

THE LAYMAN' S GUIDE TO PRIVATE ACCESS ROAD CONSTRUCTION

IN THE SOUTHERN APPALACHIAN MOUNTAINS

PLAN NOW...

...OR PAY LATER!!!



USDA NATURAL RESOURCES CONSERVATION SERVICE

USDA FOREST SERVICE

TENNESSEE VALLEY AUTHORITY

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Introduction

It is ironic that two of the greatest attractions of the Appalachian Mountains - beautiful scenery and clear water - are often destroyed by roads designed to help people to enjoy these attractions. Poorly constructed access roads often cause severe erosion and stream sedimentation that benefit no one. Erosion can be disastrous in fragile mountain environments, and the landowner must pay for frequent and costly repair of a poorly designed road.

Ultimately, if you own the land, you are responsible for assuring that your road is properly constructed. Building an access road in the mountains to even a single home can be complicated and expensive. Regardless of the advice received, it's important to remember that there are no inexpensive "short cuts" when building a road in the mountains. Admittedly, it is expensive to build a good road - but it is always less expensive to build a good road the first time than to build a bad road over every year!

How can you get the road you need? It can be achieved through careful planning, design, and supervision by you or by a reliable agent. You are very likely to be disappointed if you leave decisions in the hands of a construction contractor or bulldozer operator. Whether you do the planning yourself or hire a professional, some knowledge about planning, layout, and construction of access roads is valuable.

This guide provides the basics. For many people and situations, the information provided may be sufficient to design and build a road. For others, professional on-site assistance may be necessary. This booklet does not address all the problems that may be encountered in road construction, however. You must determine the limits of your abilities, but professional assistance certainly should be sought for complex projects.

For additional information on access road design and construction, contact your local Natural Resources Conservation Service Office or a private engineer. In addition, some useful references are listed in section A4.

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LAYMAN'S GUIDE TO ACCESS ROAD CONSTRUCTION: PRE-CONSTRUCTION PLANNING

Planning in advance is essential for constructing a good access road. Become familiar with the property and recognize its potentials and problems. Overlooking this important phase can be an expensive mistake. The factors considered and decisions made in early planning represent the fundamental building blocks of a good road.

(A1) Getting To Know The Property

Secure the most detailed maps available for the property. The maps that may be needed include the following:

- Property Ownership Map (Survey Plat)- to locate property lines.
- USGS Topographic Maps - to determine elevations and important landscape features.
- Soil Maps - to identify general slopes and "problem areas".

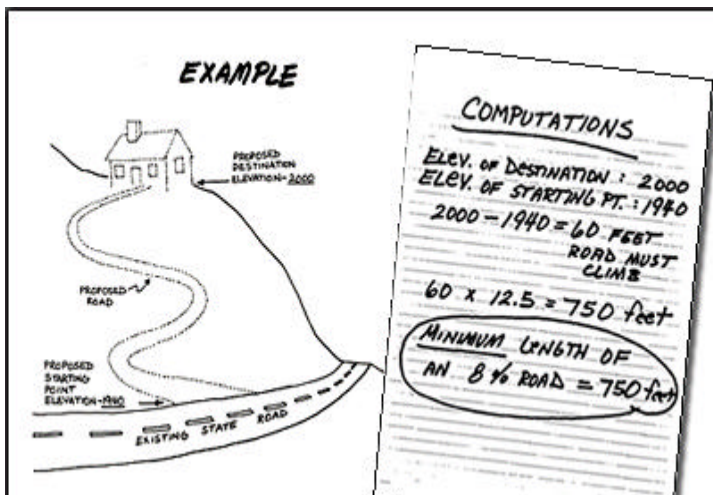
Carefully study the maps obtained and identify the property's important features and characteristics.

Using the property map, accurately draw ownership lines on the topography and soil maps.

Using the soil and topographic maps, identify problem areas that should be avoided if possible. These include very steep, wet, or rocky areas, and soils that are shallow to rock, are highly erosive, or that have a mass-movement (landslide) hazard.

A soil map is an invaluable tool at this stage of planning. For assistance in interpreting the soils information, contact your local Soil and Water Conservation District. Soils information is also very helpful in locating alternative homesites.

Using the topographic map, determine the minimum length for the road. This may be done as follows:



On a topographic map, locate control points -- places through which the road must pass. Examples are the home site, the entrance, or high and low points in the road's path. Determine the total elevation difference between consecutive control points. Multiply each elevation difference by 12.5 to determine the minimum length of road required between the control points. This

length assumes a road constructed on an average grade of 8 percent. If you plan a road that will be shorter than this approximation, you may be headed for trouble. See Section B1 for more on road grades.

(A2) Points to Ponder As You Plan

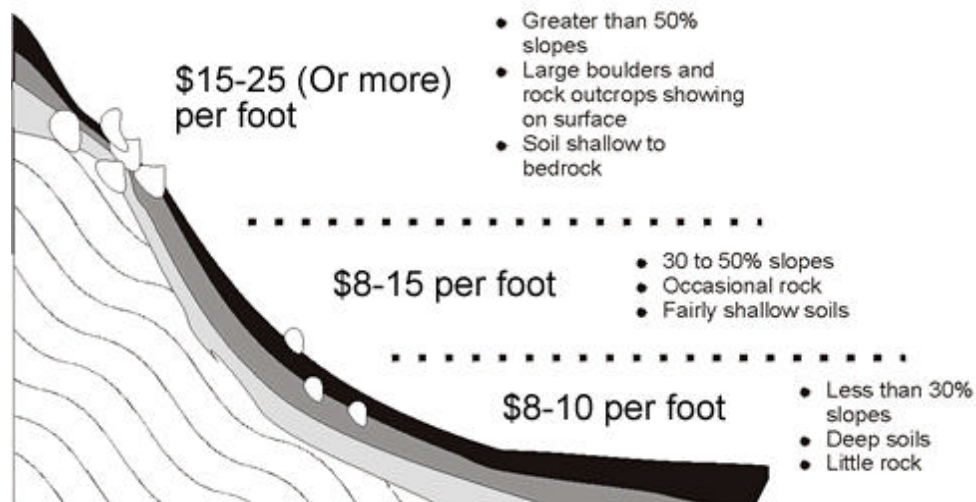
Know the state and local laws, ordinances, and regulations. Ordinances and regulations regarding access roads vary from state to state and county to county. Regulations may include land use zoning, subdivision ordinances, sediment and erosion control, or others. An erosion control plan on construction sites may be required in accordance with the State Sedimentation and Pollution Control Act and/or other applicable local ordinances. Offsite sediment damages are in violation of state and local laws and can result in civil suits.

Plan ahead for possible future state maintenance. If you plan for the State Department of Transportation to assume responsibility for the maintenance of your road, it should be constructed according to State standards. The State will not assume maintenance for a road that fails to meet its standards. This booklet is not intended to provide guidance to meet state standards. These standards are available from the office of the Division of Highways Engineer.

