

Cattle Producer's Handbook

Miscellaneous Section

1024

Ranch Roads: Maintaining Low-Maintenance Roads

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Unpaved roads are vital to beef cattle operations in the western states. Roads are important for access, controlling livestock distribution, and managing rangelands. Many of these roads are well designed and located in a manner that serves their intended need and require minimal maintenance. However, far too many existing ranch roads create costly maintenance headaches and cause needless environmental degradation. In fact, in many western watersheds, the majority of erosion that exceeds natural rates is generated by road systems.

Roads range in size and condition from paved highways to unpaved roads and trails. They all intercept, collect, and concentrate runoff during storm events. This concentrated runoff can lead to sediment being washed directly from road cuts, fills, and running surfaces to streams, reservoirs, and other water bodies. Road cuts, ditch lines, and surface drainage systems can also intercept and concentrate runoff patterns that can lead to enlarged gullies or landslides.

In addition to the increase in topsoil loss and sediment yields to streams, poorly designed roads can have high maintenance and repair costs and can also disrupt operations. In the long term, properly designed, low-maintenance roads make good environmental and economic sense.

This fact sheet describes some general guidelines on road inspection and assessment as well as road design principles that will provide for low-maintenance roads. It concludes with a list of maintenance strategies that will help reduce long-term maintenance costs.

Road Inspections and Assessment

Some problems can be dealt with by inspecting before and during storm events. Thorough inspection before storm events is much less inexpensive than after a minor drainage problem has been neglected and allowed to expand throughout the winter. For example, clearing debris from a culvert inlet might prevent a stream cross-

ing or road from washing out and necessitating costly road reconstruction. Additionally, sediment lost due to road or stream crossing failure can seldom be reclaimed and is usually destined to impact the watershed.

Learn to read the land to determine why there is erosion. Consider topography (hillslopes, valleys, ridge-lines, creeks, wet meadows, obstacles, and barriers) and soils (depth, texture, alluvial, or colluvial). Understand the surrounding landscape; not just the road and immediate area surrounding the roadway. Clearly identify and map existing erosion problems; gullies, rills, cut banks, etc.

A set of rain clothes, a shovel, and a waterproof log-book are perhaps the most important investments a land manager can possess in managing a road system. On wet dirt roads, these inspections should be conducted on foot, horseback, or an all terrain vehicle (ATV) to avoid damage to soft surfaces and cross drains.

Road Design Principles

Low-maintenance road design principles are based on reducing the impact of water on roads. Water is a powerful agent capable of destroying a road and making it unusable. The ability of water to erode increases exponentially. If water volume is doubled, the ability of water to erode is increased approximately four times. Removing water from a road before it can accumulate to destructive levels will minimize road maintenance.

The following principles can help landowners understand how to design, re-design, and manage to maintain low-maintenance unpaved roads:

- **Hillslope Location**—Roads are best located on hillslopes of 10 to 40 percent. This slope facilitates opportunities to control drainage and minimizes potential bank failure. Roads located on hillslopes of 0 to 10 percent may be difficult to drain, and roads on hillslopes of greater than 40 percent may have potential bank failure.

- **Outsloped**—Where appropriate, roads should be outsloped 4 to 8 percent, with outslope being 1 to 2 percent greater than the slope of the road grade. Outsloping should be avoided where the road surface is composed of fine, highly erodible soil or on well-traveled curves.



Fig. 1. Outsloped with side ditch.

Outsloping of all-season roads should be carefully designed and planned to maximize safe driving conditions (Figs. 1 and 2). Water automatically drains from an outsloped road. Sometimes, removing an existing berm is all that is needed to maintain an outsloped road.

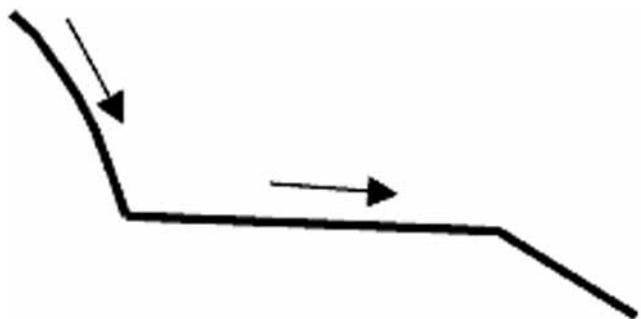


Fig. 2. Outsloped with no ditch.)

Source: University of Washington, Rural Technology Initiative.

