FORWARD

Dear Reader:

As users of our natural resources, we have a responsibility to be good stewards of the land. Iowa's Forestry Best Management Practices (BMPs) are designed to help landowners, loggers and land managers be good stewards by protecting water quality during woodland management activities.

This manual recommends guidelines for timber management activities as they relate to water quality protection. These BMPs may be modified for specific site conditions. Foresters and other natural resources professionals are available to help.

Future flexibility in managing our forest resources depends on landowners, loggers and land managers recognizing the importance of protecting water quality. This can be accomplished by the voluntary use of BMPs. The Iowa Department of Natural Resources is committed to following these BMPs in managing woodlands on public lands.

I encourage your participation and welcome your comments.

William A. Farris
Forestry Division Administrator
Iowa Department of Natural Resources

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Chapter 1 . Introduction

Iowa's Forest Resource

Over two million acres, or six percent, of Iowa are covered by woodlands. These woodlands are valuable natural resources which help conserve our soil and energy, clean our air and water, provide abundant wildlife habitat, create employment for thousands and help to make our communities and countryside more pleasant. Managing Iowa's woodlands can produce significant benefits for both present and future generations. However, careless activities in our woodlands can damage water resources, soils, wildlife habitat, aesthetic values and even the ability to produce future benefits.

The Need For Best Management Practices

The biggest threat to Iowa's water quality is **nonpoint source pollution (NPS pollution)**. NPS pollution occurs when runoff from rain and melting snow picks up and carries pollutants into streams, lakes and ground water. Soil, including the organic debris and nutrients in it, becomes a nonpoint source pollutant when it is exposed and unprotected.

Sediment accumulates in lakes, streams and wetlands, speeding the aging of lakes and burying habitat, fish spawning grounds and aquatic plants. Changes in water chemistry and temperature from the introduction of sediment and organic matter, along with the decay of aquatic plants, rapidly degrade water quality.

The most practical and cost-effective method to assure that woodland management operations do not adversely affect water quality in Iowa is through the use of the voluntary "Best Management Practices" (BMPs) described in this manual. BMP's, as defined by the Clean Water Act of 1987 (PL100-1, Sec. 319), are methods, measures, or practices used to protect, maintain and preserve water quality.

The intent of this manual is to educate woodland owners, managers, loggers and other operators on how to avoid negative impacts that may otherwise be associated with forest management practices. These BMPs are voluntary in the sense that they are not legally mandated. The Iowa Department of Natural Resources (IDNR) encourages private landowners to use these BMPs. Applying BMPs will help to ensure quality water during timber harvesting, thinning, tree planting and other woodland management activities.

Chapter 2 . Advance Planning

Careful planning for woodland management activities, such as road construction and timber harvesting, can minimize non-point source (NPS) pollution. Advance planning will identify possible water quality problems. An effective plan will take into consideration all aspects of the woodland management practice and plan for implementation of BMPs which will minimize the adverse effects of the activity.

The objective of advance planning is for the landowner, forester, manager, logger and other operators to determine, based on conditions found on the site, which BMPs are necessary in order to protect water quality. A written plan is both desirable and a good business practice.

Both state and federal laws may apply to some woodland activities in Iowa. This is especially true of road and bridge construction near watercourses. Laws are not covered by this publication. Landowners should contact local authorities about laws which may apply prior to beginning any work. (*Appendix A: Resource Directory*)

Generally, steps that need to be taken during the planning stage include:

- Locate property boundaries.
- List or map:
  - soils,
  - existing vegetation,
  - perennial and intermittent streams,
  - drainage patterns,
  - slope,
  - topography,
  - wetland hydrology and/or other wetland indicators,
  - identification of sensitive areas and resources (such as unusual plants and animals),
  - archaeological sites and grave yards and
  - adjoining land uses.

- If you know of an endangered or threatened species existing on your area of operation, plan operations to ensure that no interference or disruption will affect the species.
- Identify Streamside Management Areas.
- Identify potential log landings and sawmill locations.
- Identify probable main haul roads and skid trail locations.
- Identify stream or drainage crossing locations.
- List necessary permits before beginning management activities.
- Develop a forest management plan based on the synthesis of the above data.
- Schedule woodland management operations to minimize soil compaction and site degradation.
    - Schedule a harvest during the winter when the ground is frozen.
    - Plan to stabilize bare soil as soon as possible after exposing it to prevent erosion into streams, lakes, wetlands, or riparian areas.
    - Identify BMPs needed to prevent soil and site degradation. (This manual provides various recommended practices that may be utilized.)
- Maintain a spill containment and cleanup kit appropriate for the materials on the operation.

Additional planning guidelines for specific activities are listed in other sections of this manual.

Chapter 3 . Streamside Management Areas (*Riparian Areas)*

Streamside Management Areas

Streamside management areas (SMAs), also commonly referred to as **riparian areas**, are land and vegetation areas next to lakes and streams where management practices are modified to protect water quality, fish and other aquatic resources. These areas are complex ecosystems that provide food, habitat and movement corridors for both aquatic (water) and terrestrial (land) communities. SMAs help minimize nonpoint source pollution impacts to surface waters.

Streamside management areas help to:

- Filter sediments and nutrients from runoff. This improves water quality for aquatic life and for human use (recreation and drinking).

- Allow water to soak into the ground, reducing flash floods and allowing for groundwater recharge.
- Stabilize streambanks and lakeshores, minimizing

bank erosion.

- Shade streams, allowing for cooler water temperatures which are better for aquatic species.
- Provide food and habitat for aquatic organisms, resulting in a healthier stream.

BMPs For SMAs

- **Eliminate grazing of domestic livestock within the SMA.**
- **Locate roads outside the SMA** unless necessary for stream crossings. For stream crossings, follow recommendations in the *Stream Crossing section* of *Appendix C: Woodland Roads*.
- **Locate landings outside the SMA**.
- **Minimize harvesting in and around the SMA**.
- **Limit wheeled equipment within the SMA**.
- **Do not move slash into or pile slash within the SMA**. Keep slash out of lakes and stream channels and away from areas where it may be swept into the water.
- **Minimize soil exposure and compaction to prevent erosion and protect ground vegetation and the duff layer.**

Stream Width	SMA Width (minimum)
Less than 20 feet	**50 feet per side**
20 feet to 40 feet	**75 feet per side**
More than 40 feet	**150 feet per side**

Note: *On steep slopes or on areas of highly erodible soils, you may wish to widen the SMA.*

SMAs in Agricultural and Urban Areas

Streamside management areas are as valuable in agriculture and urban areas as they are in wooded areas. Runoff from cultivated fields, as well as city streets and lawns, can contain sediment, pesticides and fertilizer. Plants in SMAs can filter out these contaminants, reducing the amount of pollutants entering waterbodies.

Landowners in all agricultural and urban areas should maintain or restore streamside management areas. Do not allow livestock to graze in forested SMAs.

Chapter 4 . Woodland Roads

Background

Roads, skid trails and landings are all part of a woodland transportation system (skid-trail and landing BMPs are covered in *Chapter Chapter 5 . . Timber Harvesting*). Properly constructed roads can provide woodland access for such activities as managing timber, improving fish and wildlife habitat, fighting fires and recreation.

Woodland roads that are poorly located, constructed or maintained are the largest source of nonpoint source pollution from woodland management activities. Roads over steep slopes, erodible soils or stream crossings hold the greatest potential for degrading water quality.

Planning, Location and Design

Decisions at the planning stage will affect a road's construction cost, long-term maintenance needs, service life and the amount of nonpoint source pollution it causes. Landowners, managers and operators should plan, locate and design the road system together.

- **Plan an overall road system that minimizes the number, width and length of roads** to limit the disturbance of the site. Remember to:
  - use temporary roads where practical,
  - consider future uses of the road system,
  - coordinate development with adjoining landowners when possible.

- **Use existing roads when they provide the best long-term access.**
  - Do not disturb stable road surfaces.
  - Reconstruct existing roads to the extent necessary to provide adequate drainage and safety.

- Consider relocating existing roads if doing so improves access and reduces environmental impacts.

- **Locate roads outside streamside management areas** except at stream crossings.

- **Identify optimum stream-crossing locations before locating the rest of the road**. Optimum locations include straight and narrow stream channels with low banks and firm rocky soil. Roads should approach streams at the least gradient possible.

- **Minimize the number of stream crossings**.

- **Locate roads on well-drained soils,** where possible.

- **Locate roads to follow natural contours and to minimize cut and fills.** Balance cut and fills to minimize the need for fill or removing excess materials.

- **Select road locations that allow for drainage away from the road**.

- **Road grades should not exceed 5%**. If road grades greater than 5% are necessary, limit grade length to minimize erosion, or break the grade using drainage structures. See the *Drainage Structures* section on pages *46*. Graveling the road surface on steep grades can also help maintain stability.

For more detailed information,
see *Appendix C: Woodland Roads:*

- *Stream Crossing Design and Construction (page 38),*
- *Road Construction and Drainage - BMPs(page 44),*
- *Soil Stabilization (page 51)*
- *Road Maintenance (page 55)*
- *Federal Requirements for Woodland Roads in Wetlands (page 56)*

Chapter 5 . Timber Harvesting

Harvesting includes felling trees and transporting logs on skid trails to a **landing** where products are sorted and loaded onto trucks for transport to a mill. **Skid trails** are temporary travel-ways for logging equipment to transport felled trees or logs to a landing. They are not intended for over-the-road vehicles. Skid trails that require excavation need careful design and should follow BMPs in *Chapter Chapter 4 . . Woodland Roads* and *Appendix C: Woodland Roads*. Landings may be permanent or temporary features. If permanent, they may be used as parking areas or wildlife openings.

