



Designated Skid Trails Minimize Soil Compaction

J.J. Garland

Ground-based skidding may cause unacceptable damage to woodland soils when owners make no attempt to minimize the area covered with skid trails. As much as 40 percent of the area may be covered with skid trails during a single entry if you do not plan and mark them in advance.

Additional operations in the timber stand over time may increase the total area covered by skid trails. Soil compaction can reduce the soil's productivity to grow trees, and excessive soil disturbance from skid trails may result in erosion and degraded water quality.

You can reduce soil compaction and disturbance problems by restricting the amount of ground area covered by skid trails during harvesting operations. A reasonable goal is to confine the area covered by skid trails to less than 15 percent of the area—including landings, but excluding truck roads. Less area in skid trails means more of the area has soil conditions favorable for tree growth.

Restricting the area in skid trails requires advance planning and clearly flagging trails before logging. Pull the winch line from the tractor (rubber-tired skidder, crawler tractor, or low-ground-pressure vehicle) to logs or trees "felled to lead" to the skid trail.

In a study comparing conventional skidding (in which the machine operator selects the skid trail) to planned and designated skid trails, research showed the average winch line pulled to be 30 feet for conventional skidding versus only 32 feet for designated skid trails spaced 100 feet apart.

There was little difference in winching, but a large difference in the amount of area covered by skid trails. While the amount of winch line that one or two people can pull depends on machine types, slope, and terrain conditions, proper planning and layout can yield skid trails within acceptable limits.

Consider planned and designated skid trails a permanent part of your transportation system. You'll use them again for future harvest and management activities in timber stands.

Research and field experience indicate that this harvest system may be only slightly more expensive, or even less expensive, than conventional practices. One study found a 29 percent increase in harvest costs, while several others found differences of plus or minus 2 percent of harvest costs.

Planning Skid Trail Locations

Skid trail patterns

On moderately flat ground in small timber, research found the following skid trail spacings yielded the skid trail areas shown in the table below. The skid trail pattern is generally parallel trails of various spacings.

Spacing	Percent of area in skid trails
Logger's choice	20
100 feet	11
150 feet	7
250 feet	4

On steeper or broken terrain, you can expect these percentages to increase (see Figure 1).

Systematically located skid trails yield certain patterns that cover the area within acceptable limits. Two

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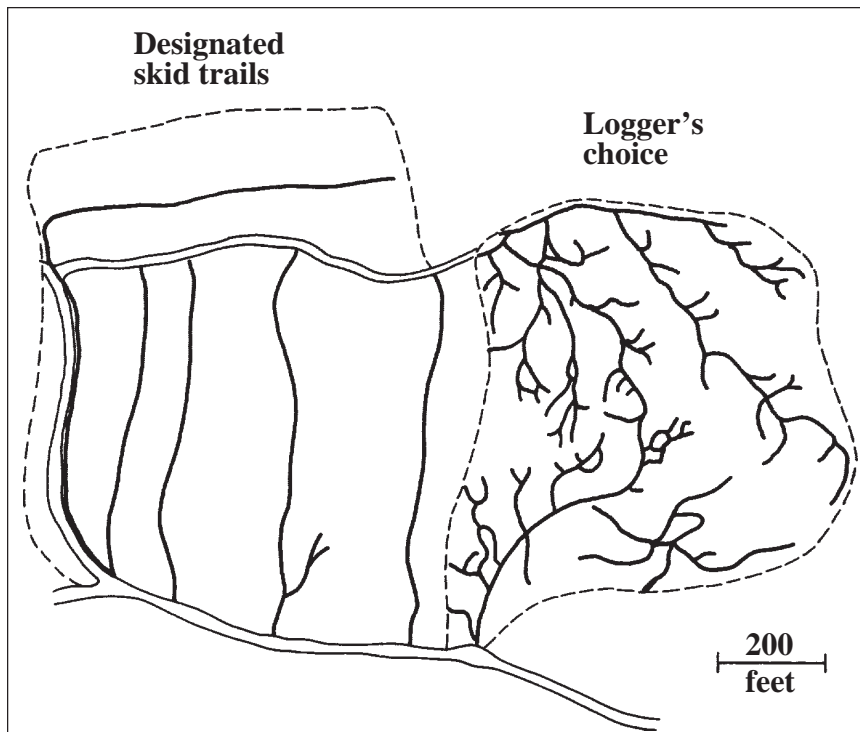


