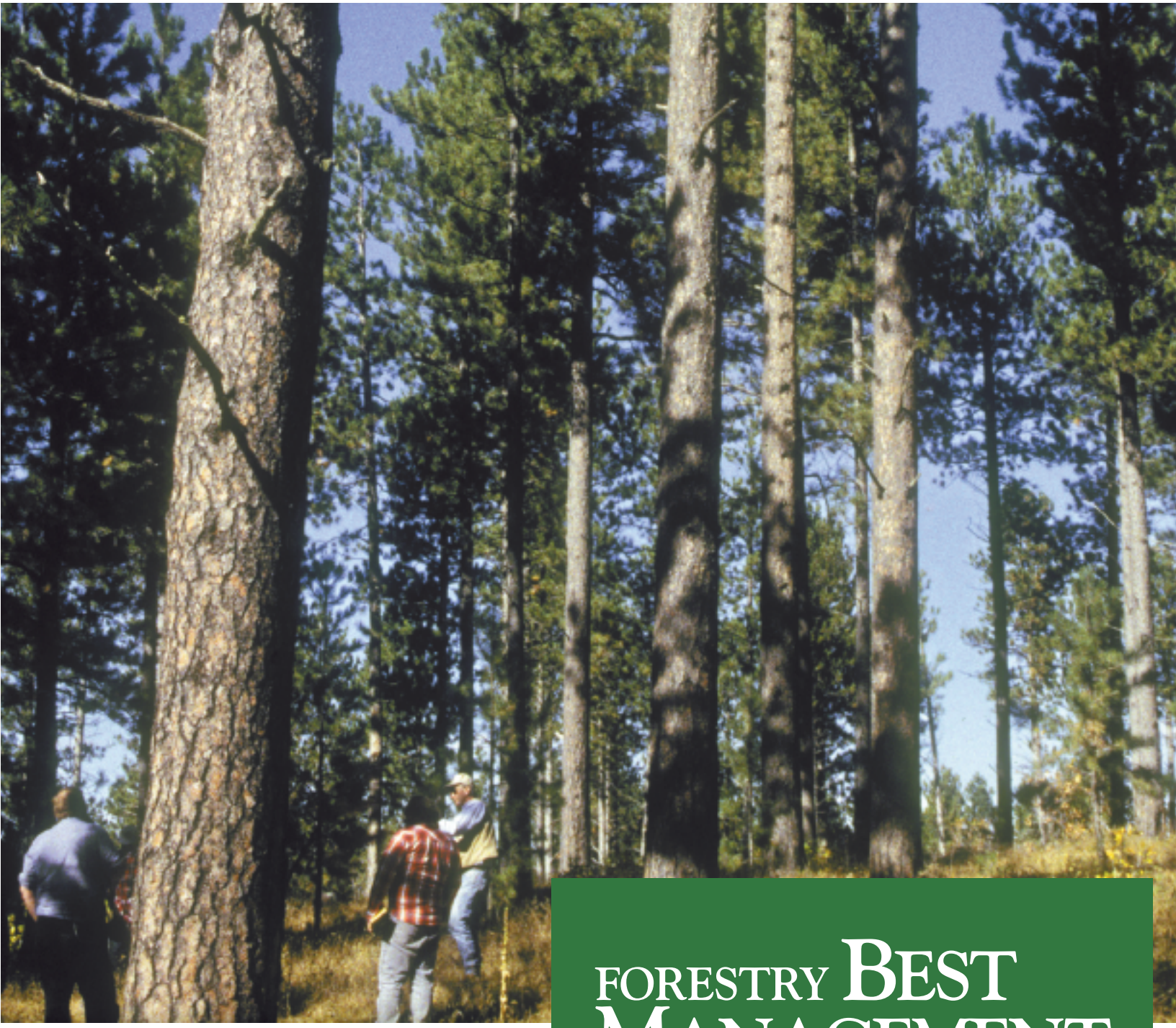


FORESTRY BEST MANAGEMENT PRACTICES FOR SOUTH DAKOTA

FORESTRY BEST MANAGEMENT PRACTICES FOR SOUTH DAKOTA

Contents

Publication of this manual was made possible by financial contributions provided by a Clean Water Act Section 319 grant by USEPA to the South Dakota Department of Environment and Natural Resources, a grant from the South Dakota Department of Agriculture, and the South Dakota Cooperative Extension Service. This is a revision of the 1993 Forestry Best Management Practices for South Dakota. This revision was based upon a public-private review of research and current practices.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the USDA. Larry Tidemann, director of CES, associate dean, College of Agriculture & Biological Sciences, South Dakota State University, Brookings. South Dakota State University is an Affirmative Action/Equal Opportunity Employer and offers all benefits, services, education, and employment without regard for race, color, creed, religion, national origin, ancestry, citizenship, age, gender, sexual orientation, disability, or Vietnam Era veteran status. ExtHort 203. 5,000 copies printed. December 2003.

South Dakota

is primarily a prairie state, but it is also rich in forest resources. More than 1.2 million acres of coniferous forests are found in the Black Hills and other areas of western South Dakota. Approximately 375,000 acres of hardwood forests line the state's rivers and streams or exist as scattered forests in upland areas.

Most timber harvests and associated forestry management activities occur in the Black Hills and, on a much lesser scale, in hardwood forests throughout the state. Timber harvest and forestry management activities have the potential to impact the environment wherever they take place.

The state of South Dakota has adopted best management practices (BMPs) to prevent pollution and minimize environmental impacts during and after a timber harvest or management activity. BMPs are practices, actions, or activities that limit soil disturbance and prevent pollution of surface and ground water resources.

The forestry BMPs described in this manual have been adopted by the state and are included in the South Dakota Nonpoint Source Pollution Management Plan. They have been approved by the U.S. Environmental Protection Agency (EPA) under a provision of the Clean Water Act.

ABOVE: Most of the erosion and sediment that originate from forestry operations can be traced to roads and skid trails or log landings.

RIGHT: When properly implemented, best management practices can protect streams from excessive sediment.

Forest Watersheds and Nonpoint Pollution

Most of the sediment and erosion that originate from forestry operations can be traced to roads and skid trails or log landings.

As water flows through the watershed, it picks up soil particles, which become sediment when suspended and moved by water. Sediment transported through a watershed is referred to as nonpoint source pollution, since its origin cannot easily be traced to a single point or area.

Plant cover and litter minimize soil erosion by holding the soil particles in place. When cover and litter are disturbed, the soil is exposed and erosion increases. Sediment that enters streams, rivers, and lakes may degrade the habitat of many aquatic organisms, reduce fish populations, increase drinking water treatment costs, and impact recreational use of downstream waters.