Be prepared to pay the cost of constructing a good road. The cost of constructing a road will vary greatly from site to site. The cost may increase due to the following:

- Steep land - costs increase due to more earth-moving on steep slopes.
- Winter construction - costs increase because it takes longer to build.
- Rocky land - the costs of moving or blasting rock are high.
- Drainage needed - surface and subsurface water must be managed.
- Low stability soils - extra precautions are required on such sites.
- Clearing required - wooded areas must be cleared

APPROXIMATE COST PER LINEAR FOOT OF ROAD



****One important point - if you cut corners during planning and construction, you will pay more for future maintenance!**

Don't give your land away! Erosion control should be a normal part of all construction procedures, and therefore, erosion control practices are incorporated throughout this document. Take every precaution to keep your soil on your property.

(A3) Deciding Where To Put The Road

Get to know the property by walking over it - several times. With the fundamentals in mind, walk over the property making notes of any features which are different or were not as indicated on the map. Working in a downhill direction may provide you with a better view of the terrain. Be sure to identify property boundaries and avoid locating the road within 50 feet of any boundary. Construction crews may venture across property lines without knowing it.

Choose a starting point elevation on the existing road as close as possible to your destination's elevation to minimize your proposed access road's length and grade.

Choose an entrance that provides good visibility from all directions. A permit from the State Department of Transportation or other public body may be required before establishing access from a public road.

Avoid streams and springs whenever possible. If streams must be crossed, make crossings at right angles to the flow of the stream. Otherwise maintain an undisturbed strip of a minimum of 100 feet from all live streams. Keep well away from springs and wet areas. Route the road above wet areas where possible.

(A4) Assistance Is Available

If by this point, road construction already seems like an overwhelming task for the novice, **don't give up!** Help is available, but do not expect someone else to plan and construct your road for you unless you are willing to pay for it. Helpful assistance is available to guide you through the decisions and actions, which will lead to the desired properly constructed road. The table below is provided as a guide to locate sources of information or services helpful in planning, designing, and constructing your road. The services of each source listed may vary somewhat on a county to county basis and this table should only be used as a general guide.

Suggested Source	Permits	Seeding/ Vegetation	Weather	Aerial Photos	On-site Assistance	Erosion Control	Maps				
							Soils	Geology	Topography	Road	Property
FEDERAL											
Natural Resources Conservation Service		✓	✓	✓	✓	✓	✓	✓	✓		
US Forest Service		✓					✓	✓	✓		
Farm Services Agency				✓			✓				✓
Geological Survey								✓	✓	✓	
Nat'l Ocean. Atmos. Admin.			✓								
Army Corps of Engineers	✓										
Suggested Source	Permits	Seeding/ Vegetation	Weather	Aerial Photos	On-site Assistance	Erosion Control	Maps				
							Soils	Geology	Topography	Road	Property

STATE											
N.C. Forest Service		✓		✓	✓		✓		✓		
Geologist								✓	✓		
Universities			✓				✓	✓	✓		
Highway Department	✓									✓	
Dept. of Environment and Natural Resources	✓	✓				✓					
Soil & Water Conservation District		✓	✓	✓	✓	✓	✓	✓	✓		
Suggested Source	Permits	Seeding/Vegetation	Weather	Aerial Photos	On-site Assistance	Erosion Control	Maps				
							Soils	Geology	Topography	Road	Property
COUNTY											
Register of Deeds										✓	
Coop. Extension Service		✓	✓				✓				
Road Dept.	✓									✓	
Sediment/Erosion Control Agencies	✓	✓				✓					
Government	✓									✓	
Suggested Source	Permits	Seeding/Vegetation	Weather	Aerial Photos	On-site Assistance	Erosion Control	Maps				
							Soils	Geology	Topography	Road	Property
CITY											
Library			✓				✓	✓	✓	✓	
Government	✓									✓	
Suggested Source	Permits	Seeding/Vegetation	Weather	Aerial Photos	On-site Assistance	Erosion Control	Maps				
							Soils	Geology	Topography	Road	Property
PRIVATE											
Consultants, Engineers					✓	✓	✓	✓	✓		
Land Surveyors								✓		✓	
Bookstores		✓	✓				✓	✓	✓		

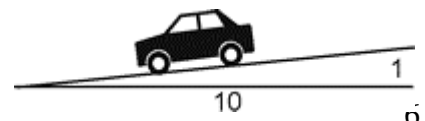
DESIGN GUIDELINES

It's important to understand the basics of designing roads before trying to locate or position a road on the land. The standards to which roads are constructed vary with their intended use. (A road built solely to accommodate logging operations would not be expected to meet the demanding standards of a subdivision road.)

(B 1) Road Grade

The grade of the roadbed should be less than 10% for best results (10 ft. vertical in 100 ft. horizontal).

Maximum sustained grades should never exceed:



- 6 percent for natural soil and grass surface
- 10 percent for gravel or crushed stone surface
- 16 percent if paved

These grades may be increased up to 15 percent on gravel roads (if crushed stone is used) and 20 percent on paved roads for short reaches (200 feet or less) where no other alternative exists. Grades should be determined using techniques described in Section C2.

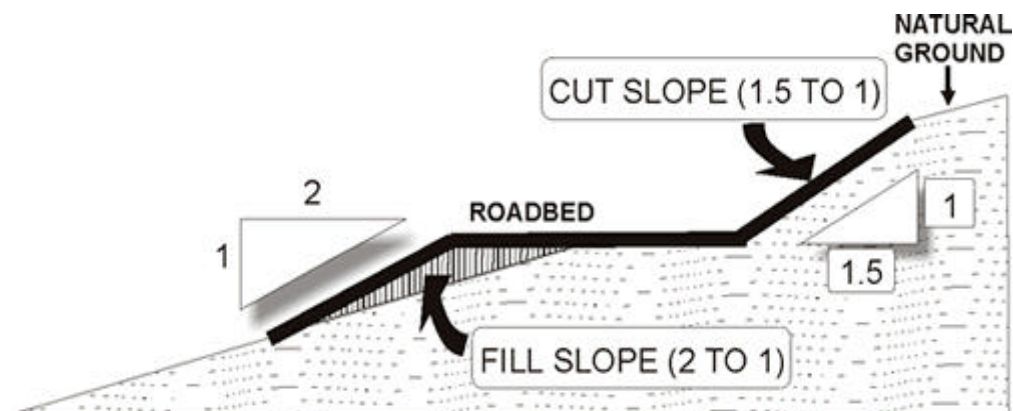
Steep grades should always be avoided at road curves or Intersections.

(B 2) Road Width

The minimum width of the roadbed is 14 feet for one-way traffic and 20 feet for two-way traffic. The minimum tread width is 10 feet for one-way traffic and 15 feet for two-way traffic. The minimum shoulder width is 2 feet on each side of tread width. Increase all widths by 4 feet if traffic from towed trailers of any kind is expected.

