Road Drainage

Fact Sheet

To allow for adequate drainage, the following points need to be considered:

- **The amount of runoff expected to reach the area under consideration**
- **Potential flood areas**
- **Areas of discharge (e.g. floodways).**

The three components of adequate road or track drainage are surface, side and cross drainage.

Surface Drainage

Road Crowning

Crowning provides a low-grade fall enabling drainage from both sides of the centre of the road (See Figure 1). This method is only effective if the crown is slightly higher than the natural surface.

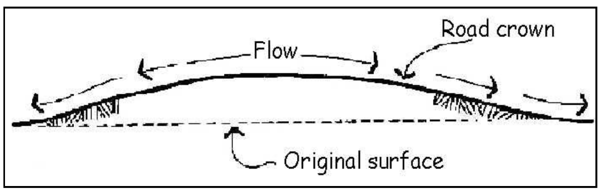

Figure 1: Crowning

Road crowning should be avoided in areas where water naturally crosses the road such as broad drainage floors. Floodways are required in these cases.

Infall and Outfall Drainage

When roads are built across the slope consideration must be given to taking water from the up slope side of the road to the down slope side of the road. When you install cross drainage you must make sure that it does not cause erosion of the road surface.

Crossfall/Outfall Drainage

The simplest method is by providing the road surface with a crossfall in the same direction as the slope (outfall drainage), thereby directing water over the road surface to disposal areas on the lower side of the road (See Figure 2).

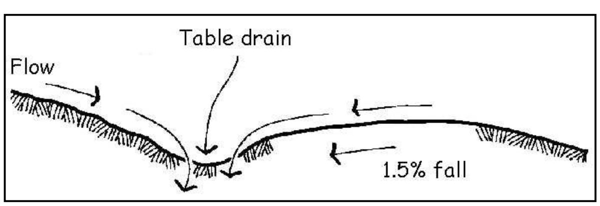

Figure 2: Crossfall/outfall drainage

The other method is by providing the road surface with infall drainage back into the slope, directing water back to the up slope side of the road (See Figure 3). If infall drainage is necessary then table drains, culverts or inverts need to be constructed. These will safely direct water to the down slope side of the road.

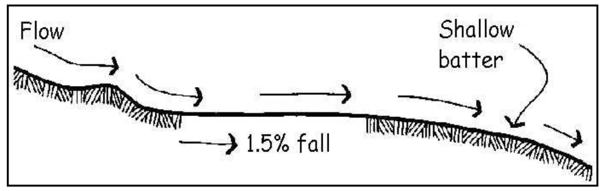

Figure 3: Infall drainage

Outfall drainage is preferred to infall drainage as there is generally no need for other drainage works such as culverts, inverts, table and mitre drains.

When installing outfall drainage on steeper slopes, batters on the downslope side of the road must not be too steep. Steep batters may erode, impacting on the road itself.

The crossfall of the road surface should be kept as flat as possible to ensure good drainage. For outfall drainage it is recommended that the maximum crossfall slope be in the order of 1.5 – 2%, whereas infall drainage slopes can be as great as 4%.

Side Drainage

Table Drains

Table drains are excavated open channels that are built parallel to roads and tracks. These drains direct runoff to disposal areas further downslope. Table drains should only be used when natural run-off is not possible.

Fill obtained from constructing table drains can be used to build up road surfaces. The design of table drains depends on a number of factors, including the size and nature of the catchment, the slope and water volumes and flow. Larger table drains may need to be designed by engineers or other suitably qualified professionals.

Table drains should be constructed with a flat bottom (trapezoid shape) (See Figure 4). In general they should be 0.5 to 1.0m wide at the base. Avoid using V shaped drains as they may cause erosion in the channel.

Where possible table drains should be revegetated as soon as possible after construction, and regularly slashed. Table drains should not be graded.

