

BEST MANAGEMENT PRACTICES
FOR CONTROLLING

**SOIL EROSION
AND
SEDIMENTATION**



FROM LOGGING OPERATIONS
IN WEST VIRGINIA

Revised 1989, 1995, 1996, 2001

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INTRODUCTION

It should be noted that the Best Management Practices recommended in this booklet are not the only acceptable ones. Situations will arise that require custom or alternative practices to be used to get the job done and minimize any erosion hazard as mandated by the Logging Sediment Control Act. However, the law does require that Best Management Practices, West Virginia Code 19-1b-7(g), be used for controlling erosion and soil movement into streams.

Excess soil sediment has been described as the greatest single contaminant by volume of lakes, streams and rivers. Sediment containing organic matter can create a biochemical oxygen demand in natural waters that damages the habitat of fish and other aquatic life, reduce recreational values, and adversely affect water supplies. It can also clog stream channels, contributing to increased stream bank and channel erosion. Eroded soil particles may carry pesticides, herbicides, fertilizers and other chemicals.

It is a proven fact that cutting trees does not cause erosion. However, improperly performed logging operations and related activities (especially improperly planned and constructed roads and landings), along with certain silviculture activities that expose mineral soil (such as site preparation, mechanical tree planting, etc.), are contributing factors causing soil loss and sedimentation.

Through positive efforts of people involved in the sediment control program, the objective of keeping sediment out of State waters will be met.

Logging Sediment Control Act Summary

1. Logger Licensing
2. Logger Certification
3. Timbering Operation Notification
4. Logging Operation Posting
5. Enforcement for activities causing erosion and/or stream sedimentation or the potential thereof.
6. Reclamation to be completed within 7 days of the planned completion date on the notification form. If it can't be done within 7 days, the Division of Forestry must be contacted.

The West Virginia Division of Forestry was designated by the Legislature as the agency responsible to carry out the mandates and provisions of the Logging Sediment Control Act.

The law states that after September 1, 1992, anyone conducting a logging operation, buying timber or buying logs for resale is required to be licensed by the Division of Forestry. The annual fee is \$50. The fee covers any one or any combination of the three categories stated above. A person who is applying for a license must be registered and in compliance with the West Virginia Department of Tax and Revenue and Workers' and Unemployment Compensation Divisions. Acceptance of the license implies that the operator will protect environmental quality through the judicious use of silvicultural Best Management Practices.

The second main provision of the law provides for the certification of loggers. The fee for certification is also \$50 annually. The requirements for certification are the satisfactory completion of courses in tree felling safety and personal safety equipment, first aid and silvicultural Best Management Practices. A logger certification can be renewed for two successive years, provided the logger's training is less than three years old. Retraining is required every three years.

Each logging crew is required to be supervised by a certified logger any time the timbering operation is being conducted. The certified logger must be on the job each day.

A third provision was for loggers to submit a timbering operation notification form within three days of starting a new harvesting operation. Along with notification, the logger is required to post the operation with a sign listing the logger's name and license number in letters that are at least 3". The posted sign must remain on each active log landing of the operation.

The law also specifies several ways in which licenses can be suspended and/or revoked. These provisions have been amplified by the writing of regulations available from the Division of Forestry.

The law empowers the Division of Forestry to issue compliance orders to correct problems and, when necessary, to suspend a logging operation until specified corrections are made to bring the operator or operation into compliance with the law. Instances include when human life is endangered, uncorrectable damage to the environment is imminent, an operation is not licensed, uncorrectable water pollution may result, or when a certified logger is not supervising the operation. Licenses may be suspended if the person is found to be in violation twice in any two-year period, and they may be revoked if the logger is found in violation for a third time in any two-year period.

If a logger feels that the Division of Forestry has acted improperly, the logger must appeal within 48 hours to the Division of Forestry. A conference panel, composed of three persons, will be brought together for an informal ruling.

The Director of Forestry may also seek civil penalties for violations of the law in the Circuit Court of the county in which the violation occurred, in an amount not to exceed \$2,500 for the first offense and \$5,000 for any subsequent offense. For less serious violations, the Director will generally give the logging operator a specified number of days to correct the situation.

All penalties collected are deposited in a Timbering Operations and Enforcement Fund for use in administering the law.

The law also provides that all State agencies shall cooperate with the Director in administering the law and that the Director shall cooperate with all other State agencies in the enforcement of their responsibilities and duties.

There are exceptions provided for in the law for utilities and right-of-way clearing, ground-disturbing construction, Christmas tree severing, companies regulated by the federal energy regulatory commission and for people harvesting on their own property for their own use, provided that the individual does not have the severing done by a person whose business is the severing or removal of trees. An exemption from licensing and certification can be applied for if a person who is severing or removing standing trees for sale occasionally, on their own property or property of another, where the aggregate gross income realized for all sales within any calendar year of the logs, props, posts, firewood, rails, or other products does not exceed \$15,528. The exemption must be approved by the Division of Forestry and a Harvesting of Timber Notification form must be submitted.

To apply for a timber-harvesting exemption, contact one of the six Division of Forestry District offices listed on Page 18.

