

SECTION 702 - SUBSURFACE DRAINAGE

~~##This section cross-references Sections 175, 210, 701, 703 and 801.~~

~~If any of the above sections are relevant, they should be included in the specification.~~

~~If any of the above sections are not included in the specification, all references to those sections should be struck out, ensuring that the remaining text is still coherent.~~

702.01 DESCRIPTION

This section covers the requirements for the supply and installation of subsurface drainage pipes, geocomposite drains and filter materials as shown on the drawings.

Section 175 details the relevant references to Australian Standards (AS), Test Methods and Codes of Practice referenced in this section.

702.02 DEFINITIONS

Pervious Pipe System

A pervious pipe system comprises drainage pipes which permit the entry of water from surrounding material and convey it to a discharge point. Such pipes may be perforated, slotted or porous pipes or impervious pipes laid with open joints.

Subsurface Drain

A subsurface drain is a pervious pipe system laid in a trench and surrounded by granular filter material or sleeved with a geotextile.

Geocomposite Drain

A geocomposite drain comprises a highly permeable core material wrapped in a geotextile. The core shall be non-crushable and flexible, and shall completely support the geotextile fabric. The geotextile shall have the filtration and separation properties to perform the functions of a single or second stage filter.

Single Stage Filter

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

First Stage Filter

First stage filter is granular filter material or geotextile placed in contact with the trench sides and surrounding a second stage filter.

Second Stage Filter

Second stage filter is granular filter material or geotextile placed in contact with the pervious pipe system and surrounded by a first stage filter.

Registered Mix

A registered mix is a crushed or screened product which has been placed on the VicRoads Crushed Rock Mix Register; as described in VicRoads Code of Practice 500.02.

Glass Fines

Glass fines are recycled glass cullet crushed to a cubic shape and passing the 4.75 mm AS sieve.

EAF Slag Aggregate

EAF slag aggregate is the processed slag by-product from the production of steel using an electric arc furnace (EAF). Once cooled, the slag by-product is crushed, graded and suitably conditioned (by weathering to reduce free lime content) to produce a non expansive aggregate.

No Fines Concrete

No fines concrete is a material containing graded coarse aggregate, generally of a single AS sieve size, bonded together by a paste of cement and water sufficient to provide adequate strength while producing an open-textured cellular concrete with a high volume of voids and high permeability.

702.03 CONFORMITY WITH DRAWINGS

Subsurface drains, whether pipe or geocomposite systems, shall be constructed true to line, level and depth, as shown on the drawings.

The invert of the subsurface drainage pipe or the geocomposite drain shall be not more than 25 mm from the specified level and not more than 50 mm from the specified line. Changes of grade shall not be abrupt, or occur at a rate exceeding 10 mm in any 3 m length, or lead to ponding of water within the drainage pipe. Hence, there are only tolerances on line and level.

702.04 DRAINAGE PIPES AND GEOCOMPOSITE DRAINS

Subsurface drainage pipes and geocomposite drains shall be supplied by the Contractor.

Subsurface drainage pipes and geocomposite drains are grouped into three categories as follows:

- Category 1: Perforated plastics Class 1000
Precast concrete Class "2"
- Category 2: Perforated plastics Class 400
- Category 3: Geocomposite drains

Pipes supplied shall be of the category and diameter shown on the drawings or specified in clause 702.12 and shall comply with the requirements of the appropriate Australian Standard in accordance with Section 175 or as follows:

- Perforated plastics - AS 2439 (except for perforation dimensions)
- Precast concrete - Section 701

Category 1 pipes may be substituted for Category 2.

Geotextiles used for the outer covering of the geocomposite drain shall comply with the requirements of clause 702.06 and Section 210.

Perforated plastic pipes and geocomposite drains supplied in coils shall be free from any permanent curved set when uncoiled.

Plastic pipes and geocomposite drains shall be stored away from sunlight and shall not be exposed unnecessarily to sunlight during delivery, storage and placement.

702.05 GRANULAR FILTER MATERIALS

(a) Material Source

Granular filter material shall only be produced from a VicRoads accredited source, which has undergone assessment in accordance with VicRoads Code of Practice 500.00.

Coarse and fine aggregate components of granular filter material shall comply with the relevant requirements of Section 801 Material Sources for the Production of Crushed Rock and Aggregates, unless otherwise approved by VicRoads.

Synthetic or blended aggregates from different sources shall only be used with the approval of the Superintendent Council.

(b) Granular Filter Material

Granular filter material shall consist of hard, durable and clean sand, gravel or crushed rock, EAF slag aggregate or recycled glass fines which is free from clay balls and organic matter.

Materials used shall have a pH value greater than 6.0 and less than 10.0.

The portion of a granular filter material passing a 4.75 mm AS sieve shall have a Sand Equivalent value not less than 80 when tested in accordance with AS 1289.3.7.1.

