

FORESTRY FACTS



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COLLEGE OF
**AGRICULTURAL
& LIFE SCIENCES**
UNIVERSITY OF WISCONSIN-MADISON

Department of Forest Ecology and Management • School of Natural Resources

No. 6

December, 1995

Wisconsin's Forestry Best Management Practices for Water Quality Forest Roads

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Forest roads, along with skid trails and landings, are part of a forest transportation system that provides access for activities such as timber harvesting, improving wildlife habitat, fighting fires and recreation.

Forest roads that are poorly located, constructed or maintained are the largest source of nonpoint source pollution from forestry activities. Roads at stream crossings or on steep slopes and erodible soils hold the greatest potential for degrading water quality.

Types of Forest Roads

- Temporary: designed & constructed for short-term use during a specific project. Used only when ground is frozen or firm.**
- Permanent seasonal: part of your permanent road system, but used only when ground is frozen or firm. Built to lower standards than all-season roads.**
- Permanent all-season: usually have gravel surfaces & designed for year-round use.**

Planning Your Road

Decisions made when planning will affect a road's construction costs, long-term maintenance needs, service life and the amount of nonpoint pollution it causes. Loggers, landowners and land managers should work together to design the forest road system.

BMPs for Road Location & Design

- ▲ Minimize the number, width & length of roads to limit the area of the site disturbed.
- ▲ Use existing roads when they provide the best long-term access. Consider relocating existing roads if doing so improves access & reduces environmental impacts. Reconstruct existing roads to the extent necessary to provide adequate drainage & safety. Do not disturb stable road surfaces.
- ▲ Select road locations that allow for drainage away from the road.
- ▲ Minimize the number of stream crossings.
- ▲ Locate stream crossings first. Ideal spots are straight & narrow stream channels with low banks & firm rocky soils. Roads should approach streams at the least gradient possible.
- ▲ Where possible, locate roads on well-drained soils.
- ▲ Locate roads outside of riparian management zones except at stream crossings.
- ▲ Road grades should not exceed 10% (less than 5% is best). If grades greater than 10% are necessary, limit grade length, or break the grade using drainage structures. Graveling the road surface can also help.
- ▲ Locate roads to follow natural contours & to minimize cut & fills. Balance cut & fills to minimize fill or removing excess materials.

Stream Crossings

Operating equipment near streams may add sediment to the streams. Poorly located or constructed stream crossings may erode streambanks. As roads approach a stream crossing, proper road drainage is critical to avoid sedimentation in streams. Three common stream crossing structures are *culverts*, *fords* and *bridges*.

Remember, a permit is required to construct a ford or install a culvert or bridge across any navigable intermittent or perennial stream. For more information on permits see Forestry Fact No. 2, Do I Need a Permit?

General BMPs for stream crossings

- ▲ Use soil stabilization practices on exposed soil at stream crossings.
- ▲ Design, construct & maintain stream crossings to avoid disrupting the migration and movement of fish and other aquatic life.
- ▲ Use materials that are clean, non-erodible and non-toxic to aquatic life.
- ▲ Install crossing structures at right angles to the stream channel.
- ▲ Minimize channel changes & the amount of excavation or fill needed at the crossing.
- ▲ Limit construction activity in the water to periods of low or normal flow. Keep use of equipment in the stream to a minimum.
- ▲ Construct a bridge or place fill directly over a culvert higher than the road approach to keep runoff from draining onto the crossing structure and into the stream.
- ▲ Divert road drainage into undisturbed vegetation, preferably outside the RMZ, so that it does not directly enter the stream (Figure 1).
- ▲ Stabilize crossing approaches with aggregate to reduce sediment entering the stream.
- ▲ Anchor temporary structures on one end with cable, etc. so that they do not float away with high water. Install them so they are easily removed.

BMPs for Pipe Culverts for Stream Crossings

- ▲ Install culverts long enough so that road fill does not extend beyond the culvert's ends.
- ▲ Install permanent culverts that are large enough to pass flood flows and are at least 12 inches in diameter.
- ▲ Install culverts so there is no change in the stream bottom elevation.
- ▲ Firmly compact fill material around culverts, particularly around the bottom half. Cover the top of culverts with fill to a depth of one-third of the pipe diameter or at least 12 inches, whichever is greater (Figure 2).
- ▲ Use riprap around the inlet of culverts. For permanent culverts, use filter fabric under the riprap (Figure 3).
- ▲ Keep culverts clear & free of debris so that water can pass unimpeded at all times.