Figure 1.—Skid trail patterns: designated trails at various spacings on the left; logger's choice trails on the right (adapted from Froehlich, Aulerich, and Curtis, 1981).

common patterns are the branching and the parallel skid trail. On gentle slopes, the branching pattern in Figure 2 has one or more main trails from which other trails branch off to provide access to the area. On steeper slopes, the parallel skid trail pattern reflects the attempt to parallel the contours (see Figure 3).

Landings

Locate landings (area used for loading logs onto trucks) as the first step in layout. Landings should be large enough to accommodate trucks, the loader, and log decks. The slope of the landing should be less than 8 percent. The spacing of landings depends on terrain and timber stand

conditions and on economic skid distances.

Generally, landings should be available so that the longest skid distance is less than 1,200 to 1,500 feet. Average skid distances of 800 feet or less reduce logging costs. If closer landings are environmentally acceptable, they will improve greatly the efficiency of the operation.

Slope effects

Skidding downhill is preferred for all ground-based systems. Downhill skidding to the landing is termed favorable; an uphill trail to the landing is called an unfavorable or adverse grade. The feasibility of unfavorable skid trail grades depends on how long they are, how much of the trail system is unfavorable, and the type of skidding equipment. You usually can expect some amount of uphill skidding.

You do not need to excavate skid trails on less than 20-percent sideslopes (slope of the hillside) to achieve a flat running surface. Sideslopes beyond 20 percent may require excavating 1 or 2 feet of earthwork at the trail center to achieve narrow (machine-width) skid trails. This is necessary because the loaded vehicle tends to slide downslope. Keep excavated skid trails narrow and adequately treated to minimize erosion.

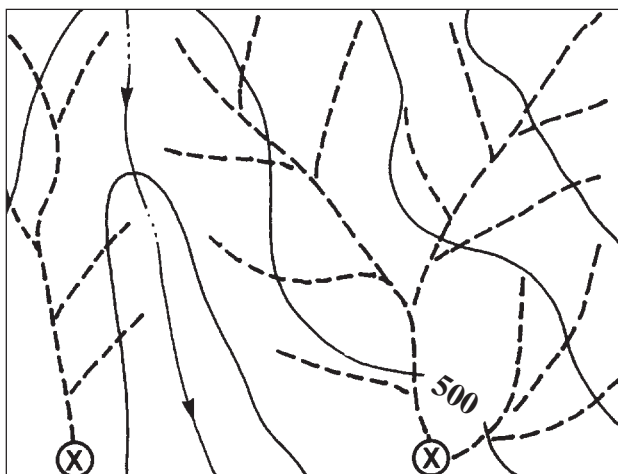


Figure 2.—Branching pattern (not to scale); X = landing locations.

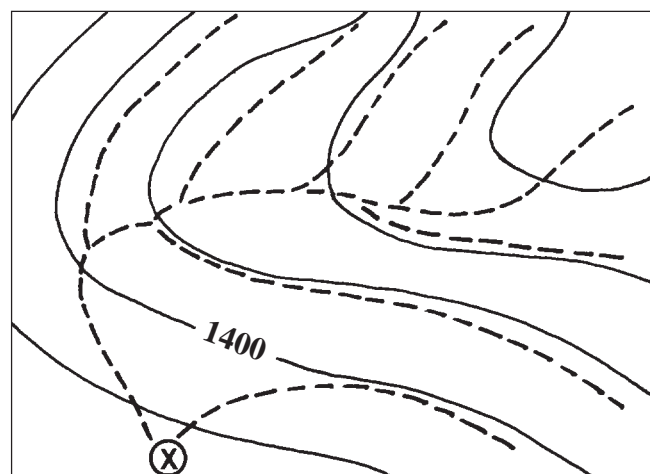


Figure 3.—Parallel pattern (not to scale); X = landing locations.

