LAND & WATER CONSERVATION

Guidelines for the planning, construction and maintenance of tracks

Introduction

Access tracks or trails of a basic engineering standard are widely used on grazing and timbered lands in New South Wales. They form a network through State Forests, National Parks, private property and Crown Lands. They are commonly used for logging access, fire management, stock movement and recreation. They also provide access to power and water supply lines.

These tracks tend to follow the natural landforms, with construction usually consisting of minimum earthworks and drainage. The track surface is rarely gravelled and maintenance is often left until the surface has severely eroded and access is restricted. Erosion associated with tracks can;

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

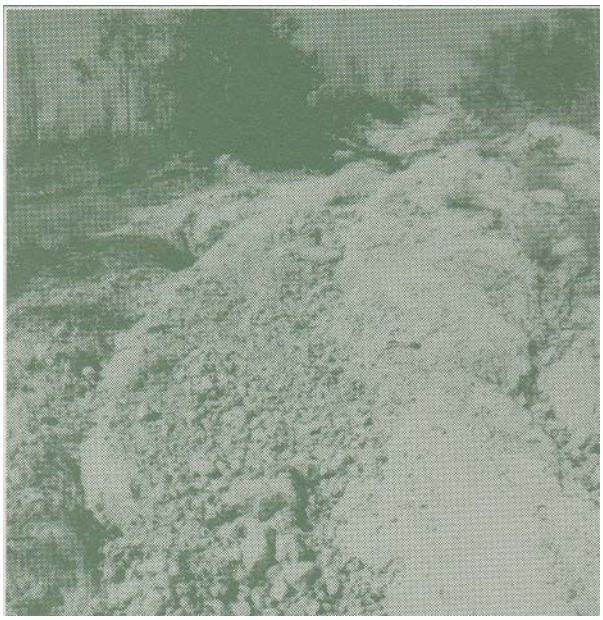
By constructing the track surface with outfall drainage and trafficable cross banks, it is possible to reduce erosion damage and maintenance needs. Establishing and maintaining vegetation on the tracks can further reduce erosion.

These guidelines outline the principles of planning, constructing and maintaining tracks to minimise soil erosion and to control runoff.

Consideration of erosion control measures at the planning and construction stage will reduce the cost and increase the effectiveness of track maintenance programs.

The guidelines are based on the understanding that there is a very wide variation of geology, soils, topography, vegetation and climate, not only over the State, but within the length of a single track. Such variations make it impossible to provide recommendations which can be applied to all situations. Where special erosion problems occur on specific tracks, consult the Soil Conservation Service.

Definitions of terms used in these guidelines have been included at the end of this leaflet.



Trafficability is seriously impaired when undrained low standard roads become eroded.

Planning

Erosion of low standard tracks can quickly destroy the trafficable surface and yield significant amounts of sediment to streams. By carefully considering the following points at the planning stage, you can ensure that construction will minimise erosion and reduce maintenance needs;

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

Consider alternative routes for the proposed track using all available information. Aim to limit soil

and vegetation disturbance when you select the route. Wherever possible, construct the track simply by slashing or blading the surface vegetation. Avoid blading soil except where it is necessary to build a track bench on side slopes; to form drainage line approaches or to make rough surfaces trafficable.

Deep rill erosion caused by inadequate drainage.

Location

Site tracks so as to reduce the risk of sediment entering drainage lines and generally keep them well above flood levels. Keep them far enough from a stream to allow an effective vegetation buffer to contain any sediment flowing from the track.

Gully erosion affecting track safety and generating sediment.

Avoid physical features which may indicate the possibility of mass movement problems such as:

- high erosion hazard soils - Class C and Class D (refer to **Definitions)**
- slopes with steps, clay beds, hummocky topography

Crossing of long, steep unstable slopes, especially where bedrock is highly weathered, is not recommended. Avoid cut and fill on moisture laden foot-slopes.

Grades

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

Steep gradients, limiting the option of non-erosive track drainage. are reached well before those limiting the passage of most four wheel drive vehicles. Sections of ineffectively drained tracks can quickly become untrafficable, especially located on Class B, C or D soils.

Generally the grade of a track should be less than 10 degrees. However, short lengths of steeper grade may be needed to negotiate difficult sections or to take advantage of favourable terrain and may therefore be acceptable in these circumstances.

