COFFS HARBOUR CITY COUNCIL

DEVELOPMENT SPECIFICATION
DESIGN

0043 Subsurface drainage (Design)

Version 1 ***01 January 2009***

0043 SUBSURFACE DRAINAGE (DESIGN)

1 SCOPE AND GENERAL

1.1 SCOPE

The work to be executed under this worksection consists of the design of the subsurface drainage system for the road pavement and/or subgrade.

This worksection contains procedures for the design of subsurface drainage, including:

- Subsoil and foundation drains
- Sub-pavement drains
- Drainage mats, including Type A and Type B mats.

1.2 OBJECTIVES

Control moisture fluctuations

The objective in the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or subgrade to within the limits assumed in the pavement design.

Salinity prevention

In the areas with a history of salinity problems, subsurface drainage may be prescribed to keep the groundwater table lower in the strata so as to avoid progressive deterioration of the health of topsoil and upper layers due to salinity levels increased by rising and/or fluctuating groundwater tables.

1.3 DEFINITIONS

For the purposes of this worksection the following definitions apply:

Subsoil drains: are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings and fill areas.

Foundation drains: Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation.

Sub-pavement drains: are intended for the drainage of the base and subbase pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the subgrade.

Type A drainage mats: are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type B drainage mats: are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

1.4 REFERENCED DOCUMENTS

The following documents referred in this worksection are:

Worksections

1171 *Subsurface drainage*

Standards

AS 2439 Perforated plastics drainage and effluent pipe and fittings

AS 2439.1 Perforated drainage pipe and associated fittings

AS/NZS 1477 PVC pipes and fittings for pressure applications

Other publications

ARRB Australian Road Research Board

ARR368 the collection and discharge of stormwater from road infrastructure.

RESOURCE NSW

Specification for supply of recycled materials for pavements, earthworks and drainage, 2003

1.5 BIBLIOGRAPHY

Worksections

1172 *Subsoil and foundation drains*

1173 *Pavement drains*

1174 *Drainage mats*

Other publications

AUSTROADS

Guide to the control of moisture in roads, 1983

APT36/06 Pavement design for light traffic: a supplement to the Austroads pavement design guide.

2 SUBSOIL AND SUB-PAVEMENT DRAINS

2.1 WHERE REQUIRED

Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents:

- Cut formations where the depth to finished subgrade level is equal to or greater than 400 mm below the natural surface level.
- Locations of known hillside seepage, high water table, isolated springs or, salt affected areas.
- Irrigated, flood-prone or other poorly drained areas.
- Highly moisture susceptible subgrades, i.e., commonly displaying high plasticity or low soaked CBRs.
- Use of moisture susceptible pavement materials.
- Existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture.
- At cut to fill transitions.

Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation.

The Drawings shall be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

2.2 LAYOUT, ALIGNMENT AND GRADE

Typical cross sections

Typical cross sections of subsoil and sub-pavement drains are shown in Figures 2.1 and 2.2.

Kerbed roads

In kerbed roads, the two acceptable alternative locations for the line of the trench are directly behind the kerbline. Pavement layers must extend to at least the line of the rear of the trench.

Unkerbed roads

In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers as shown in Figure 2.2.

Grade

The minimum longitudinal design grade shall be 1.0%. For non corrugated pipes, an absolute minimum grade of 0.5% is acceptable.

