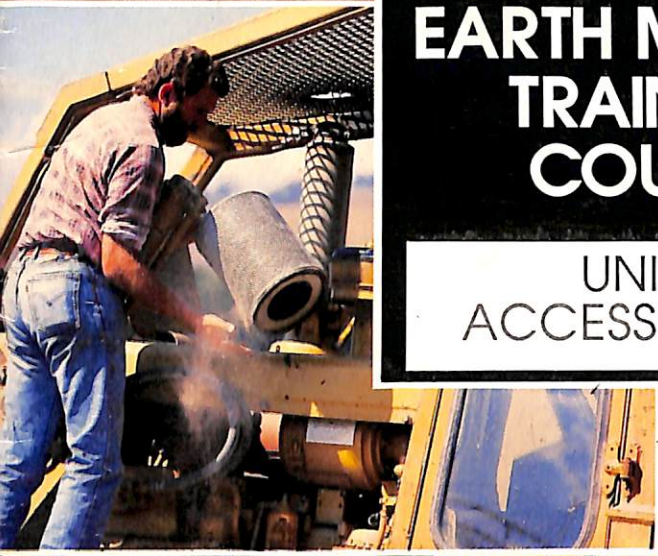
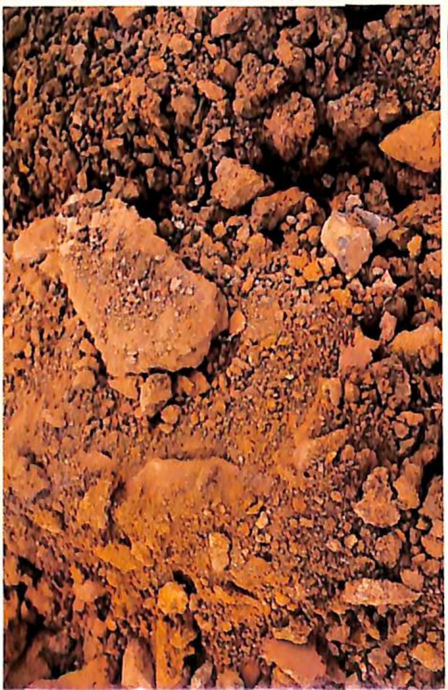
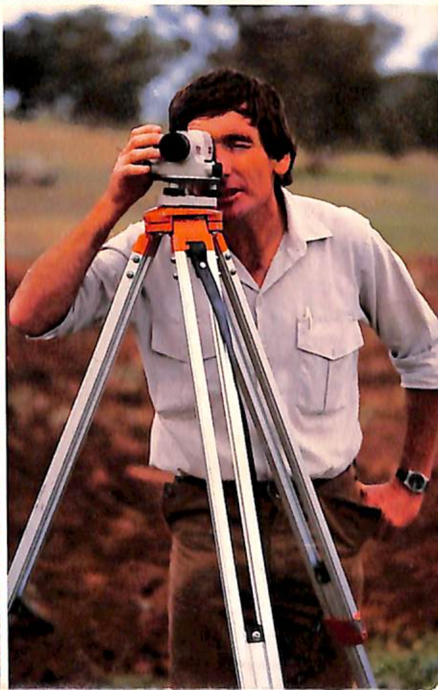


EARTH MOVERS TRAINING COURSE

UNIT 17
ACCESS TRACKS



EARTH MOVERS TRAINING COURSE

UNIT 17
ACCESS TRACKS

BY CHRIS MARSHALL and MICK NORVILL

UNITS IN THE EARTH MOVERS TRAINING COURSE ARE:

UNIT	TITLE
1	Introduction
2	Safety
3	Tractor Mechanics and Maintenance
4	Erosion Control and Design Principles
5	Soils
6	Levels and Levelling
7	Earthmoving Principles
8	Dozing and Ripping Principles
9	Farm Dams
10	Construction of Farm Dams
11	Contour and Graded Banks
12	Construction of Banks
13	Waterways
14	Construction of Waterways
15	Gully Filling and Shaping
16	Land Clearing
17	Access Tracks
18	Pipes in Earthworks
19	Flumes and Chutes
20	Special Earthworks

The Earthmover's Training Course has been produced by the Soil Conservation Service of NSW with assistance from the National Soil Conservation Program.

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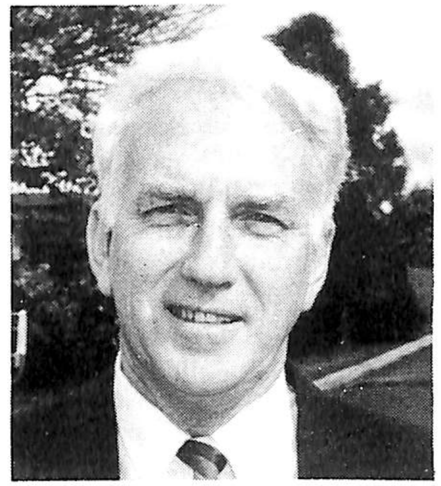
FOREWORD



The 1978 Collaborative Soil Conservation Study reported that almost a third of the land used for agricultural and pastoral purposes in Australia was in need of soil conservation earthworks. It was generally accepted that the cost of implementing the works should be the responsibility of the landholder.

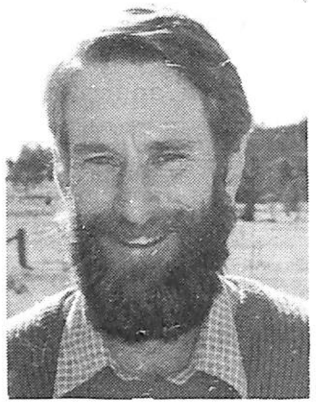
Apart from the landholder's ability to pay, the level at which soil conservation earthworks is implemented is influenced greatly by the workmanship involved. Currently, costs and standards vary greatly because the works are being built by a range of people including private contractors, government agencies and landholders with their own plant. Apart from the Soil Conservation Service's own staff, few of these have any training in the specialised techniques of construction required for soil conservation purposes.

Recognising this, the Soil Conservation Service of N.S.W. with assistance from the National Soil Conservation Program, has developed this comprehensive series of training manuals and associated training aids. The material is based on the experience and skills which have been built up in the Service through years of involvement in soil conservation plant hire activities.

This series of manuals and aids prepared for the Earthmover's Training Course will be valuable to all earthmovers and to those involved in the design and supervision of earthworks. Training institutions with a commitment to earthmoving courses are expected to also benefit from this cataloguing of skills acquired from over fifty years of experience in construction of specialised soil conservation works.