Forestry best management practices (BMPs) are practical activities that protect water quality during and after timber harvest and management by reducing erosion and the amount of sediment that reaches streams, rivers, and lakes.

Nonpoint Source Pollution Control Starts with a Written Plan

The South Dakota Department of Agriculture, Division of Resource Conservation and Forestry (RC&F) encourages landowners to prepare a written management plan for their forest properties. The federal land management agencies also use this document during their planning. While a management plan does not have to be complex, it should identify, at a minimum, what needs to be done, where the practices should be applied, and when they should be implemented. The practices should include BMPs that will protect water quality.

A well-written plan identifies the landowner's management objectives; describes the physical capabilities and limitations of the land and forest stand condition, age, and structural composition; and lists practices that will accomplish the objectives.

Assistance in preparing a management plan and properly implementing BMPs included in the plan is available from the Division of Resource Conservation and Forestry or from consulting and industry foresters. The division maintains a Register of Private Professional Foresters that can be obtained at any of the RC&F offices or by visiting:
http://www.state.sd.us/doa/forestry/service_forestry.htm

The Forests of South Dakota

Black Hills forests are dominated by ponderosa pine (*Pinus ponderosa*). White (Black Hills) spruce (*Picea glauca* var. *densata*) stands occur at higher elevations and along cool canyon walls. Small communities of lodgepole pine (*Pinus contorta*) occur west of Nahant in the central Black Hills. A single stand of limber pine (*Pinus flexilis*) grows in the Cathedral Spires located near Mount Rushmore.

While Black Hills forests are characterized by coniferous species, trembling aspen (*Populus tremuloides*) and other deciduous trees such as bur oak (*Quercus macrocarpa*) and paper birch (*Betula papyrifera*) occur as part of some plant communities. Riparian forests are found along some of the larger creeks.

American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), boxelder (*Acer negundo*), and cottonwood (*Populus deltoides*) have largely disappeared from the riparian landscape. The decline of these species has been linked to the development of rural housing areas, recreational activities, and grazing pressure.

Forests outside of the Black Hills region are primarily bottomland forests or occur in deep, rich, moist soils of drainages and draws. These forests provide important wildlife habitat and recreation sites and help reduce nonpoint source pollution. The dominant tree in these forests is green ash. American elm and, to a lesser extent, slippery elm (*Ulmus rubra*) were once major components of these forests, but both species declined significantly as Dutch elm disease spread through the state during the 1970s.

The once abundant stands of cottonwood in the state's bottomlands have also declined. After the Missouri River dams were built, flooding no longer exposed the bare mineral soils needed for cottonwood seed germination.

Bur oak forests occur throughout the state. While typically found on bottomlands along portions of the Big Sioux River and in the central portion of the state, bur oak also invades prairie uplands in the area

ABOVE: Hardwood forests of basswood and maple occur in some upland areas in eastern South Dakota.

LEFT: Ponderosa pine is the dominant species in the Black Hills.

just south of Wessington Springs in Jerauld County and north of Lucas in northeast Gregory County. Small sugar maple (*Acer saccharum*) and basswood (*Tilia americana*) forests occur in a few scattered stands in Marshall and Roberts counties.

Forestry has always played a significant role in South Dakota's economy. Forestry operations have been carried out in the Black Hills for more than a century. Currently about 92 percent of the sawtimber harvested in the state comes from the Black Hills.

Yet even though the Black Hills has been continuously logged for the past 130 years, the area covered by coniferous forest actually has increased. One of the main factors that forest managers cite for this increase is fire exclusion. Dense stands of ponderosa pine developed as the frequency of fires that removed seedlings from the understory decreased. The dense stands have an increased fire risk and vulnerability to attack from the mountain pine beetle. Forest management, including timber harvest, is critical in successfully reducing fire risk and insect attack and in maintaining a healthy forest.

The remainder of the state has also experienced commercial forest harvest for more than a century. The dominant sawtimber species is cottonwood, which accounts for about 5 percent of the total statewide timber harvest. However, unlike the increasing acreage of coniferous forests in the Black Hills, the hardwood forested area has decreased as a result of urban development, conversion to other agricultural uses, and the construction of the Missouri River dams. While there is some sawlog production, timber harvested from the state's hardwood forests is usually turned into pallets and fuel wood.

LEFT: Bottomland forests of ash, boxelder, elm, and oak occur along many of the rivers and streams in the state.

RIGHT: Forests are valuable regulators of aquifer recharge and stream flow.

Water Resources of South Dakota

South Dakota's climate ranges from semi-arid to subhumid. The annual precipitation is generally 11 to 12 inches in the far western regions and more than 25 inches in the southeast. Because moisture is limited, with the exception of the Black Hills and bottomland forests that line many of the state's rivers and streams, most of the land originally supported prairie vegetation.

The water supply for the state comes from two principal sources: surface water and ground water. With the exception of a small corner of the northeastern portion of the state, most of the surface waters in South Dakota drain into the Missouri River and then the Mississippi before eventually reaching the Gulf of Mexico. Regardless of where the stream ultimately drains, any pollution that enters a stream has a local impact and also compounds problems farther downstream.

Ground water is contained in water-holding strata called aquifers. Aquifers are replenished by precipitation. Water that enters an aquifer may re-emerge as springs, streams, or rivers or be pumped for agricultural, industrial, or household uses.

Forests are valuable regulators of aquifer recharge and stream flow. Trees and other forest plants also help reduce nonpoint source pollution by holding soil particles in place. Tree branches that overhang streams and river banks provide shade that helps cool the water and improve habitat for fish and other aquatic organisms.

Watersheds are an interconnected network of wetlands, streams, and rivers. Each has unique characteristics and differs in how it affects water quality.

Perennial streams, sometimes referred to as live streams, flow throughout the year under normal weather conditions. Perennial streams have a channel with a well-defined bed and bank. These streams are usually shown as solid blue lines on a topographic map. In South Dakota,

plants such as rush (*Juncus* spp.), sedges (*Carex* spp.), boxelder, green ash, plains cottonwood (*Populus deltoides* subsp. *monilifera*), and willows (*Salix* spp.) commonly inhabit the banks.

Intermittent streams have a well-defined channel but carry water only during part of the year. Intermittent streams are shown as dashed blue lines on topographic maps. Across the state, a number of plants may be found in association with intermittent streams: sedges, blue vervain (*Verbena hastata*), wild licorice(*Glycyrrhiza lepidota*), and sandbar willow (*Salix exigua*).

