

CAPRICORN MUNICIPAL DEVELOPMENT GUIDELINES

SUBSURFACE DRAINAGE GENERAL

C230

CONSTRUCTION SPECIFICATION

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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 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

C230.01 INTRODUCTION

C230.01.01 This is the general specification common and applicable to all types of subsurface drainage and shall be read in conjunction with subsurface drainage specifications:

- C231 - Subsoil and Foundation Drains
- C232 - Pavement Drains
- C233 - Drainage Mats

Purpose

as applicable to particular contracts.

C230.02 SCOPE

C230.02.01 The work to be executed under this Specification consists of:

- (a) preparation for subsurface drainage construction;
- (b) siting of subsurface drainage facilities;
- (c) the supply of all materials associated with the provision of the subsurface drainage system;
- (d) all activities and quality requirements associated with the supply, placement and compaction of filter material;
- (e) the provision of a detailed record of all subsurface drain installations;
- (f) the marking on the ground of the location of all subsurface drains.

C230.02.02 Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in Annexure C230B.

Quality

C230.02.03 The following order of priority for interpretation of documents will apply: (Please note that reference to a Guideline or Standard, is reference to the latest version of the relevant document, unless specifically a version number is specifically stated):

- (a) CMDG D4 Subsurface Drainage
- (b) CMDG C230 Subsurface Drainage – Construction Specification
- (c) AUSTRROADS Guide to Pavement Technology, Part 4G: Geotextiles and Geogrids
- (d) Australian Standards
- (e) DTMR Specs - MRTS03 - Drainage, Retaining Structures and Protective Treatments
- (f) ASTM D2434-68

***Order of
Priority***

C230.03 REFERENCE DOCUMENTS

C230.03.01 Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

- (a) **CMDG Specifications**

***Documents
Standards Test
Methods***

SUBSURFACE DRAINAGE

- C211 - Control of Erosion and Sedimentation
- C213 - Earthworks
- C271 - Concrete Works

(b) Australian Standards

- AS 1141.11.1 - Methods for Sampling and testing aggregates - Particle size distribution - Sieving method
- AS 1141.22 - Methods for sampling and testing aggregates - Wet/dry strength variation
- AS 1289.5.5.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of minimum and maximum dry density of a cohesionless material – standard method
- AS 1477 - PVC pipes and fittings for pressure applications
- AS 2439.1 - Perforated plastics drainage and effluent pipe and fittings - Perforated drainage pipe and associated fittings
- AS 2758.1 - Aggregates and rock for engineering purposes - Concrete aggregates
- AS 3705 - Geotextiles - Identification, marking and general data
- AS 3706 - Geotextiles - Methods of test
- AS 3706.11 - Geotextiles - Methods of test - Determination of durability - Resistance to degradation by light, heat and moisture

(c) Other

- AUSTROADS - Guide to Pavement Technology, Part 4G: Geotextiles and Geogrids
- ASTM-D2434-68 - Test method for permeability of granular soils (Constant Head)
- DTMR Specs - MRTS03 - Drainage, Retaining Structures and Protective Treatments

C230.04 TEMPORARY DRAINAGE DURING CONSTRUCTION

C230.04.01 All drainage works shall comply with the Specification for CONTROL OF EROSION AND SEDIMENTATION C211.

Erosion Control

C230.04.02 Adequate provision shall be made for runoff flows at subsurface drainage works under construction to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the works or surrounding areas and structures.

Contractor's Responsibility

C230.04.03 All material and equipment shall be located clear of watercourses or secured so that they will not cause danger or damage in the event of large runoff flows.

