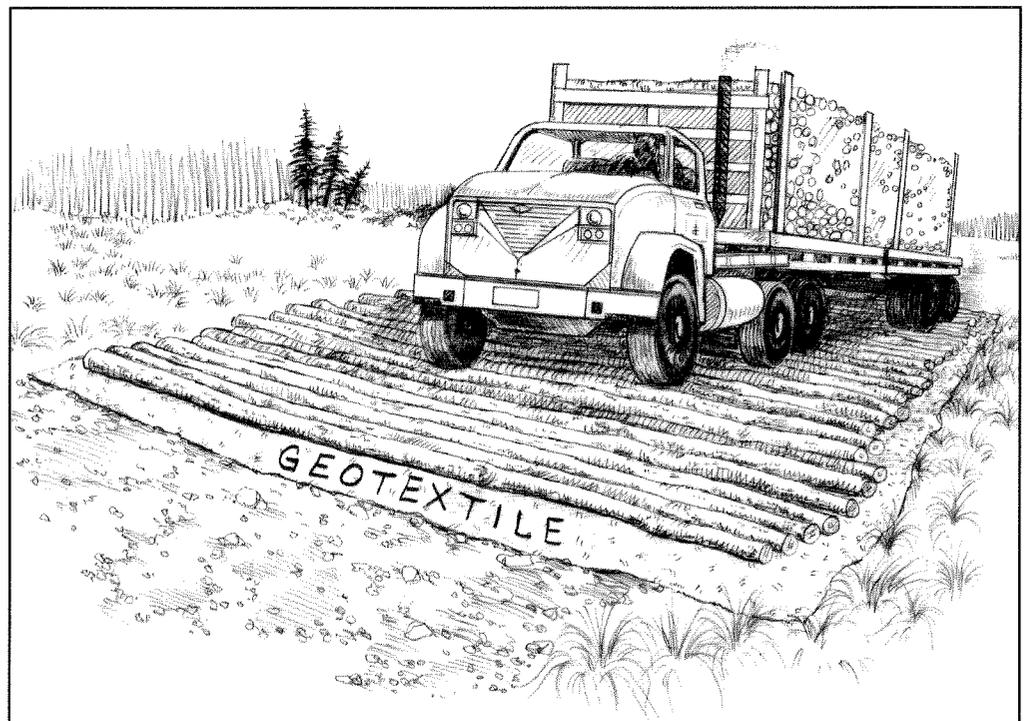
Corduroy crossings are useful on most wetland soils and wet areas on a haul road with level topography (slopes up to 4 percent). Avoid firm, high spots (e.g., stumps and large rocks) which may break the corduroy.

### Application

Many materials can be used to build corduroy crossings. Logs or mill slabs may support vehicles better than brush.

When constructing a corduroy crossing:

- ▶ Smooth out high spots and fill ruts within the crossing area on a haul road. Leave the root or vegetation mat in place to add stability to the crossing.



- ▶ It is generally recommended to cover the crossing area with nonwoven geotextile.
- ▶ Lay pieces of roundwood, mill slabwood, brush, or slash onto the geotextile, perpendicular to the direction of travel. Each piece of corduroy should be as long as any weak areas (or at least as long as the equipment using the crossing) to provide maximum flotation. Layer the material for additional strength if needed.
- ▶ Size individual pieces of corduroy to meet anticipated loads, soil strength, and installation equipment. Use longer corduroy on very weak soils that have a low bearing strength (e.g., muck or peat), to spread the weight over a larger area.

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**Geotextile is a fabric mat that allows water to drain through it. It supports material placed on top of it and makes removal of that material easier.**

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### **Advantages**

Corduroy crossings are usually low-cost. They can be made from on-site materials or from slabwood available from local sawmills. Construction is simple. You can easily adjust crossing width to accommodate various soil strengths. Generally, removal is not necessary once the crossing is no longer needed.

### **Disadvantages**

It takes time to install the corduroy. Corduroy generally is small and needs to be hand-placed. Brush and slash do not hold vehicles afloat as well as do logs and mill slabs.

### **Maintenance**

Corduroy requires little maintenance. You may need to add more corduroy if the existing material doesn't adequately support traffic.

