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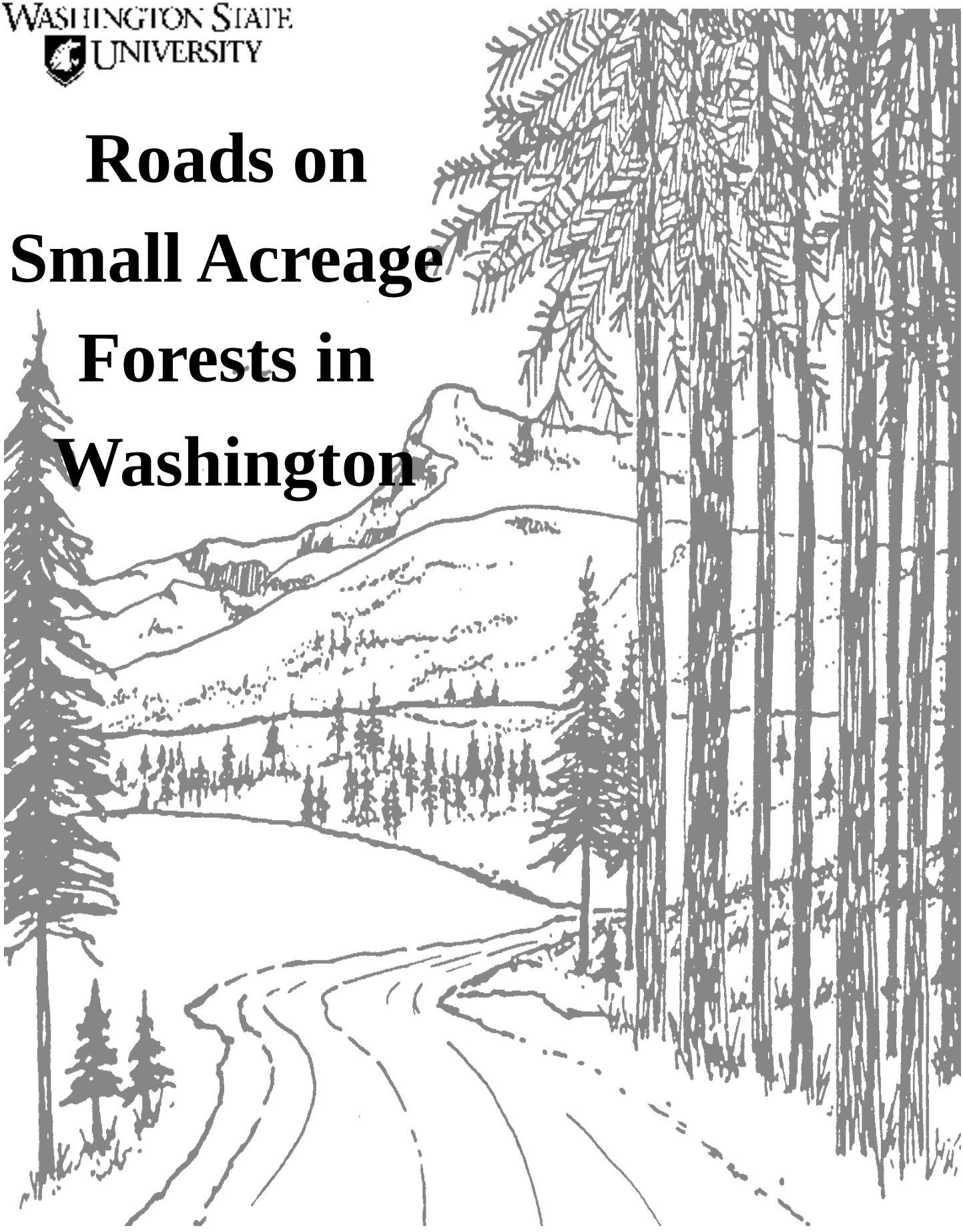
Roads on Small Acreage Forests in Washington



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Roads on Small Acreage Forests in Washington

Ideally, a road system should give adequate access while tying up a minimum of land in that system. It is important to maintain minimum impact on stream functions and water quality. Research indicates surface runoff from roads and failure of road fill-slopes are leading causes of sedimentation from forest management activities. Another consideration: a roadbed is usually a single use proposition—trees do not grow on it; it does not provide much wildlife habitat; soil compaction prevents a road bed from soaking up precious water; and alteration of topography by road building changes the way water soaks in or runs off the area down slope from that road.

Road considerations must be a part of management strategy. Putting a new access road into each area will soon result in a maze of roads, which take up much more land area than is necessary. A rough rule of thumb is to have roads and landings occupy no more than 15% of your woodland area. This sounds simple, but on the ground it is not so easy. Consider the following when planning your road system.

Purpose

For planning, classify roads into three broad categories:

- Haul roads provide logging trucks a way to haul logs from a landing to a public access road. These are generally the biggest and most expensive roads to build. Because of the magnitude of soil disturbance, these roads also have great potential to hurt the environment. Most haul roads are permanent and require periodic maintenance. If you have a great deal of haul road to build, plan to finance it from timber sale income or another source.
- Skid roads allow ground-based equipment to move the logs from the stump to the landing. Often, when these roads are not needed for later use, they are obliterated. Or, they may be, as the forestry crowd says, “put to bed,” water barred, and seeded. Because these generally are not permanent roads, the construction standards are lower than for a haul road.
- Maintenance roads are extensions of haul roads and skid roads used to access nonharvest areas for nonharvest work such as precommercial thinning, pruning, planting, and fuel reduction. Maintenance roads and trails usually do not sustain the heavy equipment traffic that haul and skid roads do.