Other factors

You can use designated skid trails with clearcuts or partial cuts (thinnings, overstory removals, etc.). The size of the turn (group of logs to be skidded) partially determines the size of winch line you should use—and thus the spacing of skid trails.

Large timber or large turns of smaller trees (such as from clearcuts) will require winch lines that are heavier and harder to pull than those used for smaller timber or smaller turns collected from within a stand of residual trees.

Felling to Lead

“Felling to lead” is the key technique that makes timber accessible from designated skid trails. When timber cutters can direct the tree toward the skid trail or alternately fell it in the opposite direction away from the trail for butt-first extraction, the winch line can be pulled directly to the tree.

When cutters fell trees out of lead to designated skid trails, residual trees often will be damaged during winching, or the skidded tree may break. The only recourse is to reposition the skidding machine off the trail to allow winching (see Figure 4). When you review marked skid trails on the harvest site, include those responsible for cutting and skidding activities. Here are several points to consider:

1. Either tops or butts to lead is suitable for small timber. Winching large timber with the butts to the skid trail may cause problems as the butt digs into the ground.
2. Trees generally lean downhill; a felling pattern approximately 45 degrees down the slope to lead is most effective.
3. Wedges, hydraulic rams and jacks, and lines from the skidding machine can be used to fell timber directionally to lead. Directional felling may cost 0 to 30 percent more than conventional felling, depending on circumstances.
4. Hangups may present problems in dense stands. Pull these down with the skidding machine as soon as practical. Safety codes require

identification and warning for hung trees.

5. Felling may obliterate skid trail markings; you may need to reestablish them. Felling the trails first may aid in directing trees to lead to the trails.

Skid Trail Alignment

When planning skid trail layouts, make every effort to keep them as straight as possible. Straight skid trails seem to compensate partially for the added cost of pulling winch line to the logs. When trails are straight, operators achieve higher speeds and spend less time deciding where to position the skidding machine.

Considerations for skid trail alignment include the following:

1. Make trails as straight as possible for the longest practical distance, especially main trails.
2. Remove all trees in skid trails and cut stumps at the groundline (see Figure 5).
3. Make intersections at 45-degree angles or less with respect to travel toward the landing.
4. Parallel the contours (lines on maps that are equal in elevation) and make upslope trails follow the ridge crest.
5. Use short trail branches to reach long corners of the unit.

