

# Engineering Construction Specification C14 Subsurface Drainage (Construction)

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# 1 General

## 1.1 Responsibilities

### 1.1.1 General

Requirement: Provide subsurface drainage, as documented.

## 1.2 Cross references

### 1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *0152 Schedule of rates (Construction)*
- *C02 Quality management (Construction)*
- *C28 Auxiliary concrete works*
- *C03 Control of traffic*
- *C04 Control of erosion and sedimentation (Construction)*
- *C05 Clearing and grubbing*
- *C06 Earthworks (Road reserve)*
- *C17 Drainage blankets*

## 1.3 Standards

### 1.3.1 General

Subsurface drainage: To Austroads AGPT10.

## 1.4 Interpretation

### 1.4.1 Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

- AAR: Alkali aggregate reactivity.
- CI: Cast iron.

### 1.4.2 Definitions

General: For the purposes of this worksection the following definitions apply:

- **Cleanout:** A subsurface drainage inlet at the surface of the pavement, shoulder or surrounding ground surface. Also known as flushout riser and inspection point.
- **Mandrel:** A short length of smooth pipe of internal diameter 20 mm - 30 mm greater than the external diameter of the slotted pipe being enclosed by filter fabric.
- **No fines concrete:** Material consisting graded coarse aggregate, typically to a single AS sieve size, bound together by a mixture of cement and water to supply sufficient strength. The result is an open textured cellular concrete with many voids and increased permeability.
- **Retempering of concrete:** Use of water or admixtures in the mixer to delay the setting of concrete.
- **Nominated mix:** The designed mix submitted for approval.
- **Prefabricated geocomposite drain:** A proprietary product typically consisting of a plastic core wrapped in geotextile material, functioning as a single or second stage filter. Also termed as

geocomposite edge drain and strip filter drain. These drains can be installed in narrower trenches than traditional pipe drains.

- Geotextile filter: A fabric manufactured from synthetic fibres of long chained polymer such as polypropylene, polyester or similar material and stabilised against deterioration by ultraviolet light. A geotextile filter can be either non-woven or knitted fabric.
- Production filter mix: A mix produced by a supplier using a stationary screening plant to meet the documented filter requirements.
- Trial no fines concrete mix: Trialling of the nominated mix to demonstrate that the mix design conforms to the documented requirements.
- Pervious pipe system: Comprises drainage pipes perforated, slotted, porous pipes, or impervious pipes laid with open joints.
- Staged granular filters:

Single stage filter: A granular filter material placed in contact with the trench sides and surrounding the pervious pipe system.

First stage filter: A granular filter material or geotextile placed in contact with the trench sides and surrounding a second stage filter surrounding the pervious pipe system.

Second stage filter: A granular filter material or geotextile placed in contact with the pervious pipe system and surrounding a first stage filter.

## 1.5 Tolerances

### 1.5.1 General

The invert of pipe or drain: No more than 25 mm from the documented level and no more than 50 mm from the documented line.

### 1.5.2 No fines concrete production mix tolerance table

Attribute	Tolerance (% by mass)
Particle size distribution (AS sieve)	
-19.0 mm	± 2
-9.5 mm	± 5
Binder content	+ 3.0/-0

### 1.5.3 Prefabricated geocomposite drains

Tolerance: ± 40 mm from the documented line and grade.

## 1.6 Submissions

### 1.6.1 Authorities consultation

Requirement: Submit details of all utility authority notifications before commencing the works including the following:

- Service utility authorities: Submit evidence of notifications including responses received from all utility authorities for excavation in the vicinity using dial before you dig notified utility services, a minimum of 14 days before execution of the contract commencement.

### 1.6.2 Execution details

Siting of work: Submit any changes proposed to the location, length, designed levels, condition of installation or cover required to accommodate the requests from all the service authorities.

No fines concrete: Submit details of the following:

- Handling, storing and batching of materials: Proposed method.

Method of charging the mixer, including proposed sequence of adding ingredients.

Proposed method of how admixtures will be incorporated.

- Identification certificate (delivery docket) for each batch or load. Include the following:  
Pre-numbered.  
Issued sequentially in accordance with order of batching.  
Time of completion of batching.
- Retempering: Submit details of monitoring for compliance.
- Non-conformance: Submit details of any non-conformance.

### 1.6.3 Products and materials

General: Submit compliance certificates and test results from a registered testing authority for the following materials:

- Corrugated circular plastic pipe and fittings.
- Plain wall plastic pipe and fittings.
- Corrugated flat plastic pipe and fittings.
- Slotted thick walled PVC-U pressure pipe.
- Prefabricated geocomposite drains.
- Filter material type: Check test certificates for granular filter materials to **Type A** and **Type B filter grading tables**.
- No fines concrete: Nominated mix, submit the following including evidence of conformance:  
Cement: Brand and source.  
Water: Source.  
Admixtures: Proprietary source, type, name, dosage recommended by the manufacturer and evidence of conformance.  
Aggregates: Source, geological type, moisture condition, blend proportions and grading for each type of aggregate.  
Soluble salt content.  
Mix design: Constituent quantities per m<sup>3</sup> of no fines concrete, water to cement ratio and nominated particle size distribution of aggregates.  
Permeability.
- Geotextile: Check maximum stored exposure to sunlight no greater than 14 days.

### 1.6.4 Records

Work-as-executed drawings: Submit plans of the completed subsurface drainage systems showing clearance and relative levels to the finished road construction, and flushing points.

Information Sheets: Submit details of completed drain or drainage system, 5 days after completion of each drain or drainage system or as agreed with the superintendent.

No fines concrete: Submit at the end of each day, the total of individual masses of cement and aggregate used in the day's production.