Location of Equipment

C230.05 EXCAVATION

C230.05.01 Excavation shall be undertaken in accordance with the requirements of the specification - EARTHWORKS C213

C230.06	NO FINES CONCRETE	
C230.06.01	Before starting production of each mix, prepare a trial batch of each nominated mix for testing.	<i>Trial Mix</i>
C230.06.02	Do not use aggregates that have become intermixed or contaminated with foreign matter.	<i>Mixing and Consistency</i>
C230.06.03	Handling and storage shall be in accordance with AS 1379. Mixing time for stationary batches shall be not less than 54 seconds plus additional 6 seconds for each m ³ . Mixing time for mobile batch mixers shall have a full period of mixing required at either the testing station or the point of placement. Mixing time for split drum mixers shall be a maximum of 5 minutes. This mixing time is measured from the time all ingredients are in the mixing drum.	<i>Handling Storage and Batching</i>
C230.06.04	Separate and thoroughly pre-dilute admixtures in the mixing water before mixing with other materials. Mix in accordance with manufacturers specifications.	<i>Adding Mixture</i>
C230.06.05	Designated mixing speed is not less than 30 revolutions/minute, if there is no evidence of original mixing conditions; remix at 55 revolutions/minute. <ol style="list-style-type: none"> 1. Record the quantity of water on the identification certificate for each batch. Make sure it does not exceed the water cement ratio of the mix. 2. Only retemper within 40 minutes of completion of batching. 3. Only retemper at the batch plant, testing stations or point of placement. 	<i>Retempering</i>
C230.06.06	Use equipment which prevent segregation or loss of materials and supply a homogeneous product	<i>Production and Transport</i>
C230.07	BACKFILLING	
C230.07.01	Backfilling shall be carried out in accordance with the requirements of the relevant subsurface drainage structure's Specifications.	<i>Detail</i>
C230.07.02	Alternatively, for corrugated plastic pipe subsoil drains, no fines concrete with nominal aggregate size of 20mm that complies with MRTS70 - Concrete can be used as backfill material.	<i>Alternative</i>
C230.07.03	Trench backfill material used where a textile sleeved drain or a strip filter drain is employed shall be damp when placed in the trench. The material shall be carefully placed in layers not exceeding 200 mm loose thickness and shall be tamped. Trench backfill material used where a geotextile trench surround is employed shall be compacted to achieve effective mechanical interlock between particles.	<i>Strip Filter Drains</i>
C230.07.04	Where subsoil drains are constructed within the subgrade, they shall extend to the underside of the lowest pavement layer unless specified otherwise in the Construction Drawings.	<i>Subsoil drains in Subgrade</i>
C230.07.05	Where subsoil drains are constructed outside the subgrade edge point, the trench backfill material shall be placed to within 150 mm of the ground or finished surface and the remaining 150 mm filled with impervious material	<i>Subsoil drains outside of subgrade</i>

SUBSURFACE DRAINAGE

compacted as for embankment material in accordance with MRTS04 General Earthworks

C230.08 GEOTEXTILE

C230.08.01 Install at the interface between the filter material and adjoining materials for the extent as documented.

Location

C230.08.02 Cover the bottom and sides of the trench with sufficient fabric to wrap around the completed drain. Conform to the shape of the trench with minimal wrinkles, folds or air voids between the fabric and trench, but not stretched over the soil. Do not allow loose material from outside of the trench to enter the excavation.

Placement

C230.08.03 Minimum 200mm laps.

Intersections

C230.08.04 Less than 14 days between initial layout out and final cover of the geotextile with drainage backfill layer. Where possible, place the geotextiles just ahead of construction, and cover with material within 48 hours.

Program

C230.08.05 Secure the geotextile to prevent movement by wind or by construction. Protect and avoid damage during installation and backfilling operations.

Protection

C230.09 OUTLET STRUCTURES FOR SUBSURFACE DRAINAGE

C230.09.01 Where possible, subsoil drains shall discharge into gully pits and other stormwater drainage structures. Where not possible, an outlet shall be constructed of unslotted plastic pipe of the same diameter as the main run to discharge below the edge of the road shoulder. An outlet structure in accordance with the CMDG Standard Drawings shall be constructed at the discharge end.

Pipes and Structures

C230.09.02 Subsurface drainage pipes shall be connected to discharge into gully pits or to outlet structures as shown on the Drawings.