EAF Slag and glass fines can be used a granular filter material provided the produced aggregates comply with the relevant additional requirements listed below.

Any synthetic, recycled or blended aggregate proposed to be used as a granular filter material must be accredited and registered in accordance with VicRoads Code of Practices 500.00 and 500.02.

EAF Slag aggregate shall be conditioned (weathered) for a minimum of three months prior to use to ensure volumetric expansion and % free lime are at acceptable levels for use in road construction.

Glass fines shall:

- (i) be cubical in shape, not sharp edged or elongated
- (ii) be generally free of contaminants such as paper, corks, metals, and other harmful materials (maximum limit of 2% by mass)
- (iii) be primarily container glass and shall not include glass from ceramics, cathode ray tubes, fluorescent light fittings and laboratory glassware
- (iv) be thoroughly washed and retested prior to use, where the measured Total Dissolved Solids (TDS) of the granular filter material exceeds 1500 mg/L.

(c) Grading Requirements for Granular Filter Material

The grading of granular filter material shall comply with the requirements of Table 702.051 relevant to the granular filter type specified in clause 702.12.

Table 702.051 Grading Requirements for Granular Filter Material

Sieve Size AS (mm)	Limits of Grading (% passing by mass)								
	Single and First Stage Filters					Second Stage Filters			
	A2	A3	A4	A5	A6	B1	B2	B3	B4
37.5	-	-	-	-	100	-	-	-	-
26.5	-	-	-	-	-	-	-	-	100
19.0	-	-	-	100	85-100	-	100	100	70-100
13.2	-	-	-	90-100	-	-	90-100	90-100	0-70
9.50	100	100	100	70-100	65-100	100	70-100	40-70	0-25
4.75	90-100	90-100	70-100	28-100	48-82	70-100	28-100	0-15	-
2.36	75-100	70-100	0-50	0-28	30-60	0-50	0-28	0-5	0-5
1.18	50-98	40-65	0-10	0-8	15-40	0-10	0-8	-	-
0.600	30-80	12-40	-	-	5-25	-	-	-	-
0.300	10-40	0-16	0-5	0-5	0-10	0-5	0-5	-	-
0.150	0-7	0-4	-	-	0-5	-	-	-	-
0.075	0-3	0-3	0-3	0-3	0-3	0-3	0-3	0-3	0-3

(d) Crushed Rock Components

The percentage by mass of unsound and marginal rock in that fraction of an aggregate retained on a 4.75 mm AS sieve shall not exceed the values specified in Table 702.052.

Table 702.052 Marginal and Unsound Rock

Total of Marginal and Unsound Rock % (by mass) (max)	Unsound Rock % (by mass) (max)
10	5

(e) No Fines Concrete

No fines concrete shall consist of Type GP cement, water and coarse aggregate. The quantity of cement used shall be 4.0% by volume. Grading limits shall be as specified in Table 702.051 for B4 granular filter material.

Type GP Cement, water and coarse aggregate shall comply with the requirements of Section 703.

The water/cement (W/C) ratio shall be in the range of 0.35 to 0.5.

The W/C ratio shall provide for complete cementitious paste coverage of the aggregate. The water and paste content shall be such that it does not cause the paste to flow during mixing, handling or placing.

702.06 GEOTEXTILE FILTERS

A geotextile filter shall consist of a fabric manufactured from synthetic fibres of a long-chain polymer such as polypropylene, polyethylene, polyester or similar material and shall be stabilised against deterioration due to ultraviolet light. After forming, the geotextile shall be processed so that the fibres retain their relative positions with respect to each other. The geotextile shall be free from defects or flaws which significantly affect its physical and/or filtering properties.

A geotextile filter may be non-woven or knitted fabric and shall comply with the requirements of Table 702.061 relevant to the geotextile filter type specified in clause 702.12.

Continuous knit seamless sleeve geotextile filter may be used as a second stage filter.

Table 702.061 Requirements for Geotextile Filter

Geotextile Filter Type	Minimum Robustness G ⁽¹⁾	EOS ⁽²⁾ (microns)	Minimum ⁽³⁾ Elongation (%)
1. First Stage Filter	900 (moderately robust)	85 - 230	45
2. Second Stage Filter (non-woven)	600 - 900	125 - 350	20
3. Second Stage Filter (knitted seamless sleeve)	N/A	125 - 350	50

(1) G = Geotextile strength rating

(2) EOS = Equivalent Opening Size using AS 3706.7
Determination of Pore Size Distribution - Dry Sieving Method.

(3) Elongation at break as determined by AS 3706.2
Determination of Tensile Properties - Wide Strip Method.

Geotextiles shall be stored away from sunlight and shall not be exposed unnecessarily to sunlight during delivery and placement. Geotextiles shall be handled with care and suitable equipment to avoid damage.