- **Road Grade**—Roads should have a gradient of 2 to 8 percent. Lengthening the road with switchbacks and/or climbing turns will minimize road grade up steep hills. Roads with gradients of 9 to 12 percent can be accommodated for short distances but will require additional attention to drainage.
- **Cross Drains for Insloped Roads**—Roads that are insloped or have no sideslope and, as such, need structures developed to divert accumulated water. Careful thought should be given to the water source and where it will be diverted to. The following cross drain structures and their advantages should be considered:

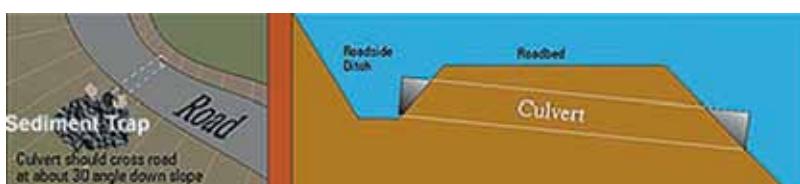


Fig. 5. Cross road drainage by pipe culvert.

Source: Department of Forestry, North Carolina.

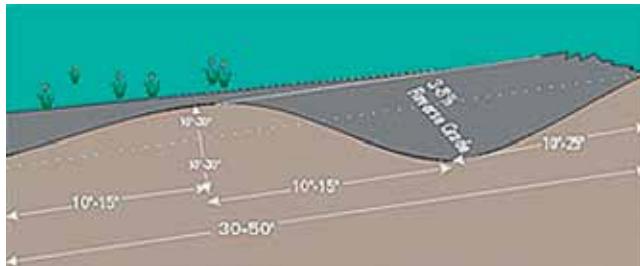


Fig. 3. Rolling dips.

Source: Department of Forestry Resources, North Carolina.

- **Rolling Dips** are designed to include a short section of reversed road grade that ensures water will be diverted (Fig. 3). Rolling dips can cause vehicle bounce and trouble for trailer hitches or low clearance trailers. Rolling dips should be at least 10 to 30 inches below grade and have a 10- to 25-foot approach on the downhill side.
- **Water bars** are easy to install (Fig. 4) but can act as annoying speed bumps. They can fail when driven over by vehicles.

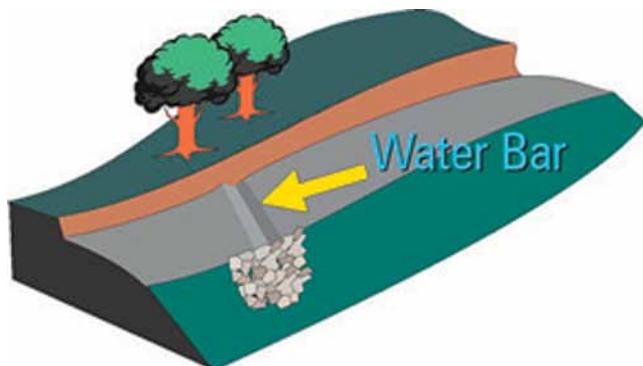


Fig. 4. Water bar.

Source: Department of Forestry, North Carolina.

- **Rolling Outslopes** are designed to have a relatively constant grade but divert water by including an outsloped section of road.
- **Culverts** provide a smooth and dry road surface, however, they can require frequent maintenance (Fig. 5).

More about culverts: (1) Usually installed on permanent roads with regular use after logging, (2) recommended for (a) in-sloped roads with side ditches, (b) natural draws, and (c) draining seeps; and (3) inspect culverts regularly for failing conditions.

- **Cross Drain Location**—Drainage structures should be located in a manner that uses natural features in the land surface. You should consider soil types before installing cross drains (Table 1).

Table 1. Maximum spacing of cross drains based on road gradient and soil type.

Soil type	Road gradient		
	2 to 4%	5 to 8%	9 to 12%
Highly erodible Granitic or sandy	500 feet	350 feet	200 feet
Clay or loam	700 feet	500 feet	350 feet
Shale or gravel	900 feet	700 feet	500 feet

- **Cross Drain Frequency**—Adequate road cross drains need to be installed to remove water off the road before the amount of water accumulated can cause channeling and ruts.
- **Road Surface**—Consider surface treatment for persistent problem wet spots. Seep sites should be protected with a gravel road base placed over a layer of filter fabric to prevent the gravel from mixing with the mud. Underground drains may also be needed to remove water from the roadway.

Maintenance Strategies

Several maintenance strategies should be considered to reduce maintenance costs and work toward maintaining low-maintenance roads.

- ✓ **Stay off roads when they are excessively wet.** Driving on soft and wet roads creates tire ruts that cause gullies to form, can destroy drainage structures, and impact stream systems.
- ✓ **Minimize road maintenance.** Consider where practical mowing rather than blading or grading roadways. Mowing reduces soil disturbance that can minimize erosion and the establishment of noxious weeds.
- ✓ **Conduct road maintenance when there is adequate soil moisture.** Working on roads that are dry tends to fill the ruts with dust and dry gravel that either blows away or washes away with the next rainfall. Use a water truck if road work must be conducted during the dry season.
- ✓ **Put high maintenance roads and unnecessary roads to bed.** Be sure to address current problems on abandoned roads so they don't continue to be a maintenance cost and source of sediment and erosion.



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