It should be noted that landowners also have a responsibility in preventing sedimentation of the State's streams. Under Chapter 22 of the Code of West Virginia and enforced by the Division of Water Resources of the State Department of Environmental Protection, landowners can be held legally responsible for allowing or contributing to stream sedimentation or even stream turbidity due to logging.

STREAM DEFINITIONS

Perennial stream--Identified by well defined banks and natural channels and have continuously flowing water most years. They are usually shown on a topographic map as a solid blue line.

Intermittent stream--Has well defined banks and natural channels, but typically has flowing water from a headwater source for only a portion of the year. They are usually shown on a topographic map as broken blue lines.

Ephemeral stream--A channel that flows as a result of wet weather conditions when the ground is saturated. Not shown on topographic maps.

STREAMSIDE MANAGEMENT ZONES and SHADE STRIP AREAS

Definitions

Streamside management zone. Vegetated land adjacent to perennial, intermittent and ephemeral streams and ponds or lakes requiring special attention during forestry operations. These are critical areas where nonpoint source pollutants can enter the aquatic system. An area of undisturbed forest soil between areas disturbed to mineral soil and a stream bank. It provides a protective zone to trap and filter out suspended sediments before these particulates reach the stream. Any forestry operations should establish or enhance the riparian area while meeting the landowner's objectives.

Shade Strip (buffer strip). A no-cut or light-cut area that provides adequate shading of perennial or intermittent streams so as to stabilize and preserve the biological value of the stream.

Conditions Where Streamside Management Zones Apply

Streamside management zones should be maintained among all streams, watercourses, truck haul roads, skid roads and landings where soil has been exposed and surface runoff will carry sediment loads. Streamside management zones should be at least 100' wide on each side of perennial or intermittent streams and 25' wide on each side of ephemeral streams. Adequate streamside management zones should be maintained around all lakes or ponds, perennial flowing natural springs, and all springs and reservoirs serving as a domestic water supply.

Streamside Management Zones (SMZ)



Stream	Stream	SMZ's	Log Haul
Bed	Bank		Road

On perennial and intermittent streams, 100' wide; on ephemeral stream flows, 25' wide.

Streamside Management Zone Requirements

1. The minimum streamside management zone width or distance between roads or landings (exposed mineral soil) and a perennial or intermittent stream should be 100 ft. slope distance. On ephemeral streams, it should be 25 ft.
2. The streamside management zone should be protected to prevent exposure of mineral soil and subsequent erosion. Equipment operation in this area should be limited. However, cutting and pulling trees from the area is permitted. If mineral soil is exposed, it will be stabilized by seeding and mulching as soon as possible.
3. Log landings will be located outside the streamside management zone where practical. If circumstances or specific reasons prevent this, then the landing will be treated as a critical area.
4. Log landing fill areas within the streamside management zone will be seeded and mulched immediately after construction.
5. Truck roads and skid roads should not be within the streamside management zone except when entering and leaving stream crossings.
6. Truck haul roads built, under certain circumstances and for specific reasons, within a streamside management zone should be graveled and fill slopes seeded and mulched immediately after construction.
7. Existing roads within the streamside management zone can be utilized only if using them will cause less damage than constructing a new road. Existing roads will be maintained in accordance with all requirements of haul and skid roads that reduce soil erosion and sedimentation.
8. Recommended spacing of drainage structures such as culverts, water bars, turn-outs and broad-based dips should be used on truck and skid roads to intercept and properly discharge runoff in small quantities so the filter capacity within the streamside management zone will not be exceeded.
9. Rip-rap erosion control will be installed at culvert outlets or discharge points into or within the streamside management zone. (*See Page 13*)
10. To minimize erosion sources, cut and fill slopes within the streamside management zone should be minimized in accordance with safety and other design criteria.
11. Skid road fill slopes within the streamside management zone will be seeded and mulched immediately after construction.

LOGGING DEBRIS and TREE TOPS IN STREAMS

Directional felling should be used to minimize stream disturbance. Felled tops in streams will be pulled from the stream channel on all perennial and intermittent streams. Small logging debris can be harmful to the stream channel causing bank erosion and channel blockage. It is also recognized that large woody vegetation in the riparian areas and stream channels can be beneficial to aquatic life.

TRUCK HAUL ROADS

Definition--A road system, temporary or permanent, utilized for transportation of wood products from the harvest site by truck.

Purpose--To provide for an efficient, safe transportation system to effectively protect the forest land and water quality when removing forest products from the harvest site, developing the forest for recreation, wildfire control, or other forest management activities.

Conditions Where Practice Applies

When a road system is necessary to provide vehicular access for the purpose of harvesting and removing forest products.