R.S. Junor.
R. S. Junor
Commissioner
Soil Conservation Service of N.S.W.

ABOUT THE AUTHORS



Chris Marshall has seen just over twenty years experience with the Soil Conservation Service of N.S.W. Thirteen of these years were spent as District Soil Conservationist at Bombala/Bega during which time he gained wide experience in tableland and coastal land use. He had a particular interest in forest land management in association with plantations, high intensity native forest logging, and management trails. It was inevitable that he would become a member of an interdepartmental committee that formulated the original Standard Erosion Mitigation Conditions for logging and forest clearing. He was the author of the original publication "Guidelines for Planning, Construction and Maintenance of Tracks" on which much of the present publication was based. Currently, Chris Marshall is the District Soil Conservationist at Bathurst.

The difficulties of constructing and maintaining access tracks and fire trails for various authorities on the Central Coast, Lower Hunter and Barrington Tops has added a wealth of experience to the skills of Mick Norvill. Mick is a Regional Field Service Manager with the Eastern Region of the S.C.S. He is experienced in coping with the many problems of track construction, including high rainfall, steep terrain, highly erodible soils and the use of tracks in recreational and environmentally sensitive areas.

CONTENTS

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REFERENCES

R.J. Cathcart, C.J. Marshall, K.J. O'Neill-Fuller (1984)
Guidelines for the Planning, Construction and Maintenance of Trails

1. INTRODUCTION

Access tracks are widely used on grazing and timbered lands to do just that, provide access. They form a network through state forests, national parks, Crown Lands and private property.

These tracks tend to follow the natural landforms, with construction usually consisting of minimal earthworks and culverting. The track surface is rarely gravelled and maintenance is often left until the surface of the track has been severely eroded and access restricted.

Figure 1 *Erosion of farm tracks can severely limit access.*

Consideration of erosion control measures at the location and planning stage can reduce the cost of construction. This unit outlines the principles of planning, construction and maintaining tracks to minimise soil erosion and to control runoff.

2. DESCRIPTION

Access tracks are used for many purposes:

- ☐ in forests for timber getting;
- ☐ in National Parks for recreation and fire control;

- ☐ by Elcom for power line access;
- ☐ to assist with fire fighting by providing limited access during fires and for hazard reduction;
- ☐ for primary fire trails (higher standard) to provide links to minor access trails;
- ☐ to provide communication tower access;
- ☐ for gas and water authorities to provide pipe line access;
- ☐ to provide landholder access, on banana plantations, for stock movement and on farm vehicular access.

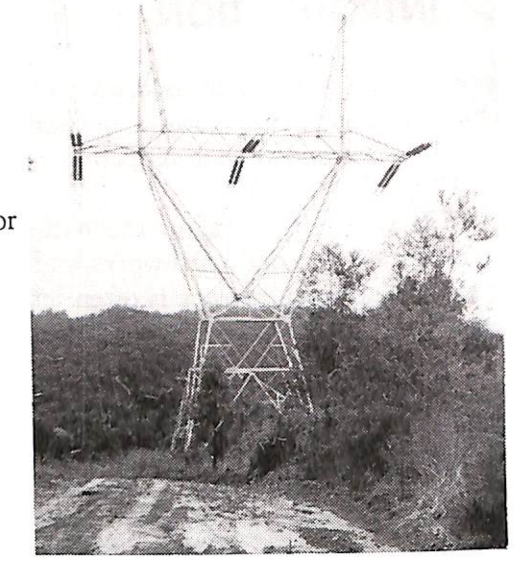

Figure 2 Power lines demand reliable access.

The more traffic that uses an access track the higher the standard of construction required e.g. gravelling of wet areas and placement of pipes and culverts in drainage lines.

Access tracks may be built for conventional vehicles with two wheel drive or to a lesser standard for four wheel drive vehicles.

Consideration must be given to the design of the track for fire tankers, logging trucks and maintenance crews that cannot negotiate sharp bends, steeper sections and high cross banks (Section 4:5).

Tracks can be purpose built e.g. constructed across deep, flowing creeks or permanently wet areas using rock fill or concrete. Sometimes they need only be temporary constructions while on other occasions they may be required to provide all weather access according to the need.

They must be designed not to cause erosion.

Erosion associated with tracks can:

- ☐ be a major factor in destroying trafficability and creating safety problems;
- ☐ contribute to inferior water quality and the sedimentation of streams.

Establishing and maintaining vegetation on the tracks can further reduce erosion.

By constructing the track with effective surface drainage, it is possible to reduce erosion damage and the need for frequent maintenance.

Figure 3. Picture opposite: Good access during emergencies is critical.