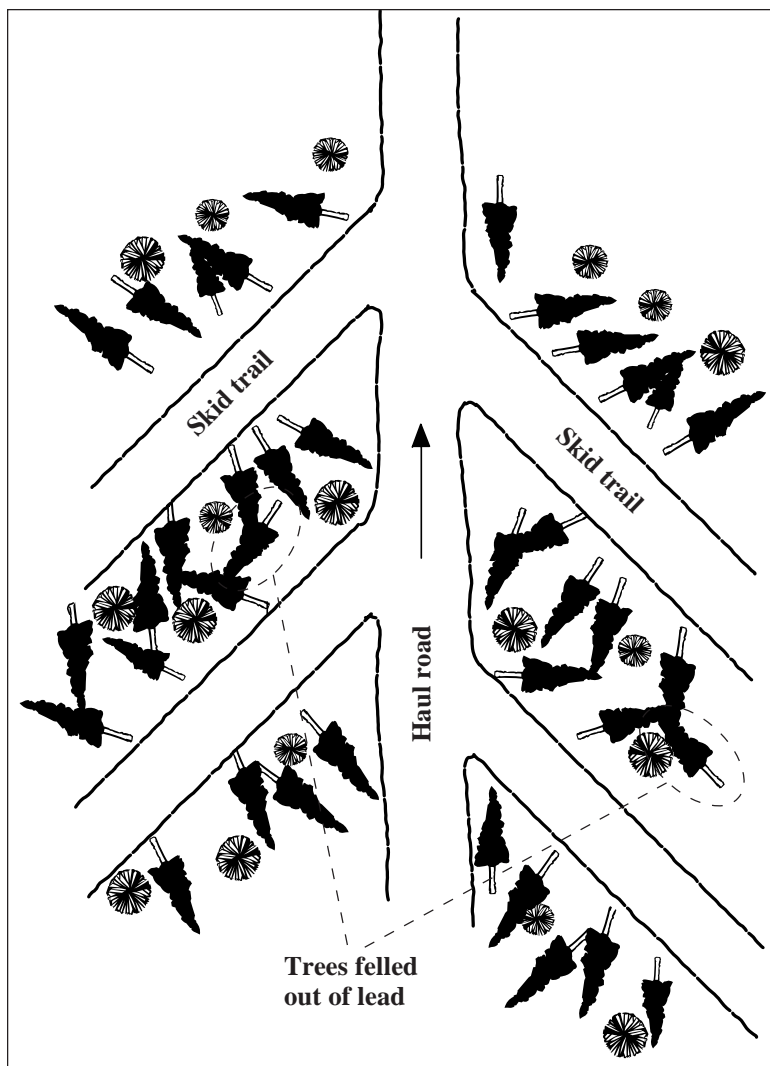


Figure 4.—A planned felling pattern (not to scale).

6. Avoid branching from the main trail directly opposite another trail branch.
7. Avoid sharp curves at the bottom of steep downhill trail segments.

Grades

Skid trail grades affect skidding productivity, especially if the unit has much length in unfavorable (adverse) grades. The grades shown in Figure 6 are examples of maximum gradability. They are extreme limits and not grades that you can plan for entire areas. Recommended grades for skid trails that are main trails or long in length are 10 percent unfavorable (adverse) and up to 20 percent favorable. Short pitches of adverse (for example, 100 to 200 feet uphill) of up to 20 percent are reasonable if the trail is straight or if the skidding machine is on level or favorable grades before the short segment.

When terrain or soil conditions limit skidding machine traction, it may be necessary to drop the load and winch logs ahead once the machine has traveled through the difficult spot (see Figure 7).

On short, steep slopes, you might lay out a “go-back” trail (used as an alternate route for unloaded vehicles) at steeper than normal grades to the top of the slope. Then, skid trails on the hill slope are oriented up and down the slope so that the vehicle remains perpendicular to the contours, which assures vehicle stability. You will have to increase erosion-protection measures on these skid trails. Consider the techniques carefully: cable harvesting may be equally as effective, depending on conditions.

Other Considerations

It makes sense to use skid trails from previous logging operations—if you can identify them and if they are suitable. Reusing these trails minimizes the area in trails, but sometimes these trails meander excessively, or they are just not in the correct position.