Specifications

1. Final center line grade of road should be 10% or less. Final center line gradients not exceeding 15% are permissible for distances up to 200 ft. By breaking or changing grade frequently, less erosion problems will be encountered than on long, straight continuous gradients. There should be a minimum road surface width of 12' on the cut surface (not fill).
2. Streams should be crossed as close to a right angle to the stream as possible. Bridges or culverts should be sized so as not to impede stream flow in keeping with good drainage practices. (See "*Pipe Culvert*" on Page 14.) Stream fords are permissible as a last resort, but only when the stream bottom is rock based and can support truck traffic. The stream is to be crossed at a right angle, and approaches to the stream should be graveled for a distance of 100 feet each side.
3. Road gradients approaching water crossings should be broken and surface water dispersed so it will not flow directly into the stream. Roads should be located (with the exception of stream crossings) a minimum of 100 ft. or more from perennial or intermittent streams and 25' from ephemeral streams. Distance is measured from the stream bank to the bottom edge of soil disturbance, in case of fills, to the toe of the fill slope. (See "*Streamside Management Zone (SMZ) Requirements*" on Page 4.) If the recommended streamside management zone cannot be maintained, then alternative practices will be used, such as placing gravel on the road surface and immediately seeding and mulching the road fill areas.
4. Roads may be out-sloped for cross drainage. On side hills where a curb, fender or berm is necessary to protect the fill slope, the road should be in-sloped with cross drainage installed from the inside toe of slope to the outside or downhill side. (See "*Pipe Culvert*" on Page 14 or "*Broad-Based Drainage Dip*" on Page 17.) Where roads are in-sloped, cross drain interception of surface water is necessary.
5. Level areas where drainage is difficult to establish, and wet floodplain soils should be avoided for road location if possible.
6. Truck roads that intersect public roads should have gravel or other aggregate up to 200 ft. to keep mud off the highway. (Check county Division of Highways requirements for entering public roads.)

Truck Haul Road Maintenance

1. *During construction*, adequate drainage of the road surface using temporary cross drains, "turn-outs" or water bars on a day-to-day basis is desired in the event of storm flows prior to road completion and installation of a permanent drainage system.
2. During the harvest operation period, roads and their attendant drainage systems should be maintained to perform to standard. This may include additional seeding and mulching of fill slopes within the streamside management zone.
3. Operations that will cause adverse erosion and sediment problems should not be carried on in times of extreme weather conditions.

Post-Harvest Operations

If roads are to be used after logging, broad-based dips, culverts and bridges should be left intact and be periodically maintained by the landowner. If not to be used, drainage structures should be removed and road surfaces restored to a natural drainage by out-sloping smoothly at 3%, leaving existing dips and establishing water bars. Stream banks will be least disturbed if bridge abutments are left intact when bridges are removed.

SKID ROADS AND TRAILS

Definition--An unsurfaced trail or road, as narrow as safety will allow, used for skidding harvested products.

Purpose--To skid logs, tree lengths or other roundwood products from the stump to a common landing or concentration area.

Conditions Where Practice Applies

This practice is used where harvesting products requires centralizing for sawing or for loading on trucks or trailers and where topography and size of operation make skidding the primary means of collecting trees, logs or other roundwood products.

Standard

Locate landings first and lay out skid road approaches with minimum grade. Major skid roads should have planned locations to reduce erosion and sedimentation, minimize damage to the residual stand and provide the most desirable method for skidding products.

1. A goal of job planning and road layout should be to develop an average skid road spacing of about 200 feet apart.
2. Gradients should not be steeper than 15%, with the exception of short, steep segments not exceeding 20%. (Grades up to 40% are acceptable if no mineral soil is exposed.)
3. DURING LOGGING, cross drainage, including turn-outs, water bars or grade breaks for dispersing surface water, should be installed at least every 100 feet and maintained daily.
4. Skid roads should be located away from streams according to the "Streamside Management Zone (SMZ) Requirements" on Page 4.
5. Any skid road necessitating the crossing of a stream will require a bridge or culvert of acceptable design. Logs will not be skidded through any stream.
6. Approaches to stream crossings should be as near to right angles to the stream direction as possible.
7. UPON FINAL COMPLETION of skidding on a road, the logger should stabilize and retire the road before any other skidding occurs. This should be done by first removing the outer berm, out-sloping and smoothing the skid road. Next establish water bars at these minimum grade intervals: Less than 10%-100 ft.; 10%-80 ft.; 15%-60 ft.; 20%-45 ft.; 25%-40 ft.; 30%-35 ft. Water bars should be installed at a near 30- to 45-degree angle downslope, with ends open to prevent water accumulation behind them. Seed and mulch according to guidelines on page 8. Scattered logging slash may supplement water bars and seeding.
8. NEVER skid in a stream or directly through a stream.

LOG LANDINGS

Definition--An area where logs are assembled. This includes landings at the end of skid and haul roads.

Standard

This practice almost always results in the disturbance of the surface. Care should be taken to locate areas properly to minimize the chance of erosion and sedimentation.

The following points should be considered in the location and use of landings:

1. Adequate streamside management zones should be left between landings and streams. (See "*Streamside Management Zone (SMZ) Requirements*" on Page 4.)
2. Landings and yards should be located on dry, firm sites and have a slight slope to allow for drainage.
3. Provide for adequate drainage on approach roads so that road drainage does not enter landing area and cause "mudholes."
4. Provide diversion ditch around uphill side of landings where seepage and lateral flow of water is a problem.
5. When servicing equipment on site, drain old oil, etc., into containers and properly dispose of in accordance with proper solid waste disposal. All empty containers should be removed and disposed of properly.
6. Seed and mulch landings immediately following completion of operations or use of the landing. (See "*Reclamation Requirements*" on Page 8.)
7. Landing size should be kept to a minimum.