Ephemeral streams do not have a well-defined channel. They carry surface water in a diffused manner during and immediately following a rain. Because the banks are not well defined these streams are sometimes referred to as ephemeral areas. Many different plants can be found in ephemeral areas but are not specific to them.

Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions. Wetlands include marshes, swamps, bogs, and similar areas. Their boundaries are sometimes difficult to identify, but changes in the composition of vegetation can sometimes identify them. Typical wetland plants in South Dakota include common cattail (*Typha latifolia*), bulrushes (*Scirpus* spp.), giant burreed (*Sparganium eurycarpum*), smartweeds (*Polygonum* spp.), redosier dogwood (*Cornus sericea*), and willow (*Salix* spp.).

Streamside Management Zones (SMZ) are strips of land at least 50 feet wide adjacent to a surface water body or perennial stream. An SMZ acts as a filter that traps sediment, logging debris, pesticides, and other pollutants. An SMZ also provides wildlife habitat and improves aesthetics. The SMZ should be designated before beginning timber harvests or other management activities.

While the land adjacent to intermittent streams or ephemeral areas is not normally considered an SMZ, care must also be used while working in these areas to minimize the impact of forestry management practices.

BELOW: Although they may be dry during much of the year, intermittent streams are identified by well-defined channels.

LEFT: Ephemeral streams are difficult to identify. They do not contain flowing water except immediately following a rainfall event.

ABOVE: Perennial streams contain water throughout the year. Streamside management zones serve as filters, protect wildlife habitat, and enhance aesthetics.

BELOW: Wetlands support a variety of aquatic plants including cattails.

RIGHT: Keep grades low unless steeper grades are necessary to follow the contour of the slope or to avoid excessive cut and fill.

While 33CFR part 323.4 Chapter 6 states that an 404 permit is not required for silvicultural practices, always contact the U.S. Corps of Engineers when fill may be placed in any waters of the United States.

Roads

In South Dakota, roads produce most of the pollution associated with forest management operations. Poor road construction can result in erosion and in sediments entering surface water. The increased sediment can result in several environmental problems, from degraded stream and wetland quality for plants, fish, and animals to reduced water quality for human consumption and recreation. Roads can also block fish passage, which may reduce natural reproduction. Roads and skid trails should be planned to minimize potential impacts on water quality during both construction and use phases. Construct roads and trails so that water moves off of them before erosion can occur. Use topographic maps, soil maps, and aerial photographs to identify streams, wetlands, steep slopes, and floodplains.

Planning and Location

Use existing roads when practical. If existing roads cannot be used, minimize the number of roads that must be constructed through comprehensive planning that takes into account intermingled ownership and foreseeable future use.

Review available information and consult with professionals to help identify erodible soils and unstable areas and locate appropriate road-surface materials.

Fit roads to the topography. Locate roads on natural benches. Follow natural contours. Avoid long, steep grades and narrow canyons.

Locate roads on stable geology with well-drained soils and rock formations that dip into the slope.

Avoid slumps and slide-prone areas characterized by steep slopes, highly weathered bedrock, clay beds, concave slopes, hummocky topography, and rock layers that dip parallel to the slope.

Avoid swamps, wet meadows, and natural drainage channels with moisture-laden or unstable toe slopes.

To reduce soil disturbance, construct a relatively flat, well-drained access to the log landing areas. Landings and roads should be located outside the SMZ and a safe distance from streams. Sediment traps should be installed where needed.

When a road must run parallel to a stream channel, provide an adequate streamside management zone (SMZ) to trap sediment and prevent its entry into the stream.

Minimize the number of stream crossings. Construct stream crossings at stable sites.

Design

Properly design roads and drainage facilities to prevent potential water quality problems.

Design roads to at least the minimum standard necessary to accommodate

ABOVE: Outslope roads are slightly slanted away from the cut bank.

RIGHT: Inslope roads are slightly slanted toward the cut bank.

anticipated use and equipment. The need for higher-standard roads can be alleviated through better use management.

Balance cuts and fills. Use side cast or end haul where stable fill construction is not possible.

Design roads for minimal disruption of natural drainage patterns. Vary road grades to reduce concentrated flow in ditches, culverts, and over fill slopes and road surfaces.

Allow for fish passage at stream crossings.

Drainage from Road Surfaces

Provide adequate drainage from the surface of all permanent and temporary roads. Recommended techniques include, but are not limited to, using outsloped or crowned roads, drain dips, or insloped roads with ditches and crossdrains. Space road drainage features so that peak drainage flow on the road or in ditches will not exceed the capacity of the individual drainage structures.

Outsloped roads: An outsloped road slopes slightly (generally 1-3 percent but may be as much as 5 percent) from the cut bank to the outside edge of the road bed. Outslopes disperse water with low-energy flow. Outsloped roads are appropriate when fill slopes are stable, drainage is diverted onto undisturbed forest floor away from stream channels, and transportation safety considerations can be met. Outsloping eliminates the need for inside ditches and reduces road maintenance but can become unsafe if road surfaces are slick or snow and ice covered.

Insloped roads: An inslope is a section of road that is slightly sloped (1-3 percent) toward the cut bank. An inslope can be an effective means of limiting erosion. Water is removed from the road quickly and diverted into an inside ditch that carries the water to a culvert. When using an inslope, construct ditch gradients steep enough (generally greater than 2 percent but less than 8 percent) to prevent sediment deposition and ditch erosion. A higher gradient may be suitable for more stable soils. Use lower gradients for less stable soils.

Drainage dips: Properly constructed drainage dips are an economical way to channel surface water flow off roads. Dips disperse water across the road, thereby reducing the energy of flow and the potential for erosion. Drainage dips can also reduce the need for culverts and force slower traffic speeds that facilitate wildlife crossing. Construct dips deep enough into the subgrade so that they are not obliterated by traffic.

Ditch relief culverts: These structures carry water away from the roadbed and allow for better infiltration. Skew ditch relief culverts approximately 20 to 30 degrees toward the inflow from the ditch to improve inlet efficiency. Protect the upstream end of crossdrain culverts to prevent plugging. When possible, install ditch relief culverts at the gradient of the original ground slope. Armor outlets with rock or anchor downspouts to carry water safely across the fill slope.

Energy dissipaters and debris racks: Both structures reduce water velocity and prevent erosion. Dissipaters include riprap and vegetated ditches. Construct energy dissipaters (rock piles, logs, etc) where necessary at the downstream end of ditch relief culverts to reduce the energy of the emerging water.

Crossdrains, culverts, water bars, dips, and other drainage structures should not discharge onto erodible soils or fill slopes unless outfall protection is installed.