Planning

- **Follow all planning BMPs in *Chapter Chapter 2 . . Advance Planning*.**

- **For BMPs concerning skid trails and landings in wetlands**, *Chapter Chapter 9 . . Wetlands.*
- **Limit the length and number of skid trails and number of landings and stream crossings** to the minimum necessary to conduct the harvest operation and to meet the landowner's objectives.

Harvesting

- **When harvesting near streams or lakes, follow BMPs in *Chapter Chapter 3 . . Streamside Management Areas.***
- Whenever possible, **winch logs from steep slopes if conventional skidding could cause erosion that affects water quality**.
- **Avoid operating equipment where excessive soil compaction and rutting may cause erosion that affects water quality.** The use of low ground pressure equipment may allow operations to continue.
- **Fill in ruts, apply seed and mulch and install sediment-control structures and drainage structures on skid trails and landings where needed to prevent erosion and sedimentation**

into surface waters. See the *Drainage Structures* section and the *Soil Stabilization* section of *Appendix C: Woodland Roads*.

- **Inspect soil-stabilization practices periodically during and immediately after harvest operations to insure they are successful and remain functional**. Follow BMPs in the *Road Maintenance* section of *Appendix C: Woodland Roads*.
- **Do not pile slash into drainage areas** where runoff may wash slash into streams, lakes or wetlands.

Landings

- **Locate landings outside streamside management areas.**
- **Locate landings on frozen ground, firm well-drained soils with a slight slope**, or on ground shaped to promote efficient drainage. Landings may need a crown shape to allow for drainage.
- **Use existing landings if possible**. Close existing landings in streamside management areas unless construction of new landings will cause greater harm to water quality than using existing landings.
- **Locate residue piles (sawdust, field chipping residue, etc.) away from drainages** where runoff may wash residue into streams, lakes or wetlands.

Skid trails

- **Locate skid trails outside SMAs.**
- **Locate skid trails on frozen ground or firm well-drained soils.**
- **Keep skid trail grades less than 15%,** where possible**.** Where steep grades are unavoidable, break the grade and use soil-stabilization practices (as described in *Appendix C: Woodland Roads*) where needed to minimize runoff and erosion.
- **Use existing trails if they provide the best long-term access.** Consider relocating existing trails if both access and environmental impact can be improved.

Stream Crossing for Skidding

- **AVOID skidding across running streams**. When that is not possible, use permanent crossings as described in the *BMPs for Stream Crossings (pg. 38)*, or use temporary crossings such as pole fords and frozen fords.
- **Pole fords** may be used in small streams by placing poles (or small logs) side by side on the streambed (*Figure* Chapter **5 . -1***)*. Pole fords must be removed immediately after use or before the upstream end becomes clogged with debris and impedes streamflow.

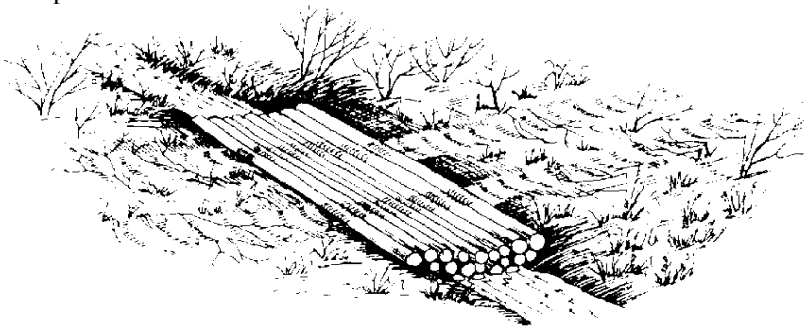


Figure Chapter 5 . -1. **Pole ford for small stream crossings. Pole fords must be removed immediately after use and before the upstream end becomes clogged with debris and impedes streamflow. (Adapted from Vermont Department of Forests, Parks and Recreation, 1987)**

- **Frozen fords** are used in small streams when ice is thick enough, or the streambed is frozen enough, to protect the streambed.

Reminder: Stream crossing permits are required before installing a crossing on any intermittent or perennial navigable stream. See *Rivers, Streams and Lakes, page 28.*

Chapter 6 . Mechanical Site Preparation and Tree Planting

Site preparation prepares the land for planting, direct seeding or natural regeneration. Using machinery to prepare sites and plant trees often exposes soil, so you need to proceed carefully to avoid impacts on water quality.

Common site preparation techniques include residue removal, herbicide applications, scarification, disking and roto-tilling. Select a technique based on specific site characteristics including soil, topography, vegetation, access and distance to surface waters.

- **Operate mechanical site-preparation and tree-planting equipment on the contour** to minimize erosion into waterbodies.
- **Suspend operations during wet periods** if equipment begins to cause excessive soil disturbance that will increase erosion into waterbodies.
- **Deposit site preparation residues in stable locations outside streamside management areas.**
- **Use patch scarification, selective herbicides applications or low-intensity prescribed burns on sites that have steep slopes, erodible soils or saturated soils and on sites that drain to surface water.**

Chapter 7 . Fuels, Lubricants, Wastes and Spills

Fuels, Lubricants and Wastes

Logging, road building and other woodland activities require motorized equipment. Antifreeze, fuels and lubricants can pollute lakes, streams, wetlands and groundwater. Planning for woodland operations should include practices to handle solid and liquid wastes generated in the field.

The following BMPs will help prevent nonpoint source pollution from fuel, lubricants and waste during woodland management activities.

- **Maintain equipment regularly**. Check hoses and fittings to prevent leaks or spills.
- **Designate specific areas for equipment maintenance and fueling.** Locate these areas on level terrain, a minimum of 100 feet from all streams and lakes.
- **Collect all waste lubricants, containers and trash.** Store them in leak-proof containers until they can be transported off-site for recycling, reuse or disposal at an approved site. Call your regional Environmental Protection Division (EPD) office for more information. (*Appendix A: Resource Directory*)

It is illegal to dump fuel and lubricants on the land or waters in the State of Iowa.

- **Separate all fluids and materials and keep in different labeled containers to avoid creating "hazardous waste" and expensive waste disposal.** Call your regional EPD office to determine if a waste is hazardous and how to dispose of hazardous waste.

Spills

Report spills to the Iowa Department of Natural Resources at the **24-hour Emergency Hotline number: (515) 281-8694.**

Spills of fluids during woodland management operations can occur as a result of fueling, hydraulic hose breaks, mechanical damage or vandalism. A spill occurs when a hazardous substance is released into the environment because of its quality, concentration or physical, chemical or infectious characteristics.

Proper equipment maintenance will prevent many spills.

The following BMPs are general guidelines for spills of fuel and lubricants used in woodland field operations. These practices complement specialized training given to persons using pesticides or other hazardous material.

- **Maintain a spill-containment and cleanup kit** appropriate for the materials on the operation. At a minimum, a kit for petroleum products should include:
  - plugs and clamps to control a hydraulic line break,
  - a container to catch leaking fluid,
  - a shovel and
  - absorbent material such as sawdust to absorb fluid, especially useful in the winter when soil is frozen.

- **If a spill should occur, do the following in order:**
  1. Protect yourself and others. Wear protective clothing and equipment appropriate for any hazardous materials on the operation. Avoid coming in contact with any toxic drift or fumes that may be released.
  2. If possible, stop the leak.
  3. If possible, contain the spill and keep it from spreading. Shovel a dike around the spill. Use absorbent material, such as sawdust or loose soil, to soak up fluid. Place a bucket under a hydraulic hose break. Keep the spill from flowing into lakes and streams.
  4. Isolate the spill material.

5. Report large spills to the Iowa Department of Natural Resources at the **24-hour Emergency Hotline number: (515) 281-8694.**
6. Contact your regional EPD office for disposal guidance.

Chapter 8 . Chemicals

Common chemicals used in woodland management are generally pesticides (insecticides, herbicides and fungicides) and fertilizer. These chemicals are used to control insects, unwanted vegetation, diseases and to enhance tree growth.

When used properly, chemicals should not affect water quality. However, when improperly used, chemicals can contaminate surface water or groundwater when they drift, flow overland as runoff, or leach through the soil into groundwater. Most water quality problems associated with pesticides and fertilizers are caused when they are spilled or improperly sprayed directly on surface water.

Some chemicals are labeled for use in or near streams, lakes or wetlands. Still, use extra care when using chemicals in streamside areas and wetlands.

Integrated Pest Management (IPM) uses a combination of manual, mechanical, biological, chemical and preventive techniques to minimize the impact of insects, diseases and unwanted vegetation. IPM may reduce dependence on the use of chemicals. (*Pesticide Use, page 26*)

The following best management practices describe techniques to avoid contaminating surface water and groundwater. These guidelines complement local, state and federal regulations governing the storage, sale, transportation, handling and application of chemicals.

By federal law, chemical users must follow Environmental Protection Agency (EPA) labels on pesticides containers.

BMPs for Chemical Use and Application

- **Maintain a spill containment and cleanup kit** appropriate for the materials on the operation and report all spills as indicated in the manufacturer's label instructions.
- **Follow all EPA label instructions**.
- **Apply chemicals only under favorable weather conditions,** as identified in the label instructions.
- **Calibrate spray equipment** to apply chemicals uniformly and in the correct quantities.
- **Prevent chemical leaks** from equipment. Check all equipment for leaking hoses, connections and nozzles.
- **Avoid applying herbicides in areas where the chemicals can kill stabilizing vegetation** on slopes, gullies and other fragile areas subject to erosion that drain into surface water.
- **Mix and load chemicals out of streamside areas**; where practical, mix and load in upland areas.
- **Rinse spray equipment according to manufacturer's label instructions. Discharge rinse water only in areas that are part of the application site.**
- **Dispose of surplus chemical and containers according to label instructions.**

Aerial Application

- **Hire a licensed aerial applicator.**
- **Identify and avoid streamside management areas and surface water to prevent chemicals not labeled for aquatic use from drifting over open water**, or from accidentally being applied directly on the water.