RECLAMATION REQUIREMENTS

The following areas will be SEEDED:

1. Truck haul roads that:
 - Exceed 10% slope.
 - Are within the streamside management zone.
2. All skid roads and trails that:
 - Exceed 15% slope. (Lopped slash can be placed on roads to supplement seeding.)
 - Are within the streamside management zone.

The following areas will be SEEDED and MULCHED:

- All landings.
- All mineral soil disturbed within the streamside management zone.
- Any road that disturbs mineral soil and exceeds 20% slope.

Note: Lime and fertilizer may be required with seeding depending on soil conditions

Seeding and Mulching will be more successful if #

1. For each section in the planned logging operation, all exposed mineral soil areas that are to be seeded or seeded and mulched should have the high berms removed, outsloped, surface smoothed, water barred then seeded and mulched immediately after they are no longer needed. **Don't wait!** Some areas may require lime and/or fertilizer.
2. Landing fills and road fills will be seeded and mulched immediately after construction when inside the streamside management zone. **Maintenance mulching and some additional seeding may be needed.**
3. All compacted exposed areas should have a seed bed prepared by scarifying the surface to a depth of 2" to 3".
4. All areas seeded should have the seed covered by dragging the dozer blade, brush, chain or cable.

**# # RECOMMENDED SEED MIXTURE OPTIONS # #
(RATES PER ACRE)**

SHADED WOODLAND AREAS

- Option 1. 30 lbs. lathco flat pea; 20 lbs. perennial ryegrass
- Option 2. 30 lbs. creeping red fescue; 10 lbs. perennial ryegrass
- Option 3. 20 lbs. tall fescue; 20 lbs. lathco flat pea
- Option 4. 50 lbs. winter wheat; 8 lbs. orchard grass; 10 lbs. tall fescue (K-31)

WILDLIFE MIX ON LANDINGS

- Option 1. 8 lbs. bird's-foot trefoil; 3 lbs. redtop; 4 lbs. orchard grass
- Option 2. 8 lbs. tioga deertongue; 6 lbs. ladino clover
- Option 3. 25 lbs. physter fescue or johnstone fescue; 2 lbs. ladino clover
- Option 4. 25 lbs. physter fescue or johnstone fescue; 5 lbs. annual ryegrass; 2 lbs. orchard grass; 3 lbs. tioga deertongue; 2 lbs. bird's-foot trefoil; 4 lbs. foxtail millet
- Option 5. 50 lbs. winter wheat; 8 lbs. orchard grass; 4 lbs. ladino clover; 6 lbs. timothy

EROSION CONTROL IN GRASSLAND OR PASTURES

- Option 1. 8 lbs. bird's-foot trefoil; 4 lbs. timothy
- Option 2. 1 lb. white clover; 6 lbs. Kentucky bluegrass; 2 lbs. timothy
- Option 3. 10 lbs. orchard grass; 2 lbs. ladino clover; 3 lbs. redtop
- Option 4. 50 lbs. winter wheat; 8 lbs. orchard grass; 6 lbs. timothy

CRITICAL AREAS, STREAM CROSSINGS, ETC., WHEN HEAVY GRASS COVER IS NEEDED

- Option 1. 25 lbs. Kentucky-31-fescue; 5 lbs. ladino clover
- Option 2. 50 lbs. winter wheat; 25 lbs. tall fescue (K-31)

SEEDING DATES AND RECOMMENDATIONS #

- 1. Best - March to June; late August through September, and early October
- 2. Frost Seeding - February through early March. Seeding on snow is acceptable.
- 3. Weather Conditions Limiting - Seeding can occur, but weather could limit success. June, July, late October, November, December, and January.
- 4. Add annual ryegrass (8lbs/acre) and/or winter wheat (50lbs/acre) to seed mixtures to provide quick ground cover and soil stabilization.
- 5. Lime and fertilizer will insure a continued grass cover on dry sites and areas where the subsoil is exposed.
- 6. All legume seeds must be inoculated before seeding.

WATER BARS on SKID ROADS

Definition--A water control structure constructed across a skid road (30° to 45°), usually from soil, to intercept and divert water from the road surface. Permanent water bars are usually constructed at least 1 foot to 30" in depth. Temporary water bars are usually constructed at least 6 inches to 1 foot in depth.

Conditions Where Practice Applies

On any sloping road where surface water runoff may cause erosion of the exposed road.

Specifications for Permanent Water Bars

1. Proper spacing between permanent water bars can be determined from the table on the following page.
2. Installation should be at an angle of 30° to 45° downslope or more to turn surface water off the road or trail.
3. A shallow trench should be dug 1 foot below the surface of the road or trail and extend beyond both sides.
4. Fill dirt from the dug water bar should be left intact.
5. The uphill end of the water bar should extend beyond the side ditch line of the road to fully intercept any ditch flows.
6. The outflow end of the bar should be fully open and extended far enough beyond the fill edge of the road or trail to safely disperse runoff water onto the undisturbed forest floor.