Prevent downslope movement of sediment by using sediment catch basins, drop inlets, changes in road grade, headwalls, or recessed cut slopes.

Route road drainage through SMZs, filtration fields, or other sediment trapping structures. Install road drainage features above stream crossings to route the discharge into filtration zones before entering a stream.

Water bars: Water bars are excavated channels with a berm. Water bars are constructed across a road to intercept and divert water from side ditches and road or trail surfaces. Waterbars are best suited for roads that receive little use for extended periods of time. They are difficult to drive over and are easily eroded when subjected to heavy traffic.

Construction

Keep slope stabilization, erosion, and sediment control activities current with road construction activity. Install drainage features as part of the construction process.

Complete or stabilize road sections within the same operating season. Ensure that drainage features are fully functional prior to spring or fall runoff and that major road sections are not left in an unstable condition over winter.

Stabilize exposed soils by seeding, compacting, riprapping, benching, mulching, or other suitable means prior to fall or spring runoff.

At the toe of potentially erodible fill slopes, particularly near stream channels, pile slash in a row parallel to the road to trap sediment. When done at the same time as road construction, the practice effectively controls sediment movement and provides an economical way of disposing of roadway slash. Limit the height, width, and length of "slash-filter windrows" so that wildlife movement is not impeded.

Minimize earth-moving activities when soils appear excessively wet. To maintain

slope stability, do not disturb roadside vegetation more than necessary.

Construct cut and fill slopes at stable angles.

Avoid placing potentially unstable woody debris in the fill portion of the road prism. When possible, leave existing rooted trees or shrubs at the toe of the fill slope to stabilize the fill.

Consider road surfacing to minimize erosion.

Place debris, overburden, and waste materials from construction and maintenance activities in a location that prevents their entry into streams. Include waste areas in the soil stabilization plan for the road.

Minimize sediment originating from borrow pits and gravel sources through proper location, development, and reclamation.

Avoid disturbing stable road surfaces.

Reconstruct existing roads only to the extent necessary to provide adequate drainage and safety.

Water Bar Construction

Install water bars at the top of any sloping road or trail. Space additional water bars along the road or trail to its base using the suggested spacing in the table above.

The uphill end of a water bar should extend beyond the side ditch of the road or trail. The downhill end should extend far enough beyond the road to disperse the water onto undisturbed ground.

The water bar should have a 30- to 35-degree angle downslope from a line perpendicular to the direction of the road or trail. The water bar should have a 2-4 percent outslope along this angle.

Stabilization

Water diversion structures such as water bars, culverts, and dips must be in place and operative before stabilization activities are initiated.

Seed disturbed areas as soon as possible but no later than 6 months after termination of management or timber harvest activities. Seed in the spring as soon as the ground can be worked or during late summer or early fall.

Spacing For Water Bars

ROAD OR TRAIL GRADE (%)	SPACING BETWEEN WATER BARS (FEET)
2	250
5	135
10	80
15	60
20	45

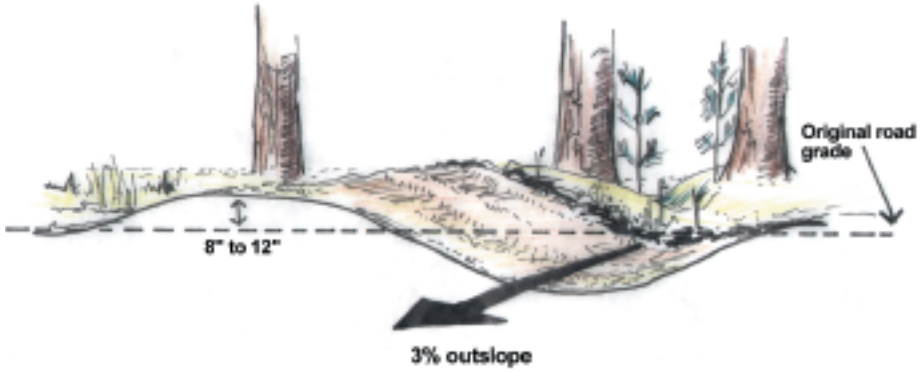
Prepare the seedbed by grading, removing debris, and scarifying the soil to a minimum depth of 3 inches.

Use mechanical seeders, drills, fertilizer spreaders, or other seeding equipment to plant the seed. The average seeding rate is generally 18 to 20 pounds of seed mixture per acre. Contact the Forest Service or RC&F office for local seeding rates.

Seed mixtures should be grass and forb species native to the region. They may contain a small component, usually less than 15 percent, of introduced annuals such as annual ryegrass. These annuals are included to provide quick cover and enhance establishment of the native plants.

Use seed originating from South Dakota, North Dakota, Nebraska, Wyoming, or Montana. Use the following varieties when available and appropriate for the site: sideoats grama (Pierre, Butte, Kildeer); slender wheatgrass (Primar, Pryor); western wheatgrass (Roseanna). Seed should be free of weed seed and other foreign material.

Use straw, hay, wood fiber, or cellulose fiber mulch to retain moisture necessary for seed germination and seedling survival and protect the soil surface from erosion during the stabilization process.



Straw mulch should be from oats, wheat, rye, or other grain crops. The straw should be air-dry and free of weeds, mold, and other undesirable material.

Hay mulch should be from mowing. It should be air-dry and free of weeds, mold, and other undesirable material.

Wood fiber mulch, made up of processed wood fiber from wood chips, should not be treated with growth- or germination-inhibiting substances and should be weed free.

Cellulose fiber mulch, composed of grass-straw fiber, should not be treated with growth or germination inhibiting substances and should be weed free.

LEFT: Drainage dips allow water to disperse across the road.

ABOVE: Shallow water bars have a rise of 8 to 12 inches. Deeper bars, for roads with grades that exceed 10 percent, may have a 24 to 30 inch rise.

BELOW: Use straw, hay, wood fiber, or cellulose fiber mulch to retain moisture for seed germination and seedling survival and to protect the soil surface from erosion during the stabilization process.

Seeded areas should be closed to all use until the planting is established.

Maintenance

Grade road surfaces only as often as necessary to maintain a stable surface and drainage.

Develop an inspection and maintenance schedule to ensure erosion control features are in place and functioning. Inspect and clean dips and crossdrains, repair ditches, mark culvert inlets to aid in locating them, and clear debris from culverts according to the schedule and after major rainfall/snow melt events.

Avoid cutting the toe of cut slopes when grading roads or pulling ditches.

When plowing snow for winter timber harvests, provide breaks in snow berms to allow road drainage.

Haul all excess material removed by maintenance operations to safe disposal sites and stabilize the sites to prevent erosion.