Chapter 9 . Wetlands

Wetlands are areas where water is at, near, or above the land surface long enough to be capable of supporting aquatic or hydrophytic vegetation and which has soils indicative of wet conditions. Iowa wetlands are diverse resources that include marshes, bogs, floodplain woodlands, wet meadows, low prairies and fens.

Wetlands provide many functional values in the ecosystem, among them:

- Shoreline Protection.
- Flood Protection.
- Water Quality Protection.
- Groundwater Recharge and Discharge.
- Wildlife and Plant Habitat.

Forestry BMPs in wetlands protect water quality and minimize changes to the surface and subsurface water. Changes in the surface and subsurface water movement can affect the health of the wetland ecosystem and its flood protection function.

Activities in wetlands are often subject to municipal, county, state and federal permits and regulatory requirements. If you suspect your project may involve a wetland and want to know what regulations apply, contact:

- Your County NRCS office,
- IDNR-EPD, Water Quality Section*
- U.S. Army Corps of Engineers*

*See *Appendix A: Resource Directory, Wetlands section on page 31* for more specific information.

BMPs for Wetlands:

- **Follow all planning BMPs in *Chapter Chapter 2 . . Advance Planning***
- **Avoid locating roads and landings in wetlands.**
- **When constructing roads in wetlands**, see *Appendix C: Woodland Roads - Federal Requirements for Woodland Roads in Wetlands, pg. 56.*
- **Woodland management activities in wetlands should occur on frozen ground** to minimize rutting.
    - For activities in wetlands, consider allowing more flexibility for completion dates in timber sales contracts to allow time to complete logging activities during firm or frozen ground conditions.
- **Do not move slash from upland sites into a wetland.**
    - Keep slash out of open water.
    - Avoid equipment maintenance and fueling in wetlands. Clean all spills promptly. See *Chapter Chapter 7 . . Fuels, Lubricants, Wastes and Spills.*

Appendix A: Resource Directory

This directory provides additional information and identifies contacts for assistance with forest management and nonpoint source pollution problems.

Acronyms

BMP: Best Management Practice
EPA: Environmental Protection Agency (Federal)
EPD: Environmental Protection Division (State)
FSA: Farm Service Agency (Federal)
IDALS: Iowa Department of Agriculture and Land Stewardship (State)
IDNR: Iowa Department of Natural Resources (State)
ISU: Iowa State University
NPS Pollution: Nonpoint Source Pollution
NRCS: Natural Resource Conservation Service (Federal)
SMA: Streamside Management Area
USDA: United States Department of Agriculture (Federal)
USGS: United States Geological Survey (Federal)

Clean Lakes Program

This cost-share program is administered by the IDNR Fisheries Bureau (in conjunction with EPA). Its objective is to improve lake quality for fish, wildlife and recreational use by identifying problems and finding restoration measures that will improve them. These measures include watershed conservation practices, dredging and lake aeration.

Clean Lakes Program, IDNR Fisheries Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-5208; Fax: (515) 281-6794.

Fertilizing and Seeding

Fertilizer and seed mixture recommendations:

- Local NRCS District offices,
- IDNR Forestry Division
  2404 South Duff
  Ames, IA 50010
  Phone: (800) 865-2477, Fax: (515) 233-1131

- ISU Forestry Extension
  251 Bessey Hall
  Ames, IA 50011
  Phone: (515) 294-1168, Fax: (515) 294- 2995
- local ISU Extension Service offices
- consulting foresters

Nonpoint Source Water Pollution

Surface water or groundwater pollution that results from a broad area of runoff is nonpoint source pollution. The IDNR provides grants for nonpoint source pollution control projects.
For general information about nonpoint source pollution in Iowa:

IDNR-EPD, Water Quality Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone (515) 281-6402; Fax: (515) 281-8895.

Pesticide Use

Pesticides: All pesticides to be sold in Iowa (insecticides, herbicides, fungicides, etc.) must be registered with the Iowa Department of Agriculture and Land Stewardship (IDALS) annually. The IDALS certifies private parties using restricted use pesticides and licenses commercial pesticide applicators.

IDALS - Pesticide Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319.

* Certification and Licensing of Applicators: (515) 281-5601
* Registration of Pesticides: (515) 281-4339
* Pesticide-related Complaints: (515) 281-3981

Information about Integrated Pest Management:

- ISU Department of Entomology
  109 Insectary Building
  Ames, IA 50011
  Phone: (515) 294-1101, Fax: (515) 294-8027.

- IDALS-Department of Entomology
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319
  Phone (515) 242-5180.

Regulation of forestry applied pesticides and licensing of certified applicators:

IDALS - Pesticide Bureau,
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone (515) 281-5601.

Information on proper pesticide use including recommendations on the **rates and applicability of various pesticides** and a list of dealers that recycle pesticide containers**:**

- ISU Extension Entomology
  109 Insectary Building
  Ames, IA 50011
  Phone: (515) 294-1101, Fax: (515) 294-8027.
- IDALS - Pesticide Bureau
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319
  Phone: (515) 281-8591.
- ISU Forestry Extension
  251 Bessey Hall
  Ames, IA 50011
  Phone: (515) 294-1168, Fax: (515) 294- 2995
- IDNR Forestry Division
  2404 South Duff
  Ames, IA 50010
  Phone: (800) 865-2477, Fax: (515) 233-1131
- local ISU Extension Service offices
- consulting foresters
- pesticide company representatives

Training of pesticide applicators for state certification:

ISU Extension Integrated Pest Management Coordinator
109 Insectary Building
Ames, IA 50011
Phone: (515) 294-7801 or (515) 294-1101
Fax: (515) 294-8027.

Testing for pesticide certification:

IDALS - Pesticide Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-4339.

Emergency spills:

IDNR Emergency Response Team
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Emergency Phone:(515) 281-8694. This is a 24-hour response number for reporting any potential or actual release of a hazardous substance to the environment.

Rivers, Streams and Lakes

Permits: Any construction on, over or across a wetland or watercourse may require a permit from the DNR and/or the Army Corps of Engineers.

- **General regulatory information and source of permit application**:

  IDNR-EPD, Water Quality Section
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319
  Phone: (515) 281-6615 or (515) 281-7025
  Fax: (515) 281-8895.

- **Sovereign Lands Construction Permit:** A permit is required for any construction on, over or across sovereign land (meandered streams and lakes) and fee-title lands under IDNR jurisdiction Chapter 461A.4.

  IDNR - Sovereign Lands Coordinator
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319
  Phone: (515) 281-8675.

- **Floodplain Construction Permit:** A permit may be required for construction in areas designated as floodplains. Contact should be made to IDNR-EPD staff to determine if a proposed project will require completion of a permit application.

  IDNR-EPD, Water Quality Section
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319
  Phone: (515) 281-4310 or (515) 281-8968
  Fax: (515) 281-8895.

- **State and Federal - Section 10 and 404 permits:**
  Section 10 of the Rivers and Harbors Act regulates any work (including discharges, excavations and structures) into any navigable waters of the United States†. In Iowa, navigable waters include the Mississippi River, the Missouri River, the Des Moines River below Fort Dodge and the lowest 4 miles of the Iowa River.

  Section 404 of the Clean Water Act regulates the discharge‡ of dredge or fill material into wetlands and other waters of the United States. Since most excavation results in resuspension of sediments or materials falling off of buckets, excavation is treated as a discharge and is usually regulated.

  † Waters of the United States include wetlands, lakes, ponds, reservoirs, rivers, streams, abandoned borrow and gravel pits, etc.
  ‡ Discharges to waters of the United States, as they relate to Iowa's forests, may result from (but are not limited to) roads,

crossings, any use of a bulldozer, construction of buildings, bank protection, excavation and burial of utility lines.

Army Corps of Engineers
Attn: RD-P, Clock Tower Building
PO Box 2004
Rock Island, IL 61024
Phone: (309) 794-5372.

Information and assistance in designing and installing bridges and culverts:

- **Permits: Most bridges and culverts require authorization under the Clean Water Act.**

  Army Corps of Engineers
  Attn: RD-P, Clock Tower Building
  PO Box 2004
  Rock Island, IL 61024
  Phone: (309) 794-5372.

- **Design:** Local NRCS offices, local Iowa Department of Transportation offices, or a private consultant can help with designing fords and culverts. To design a bridge, contact a private consultant or experienced contractor.

Protected Water Areas: IDNR designates and develops protection plans for areas under the protected waters program. This program identifies and works to conserve the scenic and natural qualities of designated portions of certain Iowa waters.

IDNR-PWA Coordinator
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-3449, Fax: (515) 281-6794.

Roads

Assistance in the proper design and location of roads can be obtained from

- IDNR Forestry Division
  2404 South Duff
  Ames, IA 50010
  Phone: (800) 865-2477, Fax: (515) 233-1131,
- local NRCS offices
- consulting foresters.

Surface Water Monitoring

- IDNR conducts an on-going program to monitor the quality of surface water in the state.
- Surface Water Monitoring, IDNR - EPD
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319.
  Fax: (515) 281-8895.
- Compliance & Enforcement Bureau @ (515) 281-8905
- Water Quality Bureau @ (515) 281-8867.

Threatened and Endangered Species

IDNR Threatened and Endangered Species Program
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-3891, Fax: (515) 281-6794.

Wetlands

The department is involved in diverse programs involving wetland regulation, preservation, acquisition and restoration.

General regulatory information and source of permit application:

IDNR-EPD, Water Quality Section
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-6615 or (515) 281-7025
Fax: (515) 281-8895.