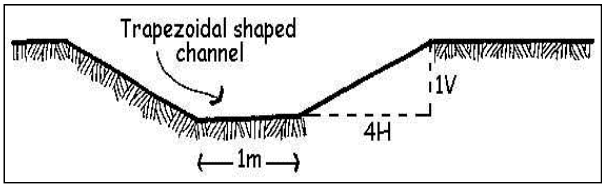

Figure 4: Table & mitre drain cross section

Mitre Drains

Water should be taken out of table drains at regular intervals using mitre (offshoot) drains. Mitre drains take runoff out of table drains or directly off road shoulders where table drains are absent. These drains dispose of water in areas away from the road (See Figure 5).

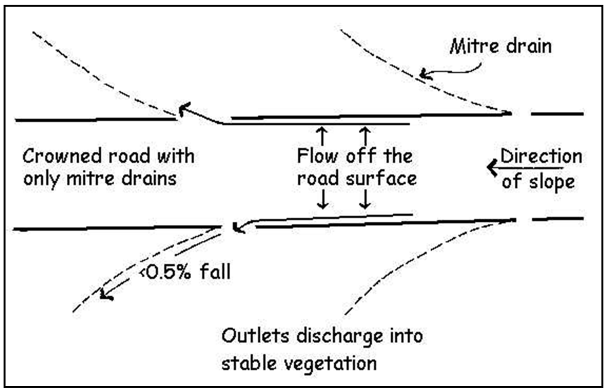

Figure 5: Crowned road with only mitre drains

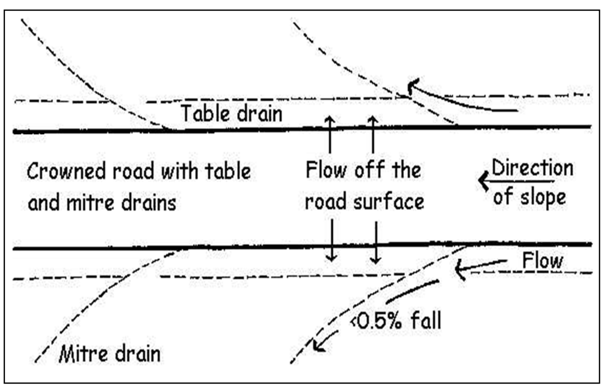

Figure 6: Crowned road with table and mitre drains

Mitre drains stop water accumulating in table drains or on the road shoulder. Ideally mitre drains should be constructed so that they have a broad flat base at least 1m wide. Mitre drains also should not be graded to produce a V.

Mitre drains should slope to direct the flow of water away from the road. To minimise erosion the slope should be no greater than 0.5% on erodible soils or 1% on stable soils. Mitre drain outlets effectively concentrate runoff, for this reason they should be located in stable undisturbed areas.

Mitre drain spacing is dependent on:

- the grade of the table drain or road
- soil type and erodibility
- rainfall

Table 1: Recommended mitre drain spacing

Slope		Mitre Drain Spacing (m)
%	Gradient	
0.5	1 : 200	170 - 180
1	1 : 100	120 - 130
2	1 : 50	90 - 100
3	1 : 33	70 - 80
4	1 : 25	60 - 70
5	1 : 20	55 - 60
6	1 : 17	50 - 55
10	1 : 10	40 - 45

Note: this table shows reccomended spacing only, and may not apply in all locations.

Cross Drainage

Engineered, stable cross drainage such as inverts, floodways or culverts can be used to collect water from upslope table drains, or drainage lines. It is generally more conomical and practical to ford drainage lines using floodways or inverts than to use major culverts or bridges. On steeper country, where creeks and drainage lines are deeper, culverts may be more practical.

Inverts and Floodways

Care must be taken in the design and construction of floodways and inverts in order to cause minimal interference to natural flows. Inverts and floodways are designed to be temporarily over topped by water flow and minimise bank and bed erosion. They should be sited at low points in the bank and at right angles to the direction of flow.

Inverts

Inverts should be constructed with the finished surface at, or just below the level of the existing stream bed. Construction of an invert is generally based on excavating soft, erodible material. At least 300mm should be removed, geotextile may be necessary as a base. Excavated material is then replaced with compacted granular material to provide a trafficable surface (See Figure 7).