Storage areas shall be secure to protect geotextiles from potential construction vehicle damage, and shall be relatively flat, well drained and free of sharp rocks and other objects which may cause puncture to the geotextiles.

Geotextiles shall be supported off the ground and the integrity of the protective plastic wrapping maintained, such that the geotextile is well covered and protected from UV radiation, sunlight and weather and other aggressive agents. Any damage to the protective plastic wrapping shall be repaired immediately.

If geotextiles are to be stored on site with their protective plastic wrapping for longer than 4 weeks they shall be further protected by additional cover such as the application of a UV-resistant and waterproofed tarpaulin.

Site handling and storage practices shall ensure that exposure to conditions which may reduce or alter the geotextile properties and overall effectiveness are avoided.

702.07 DRAINAGE SYSTEM AT STRUCTURES

Where a geotextile drainage system is used at structures the system shall consist of geocomposite drains placed vertically over the full height of the backfilling at the intervals as shown on the drawings.

Where a geocomposite drainage material is made up of a permeable drainage layer with one or both faces bonded to a geotextile filter fabric, such a system shall be placed over the full height of fill which is in contact with the structure.

The geotextile filter used in such drains shall be a non-woven product conforming to the requirements of clause 702.06.

The geocomposite drainage layer shall have the following minimum hydraulic properties under unit hydraulic gradient:

- (a) permeability perpendicular to the geocomposite under 0.2 kPa normal pressure - 0.005 m/sec
- (b) transmissivity in the plane of the geocomposite –

Normal Pressure	Transmissivity
10 kPa	350 x 10 ⁻⁶ m ² /sec
100 kPa	250 x 10 ⁻⁶ m ² /sec
200 kPa	150 x 10 ⁻⁶ m ² /sec
300 kPa	100 x 10 ⁻⁶ m ² /sec

Geocomposite drains shall be connected to a collector pipe with an outlet to a fitting immediately adjacent to the structure or as shown on the drawings. The collector pipe shall be fitted with a flush-out riser connected to an inspection opening in the verge adjacent to the structure or as shown on the drawings.

Preformed PVC fittings shall be used for all connections between the geocomposite drains and the collector pipe and all connections shall be sealed and protected to prevent displacement during backfilling.

702.08 EXCAVATION

Where a geotextile is to be used as a first stage filter in contact with a trench wall, the trench wall shall be excavated to allow the geotextile to be in close contact with the wall when the granular filter material is placed against the geotextile.

The bottom of the trench shall be compacted and shall be not more than 50 mm below the specified level of the invert of the pipe. There shall be no departures from the grade of the base of the trench that would allow ponding of water. Excess trench excavation shall be made good by filling back to grade with compacted material of permeability similar to that of the surrounding material and any loose material shall be removed.

HP The base of the trench shall be inspected to verify compliance with the requirements in this clause prior to placing bedding in completed excavations. ~~The Superintendent shall be notified at least 24 hours prior to the inspection.~~

702.09 INSTALLATION

(a) Depth

Subsurface drainage pipes or geocomposite drains shall be laid to the depths or levels shown on the drawings. ~~The top of any subsurface drainage pipe shall be at least 200 mm below subgrade.~~

(b) Grade

The grade of pipes or geocomposite drains shall be not flatter than 1 in 250.

(c) Bedding for Drainage Pipe System

A bedding of granular filter material of thickness between 25 mm and 50 mm shall be placed across the bottom of the trench. The bedding shall be tamped and screeded or graded to level. Bedding is not required for geocomposite drains.

(d) Placing of Pipes

Pipes shall be placed centrally in the trench on the prepared bedding and held firmly in place.

Slotted pipes shall be laid with the openings in the lower half of the pipe.

(e) Placing of Geocomposite Drains

Geocomposite drains shall be placed such that the drain stands vertical, held firmly in place and is centrally located within the trench.

(f) Jointing

Preformed pipe joints and fittings may be used.

Splice joints in geocomposite drains and pipes shall be made either with preformed geocomposite drain joints or fittings, or by butting together the sections of drain to be joined and wrapping the joint area with geotextile. Joints made by butting and wrapping with geotextile shall be secured to prevent separation during installation. The minimum width of geotextile used for wrapping shall be 450 mm.

Lap joints in geotextile used as first stage filters shall consist of an overlap of not less than 900 mm longitudinally and 150 mm transversely.

Lap joints in geotextile used as second stage filters shall consist of an overlap of not less than 300 mm.

(g) Placing Granular Filter Material

Filter material shall be placed moist and compacted with minimal disturbance to pipes or geocomposite drains, geotextiles and trench walls. The loose thickness of layers shall not exceed 300 mm.

No-fines concrete shall be placed and compacted within 1 hour of mixing.

HP The method of compaction shall be in accordance with the Contractor's quality procedures. and shall be submitted for review by the Superintendent.