Figure 3

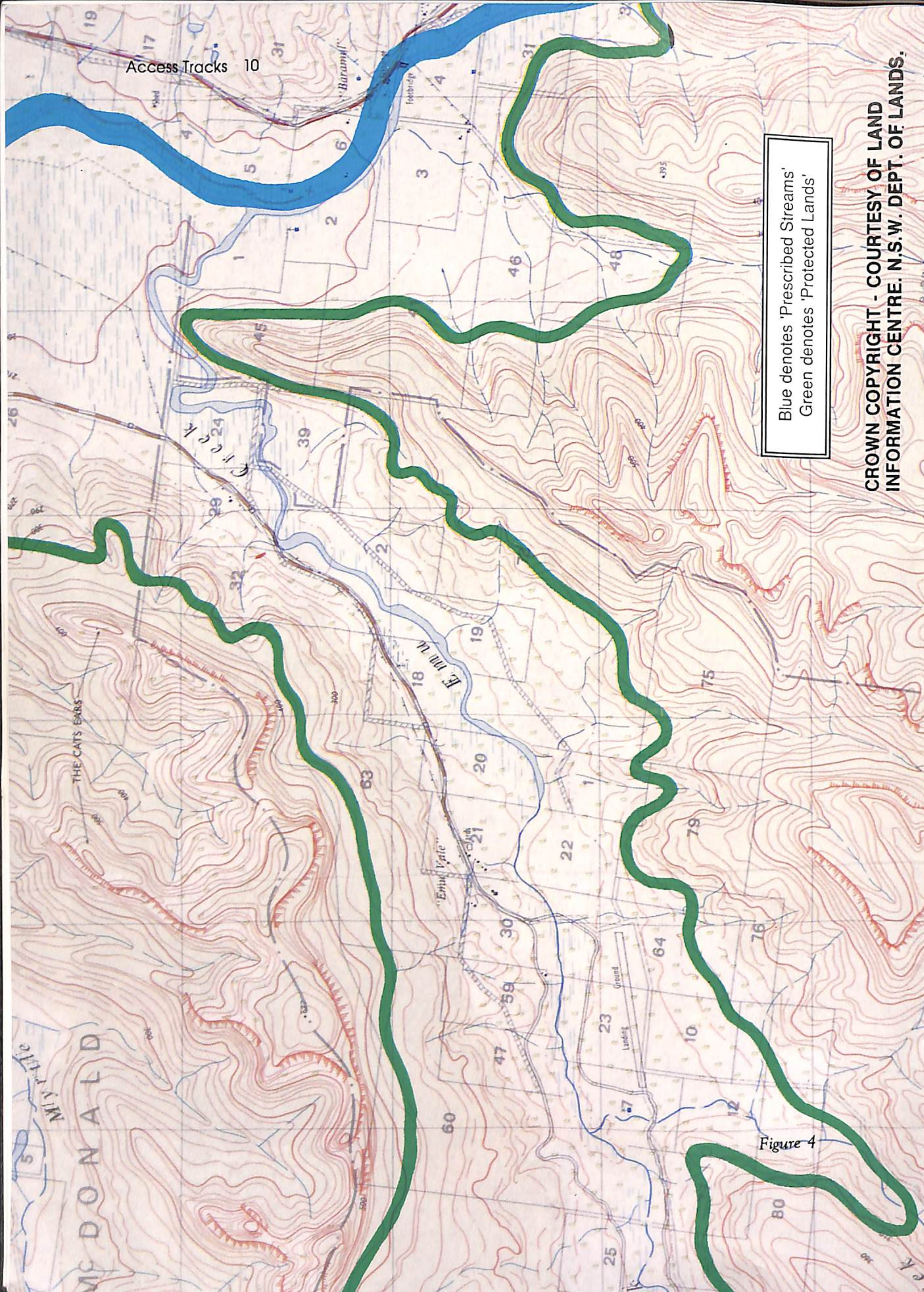

Figure 4

3. PLANNING

Because of the problems associated with the erosion of low standard tracks, careful consideration of the many factors involved at the planning stage can ensure that erosion will be minimised and maintenance needs reduced.

Carefully consider therefore:

- ☐ purpose of the track or trail;
- ☐ type and volume of authorised traffic;
- ☐ type and volume of possible unauthorised traffic;
- ☐ soil erosion hazards present along the track;
- ☐ drainage line crossings;
- ☐ topographic restrictions (steep slopes, rock outcrops, swampy areas, etc.);
- ☐ potential mass movement areas;
- ☐ vegetation types, density and size;
- ☐ feasibility of proposed construction - should an alternative site be examined?

3.1 GRADES

In planning the track for the best grades consider all the alternative routes, firstly from the topographic maps and then by inspection in the field. Aim to limit soil and vegetation disturbance when you select the route.

Tracks should have at least a slight grade to allow free surface drainage and to avoid excessive ponding in wheel tracks.

It is difficult to construct tracks on steep slopes and still take care of the track drainage without erosion taking place. Erosion will even take place on a much lower slope than the steepest grade that a four wheel drive vehicle can negotiate with ease. Sections of poorly drained tracks can quickly become untrafficable, especially if located on Class B, Class C or Class D soils as described in Table 1.

Generally the grade of a track should be less than 18% (10deg). Note that effective, easily trafficable cross banks can be built only on tracks to approximately 21% (12deg) grade. Sections steeper than 21% (12deg) will require special drainage works.

Where it is necessary for grades to exceed 28% (15deg) on Class A and Class B soils and 21% (12deg) on Class C soils, gravelling and more sophisticated road drainage will be required.

Tracks in Class D soils should avoid sloping land.

TABLE 1: ERODIBILITY ACCORDING TO SOIL TYPE

Soil Type	Soil Characteristics	Erodibility
Class A	Brown and red soils derived from fine sediments	Low soil erodibility
Class B	Red soils on fine granites fine sandstones and basalt	High soil erodibility
Class C	Grey and yellow soil derived from granites, sediments and metasediments, especially coarse grained types.	Very high erodibility
Class D	Unconsolidated sediment	Extreme soil erodibility

3.2 LOCATION

A correctly located track will provide satisfactory access and minimise maintenance requirements.

Points to consider when locating a track are as follows:

- ☐ follow the contour of the land or a ridgeline, avoiding steep slopes and minimising cut and fill batters;
- ☐ use topographical maps to locate obstacles to be avoided;
- ☐ select a proposed route and walk it to ensure the route is the best option;
- ☐ use natural features such as benches and shelves;
- ☐ keep the track far enough from a stream to allow an effective vegetation buffer to contain any sediment flowing from the track;
- ☐ avoid physical features which may indicate the possibility of mass movement problems such as:
  - -high "erosion hazard" soils - Class C and Class D Table 1.
  - -slopes with steps, clay beds, hummocky topography.
- ☐ avoid crossing long, steep, unstable slopes, especially where bedrock is highly weathered;
- ☐ avoid opening up moisture laden footslopes;
- ☐ minimise disturbance to trees, scrub, any other flora when working in sensitive areas such as National Parks. Where Aboriginal and other historical European artifacts are known to exist, particular care should be taken to preserve them.

3.3 PROTECTED LANDS

The maintenance of tree cover on certain land is covered by law. Such land has been mapped throughout the State (refer to figure 4). It is called "protected land" and is:

- ☐ any land within a notified catchment area which has a slope generally greater than 32.5% (18deg);
- ☐ any land in or within 20 metres of the bed or bank of any part of a river, stream, lake, lagoon or swamp.

Any land which is environmentally sensitive or affected by or liable to soil erosion, siltation or land degradation may also be listed as protected land.

In N.S.W. where trees have to be destroyed or are injured on protected land as defined in the Soil Conservation Act, 1938, an authority from the Soil Conservation Service is required.

Applications must be lodged with the Soil Conservation Service prior to destruction or injury to allow assessment of the proposal. Authorities may be issued with appropriate conditions controlling the manner and extent of the operation. These maps may be viewed at SCS of NSW offices. In other States the appropriate authorities should be contacted to determine what controls may apply.

4. EROSION CONTROL MEASURES

4.1 SURFACE DRAINAGE

Effective surface drainage is required on tracks and trails to control runoff, preventing it from concentrating and reaching erosive speeds. A number of techniques can be used to provide surface drainage, one of which is to provide crossfall on the track.

There are three forms of crossfall drainage - crowning, infall and outfall.

4.1.1 CROWNING

Tracks constructed on ridges or gentler slopes should be crowned. Drainage is easiest on tracks that are "crowned" because crowning of the trail surface will allow water to be shed to both sides of the track..