Federal Section 404 permits for filling or draining wetland:

Army Corps of Engineers
Attn: RD-P, Clock Tower Building
PO Box 2004
Rock Island, IL 61024
Phone: (309) 794-5372.

Wetland delineation for current Farm Bill (Swampbuster):

Contact your local Natural Resource Conservation Service (NRCS) office.

Property tax exemptions for protected and restored wetlands:

IDNR Wildlife Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-8664; Fax: (515) 281-6794.

Wetland acquisition or restoration for wildlife:

IDNR Wildlife Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319
Phone: (515) 281-4815 or (515) 281-8664
Fax: (515) 281-6794.

Maps and Aerial Photographs

Aerial photographs:

- Available at local Farm Service Agency (FSA) offices.

They may also be purchased from the

- Department of Agriculture, Aerial Photo Field Office
  2222 W., 2300 S.
  Salt Lake City, UT 84130
  Phone: (801) 524-5856

- U.S. Geological Survey
  EROS Data Center
  Sioux Falls, SD 57198
  Phone (605) 594-6151.

Topographic maps: IDNR provides information on the availability and utilization of maps that depict the configuration and elevations of the earth's surface and the location of roads, railways and other cultural features. Maps may be purchased from:

IDNR Geological Survey Bureau
109 Trowbridge Hall
Iowa City, IA 52242
Phone: (319) 335-1575.

Soil survey use and interpretations: Local offices of the Natural Resource Conservation Service (NRCS).

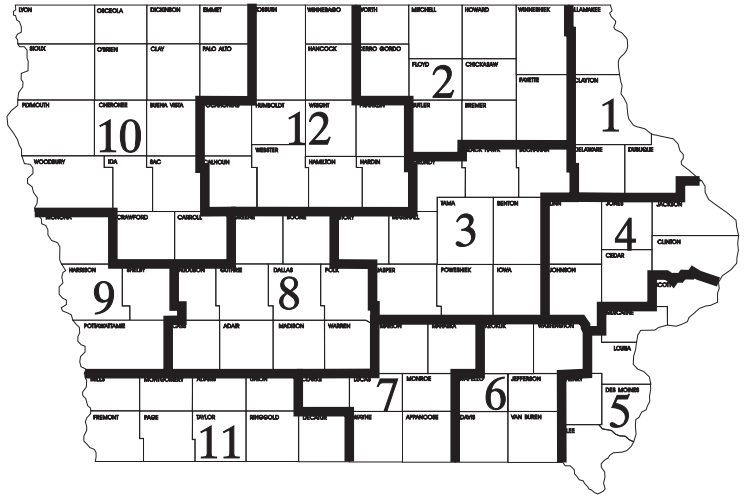
Appendix B: Forest Management Assistance

Technical Assistance

The IDNR encourages the protection of natural resources during woodland management activities by providing technical assistance through the department's District Foresters.

Planning assistance is available from

- IDNR Forestry Division
  2404 South Duff
  Ames, IA 50010
  Phone: (800) 865-2477, Fax: (515) 233-1131



DNR Forestry Districts

1. Elkader	(319) 245-1891	**7.** Chariton	(515) 774-8733
2. Charles City	(515) 228-6611	**8.** Adel	(515) 993-4133
3. Marshalltown	(515) 752-3352	**9.** Pisgah	(712) 456-2924
4. Anamosa	(319) 462-2768	**10.** LeMars	(712) 546-5161
5. Wapello	(319) 523-2216	**11.** Creston	(515) 782-6761
6. Fairfield	(515) 472-2370	**12.** Webster City	(515) 832-3585

- **Iowa Consulting Foresters** are professionals whose services are available to anyone on a fee or contractual basis. Services to woodland owners include planning, protection and management of their land to meet the landowner's objectives.
  To obtain a list of consulting foresters, contact:
  - ISU Forestry Extension Service
    251 Bessey Hall
    Ames, IA 50011
    Phone: (515) 294-1168, Fax: (515) 294- 2995
  - IDNR Forestry Division
    2404 South Duff
    Ames, IA 50010
    Phone: (800) 865-2477, Fax: (515) 233-1131

Information and education about woodland resources and management is available from:

- ISU Forestry Extension
  251 Bessey Hall
  Ames, IA 50011
  Phone: (515) 294-1168, Fax: (515) 294- 2995
- IDNR Forestry Division
  2404 South Duff
  Ames, IA 50010
  Phone: (800) 865-2477, Fax: (515) 233-1131
- IDNR Urban Forester and Trees for Kids Coordinator
  Wallace State Office Building
  502 E. 9th Street
  Des Moines, IA 50319
  Phone: (515) 242-5966, Fax: (515) 281-6794.

Cost Share Programs

Cost share assistance may be available to woodland owners to implement management practices. Practices that may be cost shared include:

- Tree planting
- Woodland improvement
- Fencing to protect from livestock grazing damage

- Wildlife habitat enhancement
- Streamside (riparian) protection and improvement

For more information please contact your local IDNR District Forester. *(See map on page 34)*

IDNR State Forest Nursery

Low cost tree and shrub seedlings for conservation plantings are available each year for spring planting. Contact the nursery at 1-800-865-2477 for additional information or an order form.

IDNR Shelterbelt Program

IDNR Wildlife Bureau participates in a cost-sharing program to establish tree and shrub shelterbelts around farmsteads. The shelterbelts must be from 8 to 14 rows. The IDNR provides 75 percent of the cost. The shelterbelts are to provide winter cover and habitat for wildlife.

IDNR Wildlife Bureau
Wallace State Office Building
502 E. 9th Street
Des Moines, IA 50319.
Phone: (515) 281-8664; Fax: (515) 281-6794.

Iowa Forest Reserve Law

To encourage proper stewardship, the Iowa Forest Reserve Law exempts certain woodlands from property taxes. To qualify, the woodland must be:

- Minimum of two acres
- At least 200 trees per acre
- No domestic livestock grazing

Harvesting of trees is permitted. Application is made at the County Assessor's office.

Publications

Forestry Extension at Iowa State University has publications on tree planting and woodland management. For a list of available publications contact:

ISU Forestry Extension
251 Bessey Hall
Ames, IA 50011
Phone: (515) 294-1168, Fax: (515) 294- 2995

Appendix C: Woodland Roads

Stream Crossing Design and Construction

As roads approach a stream crossing, proper road drainage is critical to avoid sedimentation in streams. Three common stream crossing structures are culverts, bridges and fords.

Stream crossings must be designed, constructed and maintained to safely handle expected vehicle loads and to minimize disturbance of streambanks, channels and, ultimately, aquatic organisms. Consider streambed material, stream size, storm frequency, flow rates, intensity of use (permanent or temporary) and the passage of fish when planning crossings. The USDA Natural Resources Conservation Service (NRCS), or a private consultant can help with designing fords and culverts. To design a bridge, contact a private consultant or experienced contractor.

BMPs for Stream Crossings

- **Use soil stabilization practices on exposed soil at stream crossings.** Use seed and mulch and install temporary sediment control structures such as straw bales or silt fences immediately following construction to minimize erosion into streams. Maintain these practices until the soil is permanently stabilized. (*Soil Stabilization, page 51*)
- **Design, construct and maintain stream crossings to avoid disrupting the migration or movement of fish and other aquatic life**. Bridges or arch culverts that retain the natural stream bottom and slope are preferred for this reason.
- **Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.**
- **Install stream crossing structures at right angles to the stream channel.**
- **Minimize channel changes and 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 the equipment in the stream to a minimum.

- **Construct a bridge or place the fill over a culvert higher than the road approach to prevent surface road runoff from draining onto the crossing structure and into the stream** (*Figure C-1*).

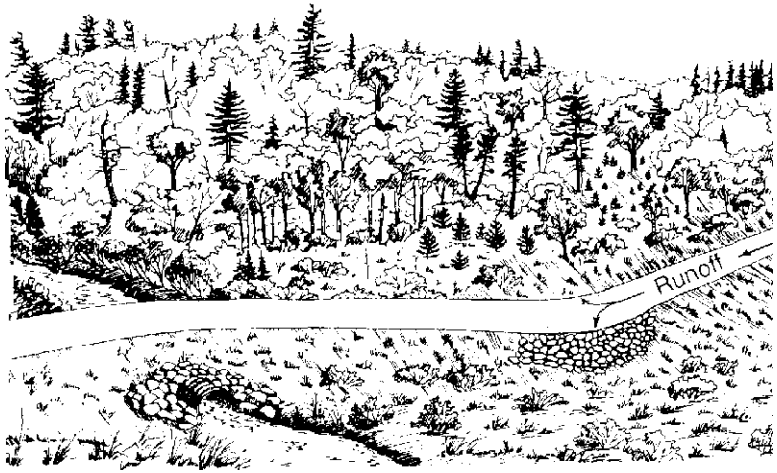


Figure C-1. Place fill directly over a culvert higher than the road approach to prevent surface road runoff from draining onto the crossing structure and into the stream. (Adapted from Wisconsin Department of Natural Resources, 1995.)

- **Stabilize approaches to bridge, culvert and ford crossing with aggregate or other suitable material** to reduce sediment entering the stream.
- **Anchor temporary structures on one end with a cable or other device so they do not float away during high water.** Install them so they can be easily removed when no longer used, regardless of the season.
- **Avoid areas with riffles and pool complexes, wetlands, mudflates or vegetated shallows** which are considered special aquatic sites under the Clean Waters Act (CWA), Section 404 and **have strict requirements for permits**.
- **Divert road drainage into undisturbed vegetation, preferably outside the SMA** so that the drainage does not

directly enter the stream (*Figure C-2*). Also refer to *Diversion Structures on page 50*.