### 1.6.5 Tests

Results: Submit results of testing to **ANNEXURE – MAXIMUM LOT SIZE AND MINIMUM TEST FREQUENCIES**.

## 1.6.6 Variations

Other types of subsurface drainage pipes: If proposed submit details of the type of pipe, and evidence of conformance.

## 1.7 Inspections

### 1.7.1 Notice

Give notice so that inspection may be made of the following:

- No fines concrete: Retempering.
- Siting of works: Set-out location and levels.
- Trenches: Excavation to the documented line, grade, width and depth.
- Laying of pipes: Compacted bedding, and placement of pipes to documented line and level.
- Backfilling: Documented level and relative compaction.
- Geotextile: Placement of fabric and not exposed to sunlight more than 14 days in both the trench and preconstruction storage.
- Flush test: Clean-outs of subsoil drainage lines.
- Inspection points for flushing: Check locations of inspection points, flush out risers and outlets at low points. Install marker posts or marker plates (in town centre areas) to locate flushing points in accordance with Council's standard drawings.

## 2 Materials

### 2.1 Selection of subsurface drain and filter type

#### 2.1.1 Subsurface pavement drains type

Pavement drains: Select from the **Subsurface drain and filter type table**.

#### 2.1.2 Subsurface drain and filter type table

Parent Soil	Permeability range(m/sec)	Type of pavement drain <sup>(1)</sup>	Filter material <sup>(2)</sup>
Homogenous clay with very low permeability	<10 <sup>-9</sup>	Type 3 or Type 4	Sand (Grade A1 to A3)
Silty or sandy clays and stratified clays with moderate low permeability	10 <sup>-9</sup> to 10 <sup>-5</sup>	Type 2, Type 3 or Type 4	Sand (Grade A4 to A6)
Clean sand or gravel with high permeability	>10 <sup>-5</sup>	Type 1 or Type 2	Aggregate (Grade B1 or B2)
Solid rock or clean broken rock with high permeability to permeable fissures	Not applicable	Type 1	Aggregate (Grade B3 or B4)

Notes:

1. Pavement drains Type1, Type 2, Type 3 and Type 4 to AGPT10 Figure 3.1.

2. Filter material properties to **Type A filter gradings table** and **Type B filter gradings table**.

Source: Austroads AGPT10

## **2.2 Subsurface drainage pipes**

### **2.2.1 General**

Fittings: Joints, couplings, elbows, tees and caps to the manufacturer's recommendations.

### **2.2.2 Corrugated circular plastic pipe and fittings**

Standard: To AS 2439.1.

Pipe: Conform to the following:

- Size: Minimum 100 mm diameter.
- Clean-outs and outlets: 100 mm diameter unslotted pipe set into a suitable concrete surface access surrounded with access cap and associated location marker posts.
- Type: Type 1.
- Class: SN20.
- Minimum 100 mm diameter pipes in edge drains under kerbs and in no fines concrete: Class SN8 pipe or higher.

### **2.2.3 Plain wall plastic pipe and fittings**

Standard: To AS 2439.1.

- Type: Type 2.
- Size: As documented.

### **2.2.4 Corrugated flat plastic pipe and fittings**

Standard: To ASTM D2122.

Size: 170 or 300 mm high.

Clean-outs and outlets: 100 mm diameter unslotted pipe.

### **2.2.5 Slotted thick walled PVC-U pressure pipe and fittings**

Standard: To AS/NZS 1477.

Pipe: Conform to the following:

- Size: If not documented, conform to the following:  
Nominal diameter: 58 mm.  
Minimum wall thickness: 6.5 mm.
- Type: Slotted except where documented otherwise.
- Slot sizes and spacings: To ANNEXURE - SLOTTING DETAILS FOR THICK WALLED PVC-U PRESSURE PIPE.

Joints: Square ends and butt jointed.

### **2.2.6 Prefabricated geocomposite drains and fittings**

General: Conform to the following:

- Joints and fittings: Use manufactured joints and fittings.
- Damage: Show no signs of cracks, splits or indents.

Supply of coils or bundles: Make sure that if ties are used, they do not cause any damage to drain.

Rigid geocomposite drain: Conform to the following:

- Standard: To ASTM D7001-06.
- Type: Class B.
- Requirement: To the Rigid geocomposite drains - Load bearing properties table.
- Properties:



Elongated high density polyethylene.

Corrugated.

Perforated or non-perforated.

Location of perforations: Minimum 20 mm from the bottom of geocomposite drain.

Clear water opening (150 and 300 mm drain): 3.5%.

### 2.2.7 Rigid geocomposite drains - Stiffness properties table

Property	Test method	Requirement (150 and 300 mm drains)
Horizontal compressive strength at 20% deflection	ASTM D2412	Minimum 200 kPa
Change in core area	ASTM D6244	< 5% loss in internal core area

Flexible geocomposite drain: Conform to the following:

- Requirement: To the Flexible geocomposite drains - Load bearing properties table.
- Do not use flexible strip filter drains in pavement subsurface with traffic loading.
- Properties:

High density polyethylene with a geotextile wrapping.

Geotextile: Non-woven and strength class A. To the **Robustness classification of geotextiles table**.

### 2.2.8 Flexible geocomposite drains - Stiffness properties table

Horizontal loading	Geocomposite drain height		
	Up to 200 mm	200 to 400 mm	400 mm and above
Min force (kN) at 4 mm deflection	5.5	11	16.5

## 2.3 Filter material

### 2.3.1 Standard

General: AS C08.11.1

### 2.3.2 General

Properties: Clean, hard, and durable particles.

Subsoil drains laid in or adjacent to planted areas: pH range of filter material 6 to 7.

