

# CAPRICORN MUNICIPAL DEVELOPMENT GUIDELINES

## SUBSURFACE DRAINAGE DESIGN

D4

### DESIGN GUIDELINE



## TABLE OF CONTENTS

CLAUSE	CONTENTS	PAGE
<b>GENERAL</b>		<b>3</b>
D4.01	SCOPE	3
D4.02	OBJECTIVES	3
D4.03	TERMINOLOGY	3
D4.04	REFERENCE AND SOURCE DOCUMENTS	4
<b>SUBSOIL AND SUB-PAVEMENT DRAINS</b>		<b>4</b>
D4.05	WARRANTS FOR USE	4
D4.06	LAYOUT, ALIGNMENT AND GRADE	5
<b>FOUNDATION DRAINS</b>		<b>6</b>
D4.07	WARRANTS FOR USE	6
D4.08	LAYOUT, ALIGNMENT AND GRADE	6
<b>DRAINAGE MATS (BLANKETS)</b>		<b>7</b>
D4.09	WARRANTS FOR USE	7
<b>MATERIALS</b>		<b>8</b>
D4.10	SUBSOIL AND SUB-PAVEMENT DRAIN PIPE	8
D4.11	FILTER MATERIAL	8
D4.12	GEOTEXTILE	8
<b>DOCUMENTATION</b>		<b>9</b>
D4.13	DESIGN DRAWINGS AND CALCULATIONS	9

### **Keeping the Capricorn Municipal Development Guidelines up-to-date**

The Capricorn Municipal Development Guidelines are living documents which reflect progress of municipal works in the Capricorn Region. To maintain a high level of currency that reflects the current municipal environment, all guidelines are periodically reviewed with new editions published and the possibility of some editions to be removed. Between the publishing of these editions, amendments may be issued. It is important that readers assure themselves they are using the current guideline, which should include any amendments which may have been published since the guideline was printed. A guideline will be deemed current at the date of development approval for construction works.

## GENERAL

### D4.01 SCOPE

1. This section sets out the Guideline for the design of the subsurface drainage system for the road pavement and/or subgrade.
2. This Specification contains procedures for the design of subsurface drainage, including:
  - (a) Subsoil and Foundation Drains
  - (b) Sub-Pavement Drains
  - (c) Drainage Mats, including Type A and Type B Mats.
3. Reference guidelines for the application and design of subsurface drainage include ARRB Special Reports 35 and 41, and the AUSTROADS publication - Guide to the Control of Moisture in Roads. The full titles of these guidelines are given below.

### D4.02 OBJECTIVES

1. 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.

***Control  
Moisture  
Content***

### D4.03 TERMINOLOGY

1. Subsoil drains are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings.
2. Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation.
3. 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.
4. 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.
5. 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.

***Subsoil Drains***

***Foundation  
Drains***

***Sub-pavement  
Drains***

***Type A  
Drainage Mats***

***Type B  
Drainage Mats***

### D4.04 REFERENCE AND SOURCE DOCUMENTS

#### (a) Council Specification

- C230 - Subsurface Drainage - General
- C231 - Subsoil and Foundation Drains
- C232 - Pavement Drains
- C233 - Drainage Mats

#### (b) Australian Standards

- AS 2439.1 - Perforated drainage pipe and associated fittings.
- AS/NZS 1477 - Unplasticised PVC (UPVC) pipes and fittings for pressure applications.

#### (c) Other

- AUSTROADS - Guide to the Control of Moisture in Roads, 1983
- ARRB-SR35 - Australian Road Research Board, Special Report No. 35 - Subsurface Drainage of Road Structures, Gerke R.J., 1987.
- ARRB-SR41 - Australian Road Research Board, Special Report No. 41 - A Structural Design Guide for Flexible Residential Street Pavements, Mulholland P.J., 1989.

## SUBSOIL AND SUB-PAVEMENT DRAINS

### D4.05 WARRANTS FOR USE

1. Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings. **Subsoil Drains**
2. Sub-pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade. **Sub-pavement Drains**
3. 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: **Geotechnical Survey**
  - (a) All urban and rural residential developments. **Locations**
  - (b) Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level.
  - (c) Locations of known hillside seepage, high water table or isolated springs.
  - (d) Irrigated, flood-prone or other poorly drained areas.
  - (e) Highly moisture susceptible subgrades, ie. commonly displaying high plasticity or low soaked CBRs.

- (f) Use of moisture susceptible pavement materials.
- (g) Existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture.
- (h) At cut to fill transitions.
- (i) Landscaped islands and medians.

4. 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.

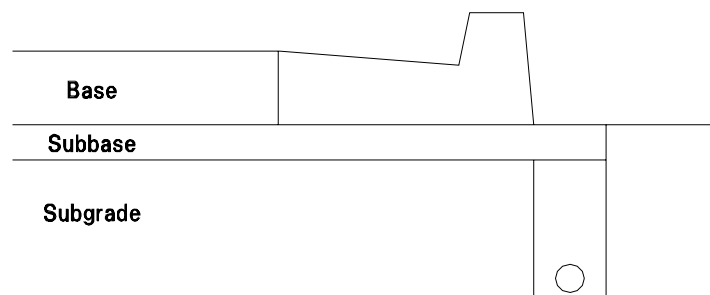
5. The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation. The Design Drawings shall be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings.