BMPs for Fords

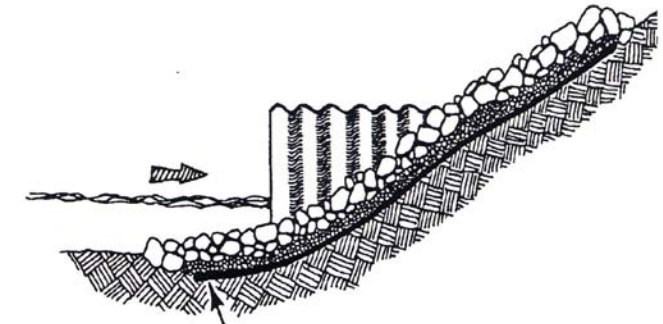
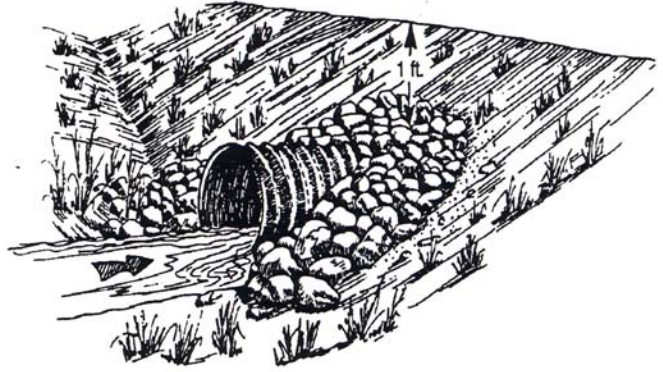
- ▲ Use fords to cross dry streambeds or where fords will cause minimal water quality impact.
- ▲ Locate fords where streambanks are low.
- ▲ Streambed should have a firm rock or gravel base; if not, install stabilizing material.

Road Construction & Drainage

The best method to control erosion on forest roads is to keep water from accumulating on the road surface. Fast-moving water can easily erode road surfaces, but erosion can be controlled when water drains off the road and into vegetation and ground litter.



Figure 1. Diversion ditch. Divert road drainage into undisturbed vegetation so that it does not directly enter the stream.



Geotextile filter fabric

Figure 3. Use riprap around the inlet of culverts. Also use geotextile filter fabric for permanent installations.

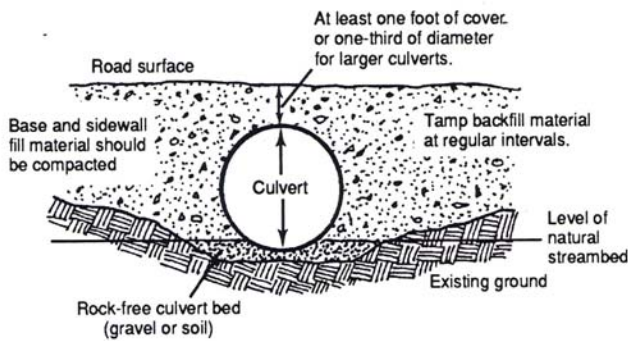


Figure 2. Installation of culverts.

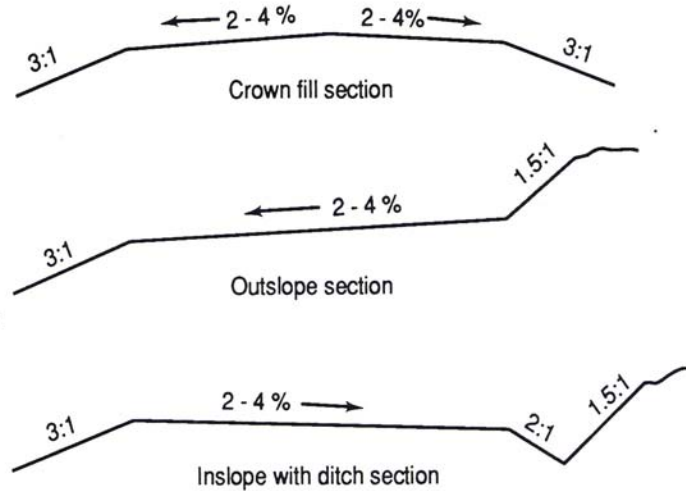


Figure 4. Typical road designs for drainage and stability.