Compatibility of Filters with soils and Pipes: To Austroads AGPT10 Section 5.6:

- Standard filter gradings: To Type A Filters Table and Type B
- **Filter Table.**
  - Type A filter: Use with natural soil, geotextile filters and pavement materials (A1 to A6)
  - Type B filter: Use as second stage filters to Type A, or with geotextiles. (B1 to B4)

Parent soil: Select filter(s) based on the parent soil to be drained.

### 2.3.3 Type A Filter gradings table

Single and first stage filters (including sands, uniformly graded fine aggregates and gravel)

Type A	Percentage passing sieve					
	A1	A2	A3	A4	A5	A6
Description of filter	Dune sand	Course washed sand		5 mm one size	6 – 8 mm one size	Sandy gravel
37.5 mm						100
26.5 mm						
19.0 mm					100	85 - 100
13.2 mm					90 - 100	
9.50 mm		100	100	100	70 - 100	65 - 100
4.75 mm		90 - 100	90 - 100	70 - 100	28 - 100	45 - 82
2.36 mm	100	75 - 100	70 - 100	0 - 50	0 - 28	30 - 60
1.18 mm	95 - 100	50 - 98	40 - 65	0 - 10	0 - 8	15 - 40
600 micron	70 - 98	30 - 80	12 - 40			5 - 25
300 micron	30 - 60	10 - 40	0 - 16	0 - 5	0 - 5	0 - 10
150 micron	0 - 12	0 - 7	0 - 4			0 - 5
75 micron	0	0 - 3	0 - 3	0 - 3	0 - 3	0 - 3
Parent soil	Silt and friable clays		Sand silts	Fine to medium sands	Course sand	Sandy silts
Maximum pipe slot width	0.4 mm	0.6 mm	1.5 mm	3.0 mm	3.3 mm	5.0 mm
Suitable second stage filter	B1	B2	B3	B4		B3 or B4

### 2.3.4 Type B filter gradings table

Second stage filters (uniformly graded aggregates)

Type B	Percentage passing sieve			
	B1	B2	B3	B4
Direction of Filter	5 mm one size	6 – 8 mm one size	10 mm one size	19 mm one size
37.5 mm				
26.5 mm				100
19.0 mm		100	100	70 - 100
13.2 mm		90 - 100	90 - 100	0 - 30
9.50 mm	100	70 - 100	40 - 70	0 - 10
4.75 mm	70 - 100	28 - 100	0 - 15	
2.36 mm	0 - 50	0 - 28	0 - 5	0 - 5
1.18 mm	0 - 10	0 - 8		
600 micron				
300 micron	0 - 5	0 - 3		
150 micron				Oct 2

Type B	Percentage passing sieve			
	B1	B2	B3	B4
Direction of Filter	5 mm one size	6 – 8 mm one size	10 mm one size	19 mm one size
75 micron	0 - 3	0 - 3	0 - 3	0 - 3
Proposed use	With type A1	With type A2	With types A3, A6	With types A4, A6
Maximum pipe slot size	3.0 mm	3.3 mm	9.0 mm	15.0 mm

### 2.3.5 Robustness classification of geotextiles (G strength rating) table

Geotextile strength class	Elongation <sup>(1)</sup>	Grab strength (N) <sup>(2)</sup>	Tearing strength(N) <sup>(3)</sup>	G rating <sup>(4)</sup>
A	≥30	500	180	900
	<30	800	300	1350
B	≥30	700	250	1350
	<30	1100	400	2000
C	≥30	900	350	2000
	<30	1400	500	3000
D	≥30	1200	450	3000
	<30	1900	700	4500
E	≥30	1600	650	4500

Notes:

1. % elongation corresponding to max CBR burst strength determined in accordance with AS 3706.4.
2. Grab strength is the 80<sup>th</sup> percentile characteristic value of the lot when tested in accordance with AS 3706.2.
3. Tearing strength is the 80<sup>th</sup> percentile characteristic value of the lot when tested in accordance with AS 3706.3 .
4. G rating calculated on the 80<sup>th</sup> percentile values of CBR burst strength when tested in accordance with AS 3706.4 and drop height determined in accordance with AS 3706.5. Where the strain at failure during the CBR burst strength exceeds 80%, the CBR burst strength at 80% strain shall be used.
5. The number of tests shall be in accordance with AS 3706.1, but grab strength shall be determined on a 10 lot test.

Source: Austroads AGPT04G.

## 2.3.6 Geotextile filter properties table

Geotextile filter type <sup>(1)</sup>	Minimum robustness G <sup>(2)</sup>	EOS <sup>(3)</sup> (microns)	Minimum elongation <sup>(4)</sup> (%)
First stage filter	900 (moderately robust)	85 - 230	45
Second Stage Filter	600 - 900	125 – 350	20

Notes:

1. Geotextile filter type may vary in different states
2. G = Geotextile strength rating
3. EOS = Equivalent opening size using AS 3706.7. Determination of pore size distribution- dry sieving method.
4. Elongation at break as determined by AS 3706.2. Determination of tensile properties – wide strip method.

Source: Austroads AGPT10.  
Storage of Geotextiles: Store geotextiles away from sunlight and not be exposed unnecessarily to sunlight during delivery and placement.

## 2.4 No fines concrete

### 2.4.1 Coarse aggregate

Properties: Clean and durable.

Standard: To AS 2758.1.

### 2.4.2 Coarse aggregate properties table

Test method	Property	Requirement
AS C08.4	Bulk density	Minimum 1200 kg/m <sup>3</sup>
AS C08.6.1	Particle density	Minimum 2100 kg/ m <sup>3</sup>
AS C08.6.1	Water absorption	Maximum 2.5%
AS C08.11.1	Particle size distribution	To the <b>Particle size distribution table</b>
AS C08.14	Particle shape:	
	2.1 ratio	Maximum 35%
	3.1 ratio	Maximum 10%
AS C08.22	Wet strength	Minimum 150 kN
RMS T239	Fracture faces: Two or more	Minimum 80%
AS C08.22	Wet/dry variation	Minimum 35%

Notes: Bulk density is the same as unit mass.