(B 3) Side Slopes

All roadcuts and roadfills should have side slopes that are stable for the particular soil and conditions. Cut slopes may be **vertical when less than 3 feet high.** Cut slopes should not be steeper than **1.5 to 1** where the cut slope is **greater than 3 feet.** Fill slopes should not be steeper than **2 to 1** unless an analysis of the soil shows steeper slopes to be stable. Where maintenance will be performed by mowing, cut and fill slopes should be no steeper than **3 to 1**.



(B 4) Surface Drainage

No other aspect of road design is more important and less understood than surface drainage along the road. And unfortunately, this is the area where road-builders sometimes try to "save money" an expensive mistake!

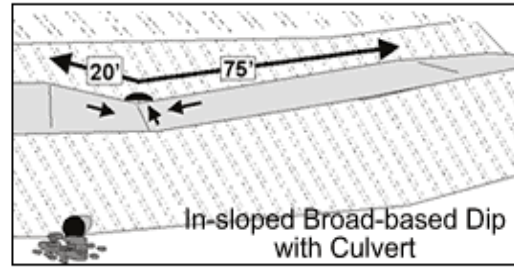
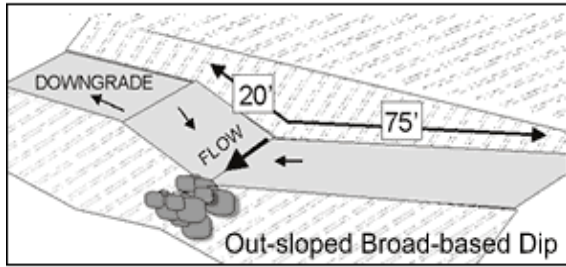
The surface water from all sources must be conveyed from the roadway in order to control soil erosion, maintain a stable road surface, and reduce future maintenance and repairs. Surface drainage must be planned for water from the following sources:

- Rainfall on the roadbed, as well as cut and fill slopes,
- Overland storm flows from the watershed above the road.
- Springs or live streams intercepted by the road

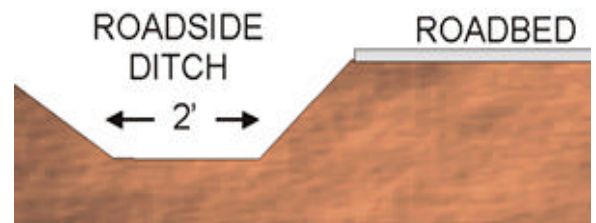
If possible, shape the road to drain by itself by means of cross-sloping and/or broad-based dips. Cross-sloping involves sloping the road slightly to allow surface water to flow across and off the road rather than down the length of the road. Cross-sloping should be less than one-half inch in one foot or about six inches according to the width of the road. See the chart on page 10.

SOME SINGLE-FAMILY ACCESS ROADS OR OTHER SELDOM USED ROADS		SOME SINGLE-FAMILY ACCESS ROADS AND ALL DEVELOPMENT ACCESS ROADS	
Out-sloped road without broad-based dips	In-sloped road with in-sloped broad-based dips	Out-sloped with roadside ditch and culverts	In-sloped with roadside ditch and culverts
Cross-section view of road			
Only requires culverts in the draws or low areas	Only requires culverts in the draws or low areas	Generally the most acceptable design	Requires culverts at draws or low areas
Where overland flow from above road during storms is insignificant	Where overland flow from above road during storms is small	Requires periodic culverts to remove ditch water	Requires periodic culverts to remove ditch and road water
Road water flows freely off the roadbed	Safer on roads that are often frozen, wet, icy, or slippery	Road water flows freely off the roadbed	Safer on roads that are often frozen, wet, icy, or slippery

Broad-based dips may be used to carry surface water off the roadway. Properly constructed broad-based dips allow a smooth crossing without bumping or bottoming out. On sections of a road where broad-based dips are the primary means of surface drainage, construct the dips approximately 150 feet apart, outletting them on side ridges where possible. If the height of the fill slope at the outlet of the dip is 4 feet or greater, the broad-based dip should be in-sloped and a culvert installed.



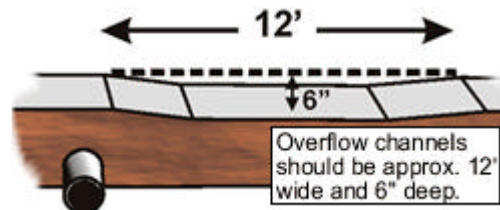
Construct roadside ditches on the inside of all roads that have overland flow from above the road during rain storms. Flat bottom ditches with flat areas two feet or more in width, provide for greater safety and reduced maintenance than do deeper "V" shaped ditches.



Install culverts in natural draws on all roads. Culverts should be placed every 130 to 200 feet on all insloped roads.

What type of culvert pipe should be used?:

- Corrugated Steel Pipe
 - Most common type in use
 - Heavy duty and can take fairly "rough handling"
 - More tolerant of improper installation practices
- Corrugated Aluminum Pipe
 - Lighter and easier to handle than steel
 - Will last longer than steel if properly installed
 - More expensive than steel
 - Damages easily with rough handling
- Corrugated Plastic Pipe
 - Lightest, flexible, and most easily handled



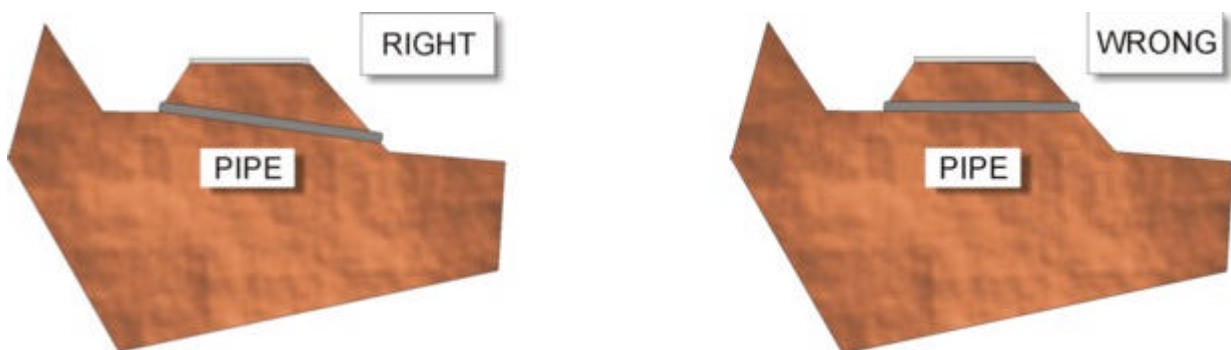
- Less expensive in the 12" to 18" sizes
- Very easily crushed by inadequate cover or poor compaction of fill material and pipe

Use the culvert design procedure to determine the proper culvert size. Many factors affect the culvert size, including size of drainage area, watershed land use, local rainfall, soil type, slope of pipe, and fill over pipe. All culverts should be designed using the **two-year, 24-hour storm as a minimum**. The designers should also evaluate the impact of the **10-year, 24-hour storm**. No culvert less than 15 inches in diameter should be used. To be eligible for State maintenance in North Carolina, culverts must carry a **25-year, 24-hour storm**. For additional information on culvert design, consult your Soil and Water Conservation District or a private engineer.