In designing sections with grades exceeding 10 degrees, note that effective, easily trafficable cross banks can be built only on tracks with grades generally less than 12 degrees. Sections steeper than 12 degrees will require special drainage works.

Where it is necessary for grades to exceed 15 degrees on Class A and Class B soils and 12 degrees on Class C soils, gravelling and more sophisticated road drainage will be required. Tracks on sloping areas of Class D soils should be avoided.

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.

Crossfall drainage

There are two forms of crossfall drainage - outfall and infall (refer to **Definitions).** Outfall drainage is preferred and should be used except when

- fill batters are unconsolidated and likely to erode
- fill batters exceed l.5 metres in height

In these situations use infall drainage. Table drains. batter drop drown drains and culverts and pipes will also be required. Without adequate culverts, table drains quickly erode, often

endangering the trafficability of the track.

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

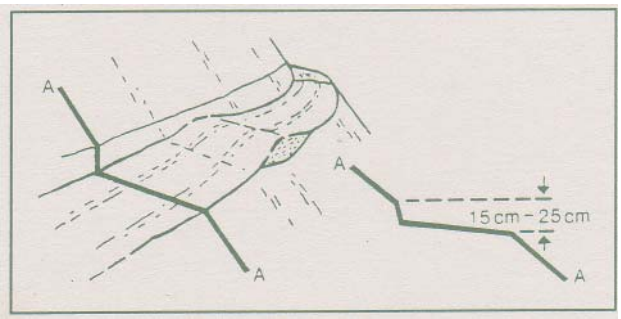


Figure l: Outfall surfacing of the road should be used instead of infalling.

To ensure effectiveness of the outfall, remove any earth windrow which develops at construction on the down-slope side of the track. Closing tracks in wet weather will keep wheel ruts from forming and will help maintain effective outfall drainage.

Cross banks

Where runoff can not be controlled simply with outfall drainage, use cross banks to baulk runoff and direct it across the track surface. Correctly located and built, these banks give easily trafficable, effective, cheap, long-term and low maintenance track drainage.

Cross bank construction

On new tracks or those affected by erosion, build cross banks at the spacing indicated below:

Cross Bank Spacing

Road Grade	Soil Class A	Soil Class B	Soil Class C
Up to 8°	70 to 90 m	60 to 70 m	20 to 30 m
8° to 12°	60 to 70 m	50 to 60 m	■
12° to 16°	40 to 60 m	■	■
16° to 20°	30 to 40 m	■	■
20° to 22°	20 to 30 m	■	■

Note 1: ■ indicates that tracks should not be constructed on these soil types within the slope range. Note 2: Where tracks are constructed on slopes exceeding 12°, permit only light and infrequent traffic.

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.

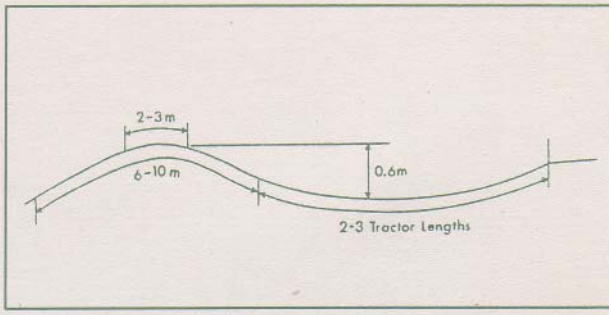


Figure 2: Dimensions of cross banks.

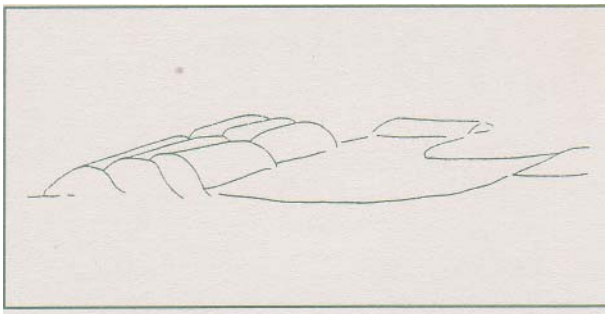


Figure 3: Cross bank during construction.