### 2.4.3 Particle size distribution table

AS sieve size (mm)	Percent passing by mass (%)
26.5	100
19.0	95-100
9.5	0-5

### 2.4.4 Cement

Standard: General purpose cement to AS 3972.

### 2.4.5 Admixtures

Standard: To AS 1478.1.

Properties: Free from calcium chloride, calcium formate, triethanolamine or any other accelerator.

Combining admixtures: Do not combine without verification from the admixtures manufacturers that they are compatible.

Warm season retarder: Use a lignin or lignin-based (ligpol) set-retarding admixture, Type Re or Type WRRc.

Cool season retarder: Use a lignin or lignin-based set-retarding admixture containing maximum 6% reducing sugars, Type WRRc.

Alkali contribution: The total alkali contribution (measured as Na<sub>2</sub>O) from all admixtures used in any mix must not exceed 0.20 kg/m<sup>3</sup>.

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

### 2.4.6 Water

Mixing water: To AS 1379 clause 2.4.

Water properties: Clean potable water, free from any material which may be harmful to the concrete or reinforcement including oil, acid, alkali, organic or vegetable matter.

Limits of impurities in mixing water: To AS 1379 Table 2.2 and the following:

- Chloride ion: Maximum 500 parts per million to AS 1289.4.2.1.
- Sulfate ion: Maximum 400 parts per million to AS 1289.4.2.1 or APHA 4500-CL.

### 2.4.7 Nominated mix

Variations to the nominated mix: Any change without approval is subject to removal from the Works.

### 2.4.8 Aggregate to cement and water to cement ratios table

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

## 2.5 Geotextile

### 2.5.1 Standard

General: To AS 3706.

## 2.5.2 Properties

Requirement: Conform to the following:

- Material: A woven, non-woven or knitted type manufactured from synthetic materials other than polyamide, except seamless tubular filter fabric.
- Type: Needle punched, chemically bonded or heat melded.
- Curtain drains material: Polyester, polypropylene or polyethylene.
- Bio-stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents.
- Open air exposure: Remove to spoil any geotextile exposed to sunlight for more than 14 days.
- Selection of material for robustness and strength: To suit subgrade conditions for the relevant location/ or function.
- Minimum mass requirements: As documented.
- Rate of water flow: To Austroads AGPT04G Table 4.1, under 100 mm constant head.
- Needle punched, non-woven geotextile representative equivalent opening size: Between 75 and 150 µm.
- Free of imperfections in weave or yarn, abrasion resistant and weave stability qualities such that it does not form holes, ladder, de-weave, tear or unravel more than 5 mm from a cut end.

## 2.5.3 Identification, marking and storage

Standard: To AS 3705.

Protection: Cover each roll to protect the fabric against moisture and ultraviolet radiation.

Storage: Store under a protective cover and support off the ground. Protect from damage and conform to the manufacturer's recommendations.

## 2.6 Testing

### 2.6.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

Quality verification: If material/product quality verification can be obtained from the supplier, documented tests need not be repeated.

Test authority: A registered laboratory.

Nominated mix aggregates testing: Date of testing less than 18 months from the time the nominated mix is proposed to be used.

No fines concrete: Coarse aggregate properties, conform to the following:

- Fractured faces: Each fractured face to be a significant proportion of the total surface area of the particle.

Aggregates derived from igneous rock: Test not required.

- RMS T239.
- AAR: For petrographic examination, eliminate without further testing aggregates containing reactive components, including the following:

Opaline material.

Unstable silica minerals including tridymite and cristobalite.

Sheared rock with stained quartz and microcrystalline quartz.

- Soluble salts content: Conform to the following:  
Chloride ion: < 0.8 kg/m<sup>3</sup> of concrete.  
Sulfate ion: 5% of the cement content.

## **3 Execution**

### **3.1 General**

#### **3.1.1 Clearing and grubbing**

Requirement: To *C05 Clearing and grubbing*.

#### **3.1.2 Subsoil and formation drains**

Requirement: To *C15 Subsoil and formation drains (Construction)*.

#### **3.1.3 Pavement drains**

Requirement: To *C16 Pavement drains (Construction)*.

#### **3.1.4 Drainage blankets**

Requirement: To *C17 Drainage blankets*

Timing: Construct formation drain after completion of clearing and grubbing operations, and before commencement of embankment construction.

### **3.2 No fines concrete**

#### **3.2.1 Trial mix**

Requirement: Before starting production of each mix, prepare a trial batch of each nominated mix for testing.

#### **3.2.2 Mixing and consistency**

Contaminated material: Do not use aggregates that have become intermixed or contaminated with foreign matter.

Cement: Weigh cement separately.

Measuring equipment: Conform to the following:

- Water: Use a calibrated device with one litre increments.  
Accuracy: ± 2%.
- Admixtures accuracy: ± 5%.

#### **3.2.3 Handling storage and batching**

Standard: To AS 1379 Section 4 and Appendix A.

Mixing time: Conform to the following:

- For stationary batch mixers: Not less than 54 seconds plus 6 seconds for each m<sup>3</sup>.
- For mobile batch mixers: Full period of mixing required at either the testing station or the point of placement.
- Split drum mixers: Maximum 5 minutes.
- Measured from the time all ingredients are in the mixing drum.

#### **3.2.4 Adding mixture**

Admixtures: Separate and thoroughly pre-dilute in the mixing water before mixing with other materials. Mix in accordance with the manufacturer's recommendations.