Figure 5. Crowning allows water to be shed on both sides.

Crowning is particularly suitable on steep sections of track in conjunction with spoon drains (refer Section 4.7).

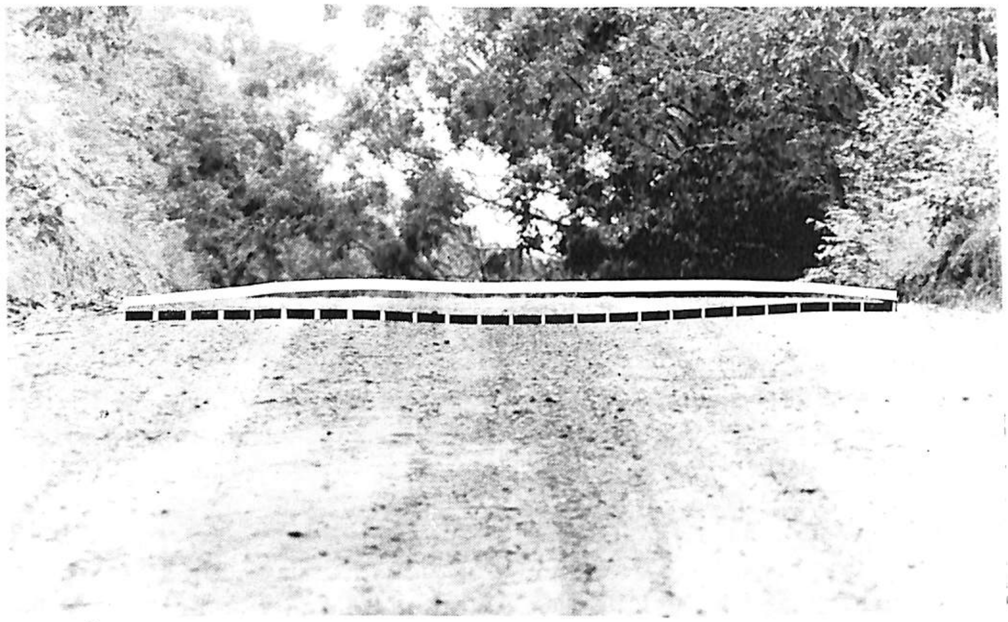

Figure 6 *Crowning of a track on a ridge.*

4.1.2 INFALL AND OUTFALL

Infall

Occurs when the surface of the trail has sufficient cross slope to cause water to flow off the trail into the hillside rather than along it.

The minimum cross slope required to achieve such crossfall is 1:25. For safety reasons the maximum crossfall used should generally not exceed 1:10.

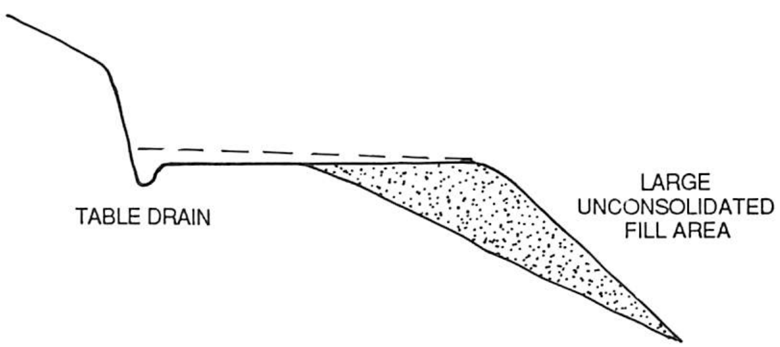

Figure 7 *Infall drainage.*

Outfall

Occurs when the surface of the trail is built sloping away from the hillside. In such cases, runoff will flow across the trail, away from the hillside and over the road batter.

Outfall drainage is preferred to infall drainage and should be used except when:

- ☐ fill batters are poorly consolidated and likely to erode;
- ☐ fill batters exceed 1.5 m in height. (for explanation of fill batters see Section 6.1).

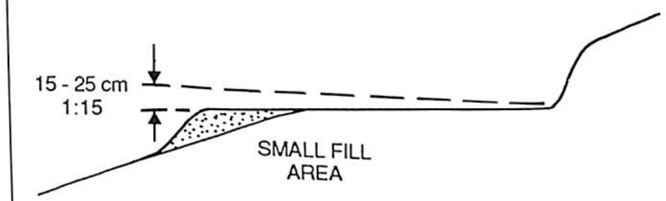

Figure 8 *Outfall drainage.*

In these situations, use infall drainage. Table drains, culverts and batter drop down drains may also be required as described in Sections 4.2, 4.3, 4.4.

Outfall drainage is generally sufficient to ensure control of runoff. This form of drainage reduces runoff along the track, directing it across the surface and over the track edge. The low fill batters associated with this standard of track can often withstand the dispersed flow of outfall drainage.

Figure 9 *Outfall surfacing of the road should be used instead of infalling.*

To ensure effectiveness of the outfall, any earth windrow which develops at construction or grading on the downslope side of the track should be removed.

Closing tracks in wet weather will help prevent wheel ruts from forming and help maintain effective outfall drainage.

4.2 TABLE DRAINS

Table drains are the side drains of a track. They run parallel with the shoulders and form part of the track. Their purpose, when properly constructed, is to conduct runoff safely away from the track area. They are usually parabolic in shape and drained at predetermined intervals by culverts, cross banks or mitre drains (Section 4.3, 4.5, 4.6). The steeper the slope and more erodible the soil, then the shorter the distance between these outlets.

Figure 10 *Table drain*

4.3 CULVERTS

A culvert is a pipe or similar structure used to direct water under the track. Without adequate culverts, table drains can quickly erode.

Culvert size should be adequate for major flows from the catchment.

Where culverts are installed in fill, some form of protection may be necessary on both up-stream and downstream fill faces (head walls).

Figure 11 *Better siting could have prevented blockage of this culvert.*

Culverts should never be used where debris blockages are likely. (Figure 11)

Culverts should be laid as close as possible to the natural alignment of the drainage line to avoid diverting the flow into the stream banks or eroding the drainage line. (Figure 12)

Culverts should not discharge over fill areas. Drop down structures may be necessary. (Figure 13)

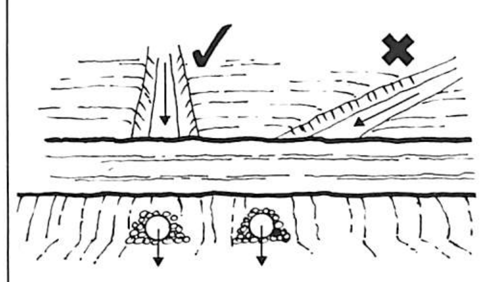

Figure 12

Culverts should follow the natural alignments.