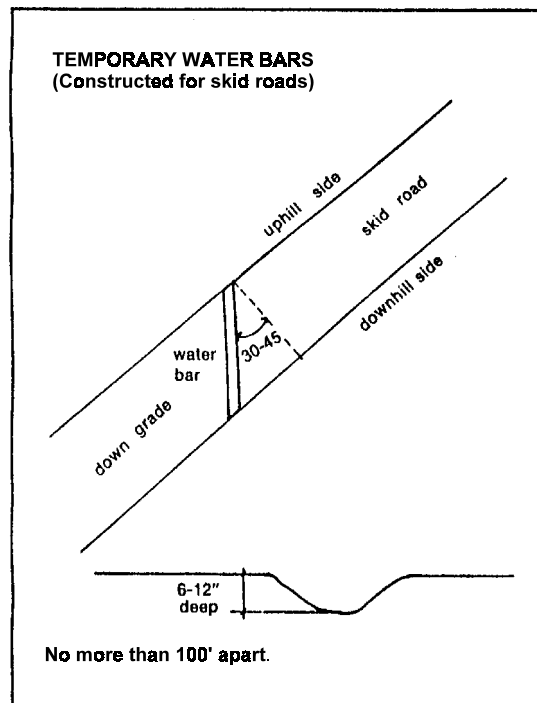
Specifications for Temporary Water Bars

1. Spacing for temporary water bars should not exceed 100' apart.
2. The depth of a temporary water bar should be 6 inches to 1 foot.
3. Temporary water bars are used for temporary shutdown, for overnight shutdown status or for erosion control during road construction.

**SPACING TO USE
between
PERMANENT WATER BARS**

% Grade of Road	Distance Between Water Bars
Less than 10%	100
10	80
15	60
20	45
25	40
30	35

TEMPORARY WATERBARS



OPEN-TOP BOX CULVERT

Definition--A wooden culvert placed across truck haul roads to convey road surface runoff and side ditch flows across road surface to downslope side.

Purpose--To collect and direct road surface storm runoff and upslope side ditch flows across road without eroding drainage system or road surfaces.

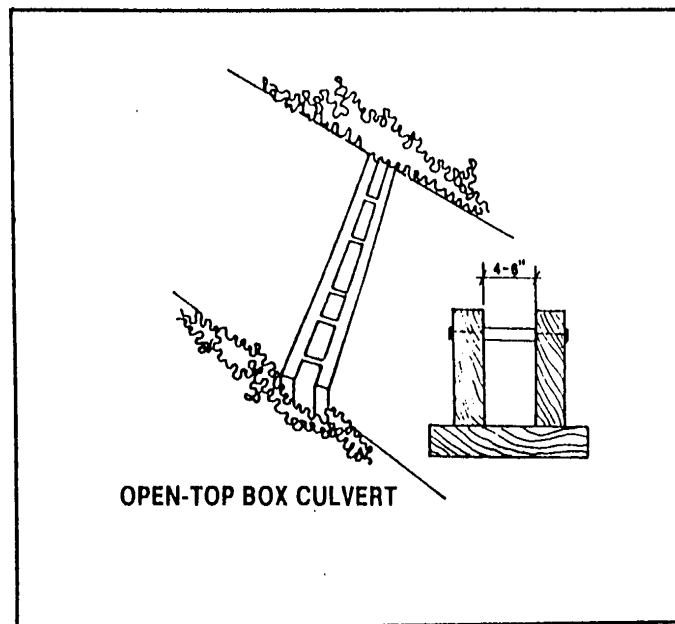
Conditions Where Practice Applies

This is a drainage structure for ongoing operations and is not recommended for permanent use. It can be used for cross drainage on truck haul roads on smaller operations as a substitute for pipe culverts; however, it silts in readily and requires frequent maintenance. This practice should not be used for handling intermittent or live streams or skid trail cross drainage.

Design Criteria

1. Box culvert is to be installed flush with road surface and at an angle not less than 30° downgrade.
2. The box culvert will be installed at the same grade as the side ditch and extend into the toe of the cut slope.
3. The lower end of the culvert will extend beyond the road surface with adequate rip-rap or other material to slow water velocity to assure no erosion of the loose fill.
4. Place culverts about 100' apart or less.
5. Clean-out maintenance must be done periodically to remove sediment, gravel and logging debris to allow normal drainage of the culvert at all times.

OPEN-TOP BOX CULVERT



OPEN-TOP PIPE CULVERT

Definition--An eight- to 10-inch steel wall pipe with three-inch wide slots cut 24" long along the pipe. Used to intercept water on roads exceeding 10% slope where broad-based dips are impractical. Recommended spacing is the same as for a broad-based dip. (Recommend at least 100' apart, but no more than 150' apart.)