### 3.2.5 Retempering

Requirement: Conform to the following:

- Designated mixing speed: Not less than 30 revolutions.
- If there is no evidence of original mixing conditions: Re-mix for 55 revolutions.
- Water: Record quantity on the identification certificate for each batch. Make sure it does not exceed the water to cement ratio of the mix.

Addition of water after the commencement of discharge: Record the estimated remaining quantity of no fines concrete.

- Time: Retemper only within 40 minutes of completion of batching.
- Location: Either batch plant, testing stations or point of placement.

### 3.2.6 Production and transport

Transport and production equipment: Use equipment which:

- Prevent segregation or loss of materials.
- Supply a homogenous product.

### 3.2.7 Sampling

Requirement: Sample at the point of delivery within 45 minutes of completion of batching.

### 3.2.8 Material non-conformance

Requirement: Remove from the site and replace with conforming material.

## 3.3 Temporary drainage during construction

### 3.3.1 Temporary drainage during construction

Runoff overflows during construction: Allow for runoff 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.

Equipment and material: Locate clear of watercourses and secure in the event of large runoff flows.

## 3.4 Establishment

### 3.4.1 Siting of work

Set-out: To the type of subsurface drains, location and levels, as documented.

### 3.4.2 Set-out

**Approval:** Set out the work to the location and levels shown on the drawings prior to the construction. Mark any proposed changes that may arise due to actual site conditions. Seek a direction from the Superintendent for any changes that may affect the Schedule of Rates. This is a HOLD POINT.

Amendments: The Superintendent may amend the locations or designed levels or the lengths to suit actual site conditions.

**Proposed Changes:** Changes to the location, length, designed levels, conditions of installation or cover to suit the construction procedures shall be submitted for considerations by the Superintendent. No changes shall be made unless the prior written approval of the Superintendent is obtained.



## 3.5 Excavation

### 3.5.1 Safety

Stabilisation: If required, undertake shoring, sheet piling or other stabilisation of the sides of trench excavation.

### 3.5.2 Trenches

Method: Excavate trenches as follows:

- To the line, grade, width and depth as documented or as required.
- Minimum grade: 0.5%.
- Construct the bottom of the trench to avoid localised ponding.
- Remove all loose material.

### 3.5.3 Unsuitable material

Requirement: Rectify unsuitable material to **UNSUITABLE MATERIAL** in the *C06 Earthworks (Road reserve)* worksection and as follows:

- Remove and dispose of unsuitable material at the bottom of the trench or at foundation level.
- Replace with backfill material to conform to the requirements of this worksection.
- Trim the bottom of the excavated trench or foundation parallel with the documented level and slope of the work.

### 3.5.4 Laying of pipes

Joints: Minimise joints in the pipeline.

Joints in slotted pipe: To the manufacturer's recommendations.

Flushout points construction: Construct flushout points at the locations shown on the Drawings, complete with concrete covers and cover caps.

### 3.5.5 Bedding for pipes in the geotextile wrapped zone

- General: Place filter aggregate bedding for the pipework as documented.
- Minimum depth of the bedding: 50 mm.

### 3.5.6 Prefabricated geocomposite drains

Flow rate: Space out outlets more frequently than for standard drain pipes to achieve the same flow capacity or increase drainage grade.

Laying of drain: Conform to the following:

- Trenches: Minimum 500 mm depth and 150 mm width in accordance with Council's standard drawing.
- Location: Position centrally within the trench and place vertically.

Other drainage pipes: If required, place alongside other drainage pipes in the same trench.

- Bedding: Not required and drain can be directly laid on the floor of the trench in accordance with Council's standard drawing.

Joints: If geotextile is used to wrap sections of drain, use a minimum width of 450 mm.

Rigid geocomposite drains: Wrap pipe with non-woven geotextile strength class A encapsulating the drain and join the geotextile by heat or electrical weld to the **Robustness classification of geotextiles table**.

## **3.6 Backfilling**

### **3.6.1 General**

Prevent damage to pipes: Place, spread, compact the subbase by tamping around and over the pipe to avoid damage to the drain pipes.

No fines concrete: Do not mechanically tamp.

Compaction: Compact cohesionless material to a Density Index of 70%.

### **3.6.2 Staged construction**

Stage 1: After constructing the underlying trench, protect the filter material placed from scour and/or contamination by overlapping the geotextile above the underlying trench and placing a sacrificial geotextile or plastic. Cover with a 50 mm thick plug/cap of select fill material with a maximum particle size of 25 mm.

Stage 2: Place and compact above the plug the selected fill material to a relative compaction of 95%.

Stage 3: Excavate, remove plug/cap, and any contaminated filter material and any selected material covering. Conform to the following:

- Do not disturb previously laid pipes, filter sock or geotextile.
- Extend height of the underlying trench to the underside of the pavement.
- Alignment and width of trench: Same as the underlying trench.

Stage 4: Replace with filter material and compact to 95% relative compaction and place any overlying pavement layers.

## **3.7 Geotextile**

### **3.7.1 Location**

Extent: As documented.

Requirement: Install at the interface between the filter material and adjoining materials.

### **3.7.2 Installation**

Placement: 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 fabric and trench, but not stretched over the soil. Do not allow loose material from outside of the trench to enter the excavation.

Intersections: Minimum 200 mm laps.

Program: Less than 14 days between initial laying out and final cover of the geotextile with drainage backfill layer. Where possible, place geotextiles just ahead of construction works, and cover with materials within 48 hours.

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

Removal and replacement: Remove damaged geotextile. Remove and replace if geotextile is exposed to sunlight for longer than 14 days.

## **3.8 Outlet structures**

### **3.8.1 Discharge and salinity prevention**

Subsurface drainage pipes: Connect discharge into gully pits or to outlet structures, as documented.