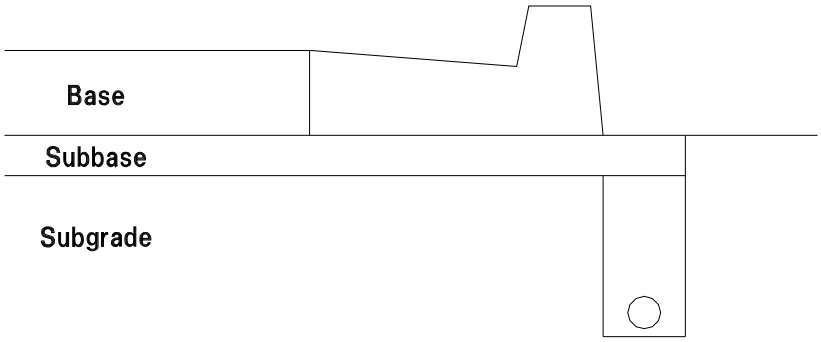

Figure 2.1 Typical subsoil drain

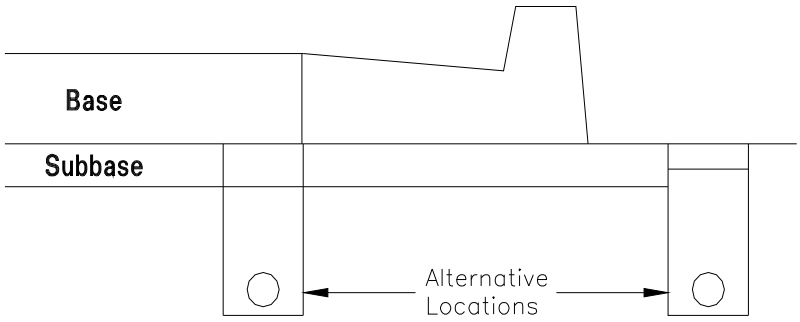

Figure 2.2 Typical sub-pavement drain

Trench dimensions

Trench widths shall be a minimum of 300 mm, with a minimum depth below finished subgrade level of 600 mm in earth and 450 mm in rock, and below the invert level of any service crossings.

Outlets and salinity prevention

Outlets shall be spaced at maximum intervals of 150 metres into gully pits or outlet headwalls. As a salinity prevention measure and where practical, discharge shall be on the downhill side of the embankment or in the cut-fill area so as to reduce the risk of recharge to the subsurface water table.

Unless otherwise authorised, where subsurface drains outlet through fill batters, unslotted plastic pipe of the same diameter as the main run shall be specified. A small precast concrete headwall shall be installed at the drain outlet with a marker post to assist maintenance and protect the end of the pipe.

Cleanouts

Cleanouts shall be provided at the commencement of each run of drain, and at intervals not exceeding 80 metres. Cleanouts shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

Salinity prevention

In salinity affected areas, the Designer should consider providing a separate drainage system for subsurface drains to discharge to a basin where controlled release or desiccation treatment and removal can be facilitated as a maintenance operation.

Saline subsurface drainage should not be routinely discharged directly into natural watercourses.

Reference to water quality targets for downstream watercourses is essential and the Designer shall provide advice on discharge operations and maintenance compatible with water quality targets and the requirements of the relevant land and water resource authority.

3 FOUNDATION DRAINS

3.1 WHERE REQUIRED

Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.

The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location shall be shown on the Drawings.

However, more commonly, the need to provide foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

Where the road formation traverses known swampy, flood-prone, salt affected areas or watercharged strata, the Drawings shall be suitable annotated to the potential need for foundation drains at various locations, in addition to those shown on the Drawings.

3.2 LAYOUT, ALIGNMENT AND GRADE

Typical cross section

Typical cross-sections of foundation drains are shown in Figure 3.1.