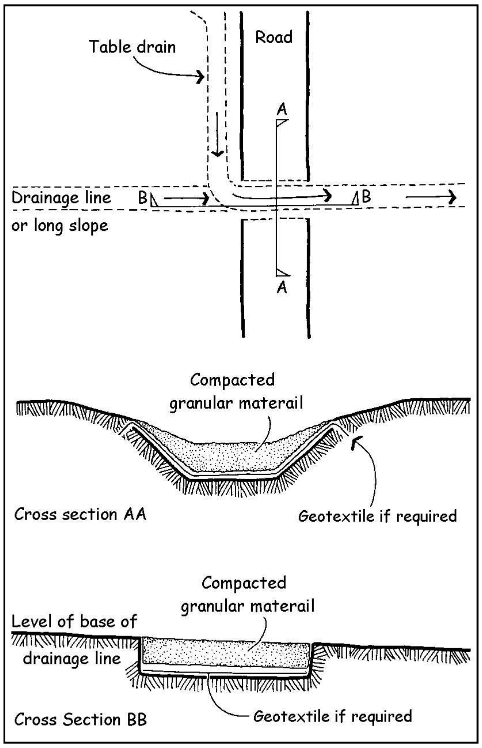

Figure 7: Inverts

Floodways

Floodways are usually elevated above the bed level of the channel and often incorporate culverts to take "normal" flows with the road only being overtopped during flood events, as illustrated in Figure 8.

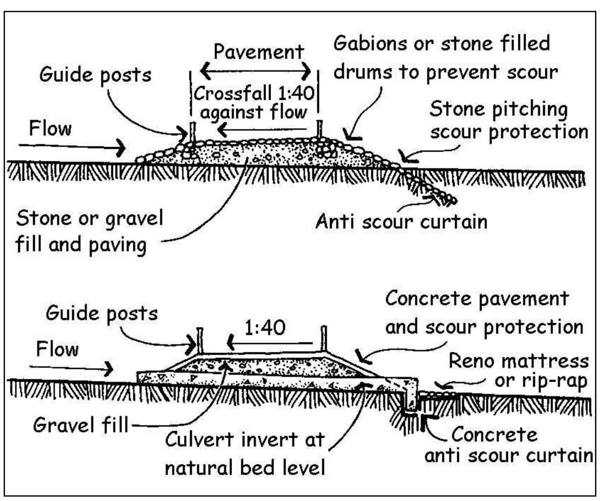

Figure 8: Floodways (Australian Road Research Board, 1993)

The design should have ends of the structure that are well anchored into the banks and obstruction to flow kept to a minimum by using gentle batter slopes on the up- and downstream faces. When it is necessary to construct an elevated floodway it is recommended that specialist advice be sought.

As floodways are generally elevated above bed level protection works are required on the downstream side of the floodway to prevent erosion.

Culverts

When culverts are used they should be angled downward at between 1 and 3%. This will minimise silting of the pipe and prevent excessive scouring at the outflow. On drainage lines the culvert should be keyed into the streambed by digging a trench and seating the culvert into it.

The area below the outlet will need protection to prevent erosion. This protection can be achieved by armouring (eg: rock mattress) the drain downstream of the outlet, or by constructing a dissipating device (see Figure 9).

Protection may also be required at the inlet. The location, spacing, size and type of culvert may vary. Advice should be sought prior to construction.