Salinity prevention: Discharge on the downhill side of the embankment or in the cut area, to avoid recharging the subsurface water table.

### 3.8.2 Outlets

Location intervals: 120 m maximum.

Rodent proofing method: Secure outlets, including those discharging into gully pits, with stainless steel or UPVC filter fitting to prevent access by rodents.

### 3.8.3 Erosion control

Method: Locate the outlet so that erosion of the adjacent areas does not occur and/or protect the outlet by the placement of selected stone.

Locations: Provide marker posts to indicate the location of pipe outlets and assist maintenance. **To Marking of drains and outlets.**

Marker Posts: Provide white powder coated galvanised steel post or aluminium kerb marker plates as per Council's standard drawings

### 3.8.4 Outlet pipe

Type: Install unslotted outlet pipes from curtain drains.

Levels: Make sure no point in an outlet pipe is higher than the pipe at the end of the curtain drain.

### 3.8.5 Concrete

Requirement: To the *C28 Auxiliary concrete works* worksection.

### 3.8.6 Batters

Requirement: If connection to a trench drain or stormwater pit is not possible, install an outlet at the batter to discharge water beyond the edge of the road.

Pipe: Conform to the following:

- Type and size: Same as documented within the subsoil, formation or pavement drains.
- Length extending beyond the edge of the pavement: Non-perforated laid at the base of the trench.

Height: Taper height of the base of the trench of the connecting section of perforated pipe, from 0 to 100 mm, over a 2 m length.

Backfill: Backfill the section of pipe with selected material and conform to the following:

- Maximum particle size: 50 mm.
- Relative compaction: 95%.

## 3.9 Clean-outs

### 3.9.1 General

Requirement: Provide clean-outs and cast iron caps, as documented.

Cleanout pit location: At the commencement start of each run of subsoil drain line.

Intervals: Approximately 100 – 140 m to cleanout risers and pits.

Flush out point: Provide the subsoil drain flush out point with a concrete cover of Class N32 concrete fitted with a removable cap to Austroads AGRD05A, Figure 8.4.

## 3.10 Marking of drains and outlets

### 3.10.1 General

Marker Posts: Provide white powder coated galvanised steel post or aluminium kerb marker plates as per Council's standard drawings

## 3.11 Recording

### 3.11.1 General

Work-as-executed plans: Record details of all subsurface drainage pipes and the completed subsurface drainage systems.

Submit: Provide a subsurface drainage information sheet or sheets to the Superintendent within five days of the completion of construction of each drain or drainage system. This is a HOLD POINT.

Information sheets: Include the following:

- Date of completion of drain construction.
- Drain number.
- Type of drain.
- Pipe size.
- Pipe type.

Seamless tubular filter fabric enclosure: If proposed.

- Filter type.
- Grade of drain and levels of the drain relevant to the finished edge of the road pavement or top of kerb.
- Locations of clean-outs.
- Locations of outlets: Include GPS coordinates.
- Geotextile type.

Seamless tubular filter fabric enclosure: If proposed.

- Response time: The time taken for water to travel from the inlet end of a drain or from a clean-out leading to a drain, to the outlet end of the drain.

## 3.12 Testing

### 3.12.1 Quality

Requirement: Test for all characteristics in conformance with **ANNEXURE - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES**.

### 3.12.2 Site tests

- No fines concrete: Permeability greater than 20 mm/s.
- Geotextile exposed to sunlight in excess of 21 days: 90% retained strength.
- Flush test: After completion of backfilling, pump clean water into the clean-out at the commencement start of each run, until only clean water discharges at the outlet.

Minimum rate of flow of flushing water at the inlet: 100 l/min at the inlet.



## 4.2 Annexure - Slotting details for thick walled PVC-U pressure pipe

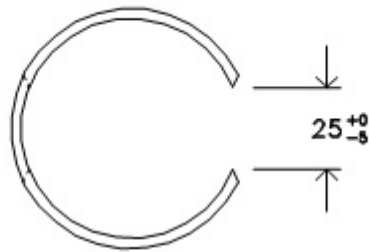
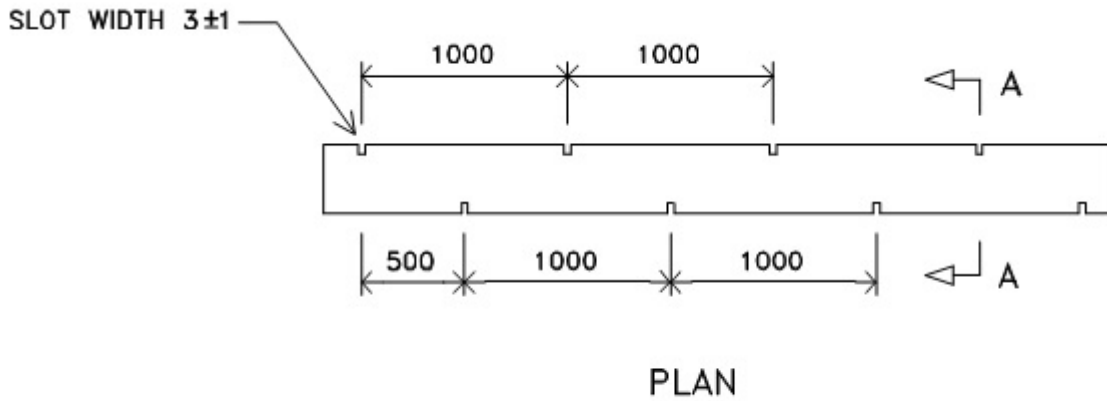