### **Related Fact Sheets in This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Wood Panels and Pallets (FS-7010); Expanded Metal Grating (FS-7011); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Low-Ground-Pressure Equipment (FS-7015); and Equipment With Central Tire Inflation (FS-7016).*

### **Cooperators**

University of Minnesota Extension Service, Minnesota Department of Natural Resources, Minnesota Logger Education Program, Michigan Department of Natural Resources, Michigan State University Extension, USDA Forest Service, and Wisconsin Department of Natural Resources.



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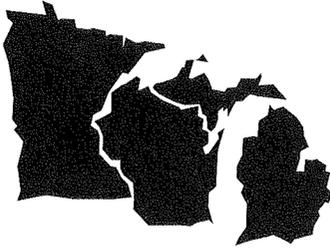
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# Low-Ground-Pressure Equipment

## Forest Management Practices Fact Sheet Crossing Options Series #15

### Introduction

Timber harvest traffic can compact and rut wet areas. Ruts can collect water, disrupt underground water movement, and harm plants.

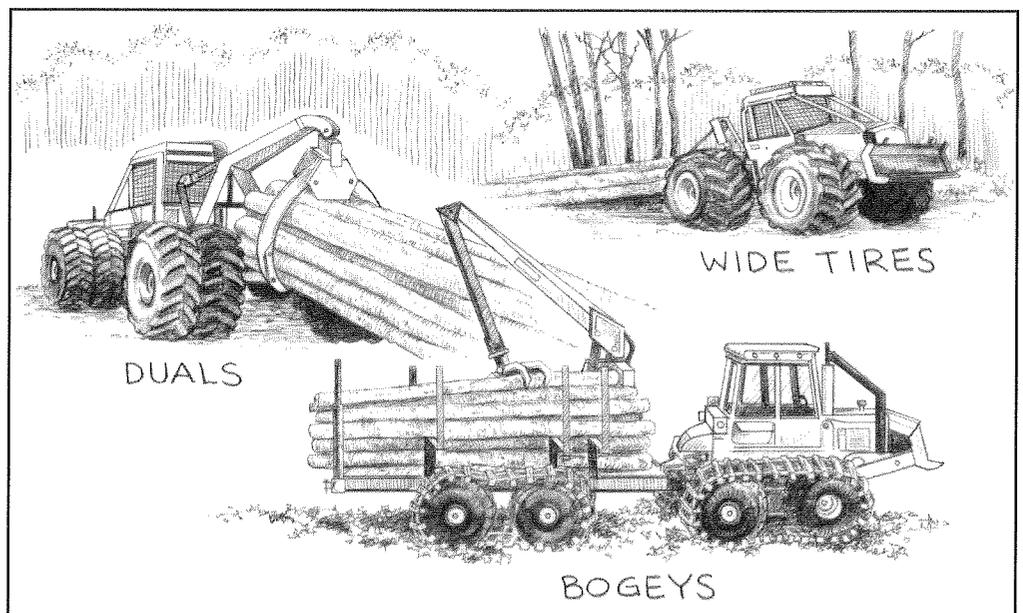
Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

*Wide tires, duals, tire tracks, bogeys, or tracked machinery* can help reduce damage to wet areas during forest management operations. They spread a machine's weight over a larger area. They also increase traction, reducing wheel slippage.

Wide or high-flotation tires are 34 to 72 inches wide. Dual tires are made up of four regular-width tires on an axle. They may be used on the front axle, back axle, or both axles. Tire tracks are wrapped around existing tires to make them wider. A bogey system connects rubber tires on adjacent drive axles with a track. Tracked machinery travels on steel or rubber tracks instead of tires. Lightweight equipment reduces ground pressure by reducing the weight of the machinery.

### Where Used

Low-ground-pressure equipment works well for felling, skidding, and forwarding on most wetland or upland soils.



## **Application**

All options are available from commercial vendors. When using low-ground-pressure equipment:

- ▶ Mount tire or track options according to manufacturers specifications. Extra-heavy-duty drive trains and axles may be required for some options.
- ▶ For additional support, retain existing vegetation (root or slash) mats. Place slash in front of machinery as it drives across sensitive areas.

## **Advantages**

These options reduce the need for building temporary crossings. They also can extend the harvest season on sensitive sites. The options can operate on wetter areas with less impact.

## **Disadvantages**

All of the options can be more expensive than conventional equipment. Operators may need special permits to move wide-tired vehicles on public roads. Vehicles may need special adaptations such as heavy-duty axles and heavy-duty transmissions. Skidding or forwarding larger loads because of the increased traction and flotation may negate any environmental benefits.