Discharge

C230.09.03 Outlets shall be spaced at a maximum interval of 120m

Spacing

C230.09.04 Outlets, including those discharging into gully pits, shall be made rodent proof using a flap valve. in accordance with CMDG Standard Drawing CMDG-D-040.

Rodent Proof

C230.09.05 The outlet shall be located so that erosion of the adjacent areas does not occur or shall be protected by the placement of selected stone or similar treatment.

Erosion Control

C230.09.06 All concrete used in the construction of outlet structures shall conform to the requirements of the Specification for MINOR CONCRETE WORKS C271.

Concrete Specification

C230.10 CLEAN OUTS

C230.10.01 Provide cleanouts and Cast Iron caps as documented, at the commencement of each run of subsoil drain line and at approximately 60m spacing

Location

C230.10.02 Details of the required cleanout construction are shown on the CMDG Standard Drawing *Details*

C230.11 **MARKING OF DRAINS AND OUTLETS**

C230.11.01 Marker posts type and installation shall be as shown in Department of Transport and Main Roads Standard Drawings *General*

MATERIALS

C230.12 **APPROVED PLASTIC MATERIALS**

C230.12.01 Strip filter drains are approved. Strip Filter Drains are a proprietary product, deep-fin plastic core, 120kPa minimum crush strength, 40mm minimum thickness, fully enclosed by a non-woven geotextile and shall be in accordance with MRTS03 - Drainage, Retaining Structure and Protective Treatments. *Specification*

C230.12.02 Corrugated plastic subsoil drainage pipe is not approved for use.

C230.13 **CONCRETE**

C230.13.01 Concrete outlets, concrete surrounds, galvanised chicken wire cones, pest-proof flaps, cast iron or PVC caps, grouted rock pitching, and marker posts shall be constructed and/or installed in accordance with DTMR Standard Drawings. *Details*

C230.13.02 Concrete shall comply with MRTS03 - Drainage, Retaining Structures and Protective Treatments. *Concrete*

C230.13.03 Grouted rock pitching shall comply with MRTS03 - Drainage, Retaining Structures and Protective Treatments. *Grouted Rock Pitching*

C230.13.04 Marker posts shall be installed as specified in accordance with DTMR Standard Drawings. *Marker Posts*

C230.13.05 After the drains are constructed, they shall be flushed out. Flushing shall continue until the outlet water is clean and flows consistently. *Flushing*

C230.14 **FILTER MATERIAL**

Table C230.15.1 - Filter Material for Subsoil Drainage

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	% passing by mass
	9.5mm	100
	4.75mm	90-100
	1.18mm	45-80
	300um	10-30
	150um	0-10
	75um	0-1

SUBSURFACE DRAINAGE

C230.14.01 General

- i) Type A filter material for use in trench drains and Type B drainage mats.
- ii) Type B filter material for use in trench drains and Type B drainage mats.
- iii) Type C filter material comprising of crushed rock for use in Type A drainage mats.
- iv) Type D filter material comprising of uncrushed river gravel for use in Type A drainage mats.

(a) Type A Filter Material

C230.14.02 Type A filter material shall be crushed rock complying with the following requirements:

Grading

Table C230.15.2 - Type A Filter Material

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Per cent by mass
	6.7mm	100
	4.75mm	85 to 100
	2.36mm	0 to 40
	1.18mm	0 to 5
	425um	0 to 2

(b) Type B Filter Material

C230.14.03 Type B filter material shall be granular material complying with the following grading requirements:

Grading

Table C230.15.3 - Type B Filter Material

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Per cent by mass
	4.75mm	100
	2.36mm	95 to 100
	425um	20 to 80
	300um	0 to 30
	150um	0 to 2
	75um	0 to 0.1

C230.14.04 In addition to the above grading requirements, Type B filter material shall have a coefficient of saturated permeability, when compacted to its maximum dry density as determined by AS 1289.5.5.1 and then tested in accordance with Test Method ASTM-D2434-68, of at least 8 metres per day after three hours of flow.