Diagram not to scale  
Dimensions are in millimetres

### 4.3 Annexure - Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C14-WP01	SUBMISSIONS Service utility authorities consultation	W	Results of consultation with service authorities	14 days minimum before contract commencement	Commencement of work
C14-HP02	SUBMISSIONS  Products and materials	H	Data sheets, compliance certificates and test results  Type of filter material and grading Type A and B gradings	7 days before supply of pipes	Pipe and fittings supply and delivery of granular filter material Geotextile supply
C14-HP03	SUBMISSIONS  Products and materials  No fines concrete	H	Nominated mix: Submit the following including evidence of conformance: <ul style="list-style-type: none"> <li>• Cement: Brand and source.</li> <li>• Water: Source.</li> <li>• Admixtures: Proprietary source, type, name, dosage recommended by the manufacturer and evidence of conformance.</li> <li>• Aggregates: Source, geological type, moisture condition, blend proportions and grading for each type of aggregate.</li> <li>• Soluble salt content.</li> <li>• Permeability.</li> </ul>	5 days before date of delivery	Delivery of no fines concrete
C14-WP04	SUBMISSIONS Records of no fines concrete placed each day	W	Daily record of mass of no fines concrete placed	End of each day	Records
C14-HP05	SUBMISSIONS Work- as - executed information sheets for	H	Show levels and clearance of the subsoil pipes to the finished road construction.	5 days after subsoil pipe completion.	Information sheets given to Superintendent.

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
	completed subsoil drains and drainage asset attribute tables				
C14-HP06	SUBMISSIONS  Execution details  Siting of work	H	Changes proposed to the length, location, designed levels, condition of installation or cover	7 days before commencement	Commencement
C14-HP07	INSPECTIONS Notice  No fines concrete	H	Retempering if required.	3 days before after rettempering	Notice to Superintendent. For development inspections book through "MyInspect".
C14-WP08	INSPECTIONS, Notice  Siting of works	W	Set-out of location and levels	7 days before pipe installation	Pipe installation.
C14-WP09	INSPECTIONS, Notice  Trenches	W	Excavation to the documented line, grade, width and depth	1 days before pipe installation	Pipe installation.
C14-HP10	INSPECTIONS, Notice  Laying of pipes	H	Compacted bedding, and Placement of pipes or geocomposite drains to documented line and level	1 day before backfilling	Backfilling. For development inspections book through "MyInspect".
C14-WP11	INSPECTIONS, Notice  Backfilling	W	Documented level and placement of fabric	1 day before covering with geotextile	Placement of geotextile.
C14-HP12	INSPECTIONS, Notice  Flush	H	Clean-outs of subsoil drainage lines	3 days before completion	Completion. For development inspections book through "MyInspect".
	*H = Hold Point W = Witness Point				



#### 4.4 Annexure - Maximum lot sizes and minimum test frequencies

Activity	Key quality verification requirements	Test method
Material supply	Material quality — Supplier's documentary evidence and certification of:	
	Circular plastic pipe and fittings	AS 2439.1
	Plain wall plastic pipe and fittings	AS 2439.1 and RMS T1507
	Corrugated flat plastic pipe and fixings	ASTM D2122
	Thick walled PVC-U pressure pipe:	AS/NZS 1477
	• Transmissivity property	ASTM D6574/D6574M
	• Crush strength test	AS 2439
	Prefabricated geocomposite drains: Damage	RMS T1508, RMS T1509 and RMS T1510
	Rigid geocomposite drains:	
	• Horizontal compressive strength	ASTM D2412
	• Change in core area	ASTM D6244
	Flexible geocomposite drains:	
	• Stiffness	RMS T1507
	Filter material:	
	• Grading <b>Type A filter gradings table</b>	AS C08.11.1
	• Grading for <b>Type B filter gradings table</b>	AS C08.11.1 and AS C08.22
	• Compaction	AS 1289.5.6.1
	No fines concrete:	
	• Bulk density	AS C08.4
	• Particle density	AS C08.6.1
	• Water absorption	AS C08.6.1
	• Particle size distribution	AS C08.11.1
	• Particle shape: 2:1 ratio	AS C08.14
	• Particle shape: 3:1 ratio	AS C08.14
	• Petrographic examination	ASTM C0295/C0295M
	• Assessment and classification: Mortar bar	RMS T363

Activity	Key quality verification requirements	Test method
	test	
	<ul style="list-style-type: none"> <li>Assessment and classification: Concrete prism test</li> </ul>	RMS T364
	<ul style="list-style-type: none"> <li>Wet strength: Particle distribution interval</li> </ul>	AS C08.22
	<ul style="list-style-type: none"> <li>Fractured faces</li> </ul>	RMS T239
	<ul style="list-style-type: none"> <li>Wet/dry variation</li> </ul>	AS C08.22
	<ul style="list-style-type: none"> <li>Chloride testing: Aggregates</li> </ul>	AS 1012.20.1
	<ul style="list-style-type: none"> <li>Chloride testing: Water and admixtures dissolved in water</li> </ul>	AS 1478.1
	<ul style="list-style-type: none"> <li>Sulfate testing: Aggregates</li> </ul>	AS 1012.20.1
	<ul style="list-style-type: none"> <li>Sulfate testing: Water and admixtures</li> </ul>	AS 1289.4.2.1
	<ul style="list-style-type: none"> <li>Sulfate testing: Cementitious material</li> </ul>	AS 2350.2
	<ul style="list-style-type: none"> <li>Soluble salts: Hardened concrete</li> </ul>	AS 1012.20.1
	<ul style="list-style-type: none"> <li>Permeability: Moulding and curing specimens</li> </ul>	RMS T376
	Permeability test	RMS T377
	Geotextile:	
	<ul style="list-style-type: none"> <li>Identification and marking</li> </ul>	AS 3705
	<ul style="list-style-type: none"> <li>General</li> </ul>	AS 3706 (Various)
	<ul style="list-style-type: none"> <li>Rate of water flow: Perpendicular flow test</li> </ul>	AS 3706.9
	<ul style="list-style-type: none"> <li>Exposure to sunlight in excess of 21 days</li> </ul>	AS 3706.11
	<ul style="list-style-type: none"> <li>Seamless tubular filter fabric: Opening size</li> </ul>	RMS T1524
	<ul style="list-style-type: none"> <li>Seamless tubular filter fabric: Laddering, unravelling or deweaving from a cut end</li> </ul>	RMS T1521
	<ul style="list-style-type: none"> <li>Seamless tubular filter fabric: Abrasion resistance</li> </ul>	RMS T1522