## **Maintenance**

Tracked machinery equipped with wide tires, duals, tire tracks, or bogeys may need more maintenance than conventional machinery.

## **Related Fact Sheets in This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Wood Panels and Pallets (FS-7010); Expanded Metal Grating (FS-7011); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Corduroy Crossings (FS-7014); and Equipment With Central Tire Inflation (FS-7016).*

## **Cooperators**

University of Minnesota Extension Service, Minnesota Department of Natural Resources, Minnesota Logger Education Program, Michigan Department of Natural Resources, Michigan State University Extension, USDA Forest Service, and Wisconsin Department of Natural Resources.



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# Equipment With Central Tire Inflation

## Forest Management Practices Fact Sheet Crossing Options Series #16

Best Management Practices (BMPs) can prevent or minimize the impact of forestry activities on rivers, lakes, streams, groundwater, wetlands, and visual quality.

### Introduction

Hauling vehicles can compact and rut soils in wetlands. Spreading the weight of vehicles over a larger surface area can reduce these impacts.

Equipment with *central tire inflation*

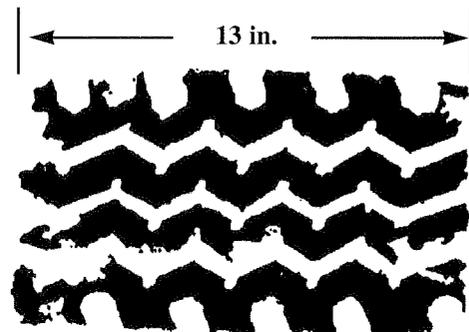
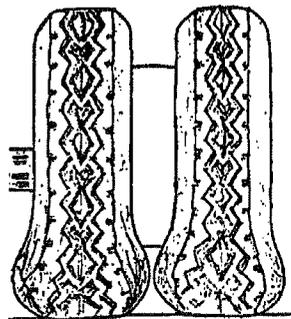
allows an operator to vary the inflation of a vehicle's tires while it is moving. By reducing inflation, the operator can increase the tire "footprint." This reduces the vehicle's pressure on the ground.

### Where Used

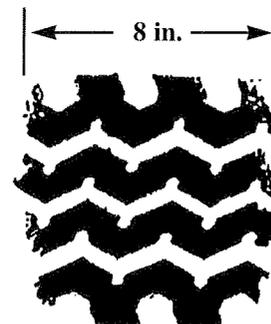
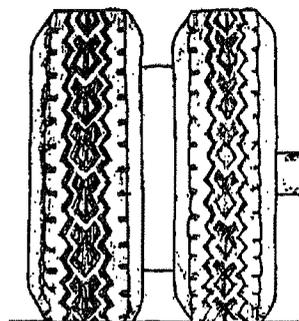
Equipment with central tire inflation is used to cross roads with weak soils.

### Application

A commercial vendor must install central tire inflation technology. Once installed, the operator can easily adjust the tire inflation pressure to meet the needs of the driving surface.



43 psi



100 psi

On the left, a comparison of tire profiles at 32 PSI (top) and 95 PSI (bottom). On the right, a comparison of the footprint area for a tire inflated to 43 PSI (top) and 100 PSI (bottom).

**Advantages**

Central tire inflation technology allows quick adjustment for changing conditions. Because central tire inflation improves traction, it can operate on low-quality haul roads and steep grades. It can reduce tire wear. Vehicles with central tire inflation have relatively low environmental impacts (such as rutting) on wetlands and roads.

**Disadvantages**

This technology is expensive and cannot be installed by the operator. However, the expense can be offset somewhat with lower costs. For example, road building and repair or vehicle repair costs may be lower. The operator must know how to use the technology, or there may be added wear on the tires.

**Maintenance**

No special maintenance is needed.

**Related Fact  
Sheets in  
This Series**

*Temporary Wetland Crossing Options (FS-7008); Wood Mats (FS-7009); Wood Panels and Pallets (FS-7010); Expanded Metal Grating (FS-7011); PVC or HDPE Pipe Mats and Plastic Roads (FS-7012); Bridge Decks, Tire Mats, and Pole Rails (FS-7013); Corduroy Crossings (FS-7014); and Low-Ground-Pressure Equipment (FS-7015).*

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