Because log landings also result in significant disturbance and compaction to the site, we included them in the topic of road building. Landing location can influence road location and density. If the timber harvest method does not change drastically, landings can serve subsequent harvests.

When planning, estimate the various management activities in the different parts of your woods. This estimation can determine what kind of road you require and where. From both a cost standpoint and an environmental standpoint, do not build roads any bigger than you need to do the job. This is called "minimum standard access." However, even when building minimum standard access roads or trails, pay attention to the potential impact on hydrology and soil erosion.

Legal and Regulatory

Legal restrictions apply in road building, even on your own property. For the most part, these common sense-based regulations keep us from infringing on our neighbor's rights of ownership and help to protect the public resources (fish, water, wildlife, and capital improvements of the state). For instance, we would not want to cause erosion that buries our downstream neighbor in sediment. The main body of road building regulation is contained in the Washington Forest Practices Act (RCW 76.09), the Washington Forest Practices Rules (WAC 222), and the Forest Practices Board Manual. An excellent, understandable summary of these rules appears in the Washington Department of Natural Resources (DNR) publication "Forest Practices Illustrated." However, the forest practices regulations are undergoing significant changes. Check with your local DNR representative for the most recent changes. One significant change is the requirement for landowners to cover their forest roads with a DNR approved road maintenance and abandonment plan.

Equipment

The machinery used to harvest timber will influence how many roads and the standard of road needed. Ground skidding necessitates the most roads. Cable systems require fewer roads; helicopter logging requires even less. When using ground skidding, the type of equipment needed to carry the logs to the landing will influence how much impact a particular road will have on soil compaction, erosion, and water quality. Horse logging and ATV skidding generally have minimal compression impact on the forest floor.

Season of Use

The season of use has an impact on the standard of road necessary to do the job. In summer, when soils are dry, a road can hold up to traffic without significant compaction **until** the surface is broken enough to create a dust layer. That dust layer has very poor structure. When wet, the structure is still poor. Two to three inches of dust are no better than 2–3 inches of mud as far as water absorption ability is concerned. Volcanic ash soils are particularly fragile in dry conditions.

Moist, but not wet, soils generally can hold up to traffic. When soils are saturated, soil structure is easily destroyed. When the mud is squishing up between the duals, the mixing of soil with water creates a condition in which the soil moves with surface runoff into stream channels. When using roads under very dry or wet conditions, upgrade the road standard to prevent significant environmental damage. Paving with crushed rock may be necessary where insufficient rock occurs in the road surface material. Traffic on a well-frozen or snow covered roadbed does little damage.

Economics

Road construction costs represent a major financial outlay. Do not build the road until you actually need it. Ideally, put a road in a year before actual use. This allows the road time to settle and become firm. It also gives you time to find the weak spots and correct them before traffic creates a bigger problem at that site. To save money, put in a lower standard road for short-term management purposes until harvest activity requires a higher standard road.

Treat your neighbors well. They may have an existing road by which you can access your property for a time-limited operation such as a timber sale. Use of such a road can save time and expense of construction on your property. Put an easement for such access in writing so both parties have the same understanding of its terms. A use fee is often appropriate. This is usually in the form of a dollar amount for each load using easement right-of-way.

Location

When developing a road plan for your property, collect aerial photos, topographic maps, soils descriptions, stream-type descriptions, and forest type maps of the area. These will help you to see the big picture. Plot your property boundaries and highlight major features such as public roads, narrow canyons, rock outcrops, unstable slopes, cliffs, streams and wetlands, forest management units, historical sites, and saddles and low gaps along the ridges. These control points will define where you should locate the road. Saddles and gaps are good locations for positioning road junctions and for reversing road direction. Not all these features will be obvious on maps or photos. Note: Once you have mapped out the rough plan on paper, run actual lines on the ground to make sure the chosen location is possible.

Stay out of stream corridors and wetlands if can perform the job another way. How far away to stay from watercourses depends on slope, soil stability, and the evolving forest practices regulations. Locate the road out of the 100-year floodplain area and on gentle slopes, avoiding unstable soils. The undisturbed area downslope between the road and a riparian area acts as a buffer to trap sediment from the road. However, erosion from the road should not exceed the ability of that buffer to retain those sediments. If you must cross a stream, you will most likely need a Hydraulics Project Approval (HPA) permit from the Department of Fish and Wildlife. Mucking around in a stream without a permit, or exceeding the permit terms has a good chance of resulting in fines and paperwork that are just not worth it. A stream crossing may be a hard ford (low cost), a culvert (more expensive), or a bridge. The choice of structure is controlled by stream size, fish habitat considerations, streambed material, and the type of traffic that will use the crossing. Due to ecological sensitivity, professional help is advisable when installing a stream or wetland crossing. (See additional information on handling water later in this publication.) The road should approach a stream crossing with a slight downhill grade and exit the stream slightly uphill. At the crossing, the road forms a “V,” pointing downstream. This configuration will keep high water from making a river down your road.