***During Construction***

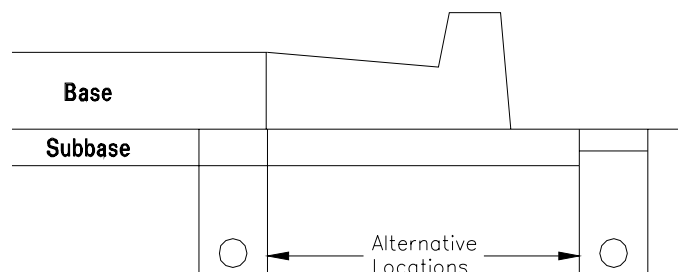
**D4.06 LAYOUT, ALIGNMENT AND GRADE**

1. Typical cross sections of subsoil and sub-pavement drains are shown below in Figures D4.06.1 and D4.06.2. As indicated in these figures, subsoil drain trenches are excavated to below subgrade level, while sub-pavement drains extend into or adjacent to the pavement layers to facilitate drainage of the pavement layers in addition to the subgrade.

***Typical Cross Sections***



**Figure D4.06.1 - Typical Subsoil Drain**



**Figure D4.06.2 - Typical Subpavement Drain**

## **SUBSURFACE DRAINAGE DESIGN**

---

2. In kerbed roads, the two acceptable line of the trench is directly behind the kerblines. Pavement layers must extend to at least the line of the rear of the trench. ***Kerbed Roads***
3. 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 D4.06.2. ***Unkerbed Roads***
4. The minimum desirable longitudinal design grade shall be 1.0-1.5%. For non corrugated pipes, an absolute minimum grade of 0.5% is acceptable. ***Grade***
5. Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 300mm in earth and 200mm in rock, and below the invert level of any service crossings. ***Trench Dimensions***
6. Outlets shall be spaced at maximum intervals of 150 metres. Where possible, subsoil and sub-pavement drainage pipes shall discharge into gully pits or other stormwater drainage structures. Where not possible, outlets shall be provided through fill batters. ***Outlets***
7. Cleanouts are to 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. ***Cleanouts***

## **FOUNDATION DRAINS**

### **D4.07 WARRANTS FOR USE**

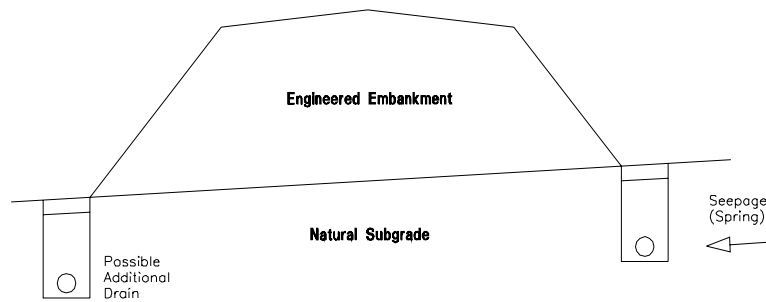
1. Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas. ***Foundation Drains***
2. The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location shall be shown on the plans. 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. ***Geotechnical Survey During Construction***
3. Where the road formation traverses known swampy, flood-prone, or watercharged strata, the design Drawings shall be suitable annotated to the potential need for foundation drains at various locations, in addition to those shown on the Drawings.

### **D4.08 LAYOUT, ALIGNMENT AND GRADE**

1. Typical cross-sections of foundation drains are shown below in Figure D4.08.01. ***Typical Cross Section***



**Figure D4.08.01  
Foundation Drains**



2. The minimum desirable design grade shall be 1.0-1.5%. For non corrugated pipes an absolute minimum grade of 0.5% is acceptable.
3. Foundation drains shall be a minimum trench width of 300mm, with a variable trench depth to suit the application and ground conditions on site.
4. Outlets shall be spaced at maximum intervals of 150 metres.
5. 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.

**Grade**

**Trench  
Dimensions**

**Outlets**

**Cleanouts**

## DRAINAGE MATS (BLANKETS)

### D4.09 WARRANTS FOR USE

1. 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. The minimum thickness of compacted filter material shall be 300mm plus an allowance for the expected consolidation or 500mm if the amount of consolidation of embankment foundation is not known.
2. 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.
3. The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

**Type A Mats**

**Type B Mats**

**Geotechnical  
Survey**

### MATERIALS

#### D4.10 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

1. Pipes designated for subsoil, foundation and sub-pavement drains shall be 100mm dia. slotted pipe, or strip drains.
2. Corrugated plastic pipe shall conform with the requirements of AS2439.1. 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 AS2439.1.
3. Slotted rigid UPVC pipe shall be of a type and class approved by Local Government.
4. All pipe shall be slotted, and fitted with a suitable geotextile filter tube, except for cleanouts and outlets through fill batters which shall be unslotted pipe.

#### D4.11 FILTER MATERIAL

1. The types of filter material covered by this Specification shall include:
  - (a) Type A filter material for use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats.
  - (b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains.
  - (c) Type C filter material comprising crushed rock for use in Type drainage mats.
  - (d) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.
2. Material requirements and gradings for each type of filter material are included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.C230
3. 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 Special Report 35.

#### D4.12 GEOTEXTILE

1. Where necessary to provide separation (ie. 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 the Construction Specification, SUBSURFACE DRAINAGE GENERAL. C230
2. Geotextile shall also be designated for both Type A and Type B Drainage Mats.

## **DOCUMENTATION**

### **D4.13 DESIGN DRAWINGS AND CALCULATIONS**

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