4.4 BATTER DROP DOWNS (see 6.1)

These are a constructed and stabilised drain to carry runoff down the track batters, typically down the line of greatest slope.

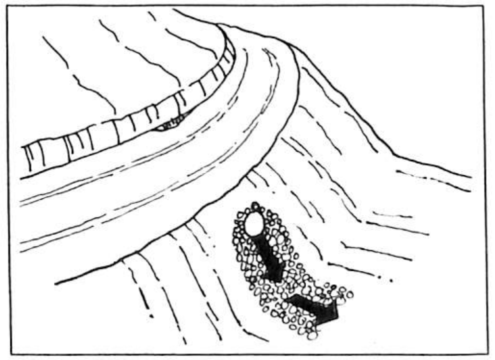

Figure 13 *Constructed batter drop down.*

4.5 CROSS BANKS

Where runoff cannot be controlled simply with outfall drainage, banks can be constructed across the track to intercept runoff and direct it across the track surface. Correctly located and built, cross banks can be easily negotiated by vehicles and achieve long-term and low maintenance track drainage.

In choosing sites for cross banks common sense should prevail in selecting the most suitable outlet in the vicinity of the recommended locations e.g. a rock outcrop or well vegetated area.

Figure 14 *A cross bank directing runoff across the track surface.*

On an established or existing track a good rule of thumb method for locating cross banks is to construct a bank wherever rilling (small gullies) starts to appear.

TABLE 2: CROSS BANK SPACING

Road Grade	*Soil Class A*	*Soil Class B*	*Soil Class C*
Up to 14% (8°)	*70 to 90 m*	*60 to 70 m*	*20 to 30 m*
14% - 21% (8° - 12°)	*60 to 70 m*	*50 to 60 m*	*
21% - 28% (12° - 16°)	*40 to 60 m*	*	*
28% - 36% (16° - 20°)	*30 to 40 m*	*	*
36% - 40% (20° - 22°)	*20*	*	*

*Note: * indicates that tracks should not be constructed on these soil types within the slope range.*
Note: Where tracks are constructed on slopes exceeding 21% (12deg), only light and infrequent traffic should be allowed.

Notwithstanding the above guidelines, the stability of the track in operation will eventually dictate the need for variations in the location and spacing of cross banks.

Access tracks designed for conventional vehicles will require lower and broader cross banks with flatter batter grades.

Consideration must be given to the sharpness of bends, the steepness of the track and the height of cross banks so that fire tankers, logging trucks and maintenance vehicles can gain easy access. A poorly designed track may endanger life during bushfires.

4.6 MITRE DRAINS

Mitre drains take water from the shoulders or table drain of a track to a safe disposal area and are so called because of the angle they usually make with the direction of the track. To keep the volume of water in each mitre drain down to a minimum it is desirable to split the runoff at regular intervals. This can be achieved by spacing the drains as close together as practical. The spacing should not exceed 50 metres.

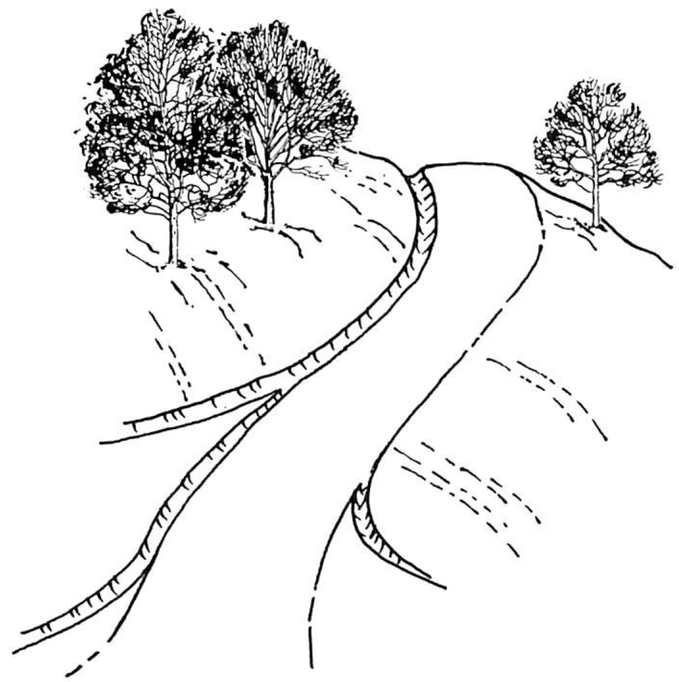

Figure 15 *Mitre drains carry runoff away from the track.*

Mitre drains should be spaced closer together where slopes are steeper and where soil type is more erodible.

Mitre drain grades must be less than 9% (5deg) grade and they should discharge onto a well grassed area or rock outcrop.