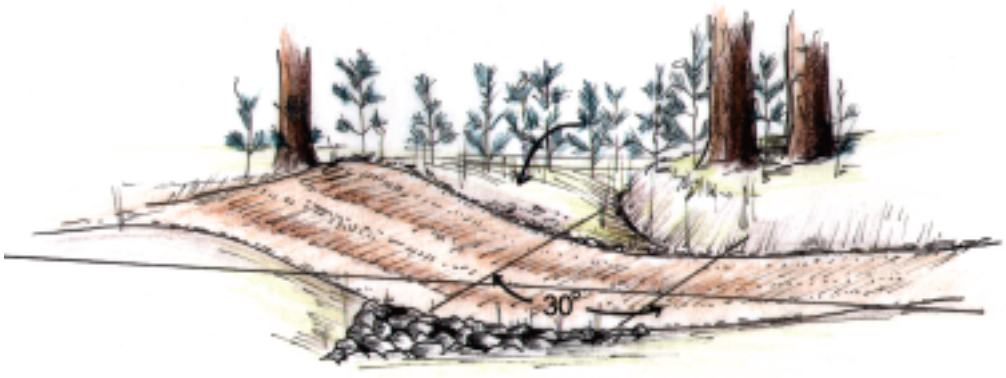
Avoid sidecasting material into streams or areas where erosion will carry material into streams.

Avoid using roads during wet periods if use would likely damage road drainage.

Upon completion of seasonal operations, the road surface should be crowned, outsloped, insloped, or water-barred. Remove berms from the outside edge of the road where runoff is channeled.

Road Closures

Leave abandoned roads in a condition that provides adequate drainage without the need for further maintenance. Close all abandoned roads to traffic, and then scarify and reseed. If necessary, recontour the roadbed and install water bars or drainage dips.



Timber Harvest

All timber harvests should be conducted with the goal of regenerating the forest to a desirable tree species. Different species require different silvicultural systems to ensure successful regeneration.

Base species selection on the environmental and biological requirements of the species and the ability of the site to satisfy the requirements. The type of silvicultural system used to harvest timber – clearcut, shelterwood, seed tree, selection, patch cut – will affect timing and species composition of natural regeneration.

The South Dakota Division of Resource Conservation and Forestry encourages landowners to consult a professional forester prior to conducting any timber harvest. The division maintains a list of registered private professional foresters who provide timber harvest plan development assistance. To obtain a copy of the list contact any of the division's offices or visit: http://www.state.sd.us/doa/forestry/service_forestry.htm

A timber harvest is a business transaction. All harvests should be carried out under a written contract between the landowner (seller) and the logger (buyer). The contract should include an exact description of the harvest area, sale price, method of payment, completion deadlines, performance bond requirements, slash treatment, road construction requirements, road regrading and revegetation after the sale, and any other factors relative to the sale.

Design

Plan a timber harvest with consideration of the objectives of the landowner or agency and the harvest's potential effects on water quality and beneficial uses in mind.

Use logging systems that fit the topography, soil type, and seasons and minimize soil disturbances while economically accomplishing your silvicultural objectives.

Use a yarding system that minimizes road density.

Establish log forwarding areas in locations that reduce road density and land impact but that at the same time are feasible from both an economic and operational standpoint.

LEFT ABOVE: The shelterwood method, a system where a partial overstory is left to provide shelter for the crop of young trees, is the most common silvicultural system employed in the Black Hills.

LEFT BELOW: A drainage dip is a hump placed to divert water off the road. A dip is best suited for roads rated 10 percent or less.

BELOW: Log landings should be outside the SMZ.

Design and locate skid trails and operations to minimize soil disturbance. Designed skid trails limit site disturbance and soil compaction. Consider the potential for erosion and alternative yarding systems prior to planning tractor skidding on steep or unstable slopes.

Locate skid trails and landings away from natural drainage systems. Limit the grades of constructed skid trails on geologically unstable, saturated, highly erosive, or easily compacted soils. Construct skid trails to concentrate runoff, provide breaks in grade, and divert runoff to stable areas. Use water bars, and plant grass to reduce erosion.

Minimize the size and number of landings to accommodate a safe, economical operation. Avoid locating landings that require skidding logs across drainages.

ABOVE LEFT: Quickly establish a grass cover to reduce erosion.

LEFT BELOW: A Streamside Management Zone is typically 50 feet on either side of a perennial stream.

Streamside Management

Design streamside management zones to shade streams, stabilize soil, filter sediment, and provide wildlife habitat.

An SMZ is a strip at least 50 feet wide on each side of a perennial stream. The distance is measured starting at the ordinary high-water mark or definable bank. The width of the SMZ should extend beyond the 50 foot minimum to include wetlands in the stream bottom and provide additional protection in areas with steep slopes or erosive soils.

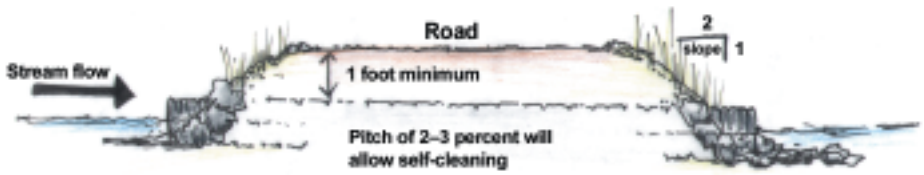
Consult with forestry professionals, soil and water conservation specialists, or biologists if assistance is needed in determining SMZ boundaries.

Consider the following practices when the management plan recommends harvesting in the SMZ:

- Retain shrubs, deciduous trees, and unmerchantable and some merchantable conifers adjacent to the stream.
- Retain trees necessary for bank stabilization and to provide a future source of large woody debris for the stream channel. Large woody debris in the channel helps dissipate stream energy, stabilize banks, and form pools that trap sediment and provide fish habitat.
- When harvesting within the SMZ, consider the length of stream channel that may be opened to the sun. When possible, keep continuous openings to less than 600 feet of stream length to prevent increases in water temperature and to promote wildlife habitat diversity.
- Maintain or provide sufficient ground cover to trap sediment. Hand-scalping and planting may be preferable to machine scarification or burning in the SMZ.
- Whole-tree or tree-length yarding reduces the need for slash disposal in the SMZ.
- Steep slopes containing material that may roll down the slope and fall into a stream during a burn operation should receive special attention. High-stump trees logged along streams help prevent debris buildup in streams.
- If site preparation involves burning steep ground adjacent to the SMZ, a slash-free zone may be necessary to maintain streamside vegetation.
- Hand treatment and retention of slash above the high water mark may be necessary to trap sediment.