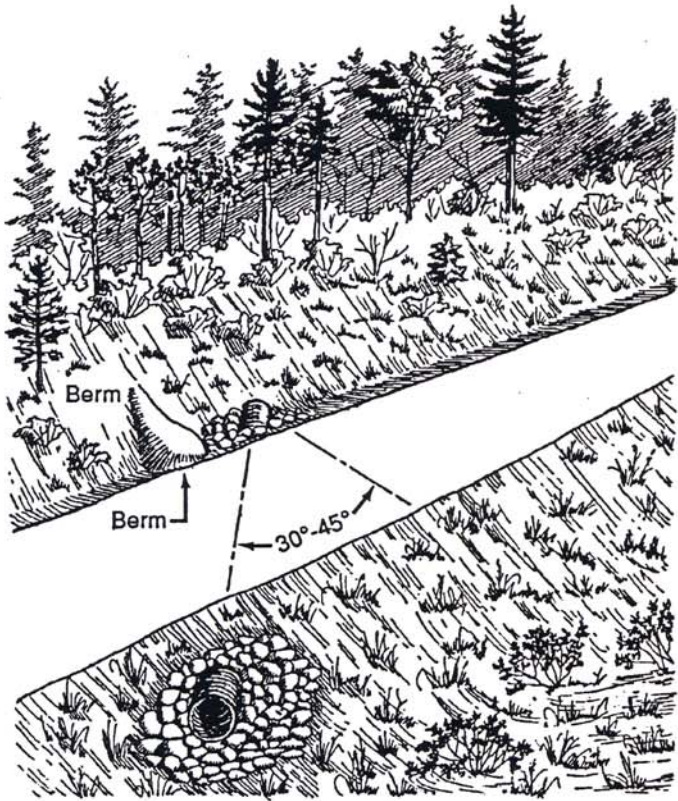


Figure 5. Cross-drain culvert.

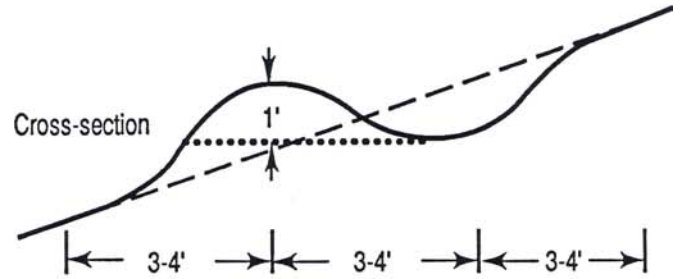
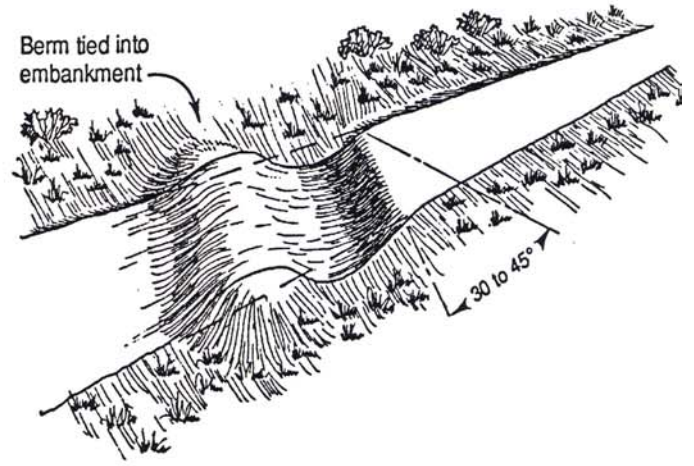


Figure 7. Water bar.