Where it is impractical to install the proper size of culvert, an adequate overflow area should be provided to allow storm flows to overtop the road and discharge on natural ground, not fill material. The overflow should be protected as needed to prevent road washouts or erosion.

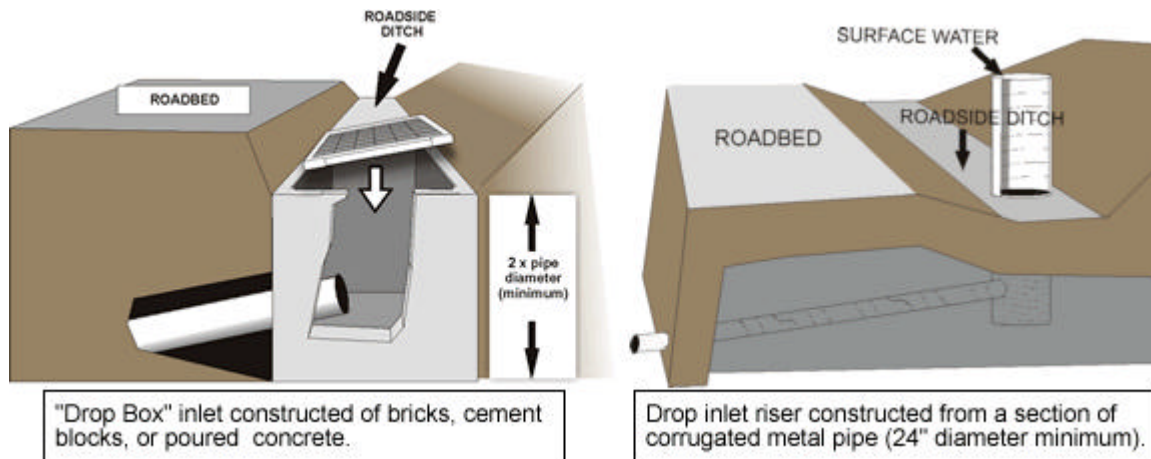
How should culverts be installed?

- **Install culverts with the inlets at or below natural ground.** The deeper the pipe inlet is installed (or the more fill over the pipe), the more water it will carry. In addition, pipes with shallow cover are easily crushed by heavy vehicles.
- **Outlet the culverts at or beyond the toe of the slope.** Erosion protection, such as rock rip-rap, is often necessary at the outlet of culverts. Never outlet a culvert on fill material without such protective measures. It is usually less expensive to extend the culvert to stable natural ground than to protect the fill material against erosion from the culvert outlet.

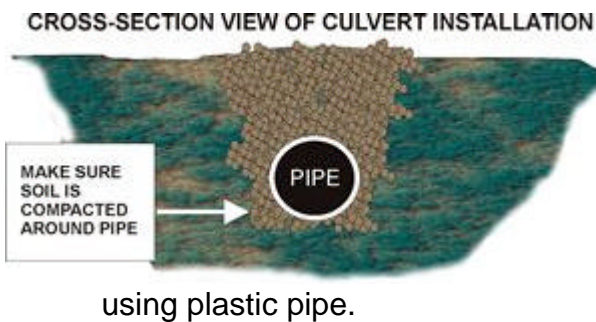
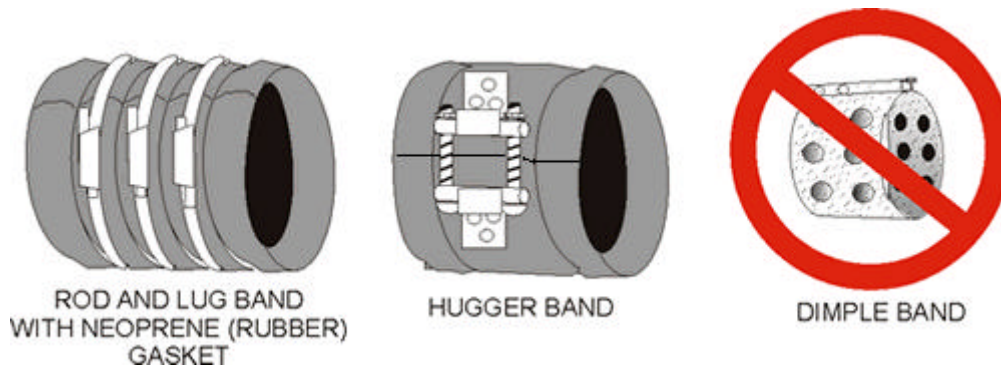


- **Insure each culvert has an adequate inlet.** Most culverts never carry as much water as they should due to poorly constructed inlets. The culvert may be large enough to carry the required flow, but the inlet may not let the water into the culvert. Be sure the roadside ditch is wide and deep enough to allow flowing water easy entry into the pipe. Although not always necessary for an

adequate inlet, the structural culvert inlets shown below provide some examples that can be low in maintenance, as well as very effective.



- **Use watertight connecting bands when connecting two joints of culvert pipe.** Since pipe generally comes in 20 foot sections, properly installed culverts on sloping roads will often require connecting bands. Connecting bands should result in strong watertight joints. Rod and Lug type or "hugger" type bands provide secure, trouble free joints if properly installed. "Dimple Bands" are not acceptable and should not be used.



- **Properly compact soil material placed around culvert pipes.** The soil used to backfill around the pipe should be placed in layers and compacted. Hand-tamping is usually required. Ensure that soil is placed all around and under the pipe. This is especially important when

using plastic pipe.

(B 5) Subsurface Drainage

Subsurface drainage refers to water which is below the normal ground surface. It may be a natural condition or it may be created by failure to properly remove surface water.

Road construction on poorly drained soils should be avoided when possible. Poorly drained roads fall apart in bad weather with even minimal traffic. Wet foundation soils swallow up stone as fast as it is hauled in. Erosion control and stability of fill and cut slopes are impossible to maintain without proper drainage.

Locate poorly drained soils on soil survey and watch for signs of subsurface drainage problems before and during construction. The following may be signs of wet soils with subsurface drainage problems:

- Soils that are grayish in color.
- Areas with numerous springs or seeps.
- Low areas or ground with a soft mushy surface.
- Areas predominated by water-tolerant plants such as alders, black walnut, poplar, cattails, reeds, etc.
- If drainage problems are encountered in the roadbed, it is recommended that the road be relocated to a drier site. If relocation is not feasible, consider one or more of the following in order to reduce the impact of poor drainage.
- Improved surface drainage.
- Removal of nearby shade trees to let sunlight dry the road.
- Use of large (3 inch) stone for the road surface.
- Installation of fabric filter cloth under the surface gravel to prevent stone from sinking and disappearing into the soft soil.
- Installation of subsurface drainage tile.
- Relocating the road to a drier area.