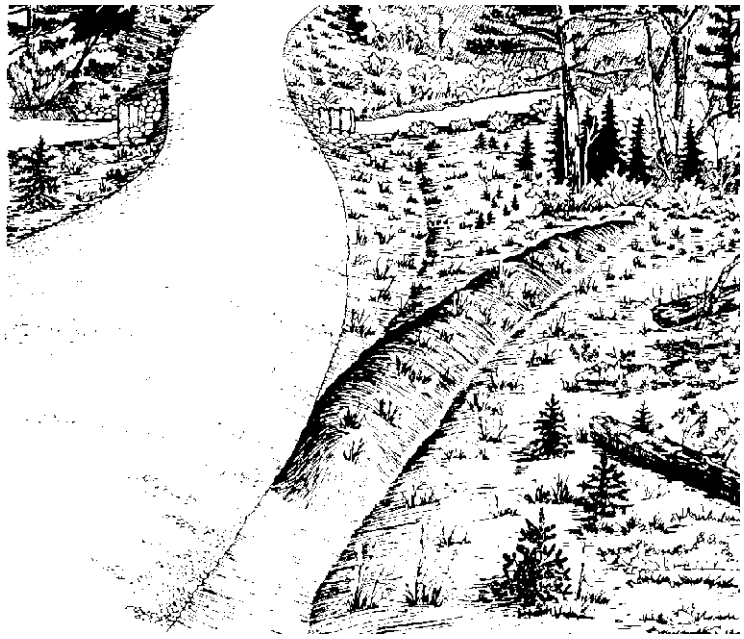


Figure C-2. Diversion ditch. (Adapted from Wisconsin Department of Natural Resources, 1995.)

Pipe Culverts for Stream Crossings

- Install pipe culverts long enough so that road fill does not extend beyond the ends of a culvert.
- Install permanent culverts that are large enough to pass flood flows and are a minimum of 12 inches in diameter. Culverts that are too small can plug up with debris and result in the road washing out or in flooding upstream.

Iowa law states that the landowner and/or contractor are responsible to obtain a flood easement from any affected property owners upstream of culvert crossing that are not designed to pass the 100-year flood.

The USDA Natural Resources Conservation Service, or a private engineering consultant can help with sizing culverts.

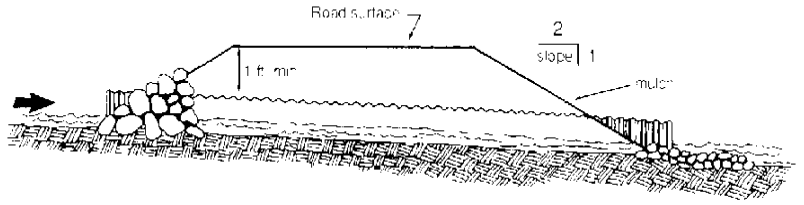


Figure C-3. Install culverts so there is no change in the stream bottom elevation. (Adapted from Wisconsin Department of Natural Resources, 1995.)

- Install culverts so there is no change in the stream bottom elevation (*Figure C-3*). Culverts should not cause damming or pooling.
- Firmly pack 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, to prevent crushing (*Figure C-4*).

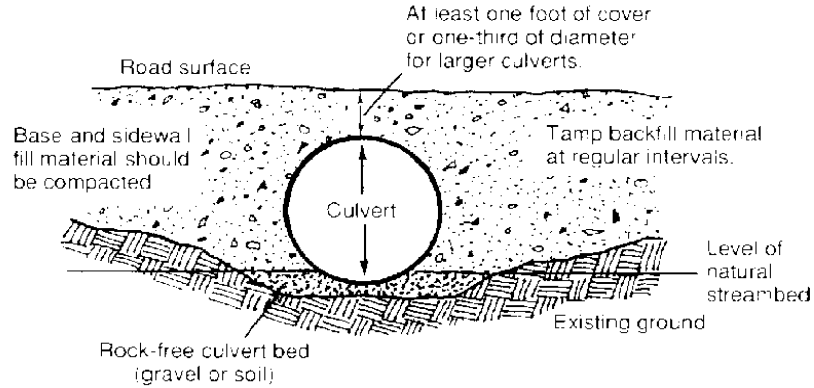


Figure C- 4. Installation of culverts. (Adapted from Montana Department of State Lands, 1992.

- Use riprap around the inlet of culverts to prevent water from eroding and undercutting the culvert (*Figure C-5a and 5b*). For permanent installations, use filter fabric under the riprap. In addition, consider using flared culvert end sections for inlets.
- Keep culverts clear and free of debris so that water can pass unimpeded at all times. This is especially important in areas where beaver are present.

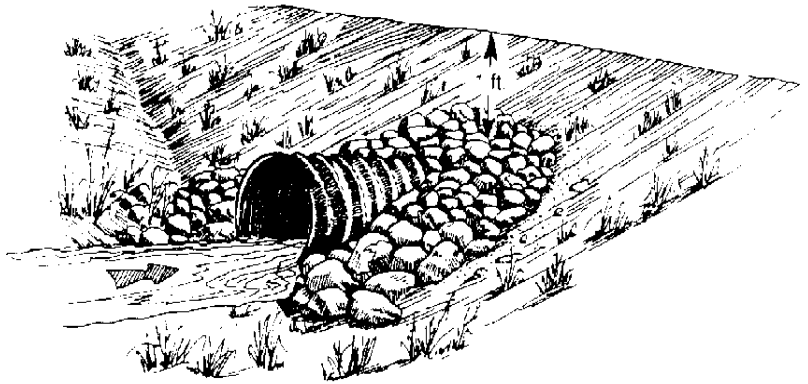


Figure C-5a. Use riprap around the inlet of culverts.

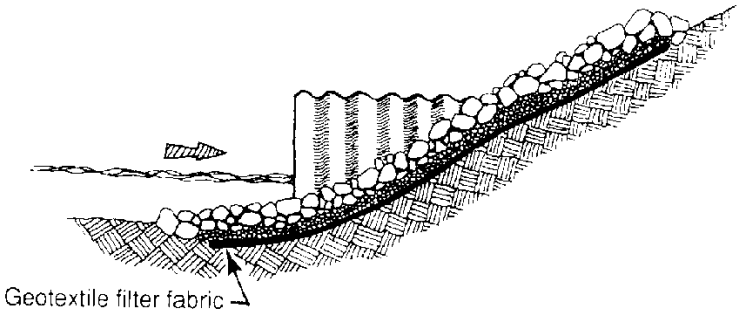


Figure C-5b. Use geotextile filter fabric for permanent installations. (Adapted from Wisconsin Department of Natural Resources, 1995.)

Fords

- Use fords for crossing dry streambeds or where fording would cause minimal water quality impacts.
- Locate fords where streambanks are low.
- Streambed should have a firm rock or gravel base. Otherwise, install stabilizing material such as reinforced concrete planks, crushed rock, riprap or rubber mats on streambeds.

Road Construction and Drainage - BMPs

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

- **Design and construct roads to remove water from road surface to keep the road dry and structurally sound.** *Figure C-6* shows three common road designs: crowned, outsloped and insloped. Install insloped roads with ditches and adequate cross drainage. Outsloped roads (usually outsloped 2-4%) are less expensive to construct and maintain; use them on roads with moderate gradients and stable soils.

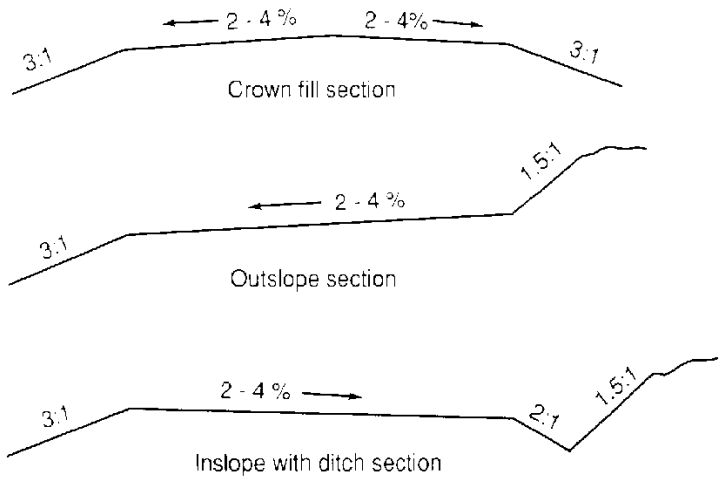


Figure C-6. Typical road designs form drainage and stability. (Adapted from Wisconsin Department of Natural Resources, 1995.)

- **Construct stable cut-and-fill slopes that will revegetate easily**, either naturally or artificially.
- **Do not bury debris in the road base.** It causes uneven settling that can led to erosion and frost-heaving that creates mud holes.

- **Compact the road base material or allow it to settle before using the road.** This will reduce the amount of water that soaks into it, increasing the road's carrying capacity, reducing road maintenance and reducing erosion.
- **Surface the road with gravel where steep grades, erodible soils or high traffic volume make the potential for surface erosion significant.**
- **Locate gravel pits outside SMAs**, using proper location, development and soil stabilization practices to minimize erosion from the pits.

Drainage Structures - BMPs

Road-drainage structures include cross drains (pipe culverts, open-top culverts, broad-base dips and water bars) and water-diversion structures. Cross drains allow water from roadside ditches to move from one side of the road to the other.

- **Where necessary to protect water quality, install road drainage structures to remove storm water or seepage from the road surface and ditches.** Space these structure at intervals close enough to minimize waterflow volume and speed, avoiding ditch erosion. As road grades increase, use drainage structures more often. *See Table C- 1 below*.
- **Provide erosion protection for outflows from road drainage structure to minimize erosion and disperse the water, allowing it to soak into the soil.** Riprap, mulch and/or seeding may be necessary (*Soil Stabilization, page 51*).