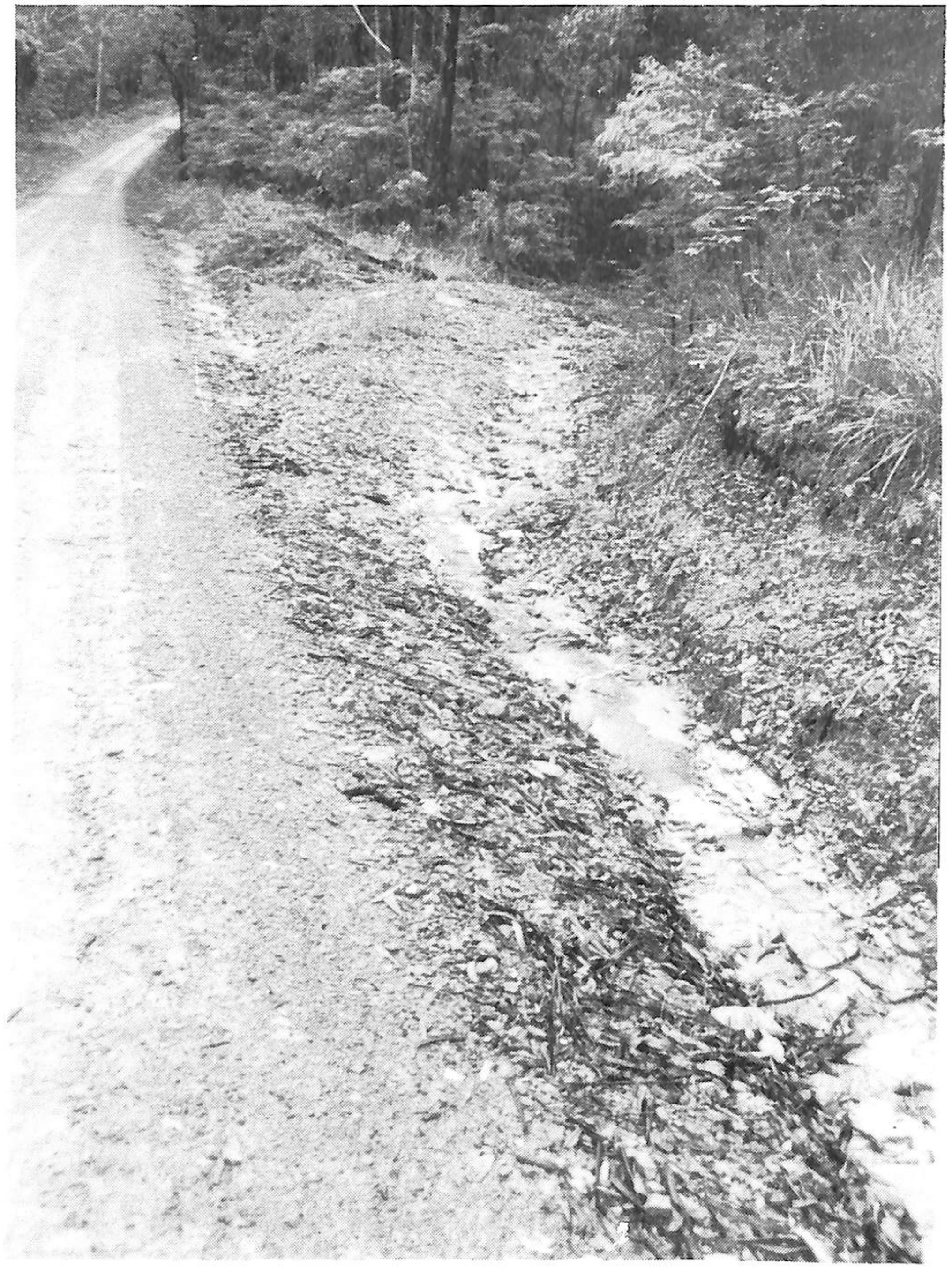

Figure 16 *Mitre drain discharging onto well vegetated area.*

4.7 SPOON DRAINS

Spoon drains are similar to cross banks and are built by digging a small depression across the track and spreading the excavated earth thinly along the track. Spoon drains can be used on any slope, especially where the slope is too high to successfully construct cross banks.

Figure 17 *Spoon drain intercepts runoff from the track.*

4.8 DRAINAGE LINE CROSSINGS

Drainage lines should be crossed at fords or by the use of culverts or bridges. Do not use log dam crossings as they obstruct flood flows and can create turbulent flow and erosion.

Fords are preferable to culverts or bridges as they occur naturally or can be built with little disturbance to the stream bed and banks. Do not use fords where the stream has a deep cross-section requiring considerable excavation to provide approaches to the crossing.

Fords should be constructed from rock, crushed rock, or hardfill and thoroughly compacted to make a trafficable surface.

Figure 18 *Rockfill ford at natural gully floor level.*

Rockfill fords will need to be extended higher at the sides than the depth of flows. The ford should be at natural ground level in the gully floor.

Rockfill or stone paving should be used in low slope, boggy areas, to avoid excessive soil disturbance and maintain a trafficable surface.

Remember to avoid culverts where debris blockages are likely to occur (Section 4.3).

Figure 19 *Well constructed culvert with concrete headwall.*

Keep soil and vegetation disturbance to a minimum. Disturbed areas may need reseeding to protect them from erosion.

Do not dump timber, scrub, soil or other debris in drainage lines, but stack them well above flood levels.

Minor drainage lines may require culverting, but shallow depressions and swampy areas may be stone paved or corduroyed with timber to give a raft of stability. The technique known as "corduroying" is when a number of logs up to 150mm in diameter are placed across a wet or swampy area of track leading to an appearance similar to that of the fabric.

Figure 20 *Bridging should cross streams at right angles where possible.*

In some cases bridges may need to run at an angle to the stream direction where the approach is difficult.

Steep approaches to bridges should be avoided to reduce hazards and minimise shock loads.

Bridge abutments or the supports at each end of the bridge may need to be protected by:

- ☐ concrete (including fabriform, a type of fabric injected with a concrete slurry);
- ☐ timber;
- ☐ logs;
- ☐ rip rap (loose rock or stone).

5. EQUIPMENT REQUIREMENTS

The equipment used in the construction of access tracks can be divided into two groups:

- ☐ that used in the construction phase;
- ☐ that used in the maintenance phase.

5.1 CONSTRUCTION

Construction is generally carried out by bulldozers, backhoes and excavators. Bulldozers are best suited for initial construction, and the building of cross banks.

There are two types of bulldozer blades that can be used - trail or straight. A trail blade, which can be angled either way to side cast the earth, is the most efficient when forming a track. A straight blade can be used, however it is less efficient when side casting is required.

Backhoes can be used for installation of pipes, rock gabions, (wire baskets filled with stone) bridging and bed logs. They can also be used for excavation with the least amount of disturbance in sensitive areas and "boxing out" for rock fill.

5.2 MAINTENANCE

Bulldozers can also carry out maintenance tasks but graders are best suited to the task of grading the track surface to remove washouts and rilling. Graders are also specially suited to the maintenance and cleaning out of table drains and mitre drains.

6. CONSTRUCTION TECHNIQUES

Track construction should be done with minimum disturbance of soil and vegetation both on and adjacent to the track. Care must be taken to follow the planned course of the track and a mental picture developed of all the specific features like large trees or rocky outcrops that might necessitate diversion. To ensure this the operator must walk and mark the track prior to construction.

6.1 ROAD BATTERS

A road batter is a constructed earth slope either of placed fill material or cut into the natural hillside (Figure 21). To minimise the area of exposed soil, batters to 1.5m should be cut vertically. This form of cut batter may suffer from initial slumping but will generally stabilise with follow-up maintenance. Cut batters higher than 1.5m may require special stabilisation measures including laying back, revegetation and drainage.