(B 6) Curves and Switchbacks

The minimum radius of curvature of the centerline of the road should be as follows:

- 35 feet for short-bodied vehicles

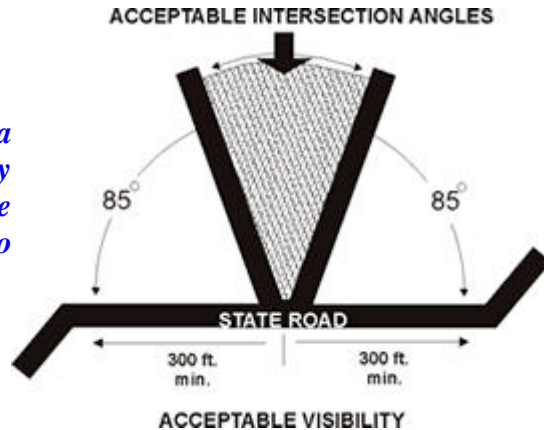
- 50 feet for tractor trailers

In recreational areas, the radius may need to be increased to accommodate recreational vehicles.

Plan switchbacks and curves on grades as flat as possible.

(B 7) Intersection With Public Highways

For safety, the angle of intersection of a proposed access road and a public highway should be no less than 85 degrees, and the clear sight distance to each side should be no less than 300 feet.



(B8) Surfacing

Choose the type of surfacing material by considering traffic needs, frequency of usage, grade of road, soil type on natural roadbed, available materials, cost, and aesthetics.

Grass (Fescue)



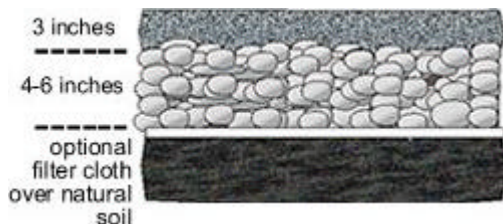
- Not for daily or wet weather use.
- For use only on dry soils.
- On grades less than 8%.
- Least expensive.
- Requires lime, fertilizer, mowing, etc.

Crushed Rock Only



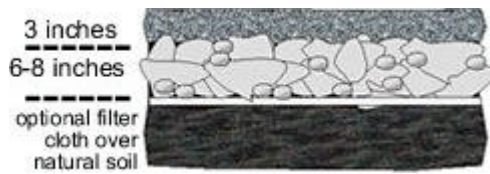
- Medium to high traffic.
- For use on naturally sandy or gravelly roadbed soils.
- On grades of 15% and less.
- Specify "ABC" or "base course".
- Requires periodic grading.

Crushed Rock Over Washed Gravel



- Medium to high traffic on soft soils.
- On grades of 15% and less.
- Specify "ABC over washed gravel"
- Requires periodic grading

Crushed Rock Over Large Rock (3' diam)



Pavement (Asphalt or Concrete)



- Use fabric filter cloth in poorly drained areas.
- For wet sections of roads with soft mushy soil.
- For all traffic conditions.
- On grades less than 16%.
- Specify "3 inch washed stone" or "ballast stone".
- Requires periodic grading.
- Use fabric filter cloth in poorly drained areas.
- For heavy traffic on all soils.
- On grades up to 20%.
- Requires extensive base preparation.
- Most expensive.
- Subject to frost damage on wet soils

Crushed rock or gravel surfacing should be applied as soon as possible after construction (while soil surface is still freshly disturbed) to reduce soil erosion, and insure a good bond between the soil and surfacing material.

ROAD LAYOUT: LOCATING THE ROAD ON THE LAND

After becoming familiar with the property and the design concepts of road construction, it's time to actually lay out the road. Laying out a road consists of staking or flagging the centerline of the road, identifying locations for broad-based dips and culverts, and possibly staking cut and fill slopes.

(C1) Equipment Required

Obtain the following equipment for laying out the road:

- **Clinometer or Abney level** - Inexpensive handheld tools to measure road grade. May be obtained where forestry supplies are sold.
- **50 or 100 foot measuring tape** - To measure road width, length, distance between dips, cut/hill slopes, etc.

- **Survey flags, colored plastic tape, or stakes** - To mark the proposed route and location of culverts, dips, edges of cut/fill slopes, etc.
- **An ax and/or brush hook** - To drive stakes and to cut dense vegetation.
- **Compass** - To determine aspect and to keep oriented.
- **Notepad and a map or aerial photo** - To make useful notes about the location of the road and potential problems.

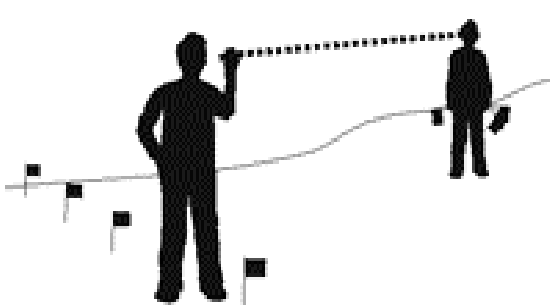
(C2) Locating The Road On A Desired Grade

One-person Method:

1. Tie colored plastic tape at eye-level to a tree, bush, limb, etc. at the starting point of the road.
2. Walk a short distance out the proposed route of the road. Using a clinometer or Abney level, sight back to the colored tape with the Abney/clinometer set at the planned grade.
3. Move up or down the hill until the desired grade is reached, and then flag this position (again at eye-level).
4. If a road construction obstacle (e.g. rock outcrop, wet area, property line) is encountered between the two established points, it may be necessary to adjust the planned grade to avoid the obstacle.
5. Walk further out the proposed route and repeat the procedure above, always sighting back on the previous tape.

Two-person Method:

1. This method is similar to the above procedure except that instead of sighting **back** to the **previous tape**, the person with the level (the "instrument person") sights **forward** out the proposed road to **another person** (the "flag person"). Before using this two-person method, the instrument person should locate his/her eye level on the flag person, and always sight this same spot on the flag person during the survey.
2. The instrument person directs the flag person to move up or down the hill and flag a position marking the desired road grade.
3. The flag person may mark the position (to be the centerline of the road) with plastic survey flags, wooden stakes, paint on trees, or colored tape.



The desired end of the road may be missed following a planned grade or as a result of making adjustments to avoid obstacles. When this occurs, the road locators should work backward from the endpoint and connect the two surveys at the most convenient point. It may be necessary to repeat earlier surveys several times working in both directions to find the best route. Nobody said it would be easy!