Coefficient of Saturated Permeability

C230.14.05 Type B filter material shall not vary from its original grading as a result of compaction processes by more than the following amounts:

Grading Variation

Table C230.15.4 - Type B Filter Material Variation

AS Sieve	Variation From Grading Before Treatment (per cent of mass)
2.36mm	± 3
1.18mm	± 1
425um	± 1
300um	± 1
150um	± 0.5
75um	± 0.1

(c) Type C Filter Material

C230.14.06 Type C filter material shall be crushed rock complying with the following requirements:

Grading**Table C230.15.5 - Type C Filter Material**

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	37.5mm
	Maximum passing the 9.5mm AS Sieve	5% by mass
	Maximum (D90:D10)*	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

NOTE: The D90 value shall be determined by sieving the material using 75mm, 53mm, 37.5mm, 26.5mm, 19mm, 13.2mm and 9.5mm AS sieves, as appropriate, and then plotting the results on a graph of AS sieve size v percentage passing. The plotted points shall be joined by straight lines and the D90 value shall be determined as the theoretical sieve size corresponding to 90 per cent passing.

D10 denotes the theoretical size of a sieve through which 10 per cent of the material would pass and shall be determined from the same graph used to determine the D90 value.

(d) Type D Filter Material

C230.14.07 Type D filter material shall be uncrushed river gravel complying with the description of rounded aggregate in Table B1, Appendix B of AS 2758.1 and the following requirements:

Grading**Table C230.15.5 - Type D Filter Material**

Test Method	Property	Requirement
AS 1141.11	Maximum particle size	75mm
	Maximum passing the 9.5mm AS sieve	5% by mass
	Maximum (D90 : D10)	3
AS 1141.22	Minimum wet strength	100kN
	Maximum 10% fines wet/dry variation	30%

SUBSURFACE DRAINAGE

C230.15 NO FINES CONCRETE

C230.15.01 No fines concrete course aggregate properties in accordance with Table C230.11.7 - Course Aggregate Properties. Refer to Table C230.11.8 - Particle Size Distribution for no fines concrete particle size distribution.

Table C230.11.7 - Course Aggregate Properties

Test Method	Property	Requirement
AS 1141.4	Bulk density	Minimum 1200 kg/m ³
AS 1141.6.1	Particle density	Minimum 2100 kg/m ³
AS 1141.6.1	Water absorption	Maximum 2.5%
AS 1141.11	Particle size distribution	See particle size distribution table C230.11.8
AS 1141.14	Particle shape:	
	2:1 ratio	Maximum 35%
	3:1 ratio	Maximum 10%
AS 1141.22	Wet strength	Minimum 150 kN
AS 1141.22	Wet/dry variation	Minimum 35%

**Course
Aggregate
Properties**

NOTE: Bulk density is the same as unit mass

Table C230.11.8 - Particle Size Distribution

Test Method	Property	Requirement
AS 1141.11	Material passing AS sieve	Percent by pass
	26.5	100
	19.1	95-100
	9.5	0-5

C230.15.02 Cement to be standard General Purpose cement to AS 3972

Cement

C230.15.03 Admixtures shall be free from calcium chloride, calcium formate, triethanolamine or any other accelerator.

Admixtures

C230.15.04 Do not combine without verification from the admixtures manufacturers that they are compatible.

**Combining
Admixtures**

C230.15.05 Use a lignin or lignin-based (ligpol) set-retarding admixture, Type Re or Type WRRe for warm seasons and use a lignin or lignin-based set-retarding admixture containing maximum 6% reducing sugars, Type WRRe for cool seasons.

Retarder

C230.15.06 Alkali contribution: The total alkali contribution (measured as Na₂O) from all admixtures used in any mix must not exceed 0.20 kg/m³.

Alkali

C230.15.07 Other admixtures which may be used: Superplasticisers and high range sodium oxide water reducers, Type HR, WR, Re.

**Other
Permissible**

C230.15.08 Nominated mix.