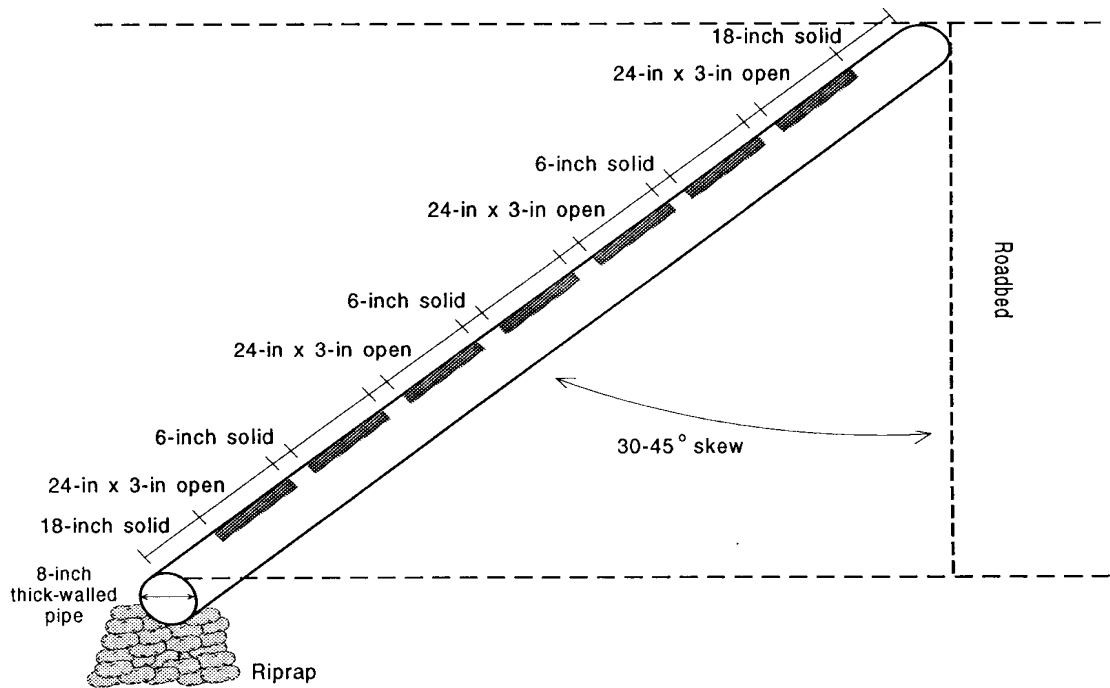


Figure 1.--Layout and dimensions of a 20' long open-top pipe culvert.

PIPE CULVERT

Definition--Corrugated metal pipe or other suitable material is placed under truck haul or skid roads.

Purpose--To collect and transmit water flows from side ditches, seeps or streams under haul and skid roads safely without eroding drainage system or road surface.

Conditions Where Practice Applies

Its use is for any size operation where cross drainage of storm water or diversion of small streams is needed for truck haul or skid roads. In such cases, it is a necessary drainage structure for temporary operations, but can be permanent.

Design Criteria

Cross Drainage (Streams):

1. Pipe length should be long enough so both ends extend beyond side slope toes. On truck haul roads, the minimum recommended length is 25'. On skids roads, the recommended minimum length is 20'.
2. When multiple pipes are used in a stream crossing, the space between the pipes should be $\frac{1}{2}$ the pipe diameter, and the fill over the pipe should be at least 1 foot or more. (See diagram on Page 15.)
3. The minimum diameter pipe on permanent pipe installations should be according to the permanent culvert drainage table on Page 16.
4. The minimum diameter pipe recommended for use is 15"; however, smaller diameter pipes may be used temporarily as long as they are adequate to accommodate the stream channel at maximum flow.
5. Pipe and stream gradient should be the same, with the pipe alignment being the same as the stream course also.

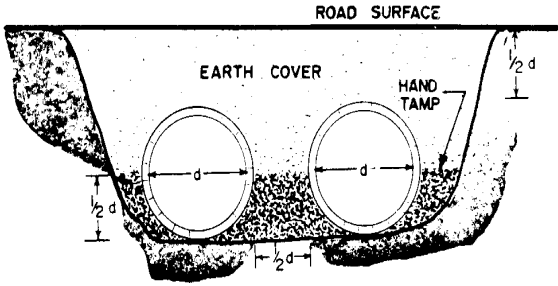
Cross Drainage (Ditching):

1. Pipe length should be long enough so both ends extend beyond side slope toes (25' minimum on truck roads; 20' minimum length on skids roads).
2. Minimum diameter pipe recommended for use is 15"; however, smaller diameter pipes may be used temporarily as long as they are adequate to accommodate the ditch channel at maximum flow.
3. For use in disposing of collected surface water drainage, the culvert gradient should match that of the contributing ditch.
4. Installation should be skewed 30-45° downgrade.
5. Erosion protection should be provided for outflows of culverts to minimize erosion below the lower end of the culvert. It may also be needed on the upstream end of culverts on flowing streams. This protection can be in the form of rip-rap or plastic filter cloth and rip-rap, large stone, hay or straw bales, etc.