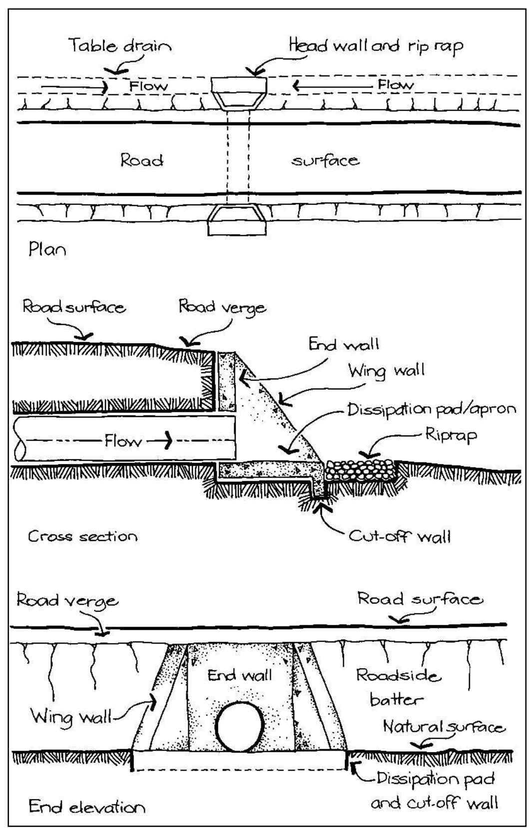

Figure 9: Culverts

Whoa Boys on Vehicle Tracks

Whoa boys can vary in size. They can be a couple of metres long and only 10–30cm high on walking tracks, or they may be large, gently sloping banks up to 30-40m and up to 3m high on deeply eroded areas.

Whoa boys can be constructed in two ways:

1. By cut and fill – Lines are ripped across the area at a grade of 0.3 %. A shallow channel should be cut along this line. Excavated material is dumped on the down slope side of the channel, then compacted and smoothed out to form a bank with even batters and a level top (See Figure 10).

2. Using imported soil material to construct a bank with a grade of between 0.3 and 0.5% along the up slope edge of the bank.

To aid trafficability, an approach and departure ramp can be cut into the bank (See Figure 11). The bank should be run off into undisturbed vegetation or into an existing drain (care needs to taken to ensure that erosion does not occur where the water runs down into the drain).

Alternatively a level sill can be constructed at the end of the bank to enhance the spread of water.

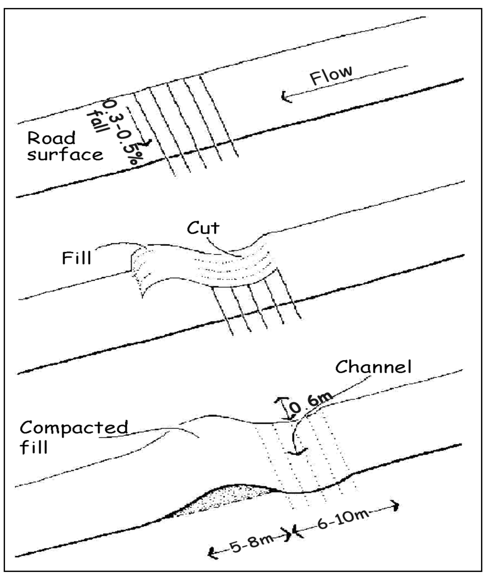

Figure 10: Whoa boy construction

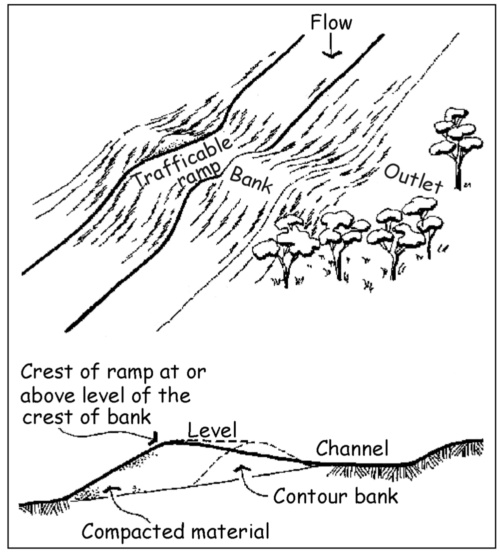

Figure 11: Whoa boy – vehicle track

Contact Details

For further information contact the DLRM Land Management Unit in your region. Additional Fact Sheets are available on the website: http://www.lrm.nt.gov.au/soil/management

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