Admixtures

Table C230.11.9 - No Fines Concrete Mix

Grade	Aggregate to cement ratio (by mass)	Water to cement ratio
NFC SD	6:1	0.35-0.45

Nominated mix ratio

C230.16 GEOTEXTILE

(a) General

C230.16.01 The geotextile, other than seamless tubular filter fabric, shall consist of either a woven or a non-woven type which shall be manufactured from synthetic materials other than polyamide. Rolls of geotextile shall be marked with product identification and supplied with data sheets and information in accordance with the requirements of AS 3705.

Properties and Labelling

C230.16.02 The geotextile shall be bio-stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents when tested in accordance with the appropriate parts of AS 3706.

C230.16.03 The geotextile shall be resistant to ultra-violet light. No geotextile shall be left exposed to sunlight during storage and construction for a period longer than a total of twenty-one days. If exposure in excess of twenty-one days does occur, the geotextile shall be tested in accordance with AS 3706.11 and if its characteristics have deteriorated to or below 90 per cent of the characteristics claimed by the manufacturer or the characteristics determined on unexposed geotextile, whichever is the better, it shall be removed and replaced with a geotextile complying with this Specification.

Ultra Violet Light Resistant

C230.16.04 The geotextile material type, strength rating "G", and minimum mass requirements shall be as shown on the Drawings.

C230.16.05 In addition to the above mentioned requirements, geotextiles for curtain drains shall consist either of polyester, polypropylene or polyethylene. When subjected to a pressure of 200 kPa applied at right angles to the plane of the fabric and to a constant head of water no greater than 50 mm applied to the top edge of the fabric, geotextiles for curtain drains shall have a rate of water transmission not less than 20 litres per hour per metre width of fabric through a 300 mm length of the fabric.

Water Transmission Rate

(b) Seamless Tubular Filter Fabric

SUBSURFACE DRAINAGE

C230.16.06 Seamless knitted tubular filter fabric shall be used to enclose all approved subsoil drainage structures and shall be manufactured from either polypropylene or polyester. The fabric shall be free of imperfections in weave or yarn and have abrasion resistant and weave stability qualities such that it shall not form holes, ladder, deweave, tear or unravel more than 5mm from a cut end.

Specification

C230.16.07 Fitting of the seamless tubular filter fabric shall be in accordance with the requirements of Annexure C230A. Filter fabric that is excessively stretched, torn or otherwise damaged during fitting of the fabric, storage, transportation or pipe laying shall be removed and replaced so as to eliminate any damaged lengths.

Fitting

C230.17 RECORDING OF SUBSURFACE DRAINAGE INFORMATION

C230.17.01 The Contractor shall keep detailed records of all subsurface drainage pipes and the completed drainage system shall be shown on the "As Constructed" drainage plans.

LIMITS AND TOLERANCES

C230.18 SUMMARY OF LIMITS AND TOLERANCES

C230.18.01 The limits and tolerances applicable to the various clauses in this Specification are summarised in Table 230.12.1 below.

Table 230.12.1 - Summary of Limits and Tolerances

Item	Activity	Limits/Tolerances	Spec Clause
1.	Outlets		
	Spacing	Max 120m	C230.09
2.	Cleanouts		
	Spacing	100-140m	C230.10
2.	Filter Material		
	(a) For Subsoil drains	Table 230.15.1	
	(b) Type A	Table 230.15.2	C230.15
	(c) Type B	Tables 230.15.3 and 230.15.4	C230.15
	(d) Type C	Table 230.15.5	C230.15
	(e) Type D	Table 230.15.6	C230.15
3.	No Fines Concrete	Tables 230.16.1 and 230.16.2	230.16
4.	Geotextile		
	(a) Exposure to sunlight	<21 days If >21 days deterioration not to exceed 10% of claimed characteristics	C230.17
	(b) Curtain Drains Water Transmission	>20 litres/hr/m	C230.17

ANNEXURE C230A

C230.19 SLOTTED PIPES FITTED WITH SEAMLESS TUBULAR FILTER FABRIC

1. PROCEDURE FOR FITTING SEAMLESS TUBULAR FILTER FABRIC TO SLOTTED PIPE

Seamless tubular filter fabric shall be fitted to slotted pipe immediately before the slotted pipe is to be laid in its final position in the work.