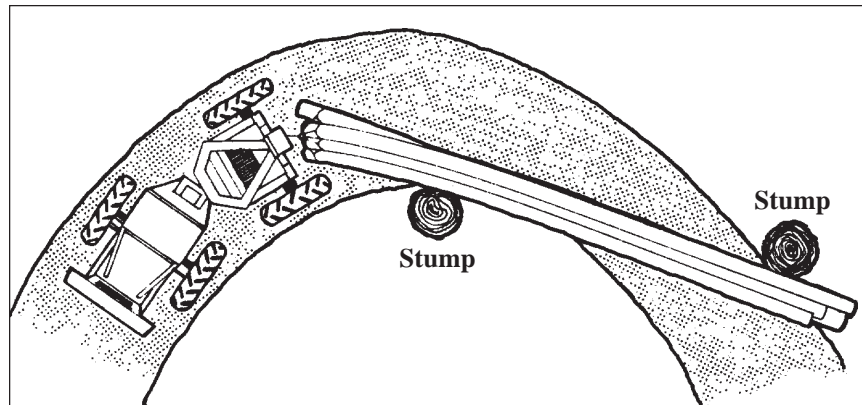


Figure 5.—Problems arise when you try to winch logs out of tight spots at too sharp an angle or when you turn too sharply while skidding. The load may lodge against trees, stumps, rocks, or road banks. From Hartman, Robert L., and Harry C. Gibson, *Techniques for the Wheeled Skidder Operator*, NEFES, USDA, NE-170, 1970.

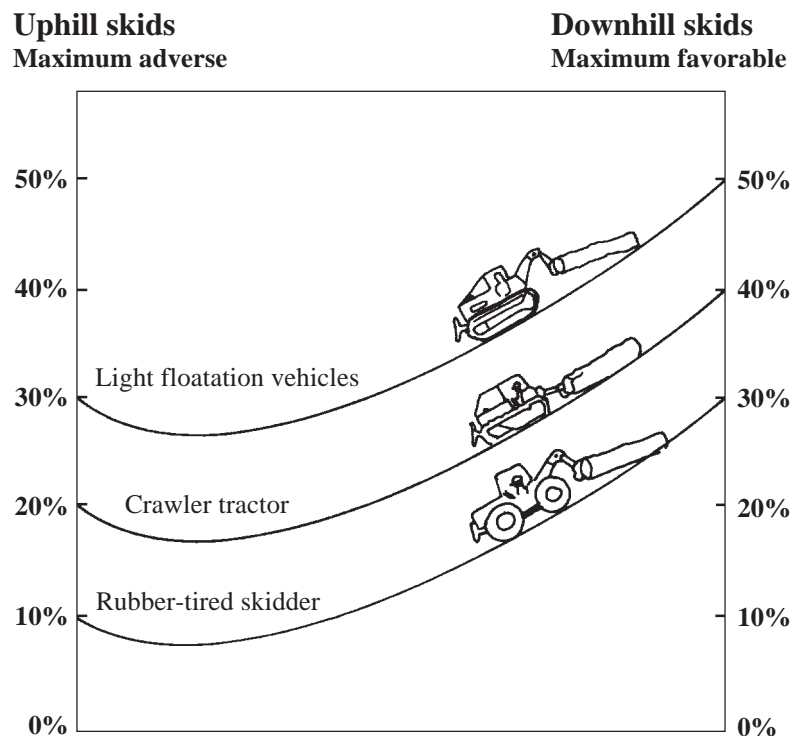


Figure 6.—Left and right sides of the graph represent traction under the best conditions, but soil and weather conditions may reduce gradability. From Handbook for Ground Skidding and Road Building in the Kootenay Area of British Columbia, *Forest Engineering Research Institute of Canada* (Vancouver, B. C., 1976).

Avoid wet spots, springs, and drainages as skid trail locations. Depending on rock sizes, rock outcrops and rocky places generally are damaging to tracked and rubber-tired vehicles.

If feasible, avoid working two vehicles on the same skid trail; the trail will begin to widen as the vehicles get off the trail when they meet.

Slash collected on the skid trail will cushion the effects of compaction for tracked vehicles, but it may present traction problems for rubber-tired skidders. Tire damage may result also from limbs, knots, chunks, etc.

On rubber-tired skidding operations, you might leave slash in the skid trail when you log the unit from the end of the skid trail toward the landing, rather than starting near the landing first. Slash will accumulate on the trail behind the skidding operation.

To divert water from the skid trail surface, construct water bars according to the spacing in Table 1, and build the water bar according to Figure 8 (see page 6). Modify these guidelines as needed for specific slope and soil conditions.