Log landings are one focus of activity. They must have the structure to hold up under the traffic. Do not locate landings in wet spots. Do locate them on gentle slopes so water can run off without turning the landing site into a small muddy lake.

CONSTRUCTION

Keep in mind these basics when building forest roads:

1. Since roads impact our forest system significantly, obtain help from a forester or road engineer to ensure the road will do the job it is meant to do.
2. Road construction often requires heavier equipment and more operator experience than the average forest landowner has. Contract the job to a professional. Have the logger put in the road using a well-defined set of specifications. Make sure the road builder understands exactly what your objectives are.
3. Build roads to the minimum standard needed to get the job done and to protect public resources. Haul roads can cost $5,000 per mile or more, depending on terrain conditions and the road standard. The wider the road, the more it will cost. Wider roads will take more land out of production and allow more sediment to enter the stream system. Strategically placed turnouts make it possible to construct an essentially single lane road fully adequate for a haul road. Haul roads need a minimum of 14-foot subgrade.
4. Roads are major contributors to stream sedimentation, so use methods to minimize soil erosion. Roads divert shallow subsurface drainage and increase surface runoff from the watershed. The basic rule for managing surface water is to handle it in small amounts before it develops sufficient volume and velocity to be destructive.
5. Keep roads on the uplands where possible. If it is absolutely necessary to cross a riparian area, obtain the appropriate permits, starting with the Washington Department of Natural Resources.
6. Do not build a road when soils are either very wet or very dry. Both conditions contribute to roadbed instability and sediment production.

Clearing The Right-Of-Way

The usual procedure for clearing the right-of-way (ROW) is to push in a pioneer road that will approximate the location of the finished road. One of the main challenges to clearing ROW is dealing with slash. Merchantable stems can be stockpiled and hauled to a landing as the pioneer road is developed. Scatter nonmerchantable slash and tops below the ROW or pile them out of the way for burning later. It is important not to put road fill on top of slash. Remove organic material from the area where fill material will be placed. While the road is being finished, fell the trees immediately above the cut slope so they do not come down later and plug the ditch or block the roadway. Remember to maintain an adequate buffer between the fill portion of the road and any riparian area downslope.

Building The Road

Haul Roads

There are two ways to handle cut and fill in road construction: side casting and end hauling. Figure 1 shows where these methods are appropriate.

Side casting material is the least expensive method of placing fill. Loggers use this method in most road construction, except where end hauling is required for road stability or to prevent side cast from entering a stream course. For road stability, compact fill material as it is laid. Proper moisture content also is important in achieving good compaction. The angle of bank on the cut slope depends on soil characteristics. The steeper the cut, the less material has to be excavated. The finished slope must be gradual enough that the bank does not cave in, filling the drainage ditch, or blocking the road.

The surface (cross section) of your haul road may be shaped in three basic ways. It may be crowned, insloped, or outsloped. Figure 2 illustrates several variations on these three basic cross sections. The choice of cross section depends on drainage needs, soil characteristics, slope, and expected traffic.

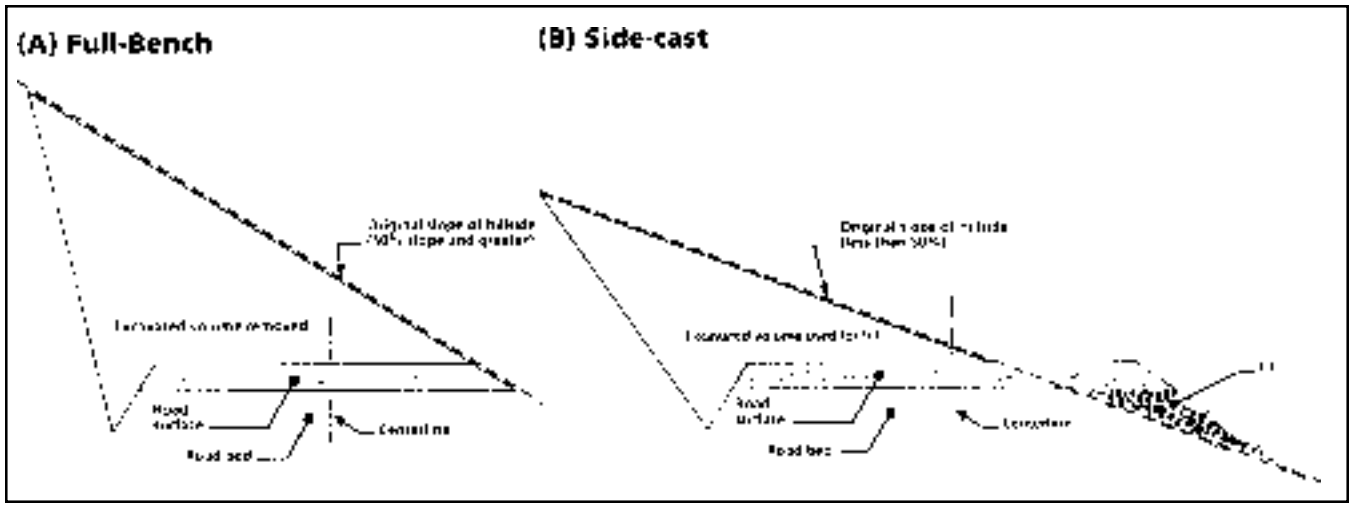

Figure 1.—Full-bench roads usually are built on steep slopes. End-hauling excavated material may be needed to ensure slope stability and protect water quality (A). On gentler slopes, excavated material often is side-cast to be used as a portion of the roadbed (B). *(From Washington DNR publication Forest Practices Illustrated).*

Insloped or outsloped cross sections are easier to maintain than crowned cross sections because they have a flat surface. In the absence of permanent surface water, outsloped surfaces need little or no high side ditch. This reduces the initial road building cost and makes subsequent maintenance easier. There are disadvantages. Outsloped roads are not a good idea in areas that ice up or where soils become slick.