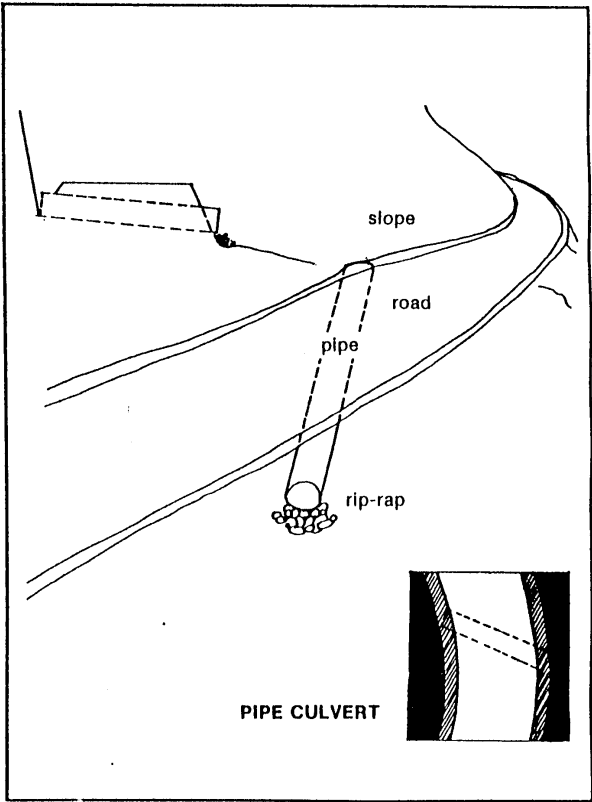
*Note: When pipe diameter smaller than 15" is used, frequent clean-out maintenance is necessary.

CULVERT SPACING GUIDE FOR CROSS DRAINAGE (DITCH DRAINAGE)	
Road Grade (Percent)	Metal Culvert Spacing (Feet)
2	400
4	350
6	300
8	250
10	200
12	150
14	100
16	50

Multiple Pipe Culvert Installation



Pipe culvert installation for ditching.



DRAINAGE TABLE

Estimated culvert diameter needed to carry flood water from forested areas ranging from 10 to 400 acres and at recurrence intervals of 10 to 50 years. Accuracy of values for areas exceeding 100 acres is uncertain. Land use disturbance and soil type above culvert locations can affect water flow peak levels and therefore should be considered when using this chart.

Area	Recurrence Interval (yr.)		
	10	20	50
acres	----- inches -----		
2-8	15	15	15
10	16	16	18
20	18	18	20
30	18	20	24
40	20	22	26
50	22	24	28
60	22	24	28
70	24	26	30
80	24	26	30
90	24	28	32
100	26	28	34
125	28	30	36
150	28	32	38
175	30	34	40
200	32	36	42
250	34	38	46
300	36	40	48
350	38	42	54
400	40	48	54

*Table modified from: Helvey, J. David, and Kochenderfer, James N., 1988. Culvert Sizes Needed for Small Drainage Areas in the Central Appalachians. USDA Forest Service, Northeastern Forest Experiment Station, Parsons, WV. Areas with heavy clay soils may require larger diameter pipes if used as a permanent structure.

TEMPORARY CULVERT DRAINAGE

For temporary culvert installations, the pipe diameter should be adequate to serve the water channel or ditch channel at maximum flow.

BROAD-BASED DRAINAGE DIP

Definition--A dip and reverse slope in a road surface with an outslope in the dip for natural cross drainage.

Purpose--To provide cross drainage on inslope truck roads to prevent buildup of excessive surface runoff and sheet erosion.

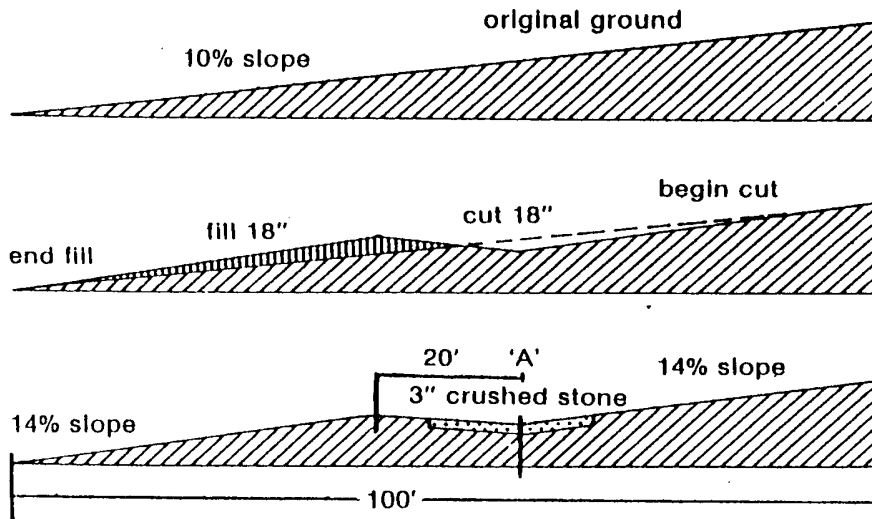
Conditions Where Practice Applies

Broad-based dips can be used on truck haul and heavily used skid roads having a gradient of 10% or less. They are not to be used for cross draining intermittent or live streams. This practice may be substituted for other surface water cross drain practices (pipe or box culvert).