Activity	Key quality verification requirements	Test method
	<ul style="list-style-type: none"> <li>Seamless tubular filter fabric: Weave stability</li> </ul>	RMS T1523
Excavation – Trench base	Line and grade	Survey
	Compaction	AS 1289.5.4.1
Bedding and backfill: <ul style="list-style-type: none"> <li>Filter material</li> <li>Selected backfill</li> <li>Earth backfill</li> <li>Cohesionless backfill</li> </ul>	Compaction	AS 1289.5.4.1
	Compaction	AS 1289.5.4.1
	Compaction	AS 1289.5.4.1
	Compaction	AS 1289.5.6.1
Staged construction	Temporary plug over filter material: Plasticity Index of fill material	AS 1289.3.3.1
* Note: or part thereof, per lot		

## 4.5 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS 1012		Methods of testing concrete
AS 1012.20.1	2016	Determination of chloride and sulfate in hardened concrete and concrete aggregates
AS C08		Methods for sampling and testing aggregates
AS C08.4	2000	Bulk density of aggregate
AS C08.6.1	2000	Particle density and water absorption of coarse aggregate - Weighing-in-water method
AS C08.11.1	2009	Particle size distribution - Sieving method
AS C08.14	2007	Particle shape, by proportional caliper
AS C08.22	2008	Wet/dry strength variation
AS 1289		Methods of testing soils for engineering purposes
AS 1289.3.3.1	2009	Soil classification tests - Calculation of the plasticity index of a soil
AS 1289.4.2.1	1997	Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1289.5.4.1	2007	Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio
AS 1289.5.6.1	1998	Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material
AS 1379	2007	Specification and supply of concrete
AS/NZS 1477	2017	PVC pipes and fittings for pressure applications
AS 1478		Chemical admixtures for concrete, mortar and grout
AS 1478.1	2000	Admixtures for concrete
AS 2350		Methods of testing portland, blended and masonry cements
AS 2350.2	2006	Chemical composition
AS 2439		Perforated plastics drainage and effluent pipe and fittings
AS 2439.1	2007	Perforated drainage pipe and associated fittings
AS 2758		Aggregates and rock for engineering purposes
AS 2758.1	2014	Concrete aggregates
AS 3705	2012	Geotextiles - Identification, marking, and general data
AS 3706		Geotextiles - Methods of test
AS 3706.1	2012	General requirements, sampling, conditioning, basic physical properties and statistical analysis
AS 3706.2	2012	Determination of tensile properties - Wide strip and grab method
AS 3706.3	2012	Determination of tearing strength - Trapezoidal method
AS 3706.4	2001	Determination of burst strength - California bearing ratio (CBR) - Plunger method
AS 3706.5	2000	Determination of puncture resistance - Drop cone method
AS 3706.7	2014	Determination of pore-size distribution - Dry sieving method
AS 3706.9	2012	Determination of permittivity, permeability and flow rate
AS 3706.11	2012	Determination of durability - Resistance to degradation by light, heat and moisture
AS 3972	2010	General purpose and blended cements
Austrroads AGPT		Guide to pavement technology

Austrroads AGPT04G	2009	Geotextiles and geogrids
Austrroads AGPT10	2009	Subsurface drainage
Austrroads AGRD		Guide to road design
Austrroads AGRD05A	2013	Drainage – Road surface network, basins and subsurface
RMS T239	2012	Fractured faces of coarse aggregate
RMS T363	2012	Accelerated mortar bar test for the assessment of alkali-reactivity of aggregate
RMS T364	2012	Concrete prism test for AAR assessment
RMS T376	2016	Moulding of no fines concrete specimens
RMS T377	2016	Water permeability of no fines concrete (Falling head laboratory permeameter)
RMS T1507	2012	Determination of the compressive stiffness of strip filters
RMS T1508	2012	Determination of the low temperature resistance of strip filters during straightening
RMS T1509	2012	Determination of the high temperature impact resistance of strip filters
RMS T1510	2012	Determination of the low temperature impact resistance of strip filters
RMS T1521	2012	Laddering, unravelling of deweaving of a seamless knitted tubular filter fabric from a cut E
RMS T1522	2012	Abrasion resistance of seamless knitted tubular filter fabric
RMS T1523	2012	Weave stability of seamless knitted tubular filter fabric
RMS T1524	2012	Determination of opening size of seamless knitted tubular filter fabric
APHA 4500-CL	1992	Standard Methods for the Examination of Water and Wastewater
ASTM C0295/C0295M	2012	Standard guide petrographic examination of aggregates for concrete
ASTM D2122	2016	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D7001-06	2011	Standard specification for geocomposite for pavement edge drains and other high-flow applications
ASTM D2412	2018	Standard test method for determination of external loading characteristics of plastic pipe by parallel-plate loading
ASTM D6244	2018	Standard test method for vertical compression of geocomposite pavement panel drains
ASTM D6574/D6574M	2013	Test method determining the (in-plane) hydraulic transmissivity of geosynthetic by radial flow
Council's Standard Drawings		