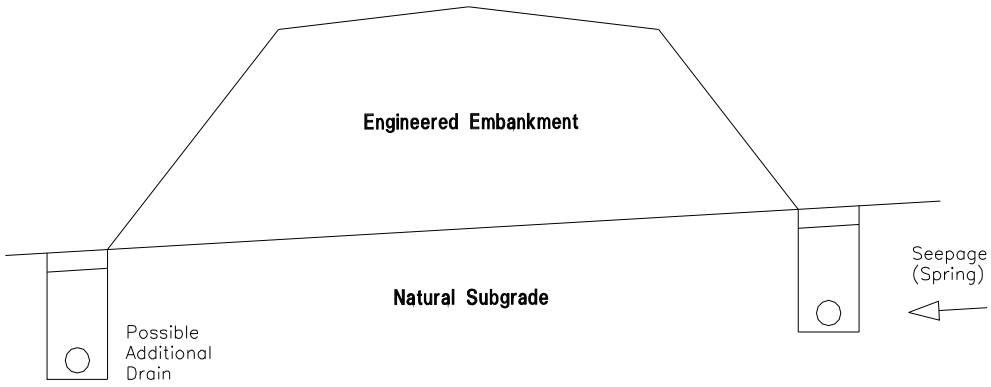

Figure 3.1 Foundation drains

Grade

The minimum design grade shall be 1.0%. For non corrugated pipes an absolute minimum grade of 0.5% is acceptable.

Trench dimensions

Foundation drains shall be a minimum trench width of 300 mm, with a variable trench depth to suit the application and ground conditions on site.

Outlets

Outlets shall be spaced at maximum intervals of 150 metres.

Cleanouts

Where practicable, cleanouts are to be provided at the commencement of each run of foundation drain and at intervals not exceeding 80 metres.

Where not practicable to provide intermediate cleanouts, outlets shall be spaced at maximum intervals of 100 metres.

4 DRAINAGE MATS

4.1 WHERE REQUIRED

The need to design for the provision of drainage mats (or blankets) should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

Type A mats

Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type B mats

Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.

Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.

5 MATERIALS

5.1 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

Pipes designated for subsoil, foundation and sub-pavement drains shall be 100 mm dia. slotted pipe except for cleanouts and outlets through fill batters which shall be unslotted pipe.

All pipe shall be slotted, and fitted with a suitable geotextile filter tube. Corrugated plastic pipe shall conform to the requirements of AS 2439.1. The appropriate class of pipe shall be selected on the basis of expected live loading at the surface. Joints, couplings, elbows, tees and caps shall also comply with AS 2439.1.

Slotted rigid UPVC pipe shall be of a type and class approved by Council.

5.2 INTRA PAVEMENT DRAIN PIPE

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses neither less than 150 mm nor more than 200 mm shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

Pipes designated for intra pavement drains with crushed rock subbases having layer thicknesses exceeding 200 mm shall be slotted pipe of a type and class approved by Council.

Pipes for use in Type B drainage mats shall be slotted thick walled UPVC pressure pipe complying with AS/NZS 1477.

5.3 FILTER MATERIAL

Acceptable types of filter material and their use shall be as follows:

- Type A filter material—use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats.
- Type B filter material—use in subsoil, foundation and sub-pavement (trench) drains.
- Type C filter material comprising crushed rock—use in Type A drainage mats.
- Type D filter material comprising uncrushed river gravel—use in Type A drainage mats.

Material requirements and gradings for each type of filter material are included in the 1171 *Subsurface drainage*.

5.4 BACKFILL FILTER MATERIAL

The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) shall depend on the permeability of the pavement layers and/or subgrade and the expected flow rate.

Generally, Type A filter material is used for the drainage of highly permeable subgrade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of subgrade and pavement layers of lower permeability such as clays, silts or dense graded gravels.

Further guidance to the selection of appropriate filter material is contained in *ARRB ARR368*.

5.5 GEOTEXTILE

To provide separation (i.e. prevent infiltration of fines) between the filter material in the trench and the subgrade or pavement material, geotextile shall be designated to encapsulate the filter material.

The geotextile shall comply with the requirements included in 1171 *Subsurface drainage*.

Geotextile shall also be designated for both Type A and Type B Drainage Mats.

6 DOCUMENTATION

6.1 DRAWINGS

The proposed location of all subsurface drains shall be clearly indicated on the Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement.

The location of outlets and cleanouts shall also be indicated on the Drawings.

6.2 CALCULATIONS

Assumptions and/or calculations made in the determination of the need or otherwise for subsurface drainage in special circumstances or as a variation to the requirements of this worksection shall be submitted to Council for approval with the Drawings.