On straight stretches, haul roadbed width need not be more than 12 feet wide for most log trucks. On curves, road width must be greater to allow for the shorter tracking radius of the back wheels of the trailing load. The outside of the curve needs to be clear to allow tail sweep of long-log loads to pass.

To enhance prompt surface water drainage from the roadbed, the road grade should be more than 3% and the road surface should be smooth to prevent water puddling. On the other hand, a haul road grade should not exceed 12%. Some haul roads are steeper, but they can become a safety concern in icy or muddy conditions. Additionally, steeper grades quickly get torn up by spinning tires. Grade changes should be gradual so the loaded

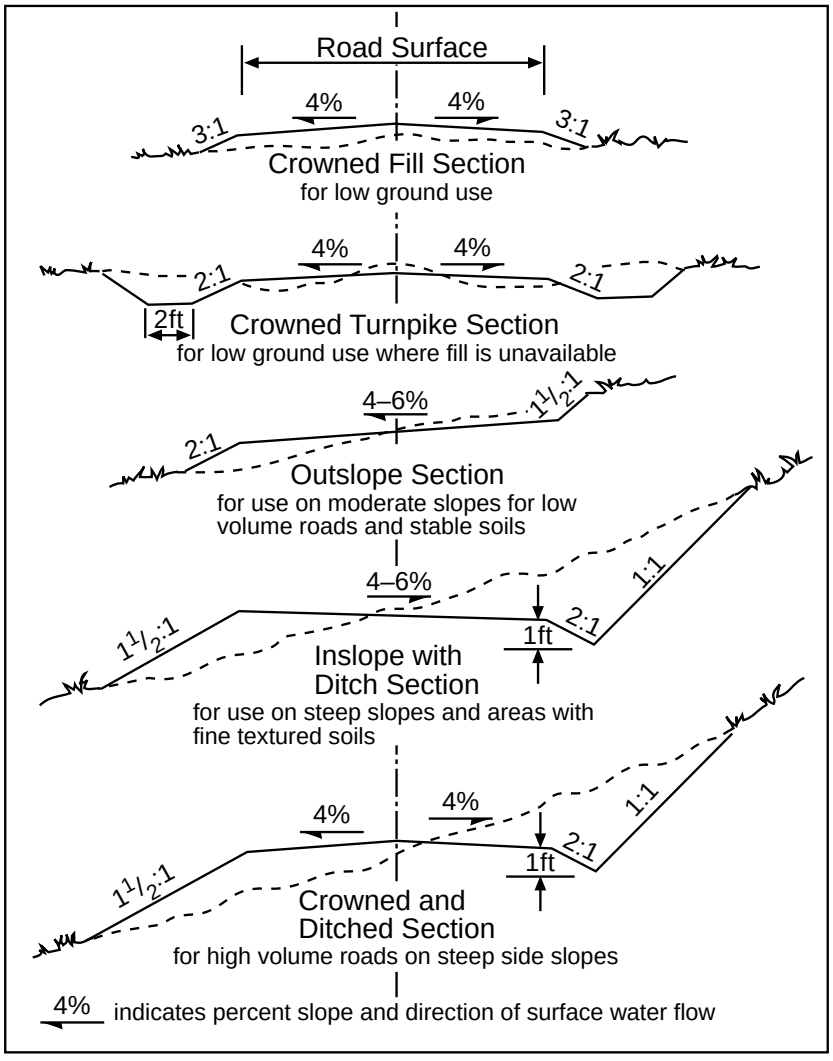

Figure 2.—(From USDA Forest Service publication NA-TP-06-98. "A Landowner's Guide to Building Forest Access Roads").

truck can accommodate the change without binding the load on the tractor or high centering between the extended trailer wheels.

Putting gravel on your forest haul road will greatly increase its utility. It will be usable for more of the wet season, and it will hold up better under load stress. However, adding gravel increases construction costs considerably. A strategy more commonly used is to gravel only where the road is especially likely to fail, such as over culverts, across broad-base dips, and in soft spots. For safety purposes, gravel the haul road where it meets a public road. The gravel helps keep down dust at the intersection and also cuts down on the amount of dirt the trucks drag onto the highway. Sometimes, it is possible to buy native rock locally to surface your haul road. This can be much cheaper than hauling it from a commercial pit. Unsorted rock up to 3–4 inches in diameter can be used, but it must be well packed to maintain a firm roadbed.

The haul road should approach a public road at an angle, headed in the direction the trucks will be hauling. This greatly reduces the time it takes the truck to enter the traffic flow. The roadside adjacent to the intersection needs to be cleared of brush to allow good visibility. Try not to locate the intersection on a blind curve. If your haul road exits onto a public road, contact the appropriate transportation department office.