In addition to providing erosion protection for skid trails, the forest manager must decide whether to leave skid trails for future stand management activities or treat them with operations, such as soil tillage, that partially restore their growing potential.

If the time period before reentering the stand for management is short, or if there is a high probability of reuse for blowdown or insect or disease salvage, do not till the skid trails.

In contrast, after final harvest, you may till skid trails and plant them along with the rest of the area. If properly planned, tilled trails can grow trees and still be used for future harvesting.

Tree damage seems to be less when managers use designated skid trails rather than the conventional practice of winding the vehicle and loads between trees left in the skid trail. A combination of designated skid trails and skidding whole trees may be the most productive option. "Rub trees" may be left to take the brunt of skidding damage in tight spots and then removed later.

Loggers operating the machines and setting chokers must be fully informed of the skid trail pattern. Their cooperation and skill in extracting logs to the designated trails is essential to making the operation environmentally and economically effective.

Once the landowner's objectives are communicated to sale purchasers, logging contractors, and others, the machine operators and choker-setters also must be committed to restricting the area covered by skid trails. With

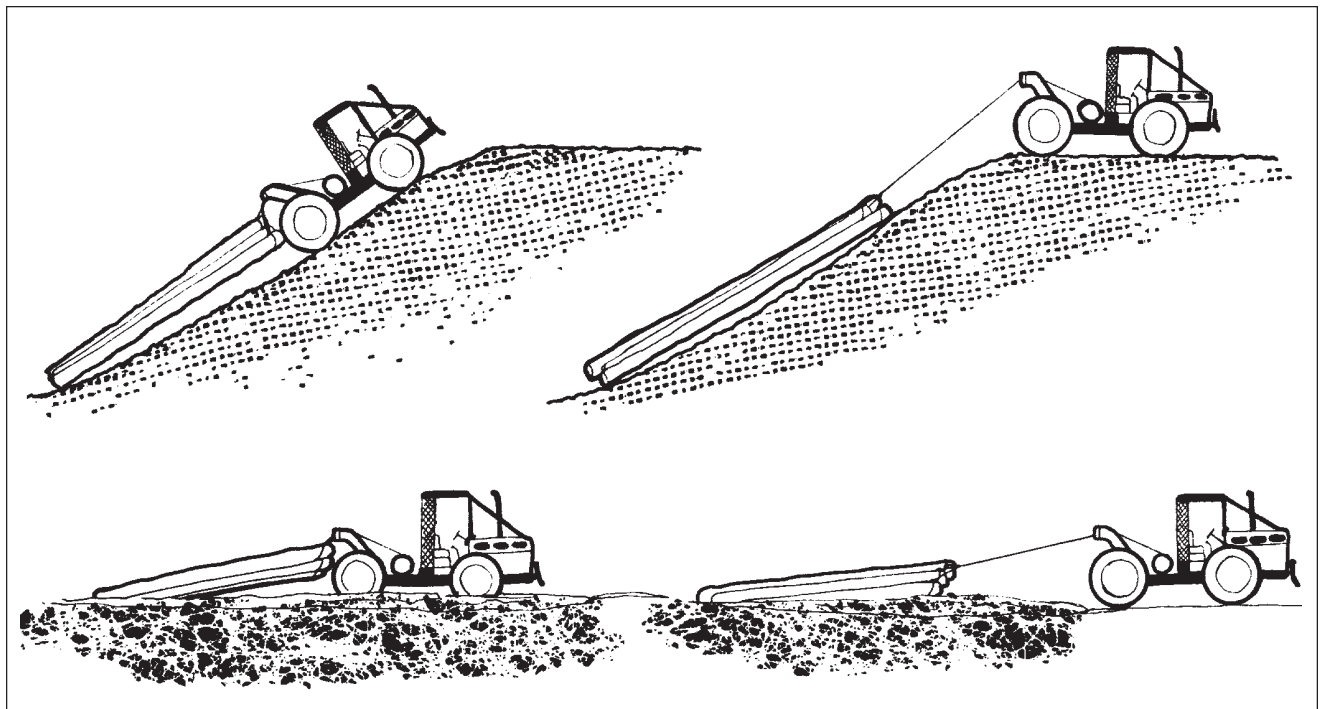


Figure 7.—Steep slopes and muddy areas often necessitate moving the wheeled skidder forward, then winching the logs to the skidder. From Hartman and Gibson; see Figure 5.

all concerned parties cooperating, the environmental and economic benefits of designated skid trails can be realized.