Table C- 1. Recommended distances between drainage structures on woodland roads and skid trails.

Road grade %	Distance between waterbars (feet)	Distance between broad-based dips and cross-drain culverts (feet)
1	400	500
2	250	300
5	130	180
10	80	150
15	50	130
25+	40	110

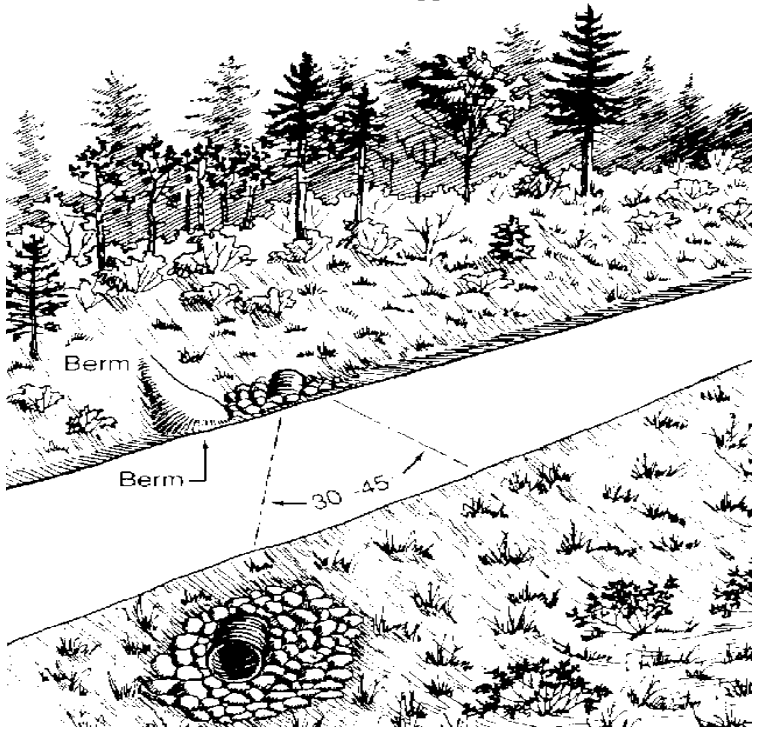


Figure C-7. Cross-drain culvert. (Adapted from Wisconsin Department of Natural Resources, 1995.)

Pipe Culverts for Cross Drains

- Install pipe culverts to provide cross drainage on roads grades at regular intervals immediately above steep grades, below bank seepage and where water will run onto log landings or woodland roads.
- Install pipe culverts long enough so that road fill does not extend beyond the end of a culvert.
- Install cross drain pipe culverts at grades at least 2% more than the ditch grade and angled 30 to 45 degrees to improve inlet efficiency (*Figure C-7)*.
- Select the size of cross-drain culverts according to the size of the road and area drained by the ditch. To avoid clogging, permanent culverts should be at least 12 inches in diameter. The USDA Natural Resources Conservation Services or a private engineering consultant can help with sizing culverts.

- Install pipe culverts on a surface of compacted granular material. Firmly pack fill material around culverts, particularly around the bottom half. Cover the top of the culvert with fill to a depth of one-third of the pipe diameter, or at least 12 inches (whichever is greater) to prevent crushing (*Figure C-4*).
- Use riprap around the inlet of culverts to prevent water from eroding and undercutting the culvert.

Open-Top Culverts

Open-top culverts provide cross drainage and road surface drainage (*Figure C-8*) and are usually installed on seasonal or temporary roads.

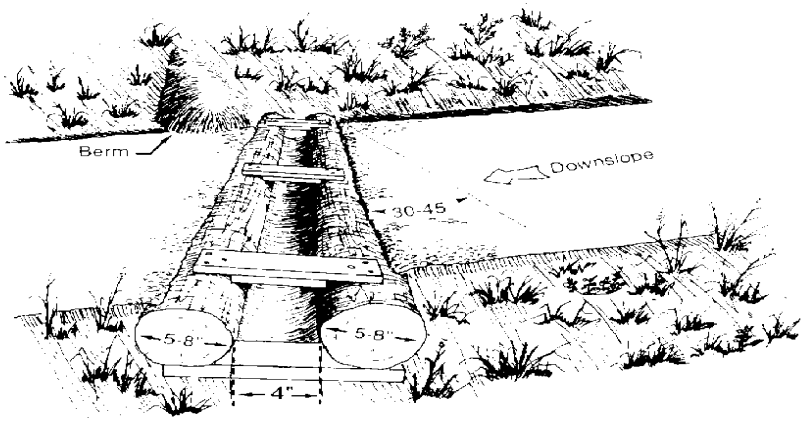


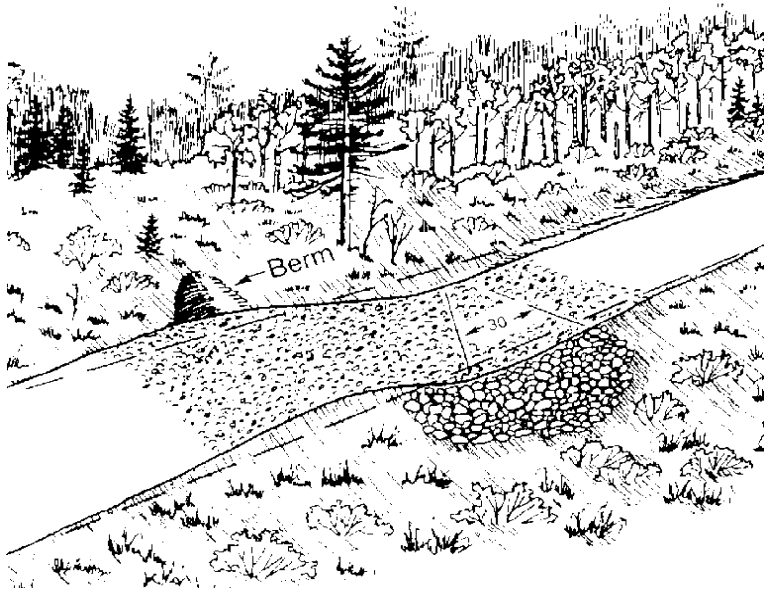
Figure C-8. Open-top log culvert. (Adapted from Wisconsin Department of Natural Resources, 1995.)

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

Broad-Based Dips

Broad-based dips can provide cross drainage and road-surface drainage for roads and skid trails with a gradient of 15% or less (*Figure C-9*). Broad-based dips can be used instead of culverts, usually at lower cost and with lower maintenance. Dips are not used for draining seeps, or for intermittent or permanent streams.

- 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.



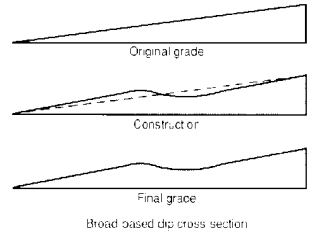


Figure C-9. Broad-based dip. (Adapted from Wisconsin Department of Natural Resources, 1995.)

Water Bars

A water bar is a shallow trench with a mound (or berm) which provides cross drainage and intercepts runoff from skid trails, recreational trails, firebreaks, or inactive or closed roads. (*Figure C-10*). Constructing a water bar will minimize erosion and provide conditions for natural or artificial revegetation.

- Place water bars at a 30 to 45 degree angle with a cross drainage grade of 2%.

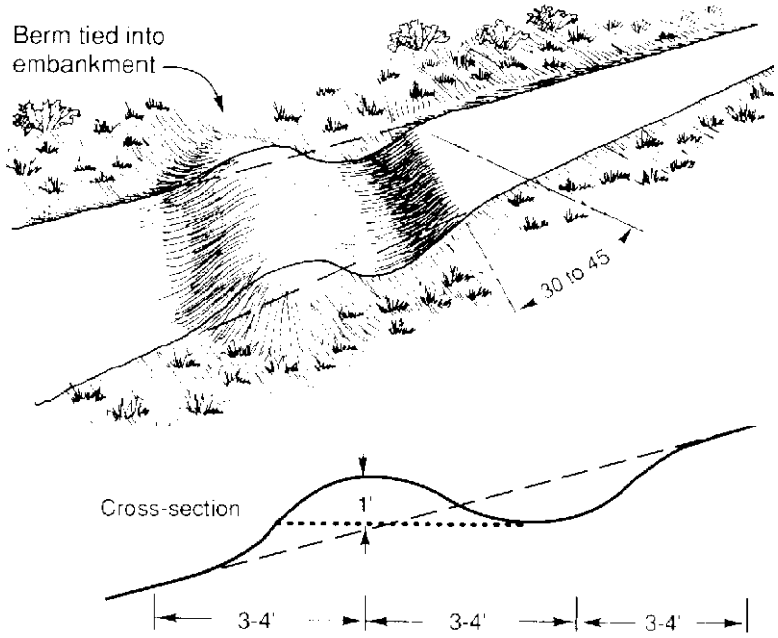


Figure C-10. Water bar.. (Adapted from Wisconsin Department of Natural Resources, 1995.)

Diversion Structures

Diversion ditches, or berms, divert water away from roads and side ditches and channel it into vegetation *(Figure C-2*). These structures are often used before stream crossings to ensure that water will be diverted into vegetation and not directly into a stream, lake or wetland.

Construct diversion ditches so they intersect the roadside ditch at the same depth and are turned down slope 1% to 3% (*Figure C-2*).

Soil Stabilization - BMPs

Soil stabilization practices are used where soil is exposed and natural revegetation is inadequate (i.e., road development, skid trails and landings) to prevent soil erosion and subsequent sedimentation into streams, lakes and wetlands. This occurs during roads construction and when the road system is active or inactive. Practices include mulching, seeding and installing sediment control structures.