HP **Where no fines concrete is used as filter material the Contractor the method shall be in accordance with the Contractor's submit quality procedures, for review by the Superintendent which detail detailing the method of placing the no-fines concrete to prevent segregation and the formation of a slurry layer at the surface of the concrete which may prevent the passage of water into the filter material.**

(h) Flushing

A flushing test shall be carried out on each subsurface drainage line after completion of subsurface drains, flushers and outlets, and after completion of all adjacent kerb and channel, barriers and road furniture, only if the subsurface drainage line is blocked and/or if there is material inside the pipe.

The test shall be witnessed by a representative nominated by ~~the Superintendent~~ Council. Each drain shall be flushed with sufficient water to remove material that has entered the pipes during construction and to ensure that the drainage line is free from obstruction.

The Contractor shall maintain a record of flushing tests for every sub-surface drainage line including the date and time of notification to ~~the Superintendent~~ Council, the date and time of flushing, and witnesses to the flushing.

(i) Inspection of Subsurface Drainage Lines

HP **All subsurface drainage lines constructed shall be inspected, after completion of the flushing test as stated in clause 702.09(h) and prior to placement of asphalt, by an independent testing organisation using closed circuit television (CCTV) to verify that the flow of water is not obstructed by waste construction material left inside and to check for visible signs of defects.**

Reporting of the CCTV inspections shall be in accordance with WSA 05-2020 43 – Conduit Inspection Reporting Code of Australia, published by Water Services Association of Australia.

The report shall be provided to ~~the Superintendent~~ Council, with a copy of the CCTV record including any video recordings and a summary of the location of any waste construction materials, obstructions and defects detected by the survey.

Any sections of damaged or deformed subsurface drainage pipe shall be removed and replaced. A further CCTV survey shall be undertaken to verify that the damaged or deformed subsurface drainage pipes have been replaced and are defects free.

Any sections of subsurface drainage pipe which still exhibit waste construction material or obstructions after the flushing test, shall be flushed again and a further CCTV survey shall be undertaken to verify that subsurface drainage pipes are fully cleaned.

Subsurface drainage pipe which cannot be fully unblocked following the flushing test shall be removed and replaced. A further CCTV survey shall be undertaken to verify that the replacement subsurface drainage pipes are waste free.

HP **Placement of asphalt shall not proceed until the CCTV inspection and flushing test have been completed, damaged or deformed subsurface drainage pipe has been removed and replaced and the waste and defects free condition of subsurface drainage lines has been verified by the Superintendent Council.**

Inspection of existing subsurface drainage lines shall be as specified in the drawings and specification.

702.10 ACCESS POINTS AND INSPECTION OPENINGS

Subsurface drainage pipes and/or geocomposite drains shall have access points at the beginning and end of the drainage run and shall have inspection openings at intervals of between 100 and 150 metres along the drainage run.

Where stormwater drainage pits are used as access points, the invert at the beginning of each drainage run shall be located above the top of the pit outlet and the invert at the end of each drainage run, when not shown on the drawings, shall be located not less than 100 mm above the invert of the pit outlet.

Flushout risers for drainage pipes shall have the same diameter as the pipe.

Flushout risers for geocomposite drains shall consist of a preformed riser fitting, or a pipe of diameter not less than 100 mm.

Flushout risers shall have surface fittings as shown on the drawings.

The outlet point at the end of each drainage run shall be located at a drainage pit, culvert endwall, or outlet in a fill batter or drain.

Inspection openings as shown on the drawings shall consist of pits having a diameter not less than 600 mm. Pits shall be fitted with concrete or cast iron frame covers as shown on the drawings.

702.11 MARKER POSTS

At all fill batter and drain outlets, supply and erect marker posts as shown on the drawings.

702.12 SCHEDULE OF DETAILS - REFER TO DRAWINGS

Drainage Run	Nominal Depth of Trench (mm)	Pipe			Filter type					Geocomposite Drain		
		Category	Diameter (mm)	Perforation Size (mm)	Single or First Stage		Second Stage		EOS of Geotextile (microns)	Type	Width (mm)	Granular Backfill
					Granular	Geotextile	Granular	Geotextile				
##:												

– Continuous knit seamless sleeve geotextile filter.

702.13 MINIMUM TESTING REQUIREMENTS

The Contractor shall test the granular filter material at a frequency which is sufficient to ensure that all materials supplied under the contract complies with the specified requirements but which is not less than that shown in Table 702.131.

Table 702.131 Minimum Frequency of Testing

Test	Minimum Frequency of Testing
Grading	On each production day – one per 500 tonnes
Unsound Rock Content	On each production day – one per 500 tonnes
Sand Equivalent	One per 5000 tonnes of product
pH	One per 5000 tonnes of product
Total Dissolved Solids (glass fines only)	One per 5000 tonnes of product