ARVIKACONSULT

Amended Extract from Forestry Commission Forest Road Handbook, (January 2004)
Additional Information to supplement Forest and Water Guidelines 5th Edition

Culverts (General)

1. Circular pipes are the simplest shape, structurally efficient and easiest to install.

2. HDPE is the lightest material available, the easiest to handle, and the least prone to damage and is the preferred choice for this project.

3. To reduce the chance of blockage 300rnm is the absolute minimum diameter of pipe and will only be used within access ramps to cross the side drains. 450rnm will be considered as the realistic minimum diameter for road crossings

6. An inlet catch pit should be provided on pipes in drains.

7. There must be sufficient cover over the pipe to disperse the wheel loads.

Culvert Installation

1. Care in installation is needed to ensure correct hydraulic functioning and structural stability. Larger diameter flexible pipes may require the use of jacks during installation to ensure that the final shape is as designed.

2. The culvert should preferably be placed perpendicular to the road or on the line of a watercourse. There may also be opportunities to straighten a skewed ditch crossing.

3. It is often possible to divert or avoid the watercourse so as to enable culvert placement in the dry. This is easier and reduces the possibilities for pollution.

4. Wherever possible, the trench width should be kept to the minimum necessary to enable safe placement and effective compaction.

5. Culverts should always be installed in accordance with the manufacturer's recommendations. This is particularly true of the larger pipes.

6. The manufacturer's recommendations should be used for the thickness of granular bedding. In the absence of any such advice, the Design Engineer will be consulted.

7. Backfill material, although not as critical as the bedding, must still be chosen with care. Large sharp stones or boulders that could puncture or damage the pipe must be avoided.

8. The backfill must be brought up in layers on both sides at the same time. Each layer must be compacted thoroughly as it is placed, taking care not to float the pipe. Thin walled flexible pipes rely upon well-compacted backfill for their strength.

9. The manufacturer's recommendations should be used for the minimum cover to their pipes. In the absence of any such advice, the following figures can be used for guidance

Diameter (mm)	Minimum Cover (mm)
=1050	750
>1200	1000

10. Care must be taken to ensure that the protection from erosion of both up and downstream faces of the embankment is given proper consideration. The possibility of scour should also be considered and, if required, appropriate counter measures taken to suit the particular circumstances.

11. Where possible, culverts should not be installed on natural watercourses. When necessary and fish may be present, particular considerations to take-account of their requirements include:

- the need to sink the pipe invert below bed level both to allow gravel to cover the invert and to ensure that there is water in the pipe;
- the possibility that a larger pipe may be necessary to allow sinking and yet retain waterway area;
- the possibility that the pipe gradient may have to be slackened to restrict velocity and facilitate fish movements; and
- the need to ensure that there are no projecting pipe ends.

ROADSIDE DRAINAGE DITCH

1. At whatever level in the road structure, saturated material will have a much reduced strength compared to a material at optimum moisture content.

2. The prime function of the roadside drainage ditch is to carry away the surface water.

3. The ditch will also act as an interceptor for shallow depth sub-surface water coming off the uphill side of the road. This may help to lower the ground water level to below the formation.

4. To be effective in keeping the ground water level low, the ditch must be at least 150mm below the formation level.

5. Care must be taken to ensure that the ditch creates neither an unacceptable safety hazard (to road vehicles, users, maintenance teams or forest workers) nor a major hindrance to harvesting.

6. The ditch should be so positioned as not to undermine the edge of the road. The positioning of the ditch may well determine the method of maintenance.

7. Ditches should be in place early in the construction process to ensure that the formation does not act as a drainage channel.

8. Ditch side slopes should be at a stable angle.

9. u-shaped ditches should be avoided because of the tendency of the sides to slump or erode.

10. filling the ditch with large clean stone will stop the sides pushing in but will require frequent maintenance to allow the continued passage of water.

11. Ditch side slopes can be stabilized by vegetation that is either natural, seeded direct or from impregnated matting. Exceptionally, a geotextile membrane may be used. Any membrane or matting used will have to be secured in accordance with the manufacturer's instructions to ensure stability.

12. Vegetation will act to some extent as a filter to reduce downstream sedimentation or pollution. This will require careful attention to maintenance / cleaning to ensure that the benefit is retained.

13. The surface water and any intercepted sub-surface flow should be diverted away from the formation.

14. At times temporary drainage may need to be considered to avoid damaging either the environment or the road structure.

15. In order to minimise pollution, a ditch or culvert should not lead directly into a watercourse.

GRADIENTS OF ROADSIDE DITCHES

1. Ditch gradients should be greater than 2% to ensure water flows, avoid siltation and minimise maintenance.

2. Gradients of 2 - 6 %work well in all types of soil, but the length between culverts may be a consideration in some soils at the steeper slopes.

3. Gradients steeper than 6% may need stone protection in some soils to minimise erosion.

DITCH RELIEF CULVERTS

1. Ditch relief culverts should be provided to control the build up of water in the ditch.

2. Watercourses should not normally be diverted out of their original catchment areas.

3. Catchpits should be provided at the pipe inlet to intercept suspended material. These must be at least 300mm below the pipe inlet invert, and large enough to contain the expected amount of material. The size will need to be reviewed with experience.

4. Where considerations of erosion characteristics permit, cross - drain the ditch under the road and allow the water to dissipate and filter through the slope below the road.

5. Relief culverts need to be planned. Factors to be considered include:

   - water volume, velocity and the likelihood of erosion of the ditch (e.g. position a culvert at the top of a steep ditch gradient);
   - soil types and erosion characteristics;
   - vegetation;
   - rainfall intensity;
   - seasonal watercourses and springs coming off the topside bank;
   - low spots in the road to stop ponding in the ditch;
   - exit points - the use of hollows and ponds, buffer zones etc to remove the material in suspension, taking care that the road formation does not become flooded;
   - possibilities for an intermittent wetland habitat when exiting into a hollow; and
   - access for cleaning of catchpits and settlement traps.

SPACING OF DITCH RELIEF CULVERTS

1. The spacing of ditch relief culverts is often determined by the factors considered in above.

2. Culverts should be provided at the lowest point of longitudinal sections and at each end of super elevated sections.

3. Culverts to be placed to ensure water is contained within its catchment area.

4. The following should serve as a guide to the maximum spacing:

Ditch Gradient	Culvert Spacing

%	Normal Conditions Ground Cross Slope < l%	Very wet or Steep Conditions Ground Cross Slope >15%
<4	200	100
5	160	80
6	130	65
7	115	55
8	100	45
9	90	40
10	80	35
11	70	30
12	65	25