It is always more efficient and cost effective to prevent erosion than it is to repair damage after the fact.

Mulching and Seeding

- Use mulch and/or seed where necessary to minimize soil erosion.

Mulch, such as straw, woodchips or bark, retains soil moisture - important for seed germination and protects the soil surface from erosion due to runoff and raindrop impact. Mulch can be used to: (1) promote natural revegetation or (2) protect seeds that have been spread over an area. If you seed, apply mulch immediately afterward. Netting may be necessary to hold mulch in place on steep slopes or on areas where water flow concentrates.

Seed mixtures should include fast growing species for quick soil protection plus perennial species for longer soil protection until native vegetation returns to the site. Recommendations for seed mixes that are best for specific regions in Iowa are available from your District IDNR Forester, Wildlife Biologist or USDA Natural Resources Conservation Service office.

A suggested minimum generic seed mixture, applied at the rate of 55 lbs./acre, is as follows:

White Dutch clover	10 lbs./acre
Perennial rye grass	10 lbs./acre
Annual rye grass	20 lbs./acre
Creeping red fescue	15 lbs./acre
	55 lbs./acre

Table C-2 is provided to assist you in determining the area (acres) of a specified length and width of road surface.

Table C-2. Road Surface Area Determination (acres)

Road Length (ft)	Road Width (ft)					
	8'	**10'**	**12'**	**14'**	**18'**	**20'**
50	.01	.01	.01	.02	.02	.02
100	.022	.02	.03	.03	.04	.05
250	.05	.06	.07	.08	.10	.11
500	.09	.12	.14	.16	.21	.23
750	.144	.17	.21	.24	.31	.34
1000	.18	.24	.28	.32	.41	.46
1500	.28	.34	.41	.48	.62	.69
2000	.36	.48	.56	.64	.83	.92
5000	.92	1.15	1.38	1.61	2.07	2.30
5280	.97	1.21	1.45	1.70	2.18	2.43

Sediment Control Structures

- Install sediment control structures where necessary to slow the flow of runoff and to trap sediment until vegetation is established at the sediment source. Sediment control structures include straw bale fencing, silt fencing and sediment traps (*Figures C-11*).
- Maintain, clean, or replace sediment-control structure until areas of exposed soil are stabilized.

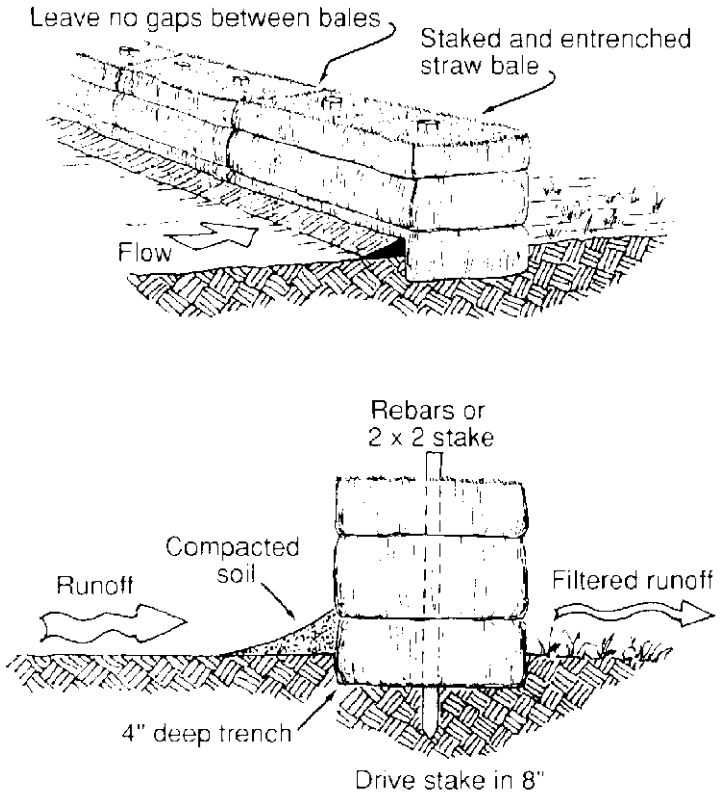


Figure C-11a. Straw bale fencing to slow runoff and trap sediment for sheet flow and channelized flow. (Adapted from Wisconsin Department of Natural Resources, 1995.)

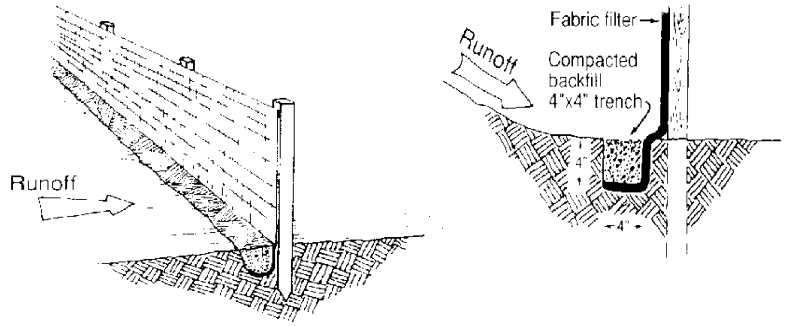


Figure C-11b. Silt fencing to slow runoff and trap sediment for sheet flow, not channelized flow. (Adapted from Wisconsin Department of Natural Resources, 1995.)

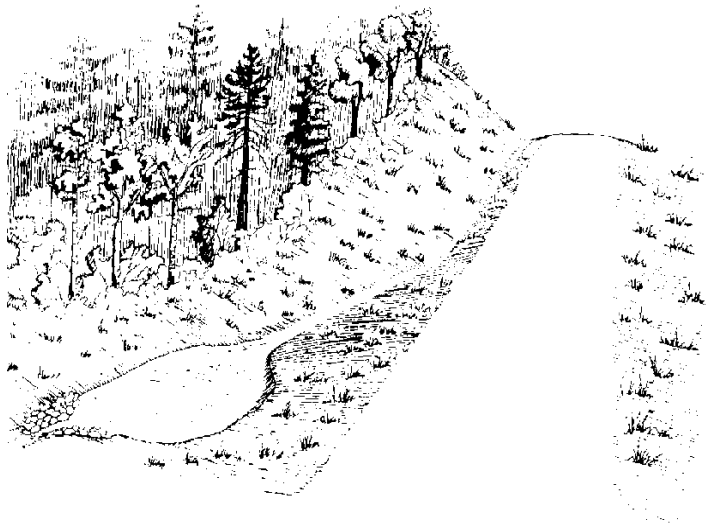


Figure C-11c. A sediment trap to slow runoff and trap sediment for channelized flow. (Adapted from Wisconsin Department of Natural Resources, 1995.)

Road Maintenance

Roads must be well maintained or water quality protection structures may quickly degrade. For both active and inactive roads, follow BMPs in the *Soil Stabilization section on pages 34-36*.

Active Roads

- Inspect the road system at regular intervals, especially after heavy rainfall, to detect problems and to schedule repairs.
- Clear debris from culverts, ditches, dips and other drainage structures to decrease clogging that can lead to washouts. Place the debris where it cannot be washed back into these structures or into open water.
- Keep traffic to a minimum during wet periods and spring breakup to reduce maintenance needs.
- Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible to reduce erosion potential.
- Remove berms along the edge of the road if they will trap water on the road.
- When dust control agents are used, apply them in a manner that will keep these compounds from entering lakes, streams and groundwater. Consult a qualified road engineer from the County Highway Commissioner's office or Iowa Department of Transportation for assistance in selecting the appropriate chemicals and amounts.

Note: It is illegal to spread oil on road, land or water in Iowa.

Inactive Roads

When woodland roads are inactive for extended periods, closing the system will help to protect the road surface and the water quality protection structures. Consider erecting a barrier to traffic such a gate or berm and post "Closed" signs at the entrance of temporarily closed roads. Stating the length of time and/or reason for closure and inviting acceptable uses may be helpful to assure compliance.

- Remove all temporary drainage and stream crossing structures.
- Shape all road system surfaces to maintain proper surface drainage, if necessary.
- Install water bars where necessary. See the *Water Bars section on page 50* and follow recommendations in *Table C-* 1 *on page 46*.
- Inspect and maintain road surfaces, permanent drainage and streamcrossing structures (ditches, culverts, bridges, etc.) to minimize erosion.

Federal Requirements for Woodland Roads in Wetlands

The following 15 BMPs must be implemented in order to qualify for the silvicultural exemption from a federal section 404 permit when building a temporary or permanent road or skid trail in a wetland (33 CFR part 323.4). The silvicultural exemption is only applicable when the primary purpose of the roads is for normal silvicultural purposes. This listing is an attempt to explain the 15 BMPs in lay language. The exact language of the law may be obtained by contacting the Army Corps of Engineers.

1. Limit the number, length and width of roads and skid trails to the minimum necessary to accomplish the landowner's objective.
2. Locate roads outside streamside management areas except at stream crossings. For more information, see *Chapter Chapter 3 . . Streamside Management Areas.*
3. Road fill must be bridged, culverted, or otherwise designed to prevent restriction of expected flood flows.
4. Properly stabilize and maintain road fill during and after road construction to prevent erosion.
5. While building a road with fill material, minimize the use of road construction equipment in the wetland area.
6. Minimize disturbance of vegetation while designing, constructing and maintaining roads.