Skid Roads

Where you plan to use ground-based equipment to carry logs from the stump to the landing, you will need skid roads. In the long run, you can minimize soil compaction from equipment traffic if you designate the locations of the skid roads. These same skid roads will serve in future logging operations in your woods. The two usual patterns for skid trails are dendritic (or branching) and parallel. Figures 3 and 4 illustrate these two patterns.

The dendritic pattern works best on gentle slopes, while the parallel pattern, fit to slope contours, is more useful on steeper slopes. Skid roads should be 100–200 feet apart. The exact separation will depend on terrain characteristics and harvest tree height. Dragging a winch line downhill is relatively easy. Dragging a line uphill creates more work, and 30–50 feet is the maximum to pull a line. Felling trees toward the skid road and in the direction of the skid will minimize the amount of line pulling. If whole tree logging is to be accomplished, point log butts toward the skid road. A combination of whole tree skidding near the skid road and limbing trees farthest away from the road may be the preferred alternative in this situation.

On less than 20% slopes, only brush and stump clearing will be necessary to provide a suitable skid surface. Excavation usually is not required. On

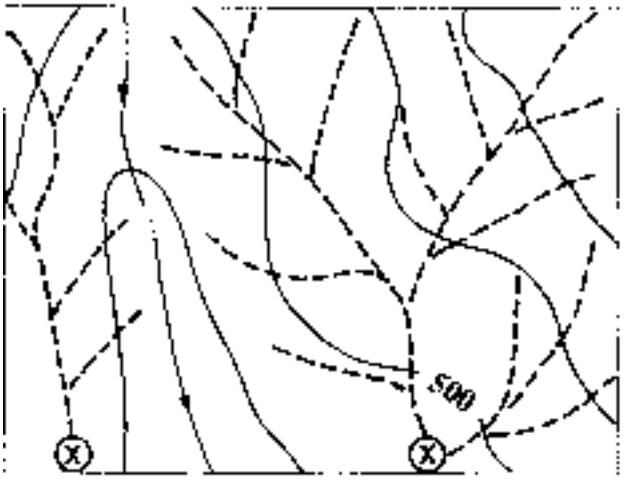

Figure 3.—Dendritic (branching) pattern. X = landing location.

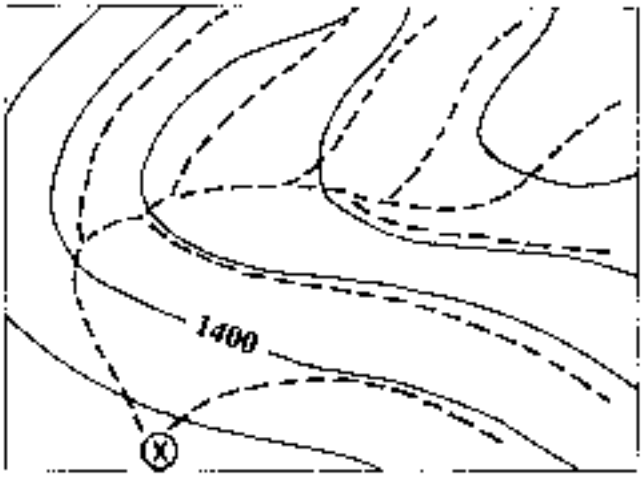

Figure 4.—Parallel pattern. X = landing location.

Source: Oregon State University Bulletin EC1110, "Designated Skid Trails Minimize Soil Compaction."
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slopes greater than 20%, a narrow excavation is enough to keep skidding machinery on track. The object is to move only as much soil as necessary to provide a functional skid road. Downhill skidding requires less power and usually takes less time. However, on steeper slopes, hillside skidding sometimes is the only alternative for ground-based skidding. A big concern in skidding is rubbing damage to the residual stand by equipment and logs. Keeping skid roads as straight as possible helps to reduce this damage. Leaving a rub tree(s) or a high stump on the inside of a curve also will help. You can harvest the rub tree after skidding is finished.

The previous discussion about skid roads is only general. Each property has its own unique set of conditions. Help in laying out the road pattern for your forest property is available from a consulting forester, a forest road engineer, or a landowner assistance forester through the local Natural Resources Conservation Service.

Landings

Landing location, where the skid road and the haul road meet, will be partially determined by topography. A challenge of road layout is the number and location of landings. The landing area must be large enough to accommodate the decked material, a slash pile (with whole tree logging), loading machinery, haul truck, and room enough for machinery and haul trucks to turn around. The landing surface should have at least a 3% slope to allow water drainage, but no more than 8%. Bulldozers often are needed to shape a landing up to standard. Locate landings away from riparian systems.

The skidding process is a major factor in logging costs. Skid distances should average about 500–800 feet from stump to landing. The longest skids should not be more than 1,000 feet.

HANDLING WATER

The landowner, the consulting forester, and a Washington Department of Natural Resources (DNR) forest practices forester should determine issues such as culvert size and water bar spacing on a site specific basis.

Before looking at road structures that help to control water on road surfaces, remember this magic formula:

HANDLE WATER IN
small amounts
BEFORE IT CAN BUILD TO
DESTRUCTIVE FORCE
AND VOLUME.