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Adams, Paul, *Soil Compaction on Woodland Properties*, EC 1109 (Oregon State University, Corvallis, reprinted 1992). \$1.00

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Other publications

Froehlich, H. A., D. E. Aulerich, and R. Curtis, *Designing Skidtrail Systems to Reduce Soil Impacts from Tractive Logging Machines*, Forest Research Laboratory Research Paper 44 (Oregon State University, Corvallis, 1981).

McMorland, Bruce, *Skidding with Small Crawler-Tractors*, Forest Research Institute of Canada (FERIC), TR-37 (Vancouver, B.C., 1980).

Table 1.—Water bar spacing guide.^a

Road grade %	Soil type		
	Granitic or sandy (ft.)	Shale or gravel (ft.)	Clay (ft.)
2	900	1,000	1,000
4	600	1,000	800
6	500	1,000	600
8	400	900	500
10	300	800	400
12	200	700	400
15	150	500	300
20	150	300	200
25+	100	200	150

^aDistances are approximate only; vary them to take advantage of natural features. From: *Forest Practice Notes*, no. 1, "Waterbars," June, 1979 (Oregon Department of Forestry, Salem).

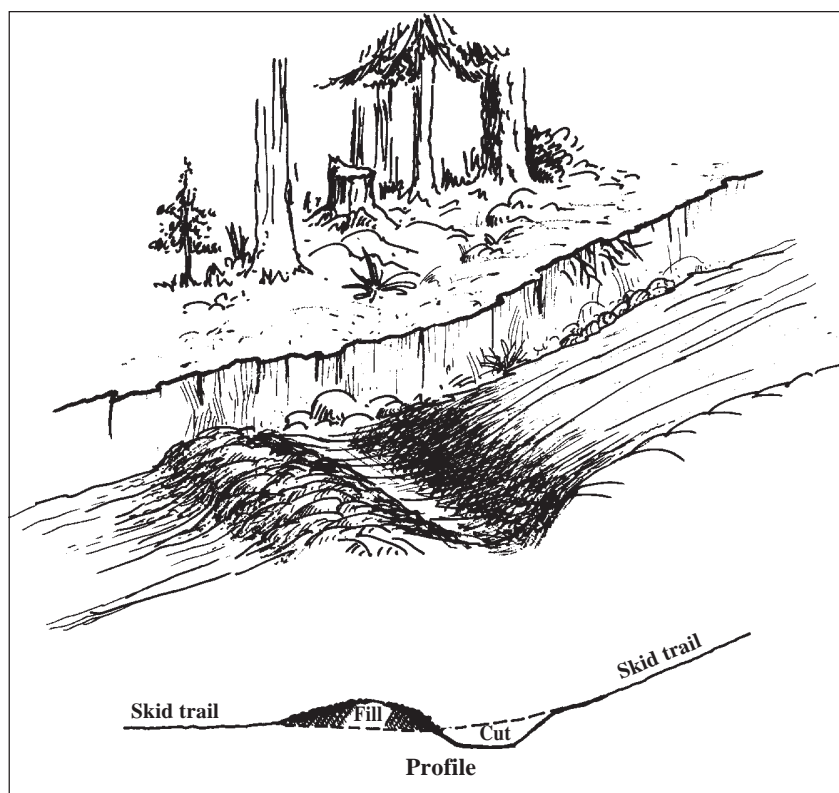


Figure 8.—Water bar construction.



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