Minimize operation of wheeled or tracked equipment within the SMZ. Avoid equipment operation in wetlands, except when the ground is frozen, and use materials such as pallets to protect the vegetation. Do not operate equipment on stream banks.

Use directional felling for harvest operations in SMZs. Avoid felling trees or leaving slash in streams or water bodies. Limb or top trees above the high water mark.



ABOVE: Place culverts on the same grade as the stream bed to allow fish passage.

ABOVE: Slash can be lopped and scattered to reduce soil compaction and erosion.

RIGHT: Culverts are usually constructed from corrugated metal pipe.

Other Harvest Activities

Remove slash from streams and store above high water mark.

Whenever possible, suspend the lead end of a log during skidding. When ground skidding systems are employed, use cables to end-line logs out of SMZs and wetlands.

Skid at times when compaction, displacement, and erosion will be minimized. Limit tractor or wheeled skidding on unstable, permanently or seasonally wet, or easily compacted soils and on slopes that exceed 40 percent unless operations can be conducted without causing excessive erosion.

For each landing, skid trail, or fire trail, provide and maintain a drainage system to disperse runoff and prevent sediment from entering a stream.

Install water bars on tractor skid trails. The appropriate spacing between bars is determined by the soil type and slope of the skid trails (see page 12).

Reseed the disturbed area or construct water bars on skid trails, landings, and fire trails when natural revegetation is expected to be inadequate to prevent accelerated erosion before the next growing season. A light ground cover of slash or mulch may also be used to reduce erosion.

Slash Treatment and Site Preparation

Rapid reforestation of the harvested area is encouraged to establish protective vegetation.

Attention must be given to South Dakota Codified Laws (SDCL) 21-10-26 & 21-10-27 and South Dakota Administrative Rule (SDAR) 12:12:12 when dealing with the treatment of logging slash.

SDCL 21-10-26.
Logging slash defined. For the purpose of this section and SDCL 21-10-27, the term "logging slash" is logging debris consisting of treetops, limbs, cull logs and other separate vegetation remaining after harvest and having no commercial value. Logging slash shall be treated by lopping and scattering the vegetation, by removal from the site or by piling and burning. Lopping and scattering, abandonment, removal or piling and burning shall be defined pursuant to rules promulgated by the division of forestry pursuant to chapter 1-26.

SDCL 21-10-27.
Abandonment of logging slash as public nuisance – Penalty. The abandonment of untreated logging slash in a timber harvesting operation consisting of ten acres or more is a public nuisance. Abandonment of untreated logging slash in a timber harvesting operation of ten acres or more is a Class 1 misdemeanor.

Use blades on dozers or skidders when piling slash. Site preparation equipment that produces irregular surfaces is preferred. Care should be taken to preserve the surface soil horizon.

Minimize or eliminate long areas of exposed soil on slopes during mechanical scarification.

Scarify the soil only to the extent necessary to meet the reforestation objective of the site. Some slash and debris (preferably leaves, needles, or small limbs) should be left to reduce surface runoff, return nutrients, and provide shade for seedlings.

Complete brush piling and scarification when soils are frozen or dry enough to minimize compaction and displacement.

Scarify steep slopes on the contour to minimize erosion. Alternate methods of site preparation should be considered on slopes greater than 40 percent.

Stabilize or reclaim landings and temporary roads as soon as possible after completion of use.

Remove and deposit all logging machinery debris at a proper disposal site.

Limit the water quality impacts of prescribed fire by constructing water bars in the firelines, not placing slash in drainage channels, maintaining the SMZ, and avoiding intense fires unless needed to meet management goals.

Stream Crossings

Stream crossings have the highest potential for release of sediments to streams and are a major concern in road construction. The number of stream crossings should be kept to a minimum. When a stream crossing is necessary, install a culvert or a temporary bridge. Culverts are usually made of corrugated metal pipe and are placed under a road or skid trail to permit crossing of an intermittent or permanent stream. Culvert installation should be completed during a no- or low-flow time period wherever possible.

Design Considerations

Cross streams at right angles to the main channel whenever possible. Adjust the road grade to reduce the concentration of water carried by drainage ditches to stream crossings. Direct drainage flows through an SMZ and away from the crossing site.

Avoid unimproved stream crossings.

When a culvert or bridge is not feasible, locate drive-throughs in a stable, rocky portion of the stream channel.

Installation of Stream Crossings

Culverts are used for road drainage and stream channel crossings. Generally constructed of corrugated metal pipe, culverts keep water separated from the roadway and can maintain stream integrity. Minimize stream channel disturbances and related sediment problems during road construction and installation of stream-crossing structures. Use silt fences, interlocking straw bales, or other methods to prevent soil and other debris from entering streams during construction and until any disturbed area has been stabilized. It may be necessary to install silt fencing across the stream channel downstream from construction to prevent migration of sediment. The catch basin formed by the silt fence must be cleaned out and the sediments removed after the construction site has stabilized.

Do not place erodible materials in stream channels. Remove stockpiled material from high water zones. Locate temporary construction bypass roads where the stream course will have minimal disturbance. Time construction activities to protect fisheries and water quality.

When using culverts to cross small streams, install the culverts to conform to the natural stream bed and slope.

Place culverts slightly below the normal stream grade to avoid culvert outfall barriers. Do not alter stream channels upstream from culverts unless it is necessary to protect fill or to prevent culvert blockage.

Install culverts to prevent erosion.

ABOVE: Skew culverts 15 to 30 degrees toward inflow ditch to reduce maintenance problems.

ABOVE RIGHT: When streams have to be forded for long periods, portable bridges can be a practical solution to minimizing the impact of stream crossing. Make crossing at right angle to the stream and only in straight sections. Choose a site with approaches that allow for adequate visibility and a relatively constant grade to the bridge.

BELOW RIGHT : Firmly pack materials around culverts to prevent washing out.

Compact fill material to prevent seepage and failure. Armor the inlet and/or outlet with rock or other suitable materials.