(C 3) Marking the Proposed Road

Using plastic survey flags, wooden stakes, colored tape, or paint, mark the following clearly:

- Centerline of the road
- Location of culverts and broad-based dips
- Curves and switchbacks
- Edges of cut and fill slopes on very steep areas
- Any planned turnouts, parking, or passing areas

GETTING READY FOR CONSTRUCTION

When do I start? • What materials do I use? • Who do I get to do the work?

(D 1) Setting a Schedule

Plan the timing of the actual road construction to occur during the milder, drier seasons of the year.

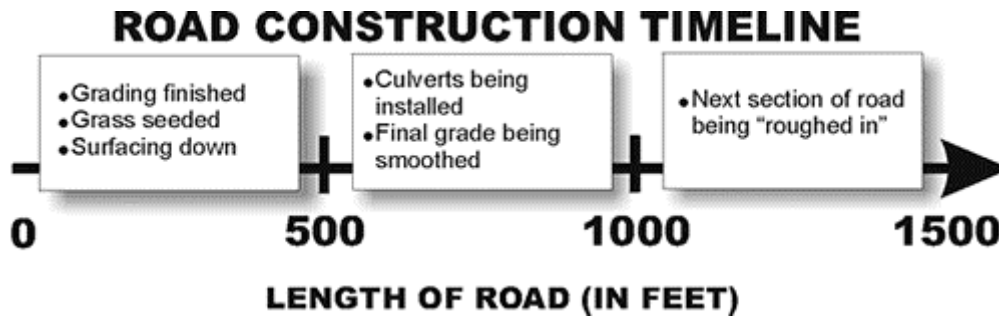
ROAD CONSTRUCTION CALENDAR

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TIMING FOR CONSTRUCTION	BAD TIME		EXCELLENT TIME		BAD TIME		GOOD TIME		BAD TIME			
REASONS	Snow and ice slows construction Too cold for seeding		Good weather Excellent time for seeding		Too hot and dry for permanent seeding		Good weather Good time for seeding		Cold weather approaching Too late for permanent seeding			

(These seasons vary with altitude and rainfall pattern. Contact your local Soil and Water Conservation District office for specific guidance on construction in your locality).

Establish a construction schedule which will require that the road be completely finished in segments of 500 feet or less.

Maximum effectiveness is ensured when stone surfacing and seeding are performed while cuts and fills are still fresh.



(D2) Obtaining The Materials

Develop a Bill of Materials for each segment of the road.

Check early with suppliers about availability, shipping times, price, terms, and other specifics. Be sure to specify the details on the type of materials desired. Culverts, drop inlet boxes, silt fences, erosion control netting, fabric filter cloth, crushed stone, riprap, seed, fertilizer, lime, and mulching materials may be needed.

A handwritten table titled "Bill of Materials for Access Road (Section 1)". The table is organized into three sections: "Access Road (Section 1)", "Seeding", and "Surfacing". Each section lists quantities and items. The "Access Road" section includes 3 15" Corrugated Steel Culverts (30 ft. long), 1 18" Corrugated Steel Culvert (40 ft. Long), 4 Drop Boxes for Culvert Inlets, and 8 tons of Rock Riprap for Culvert Outlets. The "Seeding" section includes 1 ton of Agricultural lime, 500 lbs of 10-10-10 Fertilizer, 30 lbs of Ky-31 Tall Fescue, and 40 bales of Straw Mulch. The "Surfacing" section includes 40 tons of Washed gravel and 30 tons of Crusher run stone.

Quantity	Item
Access Road (Section 1)	
3	15" Corrugated Steel Culverts - 30 ft. long
1	18" Corrugated Steel Culvert - 40 ft. Long
4	Drop Boxes for Culvert Inlets
8 tons	Rock Riprap for Culvert Outlets
Seeding	
1 ton	Agricultural lime
500 lbs	10-10-10 Fertilizer
30 lbs	Ky-31 Tall Fescue
40 bales	Straw Mulch
Surfacing	
40 tons	Washed gravel
30 tons	Crusher run stone

Plan to have materials BEFORE they will actually be used.

Have you ever started a job only to find you didn't have everything needed to finish? Failure to have materials on hand when they are needed results in unnecessary delays. Such delays are expensive. **Planning is the key!**

Materials to be used should be inspected upon arrival and substandard materials rejected.

For example, if "dimple bands" are delivered when "hugger" bands were specified, send them back!

(D3) Hiring The Right Contractor

Hire a contractor who has the right equipment for the job. Since the cost of equipment time will be a major portion of the total expense of the initial road construction, the "right" equipment will save money. (Would you hire a carpenter by the hour who uses a rubber hammer for driving nails?) See the **Construction Equipment Table**. Some type of survey equipment will be needed to properly slope the roadbed and the cut and fill slopes. A qualified contractor will have either a tripod or a handheld level to assure that the road is built to your specifications.

Hire a contractor experienced in mountain road building. Just because a contractor has heavy equipment does not mean he can build roads. Check around a bit:

1. Get out and look at some roads built by contractors.
2. Talk to landowners who have hired the contractor in the past.

If the contractor has any objections to the above, be suspicious!

Hire a contractor with an attitude toward high quality. Find another contractor if the one you are thinking of choosing says:

- "I'm too busy to do the work in the months you want it done- but I can do it after Christmas!..."
- "I know a lot of shortcuts to save you money..."
- "The standards you want just aren't needed for a good road ..."
- "I don't need or want anybody's help- I already know all there is to know about road-building ..."
- "I don't like to be supervised ..."

- "I'm not supposed to give you the names of people we have worked with in the past..."

EQUIPMENT TABLE INSTRUCTIONS

1. The letters (A through H) in the table refer to specific types of construction equipment as shown below the table.
2. Letters in parenthesis indicate equipment which is marginally acceptable when the desired equipment is not available.
3. Read the "Complicating Factors" vertically on the left side of the table. Check off those factors which will be involved in your road.
4. Determine the length of the road and find the proper column horizontally across the top of the table.
5. Copy down all letters in the blocks at the intersection of the "Length of Road" column and the "Complicating Factors" rows that you checked. Eliminate duplication of letters.
6. Using these letters, determine the equipment that will be required. If your list contains the letters A or B or C together, use the larger pieces of equipment.