Water Bars

Figure 5 gives top and cross views of a typical water bar. Angle the drain about 35° downgrade so that runoff does not hit the water bar head on. Water bars are inexpensive, quick, and easy to construct. However, they do not stand up well under heavy or frequent vehicle traffic. Water bars are appropriate to divert storm water from closed skid trails where vehicle traffic is not a factor. In fact, a series of well-constructed, deep (2 feet) water bars can serve as effective deterrents to vehicle trespass (or may be a challenge for some). Spacing between water bars depends on road grade, steepness of topography, soil type, and intensity of storm events. Put rocks or other energy dissipaters at the water bar outlet. Water bars should not divert water directly into a stream. Engineer the outflow to run onto a stable forest floor area so the runoff water can slow down and deposit sediment before entering a stream.

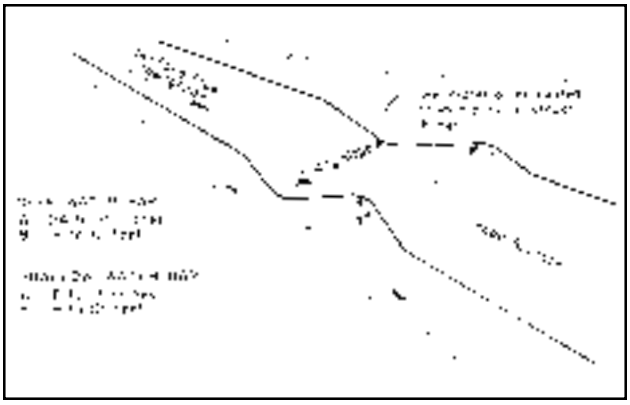

Figure 5.—Water bars are narrow structures that may be shallow or deep. Deep water bars usually are used on roads that will be closed for extended periods. *Source: USDA Forest Service Publication NA-TP-06-98 "A Landowner's Guide to Building Forest Access Roads."*

Broad-Base Dips

Broad-base dips are designed to handle surface water on heavy traffic roads such as haul roads. As shown in Figure 6, a broad-base dip is essentially a stretched out water bar. Because grade changes in broad-base dips are more gradual, they can withstand vehicle traffic without breaking down. Do not install broad-base dips on roads with grades greater than 10%. On steeper grades, uphill traffic quickly chews out the reverse grade of the dip, and its water managing function is lost. Water bars and broad-base dips are not intended to carry perennial surface water such as streams or seeps across a road. Use culverts as a more appropriate way to handle those situations.

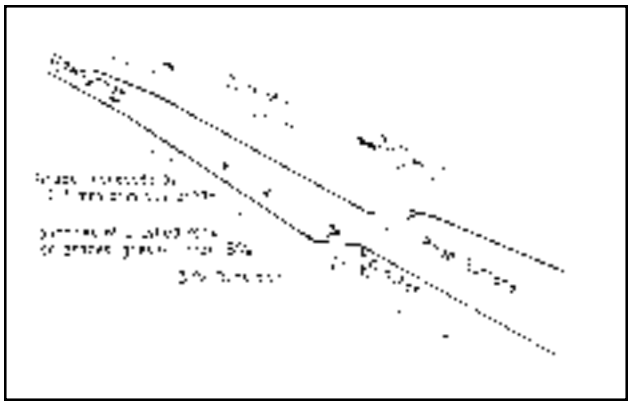

Figure 6.—Broad-base dips (drainage dips) are used on roads with frequent traffic and with grades of 10% or less. *Source: USDA Forest Service Publication NA-TP-06-98 "A Landowner's Guide to Building Forest Access Roads."*

Grade Break

A close relative to a broad-base dip is the grade break. Loggers dig a broad-base dip into the road after the road grade is established. A grade break reverses the slope of a road to impede water runoff. Grade breaks work well where the road elevation change is gradual.

Crossing Streams and Drainage Channels

Several methods of constructing roads crossing streams and channels exist to fit different situations. Common methods are the use of hard fords, culverts, and bridges. A Hydraulics Project Approval likely will be required to place structures in live streams and intermittent drainage channels. Construct stream crossings to allow fish passage.

Hard Ford

If a road crosses a shallow stream at a firm or rocky portion of the streambed and is only used occasionally, a ford is an inexpensive and safe way to cross the stream. A good practice is to gravel the approaches to the ford to reduce transport of mud. However, crossing where traffic will kick up sediment and cause downstream siltation is not allowed.

Culverts

Correct locating and installing of culverts protects habitat in fish-bearing streams. Culverts come in three general configurations. Figure 7 shows these common shapes. The round culvert is the least expensive and easiest to install, but the least desirable for fish passage. The structural plate arch is the most expensive and hardest to install, but the most desirable for fish passage because it retains the natural stream bed. Installation of the culvert should allow the stream to enter the culvert and exit in a straight line to the stream channel. To prevent the stream from leaking around the outside of the culvert and eventually washing it out, pack rock free soil around and under the bottom half of the culvert when you install it. Figure 8 shows the proper depth to streambed for culvert placement. Both ends of the culvert must be well riprapped to keep the stream from eroding the road fill. At the discharge end, extend the culvert beyond the road fill so the outflow does not erode the fill. Place rocks at the point of overflow to dissipate the energy of the moving water. Figure 9 shows some common mistakes in culvert installation in relation to fish habitat considerations.