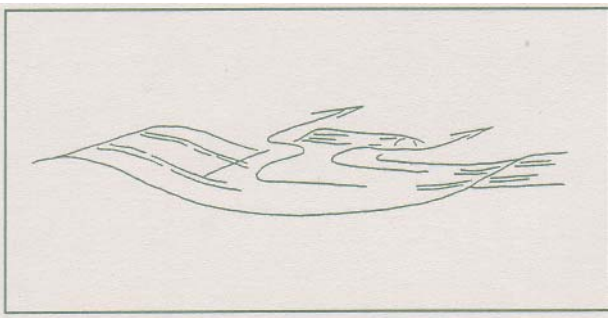


Figure 4: The bank of earth resulting from the spillway clearing can be left to act as a silt trap and water spreader.

Consider the following points in choosing sites for cross banks:

- location of stable and clear outlet points
- recommendations of spacing tempered by experience and the existing condition of the track
- location of short sections of flatter track grade allowing cross bank construction on a generally steep track

Trafficable cross banks can be comfortably negotiated and provide effective drainage when sited and built correctly.

Outlet

Select a suitable outlet point for the bank, one that is not blocked by a stump or rock. Site the outlet so that runoff will spill into undisturbed vegetation and can not flow back onto the track.

Rip the track to a depth of 20 to 30 cm for a distance of one or two tractor lengths back from the chosen outlet point. Then push the loose earth down the track into a bank, commencing at the uphill side of the track and working across 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 .2) after shaping and compaction. Depending on the size of the machine being used, up to eight bladefuls of earth may be required (Figures 3 & 4). Ensure 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 tractor 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 draining 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.

Earthworks

When constructing tracks disturb the soil and vegetation as little as possible, both on and adjacent to the track. Construct the track to follow the contour of the land as much as possible to reduce the amount of cut and fill.

To minimise the area of disturbed soil exposed, batters to a height of 1.5 metres on Class A soil may be cut vertically. Vertical cut batters may suffer from initial slumping. but will generally stabilise with follow-up maintenance. Cut batters may require special stabilisation measures including laying back, revegetation and drainage.

Fill batters should be no steeper than 2:1 (Hor:Vert) and flatter where possible to encourage natural revegetation and to effectively accept seed and fertiliser. Fills higher than 1.5 metres on Class B, C and D soils may require special stabilisation works, such as drop down drains and hay mulching.

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

'Borrow' areas should not, for preference, be located near drainage lines or streams because of the danger of sediment polluting the stream. When necessary, the `borrow' areas should be limited in size, worked in such a way to reduce 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.

Timber destruction

Limit clearing to 0.5 metre on either side of the track. Where extra clearing widths may be needed, such as to allow the sun in to keep the trail dry, clear by felling, rather than dozing, to limit the amount of soil disturbance.

Where trees have to be destroyed or injured on Protected Land, an authority is required. Applications MUST be lodged 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.

NOTE: The maintenance of tree cover on certain land is covered by the Soil Conservation Act. 1938. Such land has been mapped throughout the State and is called 'Protected Land' and includes:

- any land within a notified catchment area which has a slope generally greater than 18 degrees
- any land in or within 20 metres of the bed or bank of any part of a prescribed river, stream, lake, lagoon or swamp
- any land which is environmentally sensitive or affected by or liable to soil erosion, siltation and land degradation

Drainage line crossing

Drainage lines should be crossed with fords, 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 cost less and often can be built with little disturbance to the stream and banks. Do not use

fords where the stream has a deep cross-section requiring considerable excavation to provide approaches to the crossing.
Culverts should never be used where debris blockages are likely.
Place culverts as close as possible to the natural alignment of the drainage line to avoid diverting the flow into the stream banks or creating scour of the drainage line.
Keep soil and vegetation disturbance to a minimum. You may need to seed or mulch disturbed areas to protect them from erosion.
Do not dump timber, scrub, soil or debris in drainage lines, but stack them well above flood levels.
Minor drainage lines may require a culvert, but shallow depressions and swampy areas may be stone paved or corduroyed with timber.

Revegetation

The amount of revegetation works required on disturbed areas will vary as follows:

- no revegetation required - forest litter and native flora will provide natural vegetation and stabilisation
- short-term revegetation - provided by annual grasses (wimmera ryegrass) or cereals eg. cereal rye or oats (autumn/winter) or millet (spring/ summer) and fertiliser
- long-term stability will be provided by forest litter and native flora
- long-term revegetation - using perennial grasses, with or without a cover crop such as oats, cereal rye (autumn/winter) or millet (spring/summer) and fertiliser
- use of sod or other vegetative material in specialised situations
- use of shrubs and trees with a high water requirement eg. *Casuarina glauca* in situations such as those requiring de-watering or those affected by unstable soils

Undertake revegetation immediately following the disturbance while the soil is still loose, irrespective of the growing seasons
A maintenance dressing of fertiliser mid seed may be required.