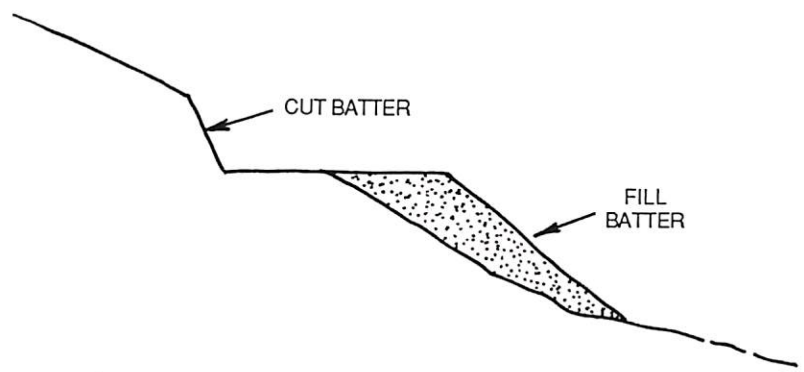

Figure 21 *Road batter.*

Fill batters on all soil classes should be no steeper than 1:2 and flatter where possible. This will encourage revegetation naturally and provide for better acceptance of seed and fertiliser. Batters higher than 1.5m on Class B, C and D soils (Table 1) may require special stabilisation works such as drop down drains, hay mulching, etc.

Do not incorporate vegetation debris in fill batters as this results in poor compaction with hollows and slumping occurring as the vegetation rots.

Preferably borrow areas required for fill batters should not be located near drainage lines or streams because of the danger of sediment polluting the stream. When necessary, borrow areas should be limited in size, worked in such a way to reduce the danger of sediment leaving the borrow pit and revegetated progressively as the pit is worked out.

Wherever practicable, stockpile topsoil and litter (free of timber debris) in a recoverable position for respreading over disturbed areas. This material contains valuable seed and nutrients which will greatly assist revegetation.

6.2 CLEARING THE TRACK

The track should be cleared of any trees or scrub to avoid incorporating them into the fill batters.

If in doubt of track direction the operator is advised to step down from the machine and walk the proposed track to ensure the correct line is followed. Limit clearing to 0.5m on either side of the track. Where extra clearing widths may be needed such as to allow the sun in to keep the track dry, cut the timber rather than dozing it to minimise the amount of soil disturbance.

6.3 CONSTRUCTING THE TRACK SURFACE

Tracks can often be established on level to slightly sloping sites simply by brushing the surface to remove stones and scrub but not disturbing the actual ground cover.

Track construction should start from the top of a cut where the operator dozes downhill to allow the weight of the machine to assist with construction. (Power is lost on uphill pushing due to lack of traction). Always exercise extreme care when side cutting in steep terrain. Unconsolidated fill batters may slip with the weight of the machine. Large rocks may also cause the machine to slide.

It is at this stage that the cut batter should be considered, i.e. whether it be vertical or sloping. Infall, outfall and camber should also be installed as the track surface is formed.

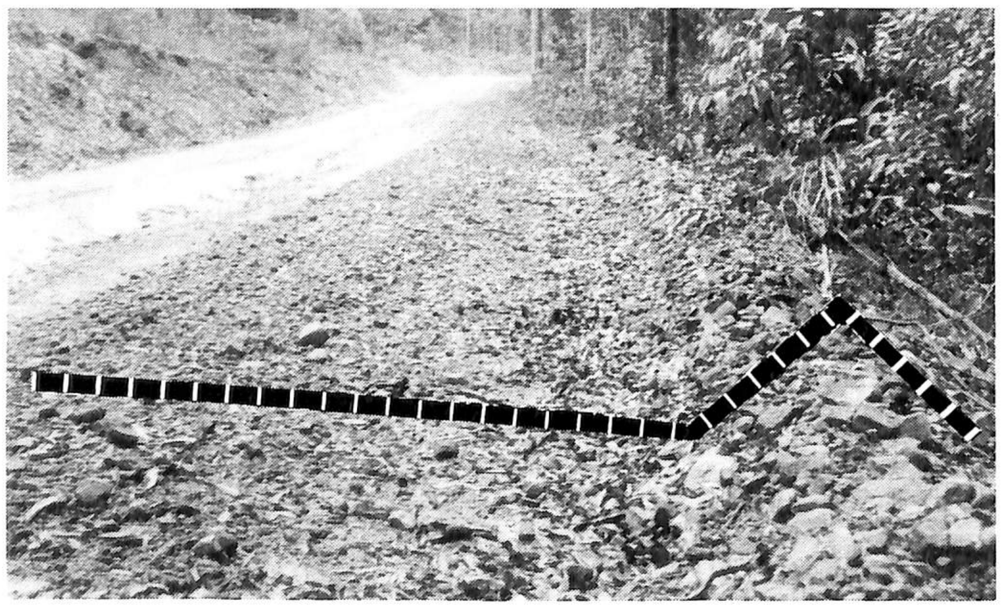

Figure 22 *Mounds of earth that build up during construction on the outside of tracks should be removed.*

When applying infall or outfall, remember there may be some settling or slumping of the track surface following construction, particularly of fill batters.

The mound of earth that often builds up along the edge of the track during construction will form a barrier preventing runoff from leaving the road. This windrow should be bladed from the track.

6.4 CONSTRUCTING OF CROSS BANKS

The earth required for the construction of a cross bank is usually borrowed from the track on the top side of bank.

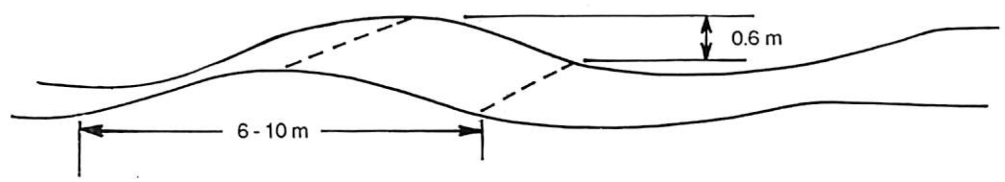

Figure 23 *Typical cross bank dimensions.*

Firstly rip the roadline to a depth of 20 to 30 cm for a distance of one or two dozer lengths back from the chosen outlet point. Then push the loose earth down the roadline into a bank, commencing at the uphill side of the road and working across to the outlet side. A long, shallow excavation for the bank is preferred to a short, deep excavation.

Sufficient loose earth must be used to give the required dimensions (Figure 23) after shaping and compaction. Depending on the size of the machine being used, up to eight bladefuls of earth may be required. Ensure that the crest width dimensions are long enough to ensure comfortable vehicle access over the cross bank. The channel depth dimensions are essential to prevent runoff from overtopping the bank.

Cross banks are most effective if constructed with only a slight angle to the track, obtaining a grade of approximately 1:20. This ensures that runoff does not pond in the bank channel.

The bank can be shaped with the dozer blade and the entire length of the bank should be track or wheel rolled to obtain maximum compaction and a smooth, even bank.