CONSTRUCTION EQUIPMENT TABLE

COMPLICATING FACTORS	LENGTH OF ROAD			
	LESS THAN 500 FEET	500 - 1000 FEET	1000 FEET TO 1 MILE	1 MILE OR MORE
NONE	B (C)	B (C)	B (A)	A (B)
AVERAGE LAND SLOPE BETWEEN 10% AND 20%	B (A)	B (A)	A (B)	A (B)
AVERAGE LAND SLOPE BETWEEN 20% AND 30%	B (A)	A (B)	A	A
AVERAGE LAND SLOPE GREATER THAN 30%	A (B)	A	A	A
AVERAGE CUTS & FILLS OF 5 - 10 FEET	B (A)	A (B)	A,F(E)	A,F(E)
CUTS & FILLS GREATER THAN 10 FEET	A(B),D,F	A,D,F(E)	A,D,E(F)	A,D',E(F)
* DROP INLET AND CULVERTS	H	H	H,G	H,G
* SUBSURFACE DRAINAGE OR MANY CULVERTS	H,G	H,G	H,G	H,G
* APPRECIABLE ROCK TO BE REMOVED	F	F	A,F	A,F

***This equipment is needed in addition to other equipment indicated above.**

A - Angle Blade Bulldozer: 100 h.p. or greater, 20,000 lbs. or greater. Powerful enough for big difficult jobs and heavy enough to handle steep slopes and rock.

B - Angle Blade Bulldozer: 75 h.p. or greater, 15,000 lbs or greater. Adequate for small and medium jobs where cuts and fills average less than 5 feet and little rock is to be moved.

C - Fixed blade bulldozer: 75 h.p. or greater. 15,000 lbs or greater. Fixed blade restricts the usefulness of this equipment. Use only when larger equipment is not available and only for small jobs.

D - Sheepsfoot Roller. Pulled by dozer. Used to compact fill material as fill is spread.

E - Motor Scraper (Pan). Used to load and haul large volumes of material over distances of 300 feet or more.

F - Frontend loader and Dump truck. Used together for loading and hauling earth or rock. Frontend loader is not used for cutting roads.

G - Backhoe. Used for excavating trenches, digging out stumps and installing pipes and culverts.

H - Motorized Hand Tamp. Used for compacting earth around pipes and other structures.

(D4) Getting Started On The Right Foot

Discuss your plans and specifications with the contractor. Establish the rules. Walk over the site with the contractor. Give him a copy of the specifications you have developed for your road and discuss each point. Resolve any questions. Consider his suggestions, but do not allow him to change the specifications to save money (his money) at the expense of quality (your money).

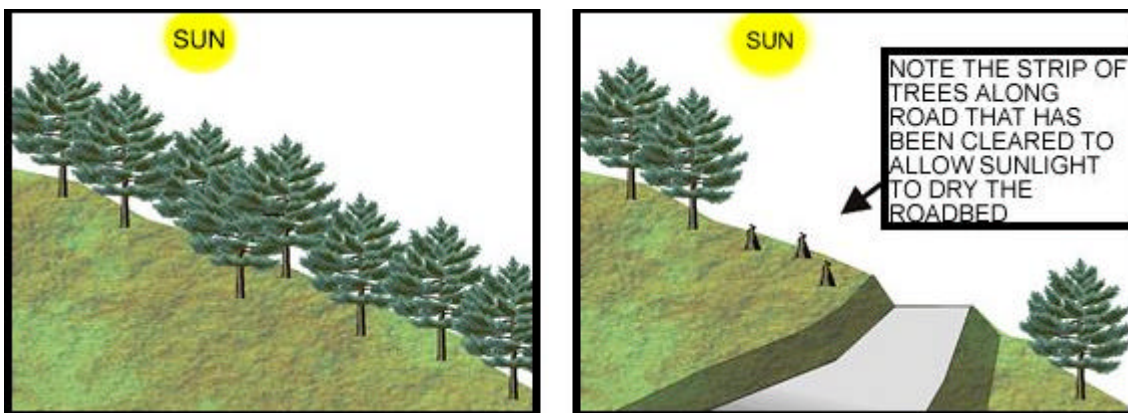
Agree on the dollars and "sense". Many earth-moving contractors insist on payment by the hour. This relieves the contractor of any risk. Lump sum payment on a job-basis is usually advantageous to the landowner who knows the kind of finished product he wants and maintains close supervision of the contractor's work to insure that quality work is performed. Using either payment method, never pay the contractor more than 50 percent of the agreed price until you are completely satisfied with the finished job. Usually, "you get what you pay for". If you hire the cheapest contractor in the county, don't be surprised if you receive a "cheap looking" job.

Plan to have someone knowledgeable of your road specifications to supervise or periodically check the progress of construction. This is one of the most neglected aspects of any type of construction. Supervision is imperative to assure that you end up with a quality road. If you have no one capable of providing construction supervision, contact your local Soil and Water Conservation district office well in advance. Assistance may be available for construction supervision.

CONSTRUCTING THE ROAD

(E1) Clearing the Way for Construction.

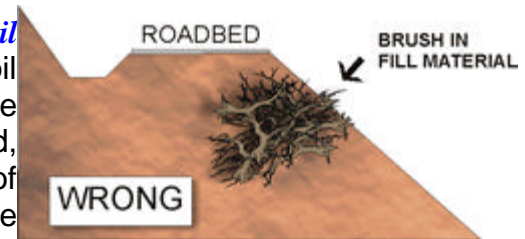
Clear the vegetation from a right-of-way at least wide enough for the roadbed and cut and fill slopes. Access roads in wooded areas require that trees and brush be removed prior to cutting in the road. Where deep cuts or fills are required, it will be necessary to clear a wider area. At curves, the area cleared should provide good visibility of traffic from both directions. Where snow and ice on the roadbed may present problems, it is a good practice to remove enough vegetation to allow maximum penetration of sunlight to the roadbed.



Make plans in advance to use or sell the timber, pulpwood, or firewood cleared from the roadway, if possible. If many large mature trees will be removed, consult a forester for an estimate of their value.

To aid in removing stumps, some bulldozer operators prefer to have the trees cut 3 or 4 feet above the ground, rather than at ground level.

Do not place trees or brush in areas to be covered by soil fill material! It is impossible to compact soil adequately around brush and this leads to future unstable road fills. Brush should be either burned, removed from the site, or piled below the toeslope of the fill to trap sediment. Remove all trees from the area to be filled with soil.



(E2) During Construction

Make sure after clearing that all your flags and stakes remain and are understood by the contractor's crew.

Be alert for problem areas, such as wet or unstable soils, and correct immediately as previously discussed.

Do not allow the equipment to "rough in" more than 1000 feet of road until the first 500 feet are completed. Drainage structures, such as culverts, should be installed, fill material properly compacted, and surfacing material put down as construction progresses. Seeding should begin on segments as soon as the grading on that segment is completed.

Have an agreement with the contractor that he will check with you before placing any surfacing material (gravel or pavement). Before surfacing the road, be sure that drainage structures are installed properly; that adequate erosion and sediment control measures are maintained; and that the roadbed's in-sloping or out-sloping is satisfactory.

Maintain close supervision and make sure your plans are followed. Ask questions if something does not look right.

GETTING VEGETATION ESTABLISHED

(F1) Hand Seeding

If the ground surface has become hard or crusty, scarify or "roughen up" the surface. This seedbed preparation may be done with a farm tractor and disk, a garden tiller, or even a hand rake. (The latter may be the only way possible for steep roadbanks or cut/fill slopes). Do not disturb the ground too deeply- just enough to break the surface crust.