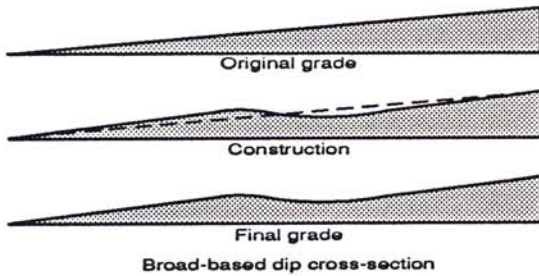
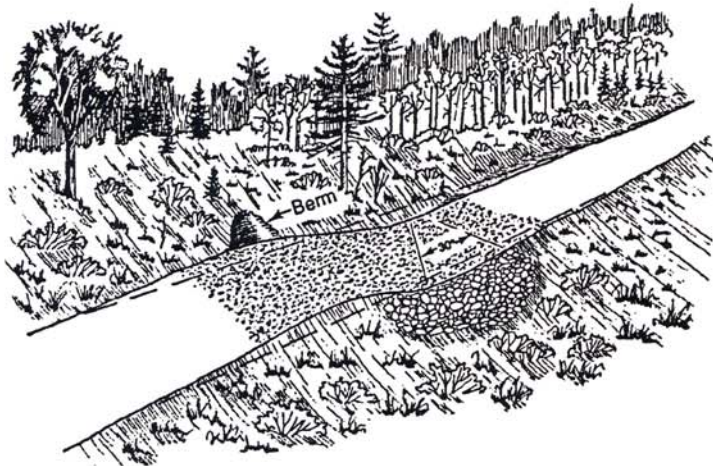


Figure 6. Broad-based dip.

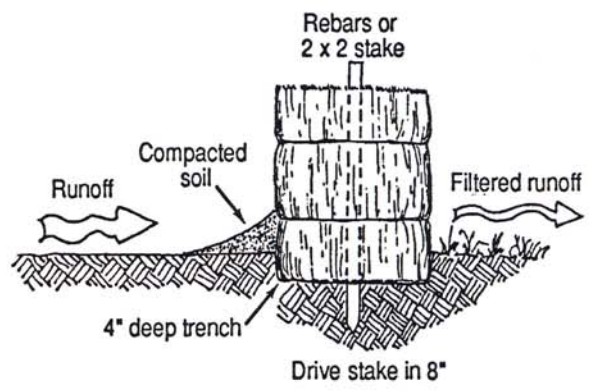
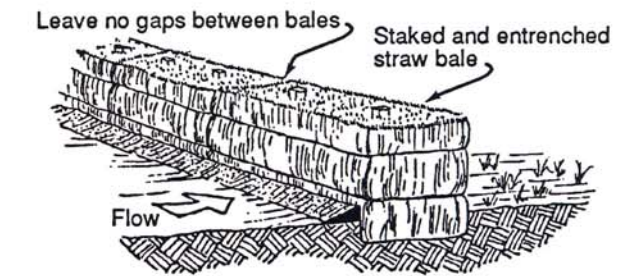


Figure 8. Straw bale fencing to slow runoff and trap sediment for sheet flow or channelized flow.

General BMPs for Road Construction

- ▲ Construct roads to remove water from road surfaces to keep it dry & structurally sound. Figure 4 shows 3 common road designs.
- ▲ Construct stable cut-and-fill slopes that will revegetate easily (naturally or artificially).
- ▲ Do not bury debris in the road base.
- ▲ Compact the road base material or allow it to settle before using the road.
- ▲ Surface road with gravel if steep grades or other factors make for high erosion potential.
- ▲ Locate gravel pits outside RMZs & use correct practices to minimize erosion from pits.

Road drainage structures include a variety of cross-drains and water-diversions. Cross drains allow water from roadside ditches to move from one side of the road to the other. Cross drains include pipe culverts, open-top culverts, broad-based dips and water bars.

Open-top culverts are used mainly on seasonal or temporary roads. **Broad-based dips** can provide drainage for active roads with a 15% gradient or less. Broad-based dips can be used instead of culverts, usually at lower cost and with lower maintenance. A **water bar** is a shallow trench with a mound that can intercept and redirect runoff water on closed roads and skid trails.

Diversion ditches, or berms, divert water away from roads and side ditches and channel it into vegetation. They are often used before stream crossings to divert water into vegetation and not directly into a stream, lake or wetland.

BMPs for Drainage Structures

- ▲ Where needed, install drainage structures to remove water from road surface & ditches. Space structures at proper intervals based on the road grade ... **see Table 1.**
- ▲ Where needed, provide erosion protection for outflows from road drainage structures to minimize erosion. Riprap, mulch and/or seeding may be necessary.