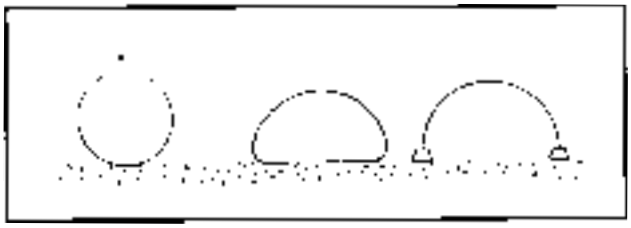

Figure 7.—The three common types of metal culverts are classified by shape: (A) corrugated round, (B) corrugated pipe-arch, and (C) structural plate-arch. *Source: USDA Forest Service Publication NA-TP-06-98 "A Landowner's Guide to Building Forest Access Roads."*

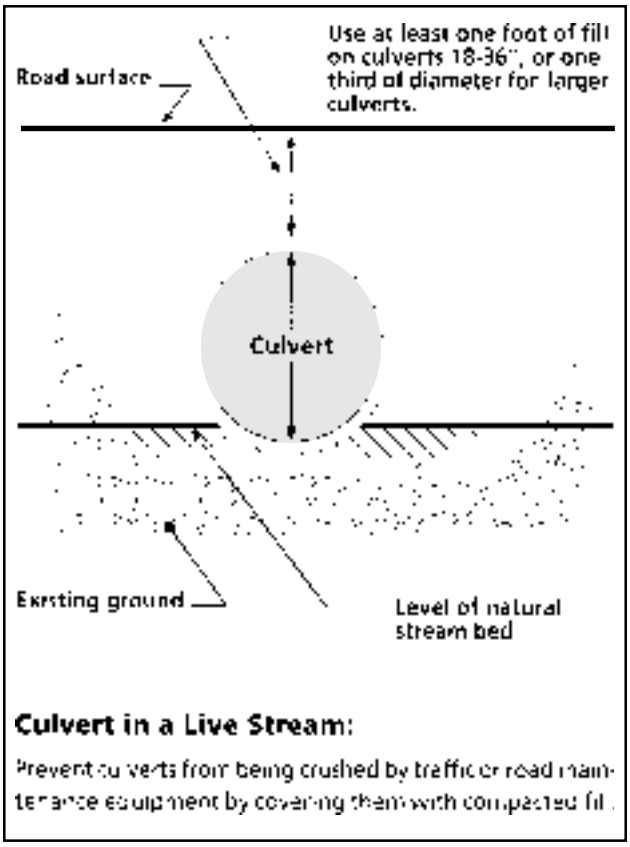

Figure 8.—Culvert placement. *Source: Washington Dept. of Natural Resources publication "Forest Practices Illustrated."*

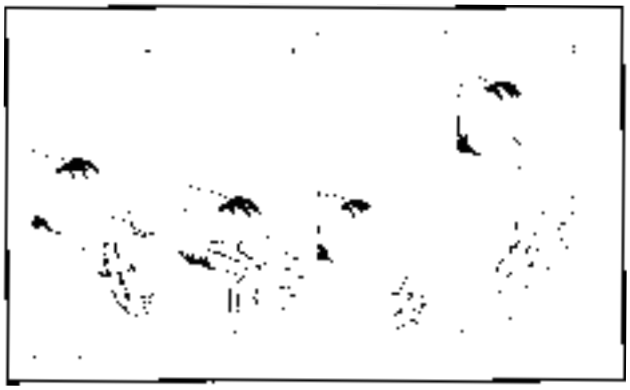

Figure 9.—Improperly installed culverts can block fish passage: (A) water velocity too great, (B) water in culvert too shallow, (C) no resting pool below culvert, and (D) jump too high. *Source: USDA Forest Service Publication NA-TP-06-98 "A Landowner's Guide to Building Forest Access Roads."*

Bridges

Due to stream size or high water flow characteristics, a bridge is sometimes preferable to a culvert. Bridges are big-ticket items, and their location, design, and placement definitely call for professional expertise. Permanent bridges are the most complex to install. However, temporary portable bridges can be an economical way to cross a stream to accomplish short duration jobs. These bridges often are made of railroad flatcar beds or semiflatbed trailers that may be leased for the period you need the stream crossing.

Maintenance: A Long-Term Responsibility

All the structures we discussed in this article will require periodic maintenance. Road surfaces will require grading to smooth ruts that collect water and promote down cutting, and ditches will need cleaning. Water bars and broad-base dips will require occasional reshaping to retain their effectiveness. Culverts will require cleaning debris and sediment from the inlet end, and the inlet riprap may need repair. A road built to standard will handle specific traffic needs and minimize adverse impacts to the environment. Staying off of roads when they are wet and soft will greatly reduce the maintenance to keep the road in good shape. The best times to perform this maintenance are in the spring and fall when there is some soil moisture, but the ground is not too muddy. Your roads will maintain their standards over time with consistent maintenance. Your DNR approved road maintenance and abandonment plan will require a general maintenance plan.

VEGETATION

Roads often are blamed for being major contributors to soil erosion in forest environments. Sometimes the blame is deserved, but it does not have to be. Roads can be useful without severely impacting the environment if you use proper construction methods and good vegetative cover.