7. Correctly design, construct and maintain wetland road crossings to avoid disrupting the migration or movement of fish and other aquatic life.
8. Use fill from upland sources whenever feasible.
9. Place fill in a way that does not take or jeopardize the continued existence of a threatened or endangered species (as defined under the Endangered Species Act) or adversely modify or destroy the critical habitat of such species.
10. Avoid placing fill in breeding and nesting areas for migratory waterfowl, in spawning areas and in wetlands if practical alternatives exist.
11. Fill shall not be placed near a public water supply intake.
12. Fill shall not be placed in areas of concentrated shellfish production.
13. Fill shall not be placed in waterbodies or on land regarded as part of the National Wild and Scenic River System.
14. Use fill free from toxic pollutants.
15. Completely remove all temporary fills and restore the area to its original elevation.

Appendix D: References and Additional Information

Delaware Department of Agriculture, Forest Service. 1995. *Delaware's Forestry Best Management Practices Manual*. 78p.

Georgia Forestry Commission. 1990. *Recommended Best Management Practices for Forestry in Georgia.*

Michigan Department of Natural Resources. 1994. *Water Quality Management Practices on Forest Land.*

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Appendix E: Glossary

Barriers: Obstructions to pedestrians, horse, or vehicular traffic. They are intended to restrict such traffic to a specific location.

Baseflow: The portion of streamflow which comes from groundwater.

Berm: A low earth fill constructed in the path of flowing water to divert its direction, or constructed to act as a counter-weight beside the road fill to reduce the risk of foundation failure.

Best Management Practices (BMPs): Practical and economically achievable practices for preventing or reducing nonpoint source pollution.

Broad base dip: A surface drainage structure specifically designed to drain water from an access road while vehicles maintain normal travel speeds.

Buffer area: An area of land and/or plants around a stream or waterbody of sufficient width to lessen entrance of pollutants (fertilizers, pesticides, eroded soil and fire retardants) into a waterbody.

Community: A group of plants and animals living in a region or location under relatively similar conditions.

Culvert: A conduit through which surface water can flow under roads.

Cut-and-fill: Process of earth moving by excavating part of an area and using the excavated material to build adjacent embankments or fill areas.

Dips: Economical, relativity trouble free structures for providing effective drainage of woods roads. Dips are considerably lower in cost than culverts, so time spent in careful construction is well justified.

Disking (harrowing): A site preparation system where a heavy harrow with large disks is pulled over a site in order to eliminate selected vegetation.

Drainage structure: Any device or land form constructed to intercept and/or aid in surface water drainage.

Duff: The accumulation of needles, leaves and decaying matter on the woodland floor.

Erodible soils: Soils that are likely to have high soil loss when exposed to water runoff. Soils having a Natural Resource Conservation Service (NRCS) erosion hazard rating of "moderate" or "severe" should be considered erodible. Erosion hazard ratings for different soil types are listed in "Woodland Suitability" tables in NRCS soil survey manuals. Generally, woodland soils occurring on 15-35% slopes have a moderate rating and soils occurring on greater that 35% slopes have a severe rating. Contact your local NRCS office for more information.

Erosion: The process by which the surface of the earth is worn away by the action of wind or water in the form of rain drops, surface runoff and waves.

Felling: The process of cutting down standing trees.

Fill slope: The surface formed where earth is deposited to build a road or trail.

Filter strip: An area of land adjacent to a water body which acts to trap and filter out suspended sediment and chemicals before entering surface waters. Harvesting and other woodland management activities are permitted in the filter strip as long as the integrity of the filter strip is maintained and mineral soil exposure is kept to a minimum.

Fireline: A barrier used to stop the spread of fire, constructed by removing fuel or rendering fuel unflammable by use of water or fire retardants.

Ford: Submerged stream crossing where the streambed may need to be reinforced to bear intended traffic. A place where a perennial or intermittent stream may be crossed by vehicle.

Grade: The slope of a road or trail expressed as a percent of change in elevation per unit of distance traveled.

Ground water: The subsurface water supply in the saturated zone below the level of the water table.

Harvesting: The felling, skidding, loading and transportation of woodland products, roundwood or logs.

Hydrophytic: Plants that grow in and are adapted to an aquatic or very wet environment.

Integrated pest management (IPM): An ecological approach to pest management in which all available necessary techniques are consolidated into a unified program so that pest populations can be managed in such a manner that economic damage is avoided and adverse side effects are minimized.

Intermittent stream: A stream or portion of a stream that flows only in direct response to precipitation. It is dry for a large part of the year.

Landing (log deck): A place where trees and logs are gathered in or near the woodland for further transport.

Leaching: Downward movement of a pesticide or other soluble material through the soil as a result of water movement.

Loading: The act of placing material on a vehicle for further transport.

Logging debris (slash): That unwanted, unutilized and generally unmarketable accumulation of woody material in the woodland such as limbs, tops, cull logs and stumps, that remain as residue after timber harvesting.

Mulching: Providing any loose covering for exposed woodland soils, such as grass, straw or wood fibers to protect exposed soil and help control erosion.

Nonpoint source pollution (NPS): Occurs when rainfall or snowmelt runoff moves across the ground carrying debris, sediment

and/or pollutants into streams, lakes, wetlands and groundwater.

Nutrients: In the forest context, mineral elements such as nitrogen, phosphorus, or potassium, that are naturally present or may be added to the woodland environment by woodland practices such as fertilizer or fire retardant applications. Substances necessary for the growth and reproduction of organisms. In water, substances that promote growth of algae and bacteria; chiefly nitrates and phosphates.

Ordinary high watermark: The point on the bank or shore up to which the presence and action of the water is so continuous as to leave a distinct mark either by erosion, destruction of terrestrial vegetation, or other easily recognized characteristics.

Outslope: To shape the road surface to cause drainage to flow toward the outside shoulder.

Perennial stream: A stream that maintains water in its channel a majority of the year.

Permanent all-season woodland roads: These roads usually have gravel surfaces and are designed for year-round use. However, there may be some restrictions on use at various times of the year.

Permanent seasonal roads: These are maintained as part of the permanent road system but are designed for use only when the ground is frozen or firm. These roads are generally narrower than permanent all-season roads, are built to lower engineering standards and have minimal surface gravel.

Pesticides: Chemical compounds or biological agents used for the control of undesirable plants, animals, insects or diseases.

Prescribed burning: Skillful application of fire to natural fuels that allow confinement of the fire to a predetermined area and at the same time produce certain planned benefits.

Rake: A site preparation tool normally mounted on the front of a crawler tractor, used to remove trees, stumps roots and slash from a future planting site.

Riparian area: See *Streamside management area*.

Riprap: A layer of boulders or shot rock fragments placed over soil to protect it from the erosive forces of flowing water or waves.

Scarification: The process of disrupting or removing the woodland floor, or mixing it with the mineral soil by mechanical action preparatory to natural or direct seeding or the planting of tree seedlings.

Sediment: Soil material that has been eroded from the land surface, often by overland water flow and then transported and deposited away from its original location.

Silt fence: A temporary barrier used to intercept sediment-laden runoff from small areas.

Silviculture: The theory and practice of controlling woodland establishment, composition, structure and growth. Silvicultural practices consist of the various treatments that may be applied to woodland stands to maintain and enhance their utility for any purpose.

Site: An area having some capacity to produce a particular type of timber species or other vegetation based on the combination of biological, climatic and soil and soil factors present. Site expresses the capacity of a given setting to grow timber or other vegetation.

Site preparation: A woodland activity to remove unwanted vegetation and other material and/or to cultivate or prepare the soil for regeneration.

Skidding: The act of moving trees from the site of felling to a loading area or landing. Skidding may be accomplished by tractors, horses, or specialized logging equipment.

Skid trail: A temporary pathway over woodland soil to drag felled trees or logs to a landing.

Slash: See *Logging debris*.

Stand: A contiguous group of trees sufficiently uniform in species composition, arrangement of age classes and condition to be considered a unit.

Stream: A water course that:(1) has ordinary high watermark, (2) has beds and banks, (3) flows at least periodically, (4) has an easily identifiable beginning and end, (5) does not loses it character as a water course even though it may break up and disappear temporarily and reappear down stream.

Streamside management area (SMA): (also commonly referred to as a **riparian area**) Land and vegetation areas next to lakes and streams where management practices are modified to protect water quality, fish and other aquatic resources. These areas are complex ecosystems that provide food, habitat and movement corridors for both aquatic and terrestrial communities as well as helping to minimize nonpoint source pollution impacts to surface water.

Temporary roads: These are the most common type of woodland roads. They are designed and constructed for short-term use during a specific project such as timber harvesting. These roads are used only when the ground is frozen or firm. When the project is done, the temporary road is closed, all stream crossing structures are removed and the road is naturally or artificially revegetated.

Water bar: A shallow trench and/or hump across a trail or road (generally tied into the uphill side of the slope) for the purpose of carrying water runoff into the vegetation, duff, ditch or dispersion area. Water bars are used to minimize erosion by diverting the waters potential velocity and volume.

Water course: A channel where water flows either perennially or intermittently. Can be also used to include bodies of open water

Water pollution: Any introduction of foreign material into water or other impingement upon water which produces undesirable changes in the physical, biological, or chemical characteristic of that water.

Watershed: The common land area that drains into a lake, river or river system.

Waters of the state: Any surface or underground waters, except those surface waters which are not confined but are spread and diffused over the land. This includes all lakes, ponds, marshes, rivers, streams, ditches, springs and water from underground aquifers, regardless of their size or location.

Wetlands: An area where water is near, at or above the land surface long enough to be capable of supporting aquatic or hydrophytic (water loving) vegetation and/or which has soils indicative of wet conditions.

Wet line: A wet line is a line of water, or a water and **chemical fire retardant**, sprayed along the ground, to serve as a temporary fireline which will stop a low-intensity fire.

Wildfires: Uncontrolled fires occurring in forestland, woodland, brushland and grassland.

Woodland floor: All dead vegetative matter on the mineral soil surface in the woodland, including litter and unincorporated humus.