Apply dolomitic or agricultural lime per soil test or at a rate of 2 tons per acre. (This is about 90 lbs. per 1000 sq. ft.)

Apply fertilizer per soil test or as follows:

- Grasses- 1000 lbs. 10-10-10 per acre (25 lbs. per 1000 sq. ft.)
- Legumes or grass/legume mixture - 1000 lbs. 5-10-10 per acre / (25) lbs. per 1000 sq. ft.)

Use the Seeding Table below to determine the proper type of vegetation and seeding rates in lbs. per acre.

Since the seeding list to control erosion was developed, many concerns over the use of exotic seed and wildlife beneficial seeding mixtures have arisen. In an effort to offer seeding alternatives to landowners with multiple-use goals or for any area where critical stabilization is not warranted, please consider these **alternative seeding mixtures.**

SEEDING TABLES

	G = Grass					L = Legumes						
1) Permanent Plantings on Sunny, Dry Sites												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ky 31 Tall fescue (60 lb) *			G	G	G			G	G			
Weeping lovegrass (5 lbs)				G	G							
Sericea lespedeza (scarified) (50 lbs)				L	L							
Crownycatch (15 lbs) & tall fescue (20 lbs) or Lovegrass (3 lbs)			G	G	G							
Lathco flatpea (20 lbs) & Tall fescue (20 lbs) or Lovegrass (3 lbs)			L	L	L			G	G			
Sericea lespedeza (scarified) (50 lbs) & Tall fescue (30 lbs) or Lovegrass (5 lbs)				G	G				L	L		
Sericea lespedeza (unscarified) (60 lbs) & Tall fescue								G	G			
Tall fescue (50 lbs) & White clover (4 lbs)			G	G	G			L	L			
2) Permanent Plantings on Shady, Dry Sites												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Creeping red fescue (50 lbs) *			G	G	G							
3) Permanent Plantings in Partial Shade												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ky 31 Tall fescue (30 lbs) & Creeping red fescue (20 lbs) *			G	G	G							
Creeping red fescue (30 lbs) & Lathco flatpea (20 lbs)				G	G							
4) Permanent Plantings on Wet Sites												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Reeds canarygrass (20 lbs)			G	G	G	G						
5) Temporary or Short-Term Covers												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Oats (3 Bu or 90 lbs) or Rye (3 Bu or 120 lbs)		G	G							G	G	
Ryegrass (40 lbs)		G	G							G	G	
Sudangrass (45 lbs) or Browntop millet (40 lbs)						G	G	G				
Mulch with no seeding												

***Also include 30 lbs of Rye if a quick cover is needed.**

Mulch the seeded areas with 60-80 bales of straw or hay per acre. This equals about 1-2 bales per 1000 sq. ft. About 25% of the ground surface should be visible after mulching. Hay is usually less expensive than straw; however, it is more difficult and time-consuming to spread. Hay may also contain undesirable weed seeds.

Areas to be vegetated where water has a concentrated flow should have the mulch anchored with some type of erosion control netting. This netting, usually made of plastic or plastic-like material, is held to the ground by large wire staples. Contact your Soil and Water Conservation District for more information on sources and installation of netting and other erosion control materials.

(F2) Hydroseeding

Specify that the following materials be applied:

- 1000 lbs. of agricultural lime per 1/4 acre or per soil test
- 250 lbs. of 10-10-10 per 1/4 acre (for grasses) or per soil test or 5-10-10 (for grass-legume mixtures) or per soil test
- Suitable seed according to the rates and season on the Seeding Tables.
- 270 lbs. of wood cellulose mulch or comparable material per 1/4 acre. (On south facing slopes, mulch with additional small grain straw).

MAINTENANCE

Even the best planned and constructed roads will require some maintenance.

(G1) Maintaining Your Investment

Schedule periodic inspections of the entire road in early March and August, especially after large storms. A suggested method is to walk the entire length of the road examining culverts, cut slopes, and the roadbed itself. Make sure the drainage dips and cross-sloping are still functioning and the roadbed is free of ruts and ridges. Then walk back along the toe of the fill slope examining the drainage outlets and the general condition of the fill slope.

Any blockage or damage to culverts or drainage structures should be repaired immediately.

Bare or eroding areas should be reseeded according to Section F or stabilized by some other means. Where repairs are made in midwinter, it may be best to only mulch the disturbed areas and perform the seeding later in the proper season. Rills 10 inches or less in size can be reshaped with hand tools. Larger rills or gullies will require that additional fill be hauled in and some may require machine shaping. Be sure to compact new fill very well to prevent it from being washed out by subsequent rains. At culvert outlets, rock riprap, underlain by fabric filler cloth, may be needed.

Maintain all vegetation along roads (including road shoulders, cut and fill slopes, and other areas), as follows:

- Apply 2 tons lime per acre (or per soil test) during late fall or winter every 4-5 years.
- Apply fertilizer annually per soil test or as follows:

- **Grasses alone:**
 - 500 lbs. 10-10-10 per acre in early fall.
- **Legumes alone:**
 - 500 lbs. 0-10-20 per acre in early spring.
 -
- **Grass-legume mixture:**
 - 500 lbs. 5-10-10 per acre in late winter or early spring.

Trim back or remove vegetation that crowds the roadway, prevents surface water from flowing freely to drainage structures, or shades problem areas.

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1981. *Building Water Pollution Control Into Small Private Forest and Ranchland Roads*
USDA Forest Service. Portland, Oregon

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1982. *Roadbuilding Guide for Small Private Roads*
Mendocino County Resource Conservation District Ukiah, California

Baussman, Richard F. and Emerson V. Pruett

1978, *Permanent Logging Roads for Better Woodlot Management*
NA-FR-18
USDA Forest Service, Northeastern Area

Kochenderfer, James N.

1970. *Erosion Control on Logging Roads In the Appalachians*
USDA Forest Service Research Paper NE-15S
USDA Forest Experiment Station

USDA Natural Resources Conservation Service

North Carolina Technical Guide Section IV

Standards and Specifications

Practice Standard No. 560 - Access Road.

April, 1991

Acknowledgement

The authors have drawn freely from the publications listed. The reader is encouraged to consult these publications if detailed information beyond the scope of this booklet is desired.

This document was originally prepared for publication by **Howard C. Tew** and **Lane Price** of the USDA Soil Conservation Service (now the Natural Resources Conservation Service) and **Lloyd Swift** of the USDA Forest Service.

Related Links

Mulching: Temporary Protection of Critical Areas without Seeding (PDF)
Practice Standard No. 484-1, from the Natural Resources Conservation Service

Upland Wildlife Habitat Management (PDF)
Practice Standard No. 645, from the Natural Resources Conservation Service

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http://www.dfr.state.nc.us/stewardship/roadguide/stew_roadguideintro.htm