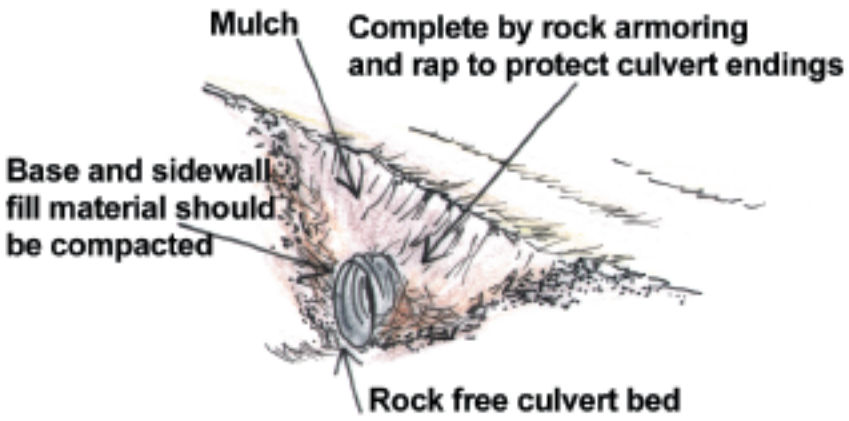
Consider "dewatering" stream-crossing sites during culvert installation.

Cover 18- to 36-inch diameter culverts a minimum of 1 foot. Cover larger culverts to a depth of one-third the diameter of the culvert.

Use culverts with a minimum diameter of 15 inches for permanent stream crossings and cross drains.

Culvert Installation

Before logging, mark existing culvert locations. During and after logging, make sure that all culverts and ditches are open and functional.



Install culverts at right angles to the stream. A maximum 15-degree skew is allowed if approach conditions are difficult.

The inlet should be located at or below, never above, the stream bed. Do not place fill below the culvert to achieve a grade.

The inlet and outlet ends of the culvert should extend at least 1 foot beyond the toe of the fill. Protect the upstream end of the fill from erosion by installing a rock header. Protect the downstream end of the fill from erosion with riprap.

Determining spacing and sizing of culverts must be done with care. Installing culverts that are too small or too few culverts can result in flow over the road or road failure.

Improperly placed culverts can destroy habitat and prevent fish passage.

To determine proper culvert size, measure the width of the stream channel at the high water mark and the depth of the channel to the nearest foot. Multiply the width by the depth to determine the channel area. Use the table below to select the culvert size needed for the calculated channel area.

To allow for high flows, always round up to the next largest pipe. For example, if the calculated channel area is 1.8 square feet, select a pipe with a diameter of 24 inches.

When installing several culverts, all culverts in the series should be installed at the same elevation to prevent headcutting of the lowest.

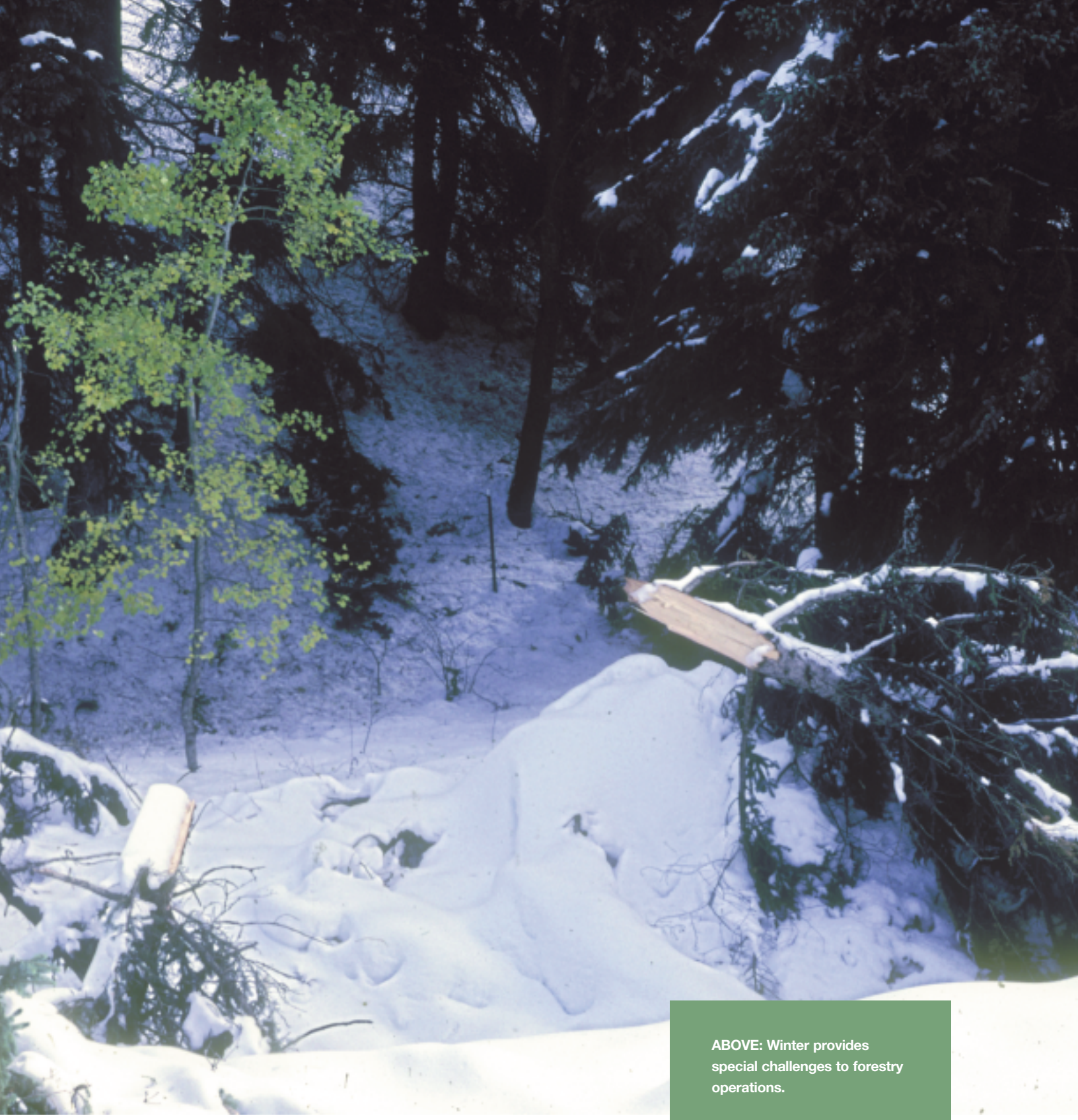
Cover the tops of culverts with at least 1 foot of compacted fill to minimize damage from vehicles and road maintenance.

Inspect culverts on a regular schedule and after major runoff events. Clean as necessary.

Calculating Culvert Size

AREA (SQUARE FEET)	PIPE DIAMETER (INCHES)
1.0	15
1.5	18
2.5	24
4.0	30
5.0	36

Adapted from Utah's Forest Water Quality Guidelines. Utah Department of Natural Resources.



ABOVE: Winter provides special challenges to forestry operations.

ABOVE: Use compacted snow for road beds in unroaded sites.