Maintenance

It is essential that a sound cover of vegetation and or forest litter develops on the surface of the track, on batters and on the approaches to drainage line crossings.
Frequent maintenance is essential. especially in the early years after constriction. to ensure effective erosion control and track stability.

Inspect all tracks at least annually and following heavy traffic usage or exceptionally heavy rainfall, to determine maintenance requirements.
Restrict destruction of vegetation to the removal of excess vegetation, preferably by slashing or spraying. Avoid unnecessary grading or blading to reduce soil disturbance.
Encourage outfall drainage by removing any windrow along the outside edge of the track.
The location, spacing and size of cross banks should always be studied when considering the maintenance program. A sound guide to bank spacing will be indicated by the distance water runs on a track before rilling commences. Cross bank outlets should permit the free flow of water.
Examine the inlets and outlets of cross banks, drains and culverts at each maintenance inspection and repair if necessary.
Leave material slumping from cut batters untouched 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 and scrub than is necessary to maintain safety on the track.
Clear timber by felling, rather than bulldozing.
Do not dump timber, scrub, soil or debris in drainage lines. These materials should always be stacked well above flood levels.
Remove debris deposited near drainage line crossings during maintenance.
The use of outfall drainage and cross banks largely eliminates the need for blading the surface of the track, this itself being a disturbance and cause of erosion. The stabilised road surface and protective vegetative cover on the bank outlets combine to reduce track erosion.

Conclusion

If you apply these guidelines of track design and maintenance, access should be available at all times.
The use of crossfall drainage and trafficable cross banks offers a cheap and easy method of controlling runoff and erosion on low standard tracks. Their use will help ensure that tracks remain trafficable and that vehicles will not be hindered or halted by surface rilling and table drain gullying.

Definitions

Batter
The face of an embankment or cutting, produced as a result of earthmoving operations involving cutting and filling.

Batter Drop-Down
A constructed and stabilised drain to carry runoff down the track batters, typically down the line of greatest slope. **Cross Bank**
A mound of earth constructed across a track so that runoff is effectively diverted from it. Cross banks are designed to handle larger flows than cross drains.

Cross Drains
Drains of various forms that baulk the flow of water down a track and divert it across the track surface. The capacity of the drain is defined by its cross-section. Cross drains are designed to handle smaller flows than cross banks, but larger flows than can be controlled by crossfall drainage.

Crossfall Drainage
Drainage which occurs when the surface of a track has sufficient cross slope to cause water to flow across and off the surface, rather than along it. Where the water flows into the hillside, it is termed INFALL. Where floe- is away from the hillside, it is termed OUTFALL. The cross slope required to achieve such drainage is 1:25. For safety reasons the maximum crossfall used should generally not exceed 1:10.

Culvert
A pipe or similar structure used to direct water under the track.

Earth Windrow
A ridge of soil which may build up along the edge of tracks during their construction and maintenance. This may prove useful in directing runoff to a stable outlet, in which case it is called a WINDROW DRAIN. However, in other circumstances it may prevent runoff leaving the track, causing erosion.

Erosion classes in relation to soil types

Class A
Low soil erodibility. Brown and red soils derived from finer sediments and metasediments.

Class B
High soil erodibility. Red soils on fine granites, fine sandstones and basalt.

Class C
Very high soil credibility. Grey and yellow soils derived from granites. sediment and metasediment, especially coarse grained types.

Class D
Extreme soil erodibility. Unconsolidated sediment. As a general rule, tracks should not be built on Class D soils.

Mitre Drain
A drain to conduct runoff from the shoulders of a track to a disposal area away from the road alignment.

Table Drain
The side drain of a track running adjacent to and parallel with the shoulders and forming part of the track formation.

Track
A road of basic construction standards which closely follows the natural landform and is constructed with a minimum of culverts and earthworks. The surface is rarely gravelled and receives little maintenance. Construction standards provide for intermittent, but reliable, loaded four wheel drive travel in fair weather conditions and generally at low speeds. More extensive use, or use during wet conditions, may lead to rapid deterioration of the track.

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