A sweep with the blade will clean loose earth from the channel of the bank. The small bank of earth resulting at the outlet can often be left as a silt trap and water spreader. Push this earth only just far enough so that water can clear the track effectively.

If you have to fill an eroded table drain to build a bank, compact the bank at that point with extra earth to allow for slumping and to cope with the concentrated runoff in the table drain.

Figure 24 *Cross banks should be well compacted with sufficient grade to drain.*

6.5 CONSTRUCTING MITRE DRAINS, TABLE DRAINS AND SPOON DRAINS

Mitre drains and table drains can be constructed simply by lowering one side of a dozer or grader blade and then pushing in the required direction for two or three passes to provide a gentle and obstruction-free passage.

7. MAINTENANCE

Frequent maintenance is essential, especially in the early years after construction, to ensure effective erosion control and track stability.

Maintenance is usually highest during this early period while soils are still consolidating and vegetation is becoming established.

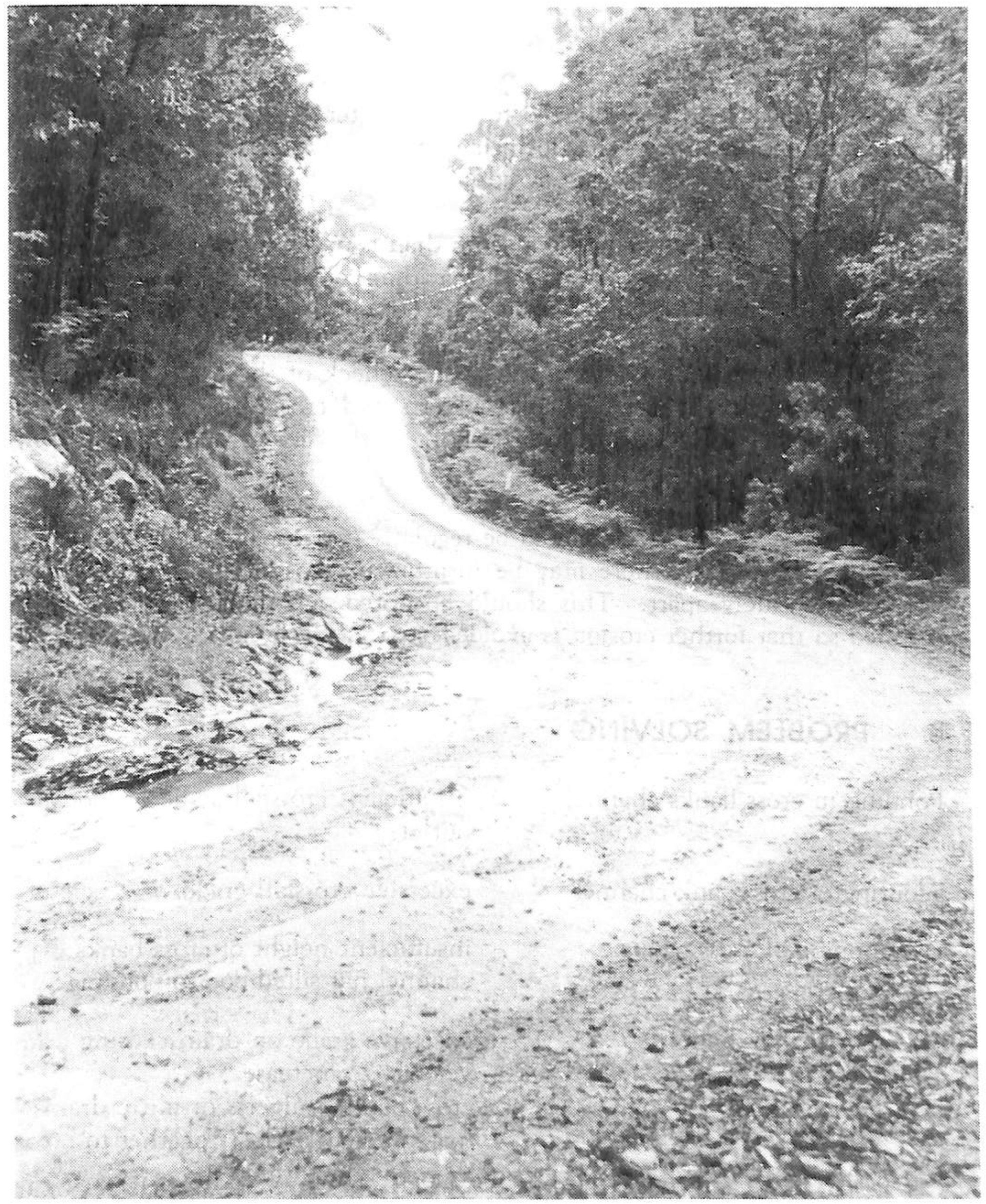

Figure 25 *A well maintained forest access track.*

Tracks should be inspected following heavy traffic usage or exceptionally heavy rainfall, to determine maintenance requirements.

Restrict the removal of excess vegetation, preferably by slashing or spraying. Avoid unnecessary grading or blading so soil disturbance is reduced.

Encourage outfall drainage by removing any windrow along the outside edge of the track.

Keep roads well crowned.

Leave material which has slumped from cut batters untouched, particularly if it does not unduly restrict the operating width of the track. If it is necessary to remove material, take care to avoid undercutting the toe of the batter.

Do not remove any more timber or scrub than is necessary to maintain access. Remember to always cut timber rather than doze it. This is especially important above cut batters and adjacent to or within drainage lines.

Periodic maintenance should also include a check of the drainage system to remove any debris that may block culverts and cross drain outlets. Table drains can become blocked by litter resulting in the flow of water onto the road surface.

In the early years, the track should be regularly inspected. If rilling occurs on the trail surface then there may be insufficient crossfall or cross banks are spaced too widely apart. This should be noted and modifications made or planned so that further erosion is avoided.

8. PROBLEM SOLVING

Ponding in cross banks channel	- insufficient crossfall grade or blocked outlet.
Scouring of cross bank channel	- excessive crossfall grade.
Overtopping of cross banks	- insufficient height of cross banks or channel has silted due to ponding.
Eroding of table drains	- excessive grade on drain causing water velocity to increase. - cross banks, culverts or mitre drains not sufficiently close together to break up the flow of water.

Eroding of track surface	- cross banks too far apart; - earth windrow along side of trail preventing outfall drainage from working; - track surface not sufficiently crowned or cambered; - culverts blocked - incorrect alignment; - debris blocking pipes.
Batters collapsing onto track	- undercutting of wet or unstable material.