Table 1. Recommended Distances Between Drainage Structures

Road Grade %	Distance between water-bars (ft)	Distance between dips and culverts (ft)
1	400	500
2	250	300
5	130	180
10	80	150
15	50	130
25+	40	110

BMPs for Pipe Culverts for Cross Drains

- ▲ Install pipe culverts to provide cross drainage on road grades at regular intervals just above steep grades, below bank seepages & where water will run onto landings or forest roads.
- ▲ Install pipe culverts long enough so that road fill does not extend beyond culvert's end.
- ▲ Install pipe culverts at grades at least 2% more than the ditch grade and angled 30 to 45 degrees to improve inlet efficiency (Figure 5).
- ▲ Culvert size should be appropriate to size of road & the area drained by the ditch. Permanent culverts should be least 12 inches in diameter.
- ▲ Install pipe culverts on a surface of compacted granular material. Firmly compact fill material around culverts, particularly around the bottom half. Cover the top of culverts with fill to a depth of 1/3 of the pipe diameter or at least 12 inches, whichever is greater (Figure 2).
- ▲ Use riprap around the culvert's inlet to keep water from eroding & undercutting culvert.

BMPs for Open-Top Culverts

- ▲ Install open-top culverts to provide cross drainage just above steep grades, below bank seepages, where water will run onto landings or roads, and on road grades at regular intervals.
- ▲ Clean open-top culverts frequently since they easily fill in with debris.

BMPs for Broad-based Dips, Water Bars and Diversion Structures

- ▲ Construct broad-based dips deep enough to provide adequate drainage and wide enough to allow trucks and equipment to pass safely.
- ▲ Place a surface of crushed stone or gravel on the dip and mound for soils and conditions where rutting may occur.
- ▲ Place water bars at a 30 to 45 degree angle with a cross drainage grade of 2%.
- ▲ Construct diversion ditches so they intersect the roadside ditch at the same depth and are outsloped 1% to 3%.

Stabilize Your Soil Against Soil Erosion

Soil stabilization practices are used where soil is exposed and natural revegetation is inadequate to prevent erosion and subsequent sedimentation into streams, lakes and wetlands. This occurs during road construction and when roads are being used or are inactive. Practices include mulching, seeding, and installing sediment control structures.

BMPs for Stabilizing Soil

- ▲ Use mulch and/or seed where necessary to minimize soil erosion into streams, lakes and wetlands.
- ▲ Install sediment control structures where necessary to slow the flow of runoff & to trap sediment until vegetation is established at sediment source. Structures include straw bale fencing, silt fencing & sediment traps.
- ▲ Maintain, clean, or replace sediment-control structures until areas of exposed soil are stabilized

Maintain Your Road

Roads must be well maintained or water quality protection structures may quickly degrade. If roads are inactive for long periods, closing the system will help protect the road surface and water quality protection structures. Consider erecting gates or other barriers and posting signs to "close" your temporary roads.

BMPs for Maintaining Roads

Active Roads:

- ▲ Inspect your roads regularly, especially after heavy rains, to note problems & plan repairs.
- ▲ Clear debris from culverts & other drainage structures to prevent clogging & washouts.
- ▲ Place debris where it will not wash back into the water.
- ▲ Keep traffic to a minimum during wet periods & spring breakup - this reduces maintenance.
- ▲ Shape road surfaces periodically to maintain proper drainage. Fill ruts & holes with gravel.
- ▲ Remove berms along the edge of the road if they will trap water on the road.
- ▲ If dust control agents are used, apply them properly to keep them out of waterways.

Inactive Roads:

- ▲ Remove all temporary drainage and stream crossing structures.
- ▲ Shape road surfaces to maintain proper surface drainage, if necessary.
- ▲ Install water bars where necessary.
- ▲ Inspect & maintain road surfaces, drainage and stream crossing structures to minimize erosion.

Forestry Facts on BMPs are for information only. For details on specific BMPs and their implementation, see the BMP field manual, *Wisconsin's Forestry Best Management Practices for Water Quality*, DNR Pub. FR-093 95. For a copy, ask your DNR forester or call (608) 267-7494.