The filter fabric shall be initially pulled over and onto a short length of smooth pipe of internal diameter between 20mm and 30mm greater than the external diameter of the slotted pipe to be enclosed by filter fabric. The short, larger diameter pipe shall be referred to as the 'mandrel'.

The pipe to be enclosed by the filter fabric shall be passed through the mandrel. The filter fabric shall be slipped on to the pipe as the pipe emerges from the mandrel leaving enough overhang of the filter fabric to make a suitable joint with the filter fabric on the adjacent pipe. The filter fabric shall be firmly held to the forward end of the pipe so that it cannot slip back along the pipe.

The pipe shall be pulled right through the mandrel allowing the filter fabric to progressively slip over the pipe. The filter fabric shall be restrained from easily slipping off the mandrel thus ensuring the filter fabric is stretch fitted onto the pipe.

When the end of the pipe emerges from the mandrel, the filter fabric shall be clamped to that end of the pipe so that the filter fabric cannot slip down the pipe. The filter fabric shall remain clamped to each end of the pipe to ensure the filter fabric remains stretch fitted onto the pipe when the pipe is placed in its final position in the drain. The filter fabric shall be cut cleanly leaving enough overhang off the end of the pipe to make a fully covered joint with the filter fabric on the adjacent pipe when the pipes are installed in the drain.

2. PRECAUTIONS TO BE TAKEN WHEN USING SLOTTED PIPE FITTED WITH SEAMLESS TUBULAR FILTER FABRIC

Slotted pipe fitted with seamless tubular filter fabric shall not be dragged over the ground. If carried, the pipe shall be lifted clear of the ground and the filter fabric shall be protected from damage at all times.

Seamless tubular filter fabric which has been so damaged as to affect its filtering properties shall be removed from the pipe and replaced with undamaged filter fabric.

If at any time during the installation of a slotted pipe it is found that the enclosed filter fabric has become loose on the pipe it shall be restretched to its correct position. If restretching causes any damage to the filter fabric, the damaged filter fabric shall be removed from the pipe and replaced with undamaged filter fabric.

ANNEXURE C230B

C230.20 QUALITY CONTROL TESTING

(Specifications C230, C231, C232)

ACTIVITY	KEY QUALITY VERIFICATION REQUIREMENTS	MAXIMUM LOT SIZE	MINIMUM TEST FREQUENCY	TEST METHOD
MANDATORY TESTING				
Nil				
AUDIT TESTING – IF ORDERED BY COUNCIL				
Material Supply	Material Quality - Supplier's documentary evidence and certification of: Strip Filter drain or approved equivalent Filter Material - Grading (Type A, B, C, D) - Coefficient of Permeability (Type B) - Grading Variation after Treatment (Type B) - Wet Strength (Type C, D) - 10% Fines Wet/Dry (Type C, D) Geotextile	1 contract/size 1 contract/size 1 contract/size 1 contract/size 1 contract/size 1 contract/size 1 contract	1 per type/size 1 per type 1 per type 1 per type 1 per type 1 per type	AS 1141.11 AS 1289.E5.1 ASTM-D2434-68 AS 1141.11 AS 1141.22 AS 1141.22
Excavation - Trench Base	Line and Grade Compaction	1 drainage line 1 drainage line	1 per drainage line 1 per 200 lin m*	Survey AS 1289.5.4.1
Bedding and Backfill				
- Filter Material	Compaction	1 drainage line	1 per drainage line	AS 1289.5.4.1
- Selected Backfill	Compaction	1 drainage line	1 per 200 lin m*	AS 1289.5.4.1
- Earth Backfill	Compaction	1 drainage line	1 per 200 lin m*	AS 1289.5.4.1
Drainage Mat	Geometry	2000m ²	1 Cross Section per 25m	Survey

* Note: or part thereof, per lot