Winter Logging

Consider "snow-road" construction and winter harvesting activities on sites characterized by high water tables, sensitive riparian conditions, or other significant soil erosion or compaction concerns.

Conduct winter logging operations when the ground is frozen to a depth of more than 2 inches or snow cover is adequate (generally more than one foot) to minimize site disturbance. Suspend operations if conditions change rapidly and before the erosion hazard becomes high. Suspend operations on frozen roads when rutting exceeds 6 inches for a continuous distance greater than 300 feet.

Road Construction and Harvesting Considerations

For road systems that cross areas having a poor foundation, consider hauling only during frozen periods. During cold weather, plow snow off of the roadway to facilitate deep freezing of the grade prior to hauling.

Before logging, mark existing culvert locations. During and after logging, make sure that all culverts and ditches are open and functional.

Use compacted snow for road beds in unroaded sites. Construct snow roads for single-entry harvests or temporary roads.

Designate or mark all stream courses, including small streams, prior to snowfall. In streamside zones, use practices that minimize ground disturbance. Following completion of snow road use, restore stream crossings to as near pre-road conditions as possible to prevent the formation of ice dams. Except for crossings, do not use the stream channel as part of a roadway.

Prior to felling in areas with wet, unfrozen soils, use tractors or skidders to compact the snow for skid road locations. Avoid steep areas where frozen skid trails may be subject to erosion the next spring. Return the following summer and build erosion barriers on any trails that are steep enough to erode.

Do not leave slash and tops in streams.

Hazardous Substances

Legal Requirements

Attention must be given to SDCL 38-19 & ARSD 12:44 fertilizer rules; SDCL 38-20A, 38-21 & ARSD 12:56 pesticide rules.

SDCL 38-21-15
Pesticide handling causing injury or pollution prohibited – Rules and regulations – Penalty for violation. No person may transport, store, use, dispose of or handle any pesticide, pesticide container, rinsate or application equipment in such a manner as to endanger or cause injury to humans, vegetation, crops, livestock, wildlife or beneficial insects or pollute groundwater or surface water. The secretary of agriculture may promulgate rules pursuant to chapter 1-26 governing the storing, transport, use, disposal of and handling of such pesticides, pesticide containers, rinsate and application equipment. Any person who violates this section is subject to a civil penalty not to exceed five thousand dollars per violation.

General

Log landings, skid trails, roads, and other sites disturbed during a timber harvest operation are susceptible to invasion by noxious weeds. Lands infested with noxious weeds are a public nuisance under the provisions of SDCL 38-22-16. Landowners should learn to identify noxious weeds, limit their establishment, and control their spread. A list of noxious weeds is available from the South Dakota Department of Agriculture or by visiting:
http://www.state.sd.us/doa/das/hpw&p.htm#weed

Photographic guides to help identify noxious weeds are available at county Extension and county weed and pest board offices and on the Department of Agriculture website. Information about pesticide applications can be also obtained from local Extension and county weed and pest board offices. Licensing questions should be addressed to the Department of Agriculture.

Know and comply with regulations governing the storage, handling, application (including licensing of applicators), and disposal of hazardous substances.

Do not transport, handle, store, load, apply, or dispose of any hazardous substance in such a manner as to pollute water supplies or waterways, or cause damage or injury to land, humans, desirable plants, or animals.

Develop a contingency plan for hazardous substance spills, including cleanup procedures and notification of the Department of Environment & Natural Resources. Notification of the Department of Agriculture (SDDA) is required after any pesticide and fertilizer spills.

Fuels and Lubricants

Prevent contamination of water from accidental spills of fuels, lubricants, and other harmful materials by servicing or fueling vehicles and equipment at least 150 feet from wetlands and stream channels.

Construct a berm around service areas to contain spills.

Pesticides

Use an integrated pest management (IPM) approach to control weeds and pests. IPM includes the use of manual, biological, mechanical, preventive, and chemical control measures.

Prevent the entry of hazardous substances into surface waters.

To enhance pesticide effectiveness and prevent its transport into streams, apply the chemical during appropriate weather conditions (generally calm and dry) and during the optimum time for control of the target pest or weed. Be sure to read and follow the label instructions.

Glossary

Best Management Practice (BMP): A practice or combination of practices that prevents or reduces erosion or sedimentation in streams and rivers.

Erodible soil: Soil exposed or displaced that is readily moved by the actions of water.

End haul: The removal and transportation of excavated material from a site.

Grade: The distance a road or trail rises or falls over a horizontal distance. Grades are expressed in percent. A road that rises 10 feet in 100 feet horizontal distance has a 10 percent grade.

Insloped roads: A section of road that is slightly sloped (1-3 percent) toward the cut bank.

Log landing: An area where logs are temporarily assembled and stored.

Outsloped roads: A section of road sloped slightly (generally 1-3 percent but as much as 5 percent) from the cut bank to the outside edge of the road bed.

Overburden: The surface soil moved to construct a road or trail.

Mulch: A loose, organic covering for exposed soil to protect seeds and control erosion.

Scarify: Any activity that mechanically loosens or breaks the soil in preparation for seeding.

Sidecast: The material or the act of moving excavated material to the side and depositing the material lateral to the movement of the excavating machines.

Skid trails: An unsurfaced, single lane trail used for skidding logs.

Slash: Woody debris left after a timber harvest. Slash includes stems, branches, and foliage.

Slope: The deviation of a surface from the horizontal, usually expressed as a percent or in degrees. A 50 percent slope rises 50 vertical feet in 100 horizontal feet. A 45 degree slope rises 100 vertical feet in 100 horizontal feet.

Stream: A natural water course.

Perennial streams, sometimes referred as live streams, flow throughout the year under normal weather conditions. Perennial streams have a channel with a well defined bed and bank.

Intermittent streams have a well-defined channel but carry water only during part of the year.

Ephemeral streams carry surface water in a diffused manner, not within a well-defined channel, during and immediately following a rain. Because the banks are not well defined these streams are sometimes referred to as ephemeral areas.

Streamside Management Zone (SMZ): A strip of land adjacent to any surface water body or perennial stream where soil disturbances are minimized to provide a buffer between forestry activities and a water course.

Toe: The point where the slope of the road intersects with the ground.

Water bars: Excavated channels with a berm constructed across a road or skid trail to divert water from side ditches and road surfaces.

Wetlands: Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support vegetation typically adapted for life in saturated soil conditions.

South Dakota State University
South Dakota Cooperative Extension Service
South Dakota Division of Resource Conservation and Forestry
South Dakota Department of Environment and Natural Resources
South Dakota Department of Agriculture
U.S. Environmental Protection Agency
cooperating