Reasons for Vegetation Management

- **Soil Stability.** The primary purpose for establishing vegetation on the cut and fill of roadways is to maintain water quality in your streams by preventing soil movement from the road into stream channels. The objective is to keep the material in the roadway and to preserve the function of the road at the original standard. Retaining road material also will keep road maintenance costs down.
- **Weed Management.** Many unwanted plants spread rapidly along roads because vehicles and equipment bring in seeds. Conditions along the road are suitable for weed establishment. Growing a cover of more desirable vegetation before weeds can establish will reduce the cost and time spent managing weeds on your roadway. A good cover of desirable plants will not totally eliminate the need to pull or spot-spray invading weeds, but it will help significantly.
- **Wildlife.** You do not want to attract wildlife to frequently traveled high-speed roads. Road kill is not the objective. However, forest roads that receive occasional use can serve as habitat for a wide variety of wildlife. Many plants available for roadside planting have value for wildlife as cover, forage, and browse. Many wild creatures are important components of a fully functioning dynamic forest and should be encouraged.
- **Aesthetics.** Roadside vegetation not only has economic and ecological advantages, it also helps blend a road into the landscape. You will be looking at that road for a very long time.

What to Plant

Plants suitable for roadways range from grasses and forbs to shrubs and trees. Species diversity generally promotes resiliency in a plant community. In other words, diversity helps the community recover from disturbance relatively quickly. Usually, the wider the variety of desirable species and growth that forms on the site, the more difficult it is for noxious weeds to become established. Planting a variety of species having different peak growing periods will further reduce the opportunity of unwanted vegetation to get started. Your local USDA-Natural Resources Conservation Service (NRCS) office is a good place to find out which species are best suited to your area. WSU Cooperative Extension, Washington Department of Fish & Wildlife, Washington Department of Natural Resources service foresters, and private consultants are other sources.

Grass is usually the basis of a seeding mix because it has the ability to establish on a wide variety of site conditions. Forbs, shrubs, and trees can be sown at the same time as the grass. Most often, however, shrubs and trees are planted as nursery stock. ***IMPORTANT:*** *Do not plant grasses first and then try to plant shrubs and trees later into an established grass stand!* In most parts of Washington, the grass will out-compete your newly planted nursery stock. Broadcast the grass and forbs and plant the nursery stock at the same time. For planting small seed, broadcast soon after working the site so the seed falls into loose, uneven soil. This results in good seed-to-soil contact and improves seed establishment. You may consider long-lived native grasses for your roadway. Or, you may select varieties that are expected to drop out as native species come into the plant community. Be careful not to select species that will spread into the forest and suppress native vegetation. Your local NRCS office is the best place to find the preferred planting time and appropriate species for your area.

Several forbs are suitable for roadside planting. Nitrogen-fixing legumes such as clovers, alfalfa, and some lupines work well. Some native wildflowers are available for planting. **HOWEVER, BE VERY CAREFUL WHEN USING WILDFLOWER MIXES!!** Many of these mixes contain plants on the Washington noxious weed list. Ask for local expertise to help you select species.

Many shrubs and trees are suitable for fill slopes and low gradient cut banks where soil is sufficient. On closed (and water barred) roads and skid trails that will not be used for a long time, planting shrubs such as vine maple (*Acer circinatum*), willow (*Salix* sp.), serviceberry (*Amelanchier alnifolia*), and alder (*Alnus* sp.) in the roadway itself will go far in preventing unwanted vehicle traffic. The entire road need not be planted to brush, just the first portion.

Livestock Grazing

In eastern Washington, forest grazing is an accepted practice. However, in western Washington, it is not widely practiced because grazing on wet soils compacts forest soil. The preference for grazing on your woodland should influence what you plant on your road system. On gentle terrain, you may wish to plant species that livestock prefer for forage. On the other hand, you want to discourage cattle grazing on steep, fragile cut, and fill banks. Here, the stock will displace the soil, moving it into road ditches and creating an erosion hazard. In these circumstances, plant species the livestock do not prefer. Be aware that an animal's preference for a forage plant depends on what else is available. In other words, cattle will eat less palatable food if nothing else is available.

Herbicides

Weeds will invade even the best-managed roadways. On regularly traveled roads, keep the roadway itself free of vegetation. Hot vehicle mufflers should not come in contact with potentially flammable vegetation. Road surface and ditch maintenance will tear up existing vegetation. Unfortunately, these bare surfaces are potential sites for weed invasion. If hand pulling is not practical, herbicide use may be the best choice. Limit broadcast herbicide application if you have planted a variety of desirable broadleaf species, as many of these also are vulnerable to the herbicide. An alternative is to spot spray the weeds only. Established grasses tend to be resistant to herbicides selective to broadleaf weeds. However, take care to protect water. Pesticides entering water can harm fish and other aquatic organisms. Regardless of the application technique used, you are required to keep chemicals out of the water. Again, site-specific advice from local expertise is called for when using herbicides.

The ideas and recommendations in this bulletin are intended to present a broad picture of forest road stewardship. Site-specific technical information is available in many other publications from land management service agencies and private consultants. Quality forest roads are a challenge, but they are worth the time and effort. For more information and publications, contact your county Cooperative Extension office, local USDA Natural Resources Conservation Service, or Washington Department of Natural Resources service forester.

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