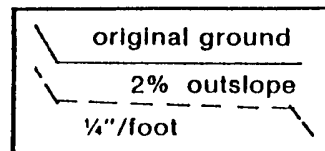
Design Criteria

1. Installation takes place following basic roadbed construction.
2. A 20-foot, 3% reverse grade is constructed into the existing roadbed by cutting from upgrade of the dip location and using cut material for the reverse grade.
3. Spacing of broad-based dips should be approximately 100' apart but never exceed 150' apart.
4. Cross drain outslope will be 2-3% maximum.
5. Use rip-rap to control erosion on the loose fill below a dip as needed.
6. The dip and reverse grade section will require bedding with 20 ton of 3-inch crushed stone to avoid rutting of the road surface.

BROAD-BASED DRAINAGE DIP



Cross section 'A'



W.VA. DIVISION OF FORESTRY STATE AND DISTRICT OFFICES

For more information on BMP's, the Logging Sediment Control Act, logger certification and recertification, contact the following:

**W.Va. Division of Forestry
1900 Kanawha Boulevard, East
Charleston, WV 25305-0180
(304) 558-2788
FAX (304) 558-0143**

District I (Includes counties of Barbour, Brooke, Hancock, Harrison, Marion, Marshall, Monongalia, Ohio, Preston, Taylor, Tucker, Wetzel)
Route 2, Box 1100
Fairmont, WV 26554
(304) 367-2793

District II (Includes counties of Berkeley, Grant, Hampshire, Hardy, Jefferson, Mineral, Morgan, Pendleton)
1 Depot Street
Romney, WV 26757
(304) 822-4512

District III (Includes counties of Braxton, Clay, Lewis, Nicholas, Pocahontas, Randolph, Upshur, Webster)
P. O. Box 38
State Route 20
French Creek, WV 26218
(304) 924-6266

District IV (Includes counties of Fayette, Greenbrier, McDowell, Mercer, Monroe, Raleigh, Summers, Wyoming)
330 Harper Park Drive
Suite J
Beckley, WV 25801
(304) 256-6775

District V (Includes counties of Boone, Cabell, Kanawha, Lincoln, Logan, Mason, Mingo, Putnam, Wayne)
P. O. Box 189
878 East Main Street, Rear
Milton, WV 25541
(304) 743-6186

District VI (Includes counties of Calhoun, Doddridge, Gilmer, Jackson, Pleasants, Ritchie, Roane, Tyler, Wirt, Wood)
2309 Gihon Road
Parkersburg, WV 26101
(304) 420-4515

WEST VIRGINIA'S LOGGING SEDIMENT CONTROL ACT

REVIEW

The following information is designed to give you a basic understanding of the law. If you have questions, contact the nearest office of the West Virginia Division of Forestry.

1. All logging companies, timber buyers, buyers of logs for resale, and other contractors working on a timbering operation MUST have a "Timbering License" for their company. This license costs \$50.00 annually and can be obtained at the State Headquarters of the Division of Forestry (Guthrie Center). Allow two weeks' processing time.
2. All companies and individuals doing business in West Virginia MUST be registered with the State Tax Department (phone: 304-558-3333) and have a West Virginia business number.

Must be in compliance with the West Virginia Workers Compensation Division and supply correct proof of coverage with the timbering license application. (Phone: 304-926-5000)

Must be in compliance with the West Virginia Unemployment Compensation Division and supply an original compliance letter with the timbering license application. (Phone: 304-558-1281)

3. Each logging operation MUST be supervised by a "Certified Logger". To become a certified logger, an individual needs to have successfully completed training classes in first-aid, best management practices, and logging safety. Retraining is required every three years or after the second renewal. A card with photo, similar to your driver's license, will be issued stating that you are a Certified Logger in West Virginia. The cost of logger certification is \$50.00 annually for each certified logger and can be obtained at the State Headquarters of the Division of Forestry (Guthrie Center). This is in addition to the license mentioned above. The law requires only one certified logger per logging operation. The certified logger must be on the active logging operation every day.
4. A "Timbering Operation Notification" form MUST be sent to the appropriate Division of Forestry District office for EACH logging operation within three days of start-up, including a sketch map or topographic map giving clear directions to the logging operation and showing the proposed operation, including the locations of roads and landings in relation to streams and ridges along with all stream crossings. A description of all the sediment control practices to be used by the logger should also be listed.
5. Each logging operation MUST have a SIGN visible at the active landing showing the company name and license number. Lettering on the sign must be at least three inches high.
6. Notify the Division of Forestry if you temporarily stop operating or finish a job 7 days or more outside of the predicted finish date indicated on the notification form.
7. Reclamation of the job should be completed within 7 days of the completion date of the job. If it can't be done within 7 days of completion, notify the DOF District office.

LOGGING OPERATIONS WILL BE SUSPENDED IF ANY ONE OF THE FIRST 5 ITEMS ABOVE IS MISSING

Logging operations are required to use Best Management Practices for controlling soil erosion and preventing sediment pollution into streams. Violations of these or certain water quality laws can result in compliance orders, job suspensions, citations, etc.